European Commission

Joint Research Centre

Methods for the definition of classes of performance and labels

Senatore, V., Gonzalez Torres, M., Rodriguez Manotas, J., Magrini, C., Kouloumpis, V., Syrus, A., Ardente, F., Gama Caldas, M.

2025

Contact information
Name: Vincenzo Senatore
Address: Edificio EXPO, C/Inca Garcilaso 3, 41092 Seville
Email: vincenzo.senatore@ec.europa.eu

The Joint Research Centre: EU Science Hub
https://joint-research-centre.ec.europa.eu

JRC143463
EUR 40496

PDF ISBN 978-92-68-32692-3 ISSN 1831-9424 doi:10.2760/2237742 KJ-01-25-526-EN-N

Luxembourg: Publications Office of the European Union, 2025

Cover page illustration generated with ChatGPT

How to cite this report: Senatore, V., Gonzalez Torres, M., Rodriguez Manotas, J., Magrini, C., Kouloumpis, V. et al., *Methods for the definition of classes of performance and labels,* Publications Office of the European Union, Luxembourg, 2025, https://data.europa.eu/doi/10.2760/2237742, JRC143463.

Contents

Abstract 6

Acknowledgements 7

Executive summary 8

Extensive summary 11

I. Method to select the products aspects and parameters appropriate for classes of performance (Chapter 3) 11

II. Development of a new method to establish classes of environmental performance (Chapter 4) 12

III. Method to develop classes of performance for circularity indicators and indexes (Chapter 5)14

IV. Classes of technical performance (Chapter 6) 18

V. Assessment of the usefulness of the ESPR label for consumers and other economic actors and interactions with other labels and the DPP (Chapter 7) 18

VI. Information potentially included on the ESPR label (Chapter 8) 22

1. Introduction 24

1.1. Policy context and background 24

1.2. Purpose of the report 26

1.3. Policy question addressed 27

1.4. Objectives of the study 27

1.5. General workflow 28

2. Setting the context: Methods for the definition of classes of performance and labels within the current MEErP 31

2.1. Methodology for the Ecodesign of Energy-related Products (MEErP) 31

2.2. Interaction between the MEErP and the methods for the definition of classes of performance and labels 32

3. Method to select the product aspects and parameters appropriate for classes of performance 34

3.1. Step 1: Assessment of the relevance of circularity aspects 34

3.2. Step 2: Collection and identification of the intrinsic characteristics of the product group/category vis-à-vis product parameters 36

3.3. Step 3: Calculation of the appropriateness 38

3.3.1. Scoring procedure 40

3.4. Step 4: Potential for improvement (PI) 43

4. A new method to develop classes of environmental performance 46

4.1. Classes of environmental performance for the PEF score (Commission Recommendation (EU) 2021/2279) ... 47

4.2. Proposed approach for the development of the classes of environmental performance for the PEF score and the impact categories ... 48

4.2.1.1. Selection of fi parameters ... 50

4.2.1.2. Criteria for best combination of f parameters ... 51

5. Method to develop classes of performance for circularity indicators and indexes ... 54

5.1. Step 1: Identification and definition of the circularity indicators ... 56

5.1.1. Definition of the criteria ... 56

5.1.2. Selection of the product parameter(s)/indicator(s) that best reflect the circularity aspect 56

5.2. Step 2: Establishing performance ranges/thresholds for circularity aspects/parameters ... 61

5.2.1. Fixed middle class taking into account a Representative Product ... 63

5.2.1.1. Selection of fi parameters ... 65

5.2.2. Fixed intervals based on min and max values ... 65

5.2.3. Fixed percentage of products in each class ... 66

5.3. Step 3: Normalisation and aggregation into indexes ... 67

5.4. Step 4: Definition of a single circularity score ... 68

5.5. Process to review classes of performance ... 69

5.5.1. The example of the Energy label ... 69

5.5.2. Indicators signalling the need for a review and update of classes of performance in the context of the ESPR label ... 70

5.6. Potential impacts due to the establishment of classes of circularity performance ... 71

5.7. Defining and assessing the best use of classes of performance considering consumer expectations and behaviour ... 72

6. Classes of technical performance ... 74

6.1. Limitations of having classes of technical performance ... 74

6.1.1. Intrinsic limitations and interaction with classes of performance for circularity aspects/parameters ... 74

6.1.2. Sufficiency ... 76

7. Assessment of the usefulness of the ESPR label for consumers and other economic actors and interactions with other labels and the DPP ... 78

7.1. Context ... 78

7.2. Literature review on Environmental Product Information (EPI) and Generalised Environmental Labelling (GEL) ... 80

7.2.1. General considerations about EPI and GEL ... 80

7.2.2. Examples of environmental labels (EL) ... 83

7.2.3. Final considerations ... 84

7.3. Method to evaluate the usefulness of the ESPR label ... 85

7.4. Interaction of the ESPR label with other relevant labels and the Digital Product Passport (DPP) ... 87

7.4.1. Energy label ... 87

Tyres label ... 89

7.4.2. Analytical framework to address the interaction between the Energy label and the ESPR label ... 93

7.4.2.1. Scope and assessment ... 93

7.4.2.2. Criteria mapping ... 94

7.4.2.3. Stakeholder consultation ... 95

7.4.2.4. Development of supplementary information guidelines ... 95

7.4.3. EU Ecolabel ... 95

7.4.4. Analytical framework to address the interaction between the EU Ecolabel and the ESPR label ... 98

7.4.4.1. Identification of overlaps ... 99

7.4.4.2. Benchmarking ... 99

7.4.4.3. Harmonisation of criteria ... 99

7.4.5. Other labels ... 100

Textile labelling (Regulation (EU) 1007/2011) ... 100

Durability index (French) ... 101

7.4.6. Digital Product Passport (DPP) and interaction with the ESPR label ... 104

8. Information potentially included on the ESPR label ... 106

8.1. Context ... 106

8.2. Information included on ESPR labels ... 106

8.2.1. Prioritisation of information on the ESPR label ... 110

8.2.2. Potential structure of the ESPR label ... 111

9. Conclusion ... 113

References ... 114

List of abbreviations and definitions 117

List of boxes 119

List of figures 120

List of tables 121

Annexes 122

Annex 1. Circularity indicator 122

Annex 2. Technical performance indicators 124

Abstract

The Ecodesign for Sustainable Products Regulation (ESPR), which aims to improve the environmental sustainability and circularity of products in the European market, entered into force in 2024.

The objective of this report is to develop methods for defining classes of performance and the content of the future ESPR label. The report outlines a multi-step approach to select relevant product aspects and parameters appropriate for classes of performance, propose a method to develop classes of environmental performance based on the Product Environmental Footprint (PEF) single score and the single impact category, and develop classes of performance for circularity aspects/parameters. Additionally, the report discusses the potential impacts of establishing classes of circularity and technical performances and the interaction of the ESPR label with other labels and the Digital Product Passport (DPP). The report also proposes a typology of information to be included in ESPR labels, ensuring that the labels effectively communicate the environmental sustainability and circularity of products to consumers and other economic actors.

The methods developed aim to provide guidance for ongoing and future preparatory studies, supporting the ESPR's objective of improving the environmental sustainability and circularity of products on the European market.

Acknowledgements

The authors would like to thank the Directorate-General for Environment (DG ENVIRONMENT), the Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs (DG GROW), the Directorate-General for Energy (DG ENER) and the colleagues of the Product Policy Analysis team (Unit B5 - Circular Economy and Sustainable Industry) for their support and valuable comments throughout the study.

Authors

Senatore V., González Torres M., Rodríguez-Manotas J., Magrini C. and Gama Caldas M. (JRC B.5 – Circular Economy and Sustainable Industry).

Kouloumpis, V. and Ardente F. (JRC D.3 – Land Resources and Supply Chain Assessments).

Syrus, A. (Deda Speed SPA)

Executive summary

Policy context

On 30 March 2022, the European Commission (EC) adopted a proposal for a Regulation on the Ecodesign for Sustainable Products (ESPR) with the aim of improving the environmental sustainability of products in order to make sustainable products the norm and to reduce the overall carbon footprint and environmental footprint of products over their life cycle, and of ensuring the free movement of sustainable products within the internal market. The proposal was finally adopted and published in the Official Journal of the European Union on 28 June 2024, and entered into force on 18 July 2024.

The ESPR expands the scope of the Ecodesign Directive to cover almost all products on the European market, including both intermediate and final products, with some exceptions. The ESPR framework not only targets the energy consumption of products, but it expands the focus to cover the full environmental sustainability of products throughout their life cycle, including product circularity aspects. The ESPR envisages the possibility to set performance and information requirements. In particular, Article 5 of the ESPR lists the product aspects that should be addressed for ecodesign requirements.

Since the ESPR is a framework regulation, product aspects should be analysed for individual product groups in so-called Preparatory Studies, with the aim of setting relevant ecodesign requirements in product-specific Delegated Acts. Under the current Ecodesign Directive (on energy-related products), Preparatory Studies are carried out based on the Methodology for the Ecodesign of Energy-related Products (MEErP). For carrying out Preparatory Studies under the ESPR, a new methodology needs to be developed.

Key conclusions

The key conclusions of this report are centred around the development of a methodology for defining classes of performance and labels for products under the ESPR. The report establishes a structured approach to assess the relevance of circularity aspects and parameters, which are crucial for the creation of performance classes. It also refines the method for developing environmental performance classes based on the PEF score and single impact category, ensuring that products are categorised in a way that reflects significant improvements in environmental performance levels.

Furthermore, the report introduces methods for developing classes of performance for circularity aspects and parameters, which are essential for promoting a circular economy. The potential impacts of establishing these classes are discussed, highlighting the importance of incentivising the best performing products and guiding consumers towards more sustainable choices.

The interaction of the ESPR label with existing labels, such as the Energy Label and the EU Ecolabel, is critically examined to ensure that the ESPR label complements and enhances the information provided by these labels without causing confusion among consumers. The report also considers the integration of the ESPR label with the Digital Product Passport (DPP), which provides a comprehensive overview of a product's sustainability features.

Lastly, the report suggests a typology of information that could be included in the ESPR labels, prioritising environmental impact, circularity aspects, and technical performance. This prioritisation ensures that the labels serve as an effective tool for consumers to make informed decisions while being economically viable for manufacturers.

Main findings

The main findings of the report focus on the development of flexible and general methods for defining classes of performance, the decision not to proceed with the development of classes of technical performance, and the potential content of labels along with their interaction with the EU Ecolabel and Energy Label.

Flexible and general methods for defining classes of performance

The report outlines flexible and general guidance for defining classes of performance based on circularity aspects and parameters, the Product Environmental Footprint (PEF) single score and the individual impact categories. These methods are designed to be adaptable to any product under the ESPR scope. The methods include a four-step approach for selecting the most relevant product parameters, developing classes of environmental performance, and establishing performance ranges/thresholds for circularity aspects. The methods proposed are intended to incentivise the use of the best performing products and help end-users choose the most environmentally sustainable products within the same product category.

Classes of technical performance

The report explains the decision not to proceed with the development of classes of technical performance. This decision is based on the sufficiency perspective, which emphasises the need to question the necessity of certain functionalities and the extent to which they are required. The report suggests that technical performance should be communicated to consumers through specific performance indicators rather than by classifying products based on technical performance, as this could potentially overshadow the promotion of environmentally sustainable products. The focus is on ensuring that environmental performance is not compromised by technical gains and that consumers are guided towards making sustainable choices.

Potential content of the ESPR label and interaction with the EU Ecolabel and Energy Label

The potential content of the ESPR label includes environmental impact scores or classes, such as the PEF score, and classes of performance for circularity indicators. The label may also include technical performance indicators where relevant. The report highlights the importance of prioritising information on the label to avoid overwhelming consumers and to ensure that the most crucial information for making an environmentally responsible choice is easily accessible. The interaction with the EU Ecolabel is addressed by ensuring that the criteria developed under the EU Ecolabel are at least as strict as the ecodesign requirements within the ESPR framework. For energy-related products for which it is not possible to incorporate a particularly relevant product parameter into the energy label, this information is instead to be communicated via an ESPR label. The methodology for this assessment includes identifying overlaps, benchmarking, harmonising criteria, methodological consistency and stakeholder consultation.

Related and future Joint Research Centre work

As part of the update of the existing MEErP, the methods developed in this report are planned to be integrated into a final report, alongside other methods developed in other reports. The aim of this work and that of other reports is to provide a guidance document that serves the study team for the development of ongoing and future Preparatory Studies in line with the mandate of the ESPR.

Quick guide

The present study focuses on the development of classes of performance for circularity parameters and the information that can potentially be included on labels for product categories/groups within specific Delegated Acts.

In relation to classes of performance, the work carried out in this report has resulted in:

- a method to select the product aspects and parameters appropriate for classes of performance and to define/assess the best use of classes of performance, taking account of consumers' expectations and behaviour **(Chapter 3)**;
- the improvement of the method to develop classes of environmental performance for the Product Environmental Footprint (PEF) score, building on the approach already included in Commission Recommendation (EU) 2021/2279 **(Chapter 4)**;
- a method to develop classes of performance for circularity indicators **(Chapter 5)**;
- consideration of classes of technical performance **(Chapter 6)**.

In relation to labels, the work carried out in this report has resulted in:

- a method to assess whether a label is useful for consumers and other economic actors, taking into account the interactions with other labels and with the Digital Product Passport **(Chapter 7)**;
- a typology of information potentially included on ESPR labels, including but not limited to classes of performance, and rationale for the various types of information **(Chapter 8)**.

The study aims to provide flexible and general guidance to be applicable to any product under the ESPR scope; therefore, the methodology might need to be adapted to the specific product under study, as appropriate and if deemed necessary by the study team conducting the Preparatory Study.

Extensive summary

I. Method to select the products aspects and parameters appropriate for classes of performance (Chapter 3)

Step 1: Assessment of the relevance of circularity aspects

Objective: Develop a method to assess the relevance of circularity aspects.

Circularity aspects considered: Durability, reliability, reusability, upgradability, repairability, maintenance, refurbishment, water use and efficiency, resource use and efficiency, recycled content, remanufacturing, recyclability, material recovery, and waste generation.

Method application:

- Apply the method reported in Rodriguez-Manotas et al., (2025) to specific product groups/categories to preselect relevant circularity aspects.
- Utilise outputs to define appropriate product parameters for classes of performance.

Exclusions:

- Substances of concern: Evaluated separately in Perez Camacho et al., (2025).
- Energy use and efficiency: Governed by existing EU regulations.
- Environmental impacts: Assessed using the Product Environmental Footprint (PEF) method.

Step 2: Collection of intrinsic characteristics

Objective: Identify intrinsic characteristics and performance variability of the product group/category.

Data collection:

- Prioritise official sources like technical reports and impact assessments funded by the European Commission.
- Supplement with data from professional associations, scientific literature and stakeholder input if needed.

Information to gather:

- Intrinsic characteristics: Functionality, quality, design, price range, target market, usage patterns, technology level.
- Properties: Quantitative (mass) and qualitative (material types).
- Standards: Recognised methods and standards for quantifying product parameters.
- Performance data: Manufacturer data, consumer reports and sectoral data for accurate statistics on functionalities.

Step 3: Calculation of appropriateness

Objective: Assess the appropriateness of product parameters using specific criteria.

Criteria for assessment:

- Scientific feasibility and robustness: Availability of data, measurability and scientific backing.
- Documentation/Standards/Certifications: Availability and accessibility of methods, standards and certifications.
- Geographical and temporal coverage: EU representation and up-to-date data.
- Uncertainty and variability: Statistical variation and data reliability.
- Calculate the score for each criterion using Equation (1).

Outcome: Calculate an appropriateness grade (A0 to A3) based on the evaluation using Equation (2).

Step 4: Evaluation of Potential for Improvement (PI)

Objective: Determine the potential for improvement (PI) in product parameters for a product group/category.

Process:

- Define key performance indicators (KPIs): Establish metrics to measure the potential for improvement (PI) (e.g. lifespan, carbon footprint).
- Baseline data: Collect current performance data.
- Set targets: Identify benchmarks or desired outcomes and calculate performance gaps.
- PI calculation: Use formula (3) to quantify the potential improvement percentage.

Analysis and decision-making:

- Assess the significance of improvements, considering marginal, moderate, significant or breakthrough levels.
- Prioritise improvements based on feasibility and strategic alignment with ESPR goals.

Considerations:

- Evaluate the cost-benefit ratio and feasibility of improvements.
- Involve stakeholders for insights on significant improvements.
- Align improvements with long-term sustainability objectives and industry benchmarks.

II. Development of a new method to establish classes of environmental performance (Chapter 4)

Objective: The aim is to create a versatile and comprehensive method to develop classes of environmental performance. This involves categorising products into five classes (A to E), with A being the best performance and E the worst. The versatile method is applicable both to an aggregated PEF score and individual environmental impact categories.

Methodology

- Dual-level approach:

  - Aggregated level: Incorporates data from all 16 Environmental Footprint (EF) impact categories into a single score to provide an overall environmental performance assessment.
  - Individual impact categories: Analyses each of the 16 EF impact categories separately for a focused evaluation of individual environmental impacts.
- Versatility and comprehensiveness:
  - The method provides both a broad overview and detailed insights into environmental performance by allowing assessments at both the aggregated and individual category levels.
- Classes of performance:
  - Establishes classes of performance based on a representative base model (BM) of a product, serving as the midpoint for Class C.
- Conducts sensitivity analysis on the representative product to identify key performance parameters.
  - Utilises industry data to define theoretical best (BP) and worst (WP) products, which set the upper and lower limits for the performance categories.
- Class boundaries and fi parameters:
  - Adjusts class boundaries using dynamic parameters (f1, f2, f3, f4) instead of fixed factors like 0.3 and 0.85, allowing the system to respond to actual data distributions.
- The Gaussian (normal) distribution is used to determine these parameters, given its relevance as a good approximation of some real-world data patterns.
- Proposed structure:
  - 5 classes from A (best) to E (worst) have been proposed.
  - Considers reducing or increasing the number of classes to balance consumer comprehension with detailed information.
- Evaluation and refinement:
  - Uses stakeholder feedback to refine outputs, ensuring accurate identification of best and worst products.
  - In the event that the proposed fi parameters are not considered adequate to correctly differentiate the performance of the product under study, tests different combinations of fi parameters across different distribution types in order to find the most effective class boundaries that will allow the products to be accurately differentiated according to the criteria proposed in this report or any other criteria proposed by the study team.
- Implementation tools:
  - Provides an Excel tool '*Template CoP v1*' for calculating class boundaries and simulating different parameter combinations, enabling tailored analysis based on specific data distributions.
- Criteria used for fi parameter selection:

- Ensures that Class A and B populations are less than Class D and E, Class C is the largest, and Class B exceeds Class A while Class D exceeds Class E.
- Considers various distribution shapes (platykurtic, leptokurtic, skewed) to ensure robustness.

Recommendations

- For establishing performance classes, predefined parameter combinations are recommended, particularly when data is insufficient.
- For customised parameter selection, study teams are advised to use the Excel tool '*Template CoP v1*'[1] provided which allows input of specific data distributions to derive tailored fi parameters.

III. Method to develop classes of performance for circularity indicators and indexes (Chapter 5)

Objective: The proposed approach aims to provide an adaptable and comprehensive system for classifying products according to their circularity performance through indicators and/or aggregated indexes, facilitating both consumer understanding and detailed communication of their environmental impact. Here are some thoughts on how indicators differ from aggregated indexes:

- **Nature of measure**: Indicators are single metrics reflecting specific performance aspects, like durability, while aggregated indexes combine multiple indicators into a dimensionless score representing a broader concept.
- **Complexity of aggregation**: Classification is simpler for single indicators due to straightforward thresholds, whereas aggregated indexes require careful methodology consideration to reflect underlying indicators accurately.
- **Normalisation and weighting**: Indicators may need normalisation for comparison, while aggregated indexes often require both normalisation and weighting to ensure appropriate contribution to the overall index.
- **Interpretation and use**: Single indicators are easier to interpret, while aggregated indexes require understanding of composite scores and how changes in indicators affect the overall classification.
- **Sensitivity and robustness**: Single indicators are sensitive to changes, while aggregated indexes may be more robust depending on aggregation methods, although they can also be sensitive to certain indicators.
- **Thresholds and cut-off points**: Establishing indicator performance classes involves clear, empirical thresholds, whereas aggregated indexes involve synthesising across multiple dimensions, making cut-off points more arbitrary.

[1] The Excel file 'Template CoP v1' is accessible only to Commission employee at the following path: "Z:\30 Publications (public)\NEW PUB_REQUESTs\JRC143463_V Senatore_ESPR Methodology\Template CoP v1.xlsx".

The report also outlines a four-step method for developing classes of performance, either as indicators, aggregated indexes, or scores:

Step 1: Identification and definition of the circularity indicators

Identify and define circularity indicators based on relevant product aspects/parameters. Criteria such as ENSOS (Easy, Noteworthy, Simple, Optimal, Solid) should be used to ensure circularity parameters are straightforward, significant, understandable, fit for purpose and reliable.

Step 2: Establishing performance ranges/thresholds for circularity aspects

The report outlines methods for establishing performance classes for circularity indicators and indexes, taking into account product category characteristics and specific product aspects and/or parameters. These methods serve as general guidelines, ensuring classes reflect considerations such as class number, adequate distribution, and class width related to uncertainty. The methods proposed are adaptable for both individual circularity indicators and aggregated indexes, such as a circularity index. The proposed methods include the following:

1. **Fixed middle class using a Representative Product (RP)**: This method involves defining a representative product as a base model (BM) to serve as a benchmark for class development. Performance classes are divided into five categories (A to E), with normalisation using the min-max approach. The upper limit for Class A is determined by the best available technology (BAT) and best not yet available technology (BNAT), while the lower limit for Class E is based on the worst product or minimum performance requirements.

2. **Fixed intervals based on min and max values**: A straightforward method that allows flexibility in defining performance classes. The method requires data availability, particularly the minimum and maximum values of a circularity indicator. Classes are created by dividing the data into intervals based on calculated ranges and interval widths, allowing for adjustments to ensure appropriate product distribution across classes.

3. **Fixed percentage of products in each class**: This method sets class boundaries based on a fixed percentage of products in each class. For example, products may be distributed among five classes (A to E) where Class A represents the best performing products, while Class E represents the lowest performing products. This method relies on the availability of product parameters data.

Step 3: Normalisation and aggregation into indexes

Transform product indicators into standardised metrics using normalisation, inversion of metrics, and weighting factors. The min-max approach is recommended for normalisation, while weighting can be determined through expert opinions or methods like the Delphi Method or Analytic Hierarchy Process (AHP). Aggregation combines normalised and weighted indicators into a comprehensive metric or score.

Step 4: Definition of a single circularity score

Optional step to aggregate normalised aspects into a single circularity score, reflecting overall circularity. This involves identifying relevant parameters, normalising them, assigning weights, and choosing an aggregation method. While a single score simplifies comparison, it may oversimplify circular economy complexities, so its use depends on technical, political and stakeholder considerations.

Overall, the report provides a flexible framework for developing performance classes and indexes tailored to specific product groups and circularity indicators, accommodating future data availability and technological advancements.

Review process of classes of performances

Objective: To identify and assess indicators that signal the need for a review and update of performance classes, particularly in the context of the ESPR label.

Approach: The review process utilises a series of indicators to determine when the classes of performance may require updating. These indicators include the following:

- **Penetration rate of top-class products**: Monitoring how many products achieve the highest performance class to ensure criteria remain stringent.
- **Technological innovation rate**: Observing the pace of innovation to align performance classes with new, sustainable technologies.
- **Average improvement in specific product parameters**: Evaluating significant improvements within product groups as a signal for updating classes.
- **Shifts in minimum performance standards**: Considering regulatory changes that affect minimum efficiency standards.
- **Market dynamics**: Analysing consumer demand shifts and manufacturer production trends toward higher efficiency.
- **Resource savings potential**: Reviewing new data on resource savings to adjust classes accordingly.
- **Differential performances**: Identifying significant performance discrepancies within the same class as an indicator for class range adjustments.

Outcome: Employing these indicators enables regulatory bodies to promptly review and update performance classes. This ensures that performance classes continually promote environmental sustainability and empower consumers to make informed choices.

Potential impacts due to the establishment of classes of performances for circularity aspects

Objective: To explore the potential impacts of establishing classes of performances on circularity aspects.

Approach: Establishment of classes of performance can influence environmental requirements through various mechanisms:

- **Setting environmental benchmarks**: Encouraging manufacturers to meet and exceed environmental standards.
- **Driving innovation**: Stimulating technological advancements that excel in environmental and circularity performance.
- **Informing regulatory standards:** Using classes of performance to update regulations and phase out underperforming products.

— **Guiding consumer choice:** Providing clear labelling to assist consumers in making environmentally conscious choices.

— **Competitive differentiation:** Leveraging classes of performance as marketing tools for competitive advantage.

— **Encouraging best practices:** Sharing successful practices across industries to promote sustainability.

Outcome: The establishment of classes of performance for circularity aspects significantly enhances environmental standards, drives innovation, guides consumer choices and encourages sustainable market practices.

Defining and assessing the best use of classes of performance taking into account consumer expectations and behaviour

Objective: To define and assess the effective use of classes of performance that communicate product sustainability and circularity attributes to consumers, aligning with consumer expectations and behaviour.

Approach: A nuanced approach is required to ensure classes of performance resonate with consumers:

— **Identifying classes of performance**: Identify key product aspects/parameters such as durability, recyclability, etc. for which classes of performance have been developed or will be developed.

— **Consumer research**: Conduct comprehensive market research to understand consumer preferences and behaviours.

— **Segmenting the market demographically, psychographically and behaviourally.**

  - Use surveys, focus groups, interviews, online reviews, and social media analysis.

— **Mapping consumer expectations**: Align consumer expectations with classes of performance, prioritising those with the most significant impact on satisfaction.

Outcome: By aligning classes of performance with consumer expectations and behaviour, companies can effectively communicate product sustainability, promote circular economy principles and drive sustainable consumption choices.

Additional considerations include ensuring horizontal harmonisation among classes developed for the same indicator across different product groups, using a letter-based nomenclature for classes of performance (A to E), and accounting for uncertainties in data. The influence of ecodesign requirements is crucial for setting performance thresholds, with scenarios like Business as Usual and ecodesign requirements projected to anticipate future distributions of product performance among classes.

This comprehensive framework aims to provide clear guidelines while allowing flexibility for adjustment across various product groups and indicators, ensuring meaningful representation of performance levels.

IV. Classes of technical performance (Chapter 6)

Objective: The primary objective of the report is to explore the challenges and considerations involved in incorporating circularity into product design, specifically in relation to technical performance. It aims to highlight the complexities of creating classes of technical performance for products and proposes a balanced approach that aligns environmental sustainability with technical specifications. The report also focuses on the limitations and consequences of prioritising technical performance over environmental considerations, advocating for a sufficiency perspective in product evaluation.

Outcome: The outcome of the analysis is a recommendation against developing classes of technical performance due to their potential limitations and conflicts with sustainability goals. Instead, the report advocates a sufficiency perspective, emphasising the need to question the necessity of product functionalities and prioritise environmental sustainability. By focusing on sufficiency, the report argues for a holistic approach that reduces overall consumption and promotes mindful product use. It highlights the importance of balancing efficiency and sufficiency to achieve genuine sustainability, encouraging innovation in product design that aligns with circular economy principles. The report concludes that sufficiency acts as a critical counterbalance to efficiency, ensuring that efforts to mitigate environmental impact are not undermined by uncontrolled consumption.

V. Assessment of the usefulness of the ESPR label for consumers and other economic actors and interactions with other labels and the DPP (Chapter 7)

Method to evaluate the usefulness of the ESPR label

Objective: The primary objective is to develop a comprehensive method for evaluating the usefulness of the ESPR label from both consumer and economic operator perspectives. The evaluation aims to ensure the label's effectiveness in providing necessary information to consumers while being economically viable for operators.

Method: The method is multifaceted, incorporating both qualitative and quantitative data collection and analysis. It involves several steps tailored to the perspectives of consumers and economic operators:

- **For consumers**:
  - **Understandability**: Assess if the label's language and terms are easily understood by consumers through surveys and focus groups.
  - **Visibility and legibility**: Evaluate the label's design elements, such as font size, colour contrast, and placement, using eye-tracking studies to determine how quickly consumers can locate and read the label.
  - **Relevance and comprehensiveness**: Gather consumer feedback to determine if the label provides all the necessary information for informed decision-making.
  - **Information overlap**: Ensure the label does not duplicate information found on other mandatory labels through cross-checking.
  - **Behavioural impact**: Analyse changes in consumer purchasing behaviour before and after the label's introduction using controlled experiments to see if it encourages the choice of more sustainable or higher-performing products.

- **Accessibility**: Check if additional information is easily accessible through QR codes, websites or other data carriers, and measure the usage rates of these channels.

— **For economic operators**:

  - **Cost and feasibility**: Analyse the financial impact of implementing the label, especially on SMEs, and explore subsidies or incentives to offset costs. Assess methodological complexities related to environmental impact assessments.
  - **Impact on sales and market position**: Monitor sales data and conduct market research to evaluate the label's effect on product appeal, market share, brand perception and competitiveness.
  - **Operational efficiency**: Evaluate the ease of integrating new labelling requirements into existing processes and the effort needed to maintain compliance with standards.

— **Cross-analysis**:

  - Conduct a cross-analysis to identify commonalities and discrepancies between consumer satisfaction and economic burden. Balance consumer demands with economic impacts, investigate the label's influence on consumer behaviour, and analyse its potential for driving sustainable consumption and product innovation.
  - Weigh the label's effectiveness in changing consumer behaviour against the efficiency of its implementation by economic operators.

Outcome: The assessment method aims to provide a comprehensive understanding of the ESPR label's usefulness for specific product groups. It highlights areas for improvement and ensures that labels effectively inform consumers while remaining economically viable for operators. The method is intended to be iterative, requiring regular reviews to adapt to changes in consumer behaviour, market trends and regulatory landscapes. Continuous engagement with both consumers and economic operators is essential to maintain the label's ongoing relevance and effectiveness.

Analytical framework to address the interaction between the Energy Label and the ESPR label

Objective: The primary objective is to develop a systematic analytical framework to address the interaction between the Energy label and the ESPR label. The goal is to determine whether and how to incorporate classes of performance from Regulation (EU) 2024/1781 into the Energy label as supplementary information or to incorporate the relevant information from the Energy Label into the ESPR label.

Method:

1. **Scope and assessment:**

   - Identify energy-related products covered by both Regulation (EU) 2017/1369 (Energy Labelling) and Regulation (EU) 2024/1781 (ESPR).
   - Decide between two options: incorporating ESPR classes of performance into the Energy label or creating a new hybrid label such as the ESPR label combining information from both.

- Assess current information on the Energy label and determine additional relevant information from the ESPR. The Energy label focuses on energy efficiency, while the ESPR label addresses overall environmental impacts, including circularity and environmental footprint.
- Integrate relevant circularity aspects into the Energy label, prioritising the most significant parameters. Use QR codes for additional information not displayed due to space constraints.

2. **Criteria mapping:**
    - **Option 1:** If energy consumption impacts ≥ 50% of the overall environmental impact, use Energy Efficiency as a proxy to define the sustainability of a product group. Circularity information should replace non-energy parameters on the label, with additional data accessible via a QR code.
    - **Option 2:** If energy consumption impacts < 50% of the overall environmental impact, display both Energy Efficiency and the EF score. This format risks information overload, necessitating stakeholder consultation to assess feasibility.
3. **Stakeholder consultation:**
    - Engage with stakeholders, including manufacturers, consumer organisations, environmental groups, and standard-setting bodies, to gather input on supplementing Energy labels or creating a new merged label such as the ESPR label plus information that is on the Energy Label.
    - Conduct consumer research to evaluate how label information influences purchasing decisions and identify the most comprehensible format.
4. **Development of supplementary information guidelines:**
    - Based on assessments and stakeholder feedback, develop guidelines for including supplementary information on Energy labels (for Option 1) or navigating a new label layout (for Option 2).
    - Establish clear definitions, measurement standards and display formats to ensure consistency and clarity.

Outcome: The outcome of this analytical framework is a clear strategy for integrating ESPR label information into existing Energy labels or vice versa. The approach aims to balance the provision of comprehensive environmental and energy-related information with user-friendliness to aid consumer decision-making. By engaging stakeholders and conducting thorough assessments, the framework seeks to ensure that labels effectively communicate necessary information without overwhelming consumers. Ultimately, this iterative process will adapt to technological advances, regulatory changes and evolving consumer preferences, maintaining the relevance and effectiveness of labelling systems.

Analytical framework to address the interaction between the EU Ecolabel and the ESPR label

Objective: The primary objective of this analytical framework is to ensure complementarity and synergy between the EU Ecolabel and the ESPR label in achieving environmental objectives. The framework aims to align and harmonise the criteria of both labels to enhance environmental performance, simplify compliance for manufacturers, and maintain the EU Ecolabel as a mark of environmental excellence while avoiding conflicts or redundancies.

Method: The methodological approach considers two scenarios:

Scenario 1: Revision of the EU Ecolabel criteria concurrently with ESPR requirements

- **Simultaneous revision**: When ESPR criteria are established for a product group already covered by the EU Ecolabel, the sets of criteria addressed by the EU Ecolabel should be reviewed and revised to ensure coherence and complementarity.
- **Alignment and harmonisation**: Align EU Ecolabel criteria with ESPR requirements to maintain the EU Ecolabel's role as a mark of environmental excellence, ensuring it sets stricter criteria than those in the ESPR.
- **Simplified compliance**: Allow manufacturers to use their EU Ecolabel certification to demonstrate compliance with ESPR requirements, simplifying the process and reducing administrative burdens.
- **Methodological consistency**: Harmonise methodologies and data sources used in calculating environmental metrics, such as carbon footprints, to ensure comparability and avoid misleading assessments of stringency.

Scenario 2: No revision of EU Ecolabel criteria after the entry into force of the ESPR requirements

- **Identifying overlaps**: Conduct a thorough analysis of both EU Ecolabel criteria and ESPR requirements to identify commonalities and potential redundancies, focusing on circularity parameters within product groups.
- **Benchmarking**: Systematically compare the ESPR label and EU Ecolabel to evaluate their requirements, criteria and outcomes. The ESPR's mandatory requirements serve as a baseline, with the EU Ecolabel setting stricter, broader criteria to maintain its mark of excellence.
- **Harmonising criteria**: Ensure the EU Ecolabel criteria remain more stringent than ESPR requirements, especially for product parameters where performance requirements are set. The upper level of classes should reflect the best performing products.

Outcome: The outcome of implementing this framework is a harmonised and complementary relationship between the EU Ecolabel and the ESPR label. This ensures that both labels effectively promote sustainable product development and higher environmental standards. By aligning criteria, the EU Ecolabel maintains its status as a mark of environmental excellence while facilitating compliance for manufacturers. The harmonised criteria enhance the overall environmental performance and market relevance of labelled products, supporting the shared objectives of both labels. This approach also ensures methodological consistency, enabling stakeholders to confidently assess and compare environmental standards and labels.

Digital Product Passport (DPP) and interaction with the ESPR label

The Digital Product Passport (DPP) is a digital document required by the ESPR for products in the EU, ensuring accuracy, completeness and up-to-date information about products. It includes essential product data, linked to unique identifiers via data carriers like QR codes, and must be machine-readable and accessible to stakeholders. A digital registry will be established by July 2026 to store these identifiers for market surveillance. The DPP enhances product traceability and regulatory compliance and supports sustainability goals.

The DPP and ESPR label both aim to promote sustainability and inform consumers about environmental impacts. The DPP stores detailed product data, while the ESPR label presents simplified, key sustainability metrics to consumers. They interact through integration of information, data carriers that link to the DPP, and a hierarchy of information to aid consumer decision-making. The ESPR label prioritises relevant information for consumers, while the DPP holds extensive data for those seeking in-depth information. Together, they facilitate regulatory compliance, traceability and consumer guidance in sustainable product choices.

VI. Information potentially included on the ESPR label (Chapter 8)

The ESPR label is designed to provide consumers with information regarding the environmental performance and sustainability aspects of products. It aims to balance essential information with simplicity to prevent overwhelming consumers. The label includes several key components:

— **Environmental impact**: The ESPR label may feature environmental footprint scores, such as the Product Environmental Footprint (PEF) score, carbon footprint or material footprint. These scores allow consumers to quickly compare products based on their environmental performance, encouraging sustainable purchasing decisions. While single scores offer simplicity, they can oversimplify complex issues, so detailed information on specific environmental impacts is available through the Digital Product Passport (DPP).

— **Circularity indicators (parameters):** The ESPR label may include classes of performances in terms of circularity aspects like durability and repairability, empowering consumers to choose products that support a circular economy by minimising waste and extending product life.

— **Technical performance**: Information regarding a product's function and efficiency is provided to help consumers assess not only environmental attributes but also how well a product meets technical performance needs.

— **Non-circularity aspects**: Details on energy use and the presence of substances of concern throughout the product life cycle are included.

— **Data carriers**: The label incorporates digital tools like QR codes, RFID tags, NFC chips, and barcodes, enabling access to detailed online information. These tools provide consumers with comprehensive and up-to-date data without cluttering the label.

The ESPR label uses a tiered approach to information, distinguishing between primary and secondary information. Primary information, visible on the ESPR label, includes simplified environmental, circularity and technical data, along with data carriers. Secondary information, available through digital means, offers more detailed insights for consumers seeking a comprehensive understanding of the product.

This approach ensures the label remains a tool for easy product comparison while providing access to detailed data for those interested. The label's design prioritises clarity and guidance, focusing on what consumers need to make informed decisions. It supports the ESPR's aim to improve environmental sustainability, making sustainable products the norm and reducing their life cycle carbon and environmental footprints.

Prioritization of information on the ESPR label

The ESPR label prioritises information to help consumers quickly identify sustainable products. The most important information is the classes of performance for environmental impact, which provide a clear understanding of the product's environmental footprint, aligning with the ESPR's goal to reduce environmental impact. Next, circularity indicators' performance classes are prioritised, offering insights, for example, into the product's life cycle, durability and recycling potential, crucial for promoting a circular economy. If space allows, technical performance details, which can indirectly affect the product's sustainability, are included. Any other relevant information will be considered at the end, provided that there is sufficient space available. This structured approach ensures essential information is prominent without overwhelming the consumer with details.

Potential structure of the ESPR label

The potential structure of the ESPR label is divided into three main sections (see **Figure 21**). Section 1 is dedicated to classes of performance for environmental impact, with the environmental footprint (EF) serving as the default measure. Alternatives like carbon or material footprint can be used if more suitable for a specific product group, but such choices must be well-justified. Section 2 includes additional information directly related to environmental impact, such as carbon footprint over the product's lifetime, annual water and energy consumption, and waste generation. The most relevant parameter for the product group should be selected. Section 3 is focused on circularity classes of performance, energy efficiency and any other pertinent information specific to the product group, such as technical performance details.

1. Introduction

1.1. Policy context and background

In 2019, the European Commission presented the European Green Deal. This growth strategy aims at transforming the European Union into a fairer and more prosperous society with a modern, competitive, climate-neutral, digital and circular economy. Regarding this last point, the Circular Economy Action Plan (CEAP) was introduced in March 2020. It provides specific objectives: reaching the 2030 climate and energy efficiency goals, climate neutrality by 2050 and decoupling economic growth and the well-being of EU citizens from environmental and climate impacts while ensuring the long-term competitiveness of the EU. It includes a sustainable product policy legislative initiative, which will ensure that products are fit for a climate-neutral, resource-efficient and circular economy, reduce waste and ensure that the use of frontrunners in sustainability progressively becomes the norm. The legislative initiative also fits into the New Industrial Strategy for Europe, which will guarantee that European industry leads the transition towards climate neutrality and digital leadership.

In June 2024, the European Commission (EC) adopted the Regulation on the Ecodesign for Sustainable Products (hereafter ESPR) with the aim of improving the environmental sustainability and the circularity of products on the European market. The ESPR is based on the success of the Ecodesign Directive, whose main focus is to improve the energy use of those products with a large energy consumption during the use stage.

The ESPR expands the scope of the Ecodesign Directive to cover all products on the European market, including both intermediate and final products, with the exception of food and feed, living plants, animals and microorganisms, products of human origin, and products of plants and animals relating directly to their future reproduction, medicinal products for human use, veterinary medicinal products, and vehicles as referred to in Article 2(1) of Regulation (EU) 2018/858, Regulation (EU) No 167/2013, Regulation (EU) No 168/2013, for those product requirements set for these vehicles under Union law. The ESPR doesn't only target the energy consumption of products, but it also expands the focus to cover the full environmental sustainability of products throughout their life cycle, including products' circularity aspects. The ESPR envisages the possibility to set performance and information requirements. In particular, Article 5 of the ESPR lists the product aspects that will be addressed for ecodesign requirements:

- durability;
- reliability;
- reusability;
- upgradability;
- reparability;
- possibility of maintenance and refurbishment;
- presence of substances of concern;
- energy use and energy efficiency;
- water use and water efficiency;
- resource use and resource efficiency;
- recycled content;

- possibility of remanufacturing;
- recyclability;
- possibility of recovery of materials;
- environmental impacts, including carbon footprint and environmental footprint;
- expected generation of waste.

As reported in Annex I to the ESPR, the product parameters shall, as appropriate, and where necessary supplemented by others, be used, individually or combined, as a basis for improving the product aspects referred to in Article 5(1):

a) durability and reliability of the product or its components as expressed through the product's guaranteed lifetime, technical lifetime, mean time between failures, indication of real use information on the product, resistance to stresses or ageing mechanisms;

b) ease of repair and maintenance, as expressed through: characteristics, availability, delivery time and affordability of spare parts, modularity, compatibility with commonly available tools and spare parts, availability of repair and maintenance instructions, number of materials and components used, use of standard components, use of component and material coding standards for the identification of components and materials, number and complexity of processes and whether specialised tools are needed, ease of non-destructive disassembly and re-assembly, conditions for access to product data, conditions for access to or use of hardware and software needed;

c) ease of upgrading, re-use, remanufacturing and refurbishment as expressed through: number of materials and components used, use of standard components, use of component and material coding standards for the identification of components and materials, number and complexity of processes and tools needed, ease of non-destructive disassembly and re-assembly, conditions for access to product data, conditions for access to or use of hardware and software needed, conditions of access to test protocols or not commonly available testing equipment, availability of guarantees specific to remanufactured or refurbished products, conditions for access to or use of technologies protected by intellectual property rights, modularity;

d) design for recycling, ease and quality of recycling as expressed through: use of easily recyclable materials, safe, easy and non-destructive access to recyclable components and materials or components and materials containing hazardous substances and material composition and homogeneity, possibility for high-purity sorting, number of materials and components used, use of standard components, use of component and material coding standards for the identification of components and materials, number and complexity of processes and tools needed, ease of non-destructive disassembly and re-assembly, conditions for access to product data, conditions for access to or use of hardware and software needed;

e) avoidance of technical solutions detrimental to re-use, upgrading, repair, maintenance, refurbishment, remanufacturing and recycling of products and components;

f) use of substances, and in particular the use of substances of concern, on their own, as constituents of substances or in mixtures, during the production process of products, or leading to their presence in products, including once these products become waste, and their impacts on human health and the environment;

g) use or consumption of energy, water and other resources in one or more life cycle stages of the product, including the effect of physical factors or software and firmware updates on product efficiency and including the impact on deforestation;

h) use or content of recycled materials and recovery of materials, including critical raw materials;

i) use or content of sustainable renewable materials;

j) weight and volume of the product and its packaging, and the product-to-packaging ratio;

k) incorporation of used components

l) quantity, characteristics and availability of consumables needed for proper use and maintenance as expressed, inter alia, through yield, technical lifetime, ability to reuse, repair, and remanufacture, mass-resource efficiency, interoperability;

m) the environmental footprint of the product, expressed as a quantification, in accordance with the applicable delegated act, of a product's life cycle environmental impacts, whether in relation to one or more environmental impact categories or an aggregated set of impact categories;

n) the carbon footprint of the product;

o) the material footprint of the product;

p) microplastic and nanoplastic release as expressed through the release during relevant product lifecycle stages including manufacturing, transport, use, and end of life stages;

q) emissions to air, water or soil released in one or more life cycle stages of the product as expressed through quantities and nature of emissions, including noise;

r) amounts of waste generated, including plastic waste and packaging waste and their ease of re-use, and amounts of hazardous waste generated;

s) functional performance and conditions for use including as expressed through ability in performing its intended use, precautions of use, skills required, compatibility with other products or systems;

t) lightweight design as expressed through reduction of material consumption, load- and stress-optimisation of structures, integration of functions within the material or into a single product component, use of lower density or high-strength materials and hybrid materials, with respect to material savings, recycling and other circularity aspects, and waste reduction.

Since the ESPR is a framework regulation, the aspects and parameters listed above should be analysed for individual product groups in so-called Preparatory Studies, with the aim of setting relevant ecodesign requirements in product-specific Delegated Acts (DAs). Under the current Ecodesign Directive (on energy-related products), Preparatory Studies are carried out based on the Methodology for the Ecodesign of Energy-related Products (hereafter, MEErP). For carrying out Preparatory Studies under the ESPR, a new methodology needs to be developed.

1.2. Purpose of the report

The main aim of this report is to contribute to the development of the methodology for setting ecodesign requirements for sustainable products for the implementation of the Ecodesign for Sustainable Products Regulation (ESPR)[2], which entered into force in July 2024.

[2] Regulation (EU) 2024/1781 of the European Parliament and the Council of 13 June 2024 establishing a framework for the setting of ecodesign requirements for sustainable products, amending Directive (EU) 2020/1828 and Regulation (EU) 2023/1542 and repealing Directive 2009/125/EC.

More specifically, this report includes the development of **"Methods for the definition of classes of performance and labels".**

1.3. Policy question addressed

The methods developed and presented in this report will provide guidance to develop classes of performance for circularity parameters and determine the information that could potentially be included on labels for product categories/groups within specific Delegated Acts.

The decision to develop classes of performance for circularity parameters is strengthened by Article 7 of the ESPR: "*When setting the information requirements referred to in paragraph 2, point (b)(i), the Commission shall, where appropriate in view of the specificity of the product group, determine classes of performance.*

The Commission may base the classes of performance on single parameters or on aggregated scores. Such classes of performance may be expressed in absolute terms or in any other form that enables potential customers to choose the best performing products. Those classes of performance shall correspond to significant improvements in performance levels.

Where classes of performance are based on parameters in relation to which performance requirements are set, the lowest class shall correspond to the minimum performance required at the time when the classes of performance start to apply."

Article 16 of the ESPR reinforces the decision to develop labels to display the overall sustainability performance of products: "*Where the information requirements indicate that information is to be included in a label pursuant to Article 7(7), point (c), the delegated acts adopted pursuant to Article 4 shall specify:*

(a) the content of the label;

(b) the layout of the label, ensuring visibility and legibility;

(c) the manner in which the label is to be displayed to customers including in the event of distance selling, taking into account the requirements set out in Article 32 and the implications for the relevant economic operators;

(d) where appropriate, electronic means for generating labels."

Moreover, this report aims to support the specific objective of analysing the appropriateness of classes of performance for the product aspects and parameters. It aims at providing insights to address two of the main identified problems:

- the lack of classes of performance for circularity aspects in the overall sustainability assessment of products;
- the need to display the overall sustainability performance of products on labels to help and guide consumers to make more environmentally sustainable choices.

1.4. Objectives of the study

There are two main reasons/drivers for establishing classes of performance and labels for products:

- **Incentivise the best performing products**: To incentivise the best performing products is to be able to classify the performance (e.g. environmental performance gained through circularity) of products and therefore distinguish between the best performing products and the worst performing products. Part of the aim of distinguishing the products based on their environmental performance is to incentivise the best performing ones and disincentivise the worst performing ones. This mechanism would indirectly lead to an improvement of products in terms of circularity/environmental performance.

— **Informed choice for end-users**: To help end-users choose the most environmentally sustainable products among the same product category by developing effective labels to display the information to the users. Classes of performances could be used by both consumers and public authorities, enabling differentiation of products based on their relative sustainability.

In relation to classes of performance, the work carried out in this report should lead to:

— a method to select the product aspects and parameters appropriate for classes of performance and to define/assess the best use of classes of performance, taking account of consumers' expectations and behaviour **(Chapter 3)**;

— the improvement of the method to develop classes of environmental performance for the Product Environmental Footprint (PEF) score, building on the approach already included in Commission Recommendation (EU) 2021/2279 **(Chapter 4)**;

— a method to develop classes of performance for circularity indicators (see Annex 1 for the definition of circularity indicator) **(Chapter 5)**;

— consideration of classes of technical performance **(Chapter 6)**.

In relation to labels, the work carried out in this report should lead to:

— a method to assess whether a label is useful for consumers and other economic actors, taking into account the interactions with other labels and with the Digital Product Passport (**Chapter 7)**;

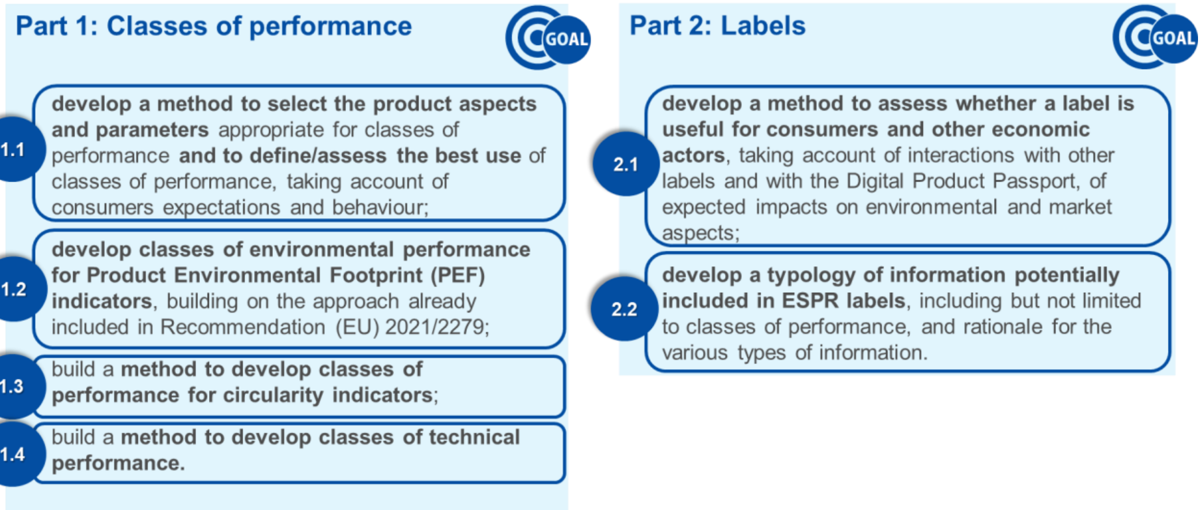
— a typology of information potentially included on ESPR labels, including but not limited to classes of performance, and rationale for the various types of information **(Chapter 8)**.

The study aims to provide flexible and general guidance to be applicable to any product under the ESPR scope; therefore, the methodology might need to be adapted to the specific product under study, as appropriate and if deemed necessary by the study team conducting the Preparatory Study.

1.5. General workflow

The workflow has been divided into different tasks as depicted in **Figure 1**.

Figure 1. Overall content of the report: "Methods for the definition of classes of performance and labels"



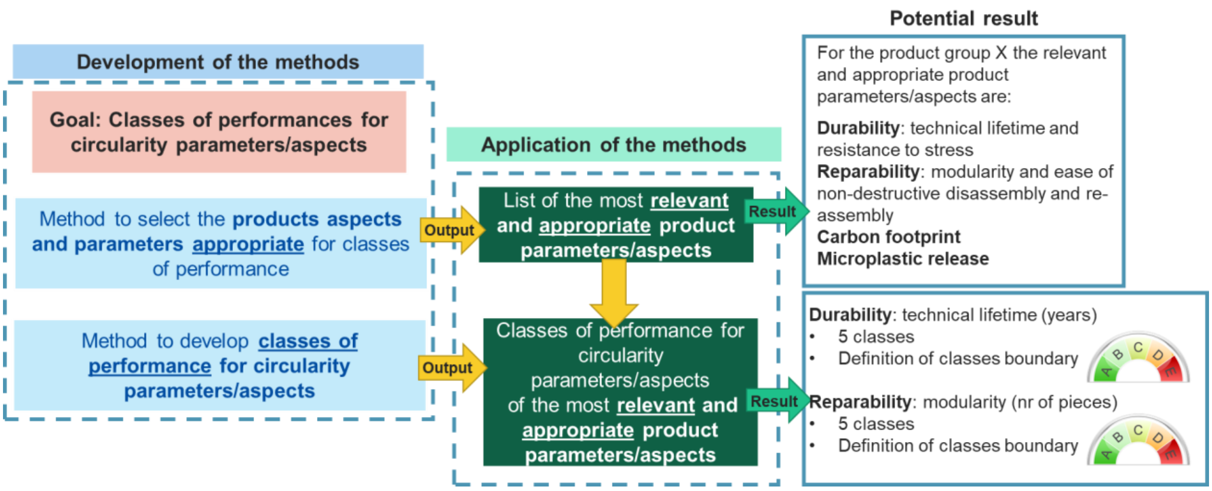
Source: own elaboration

In Figures 2 and 3, tasks 1.2 and 1.4 were not reported as part of the general workflow for the following reasons:

— Task 1.2 has been tackled as a standalone task which does not interact with the general methods developed in Part 1 of this task (shown in the figure above).

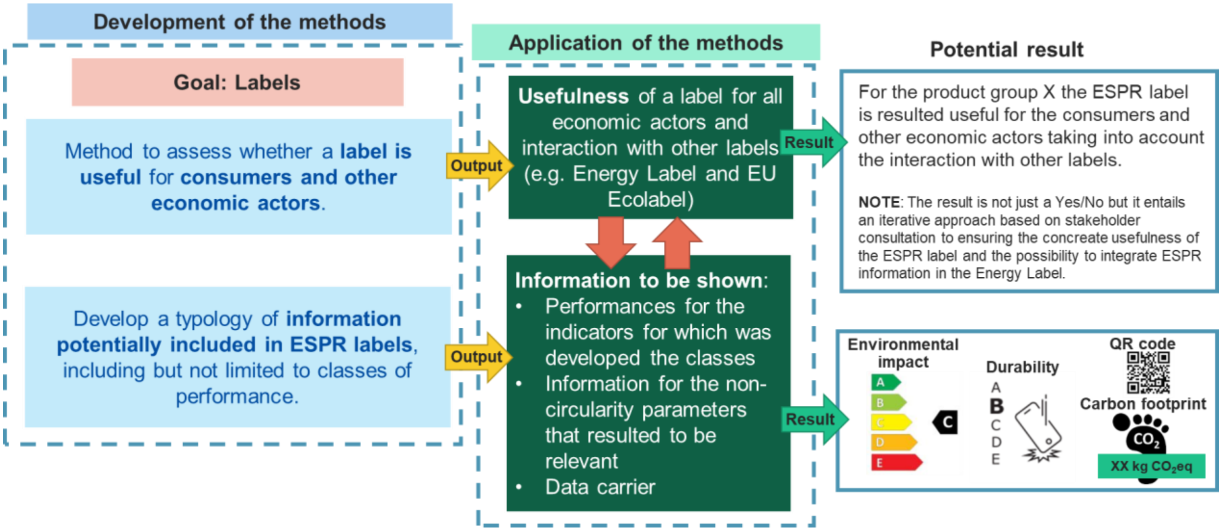
— Task 1.4: After a deep analysis, as reported in Chapter 6, it has been decided not to further develop any classes of technical performance.

Figure 2. General workflow of Part 1 (classes of performances) with the expected outputs and results.



Source: own elaboration

Figure 3. General workflow of Part 2 (labels) with the expected outputs and results.



Source: own elaboration

2. Setting the context: Methods for the definition of classes of performance and labels within the current MEErP

The present report takes the MEErP as the basis on which to build the methods mentioned in the previous section: (i) a method to select the product aspects and parameters appropriate for classes of performance, (ii) a method to develop classes of performance for circularity aspects/parameters, (iii) a method to assess whether a label is useful for consumers and other economic actors, and (iv) a typology of information potentially included on ESPR labels.

This section thus presents the steps, either within the MEErP or in addition to the MEErP, which should be carried out in an ESPR Preparatory Study.

2.1. Methodology for the Ecodesign of Energy-related Products (MEErP)

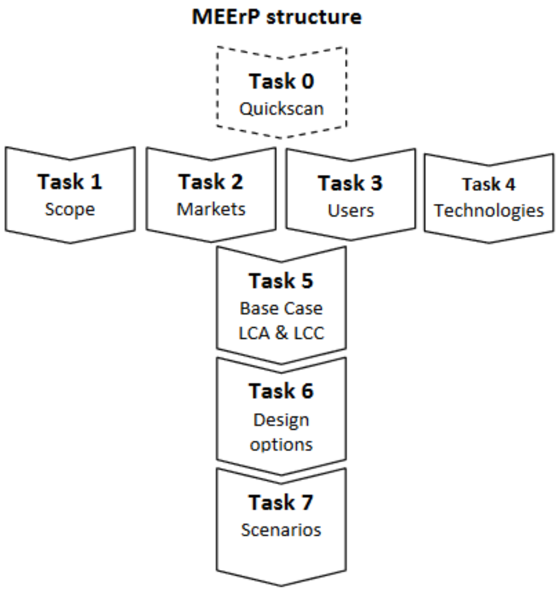
The MEErP, developed under Ecodesign Directive 2005/32/EC, evaluates whether and to what extent energy-related products (ErPs) fulfil certain criteria that make them eligible for ecodesign implementing measures. The MEErP was originally published in 2005, and then reviewed in 2011 and 2022, and has been used in more than 40 Preparatory Studies for Ecodesign of ErP.

The MEErP focuses primarily on the energy consumption of products during the use phase, and is structured in tasks as presented below and in **Figure 4**:

- **Task 0 – Quick scan:** It is an optional task for the case of large or inhomogeneous product groups, where it is recommended to carry out a first product screening. The ESPR Working Plan will serve as a basis.
- **Task 1 – Scope:** This task defines the methodology to identify the products to be included in the product groups to which the ecodesign measures would apply.
- **Task 2 – Markets:** This task provides the market analysis of the product group under assessment, including the apparent product consumption in the EU, market and cost inputs for the environmental impacts of the product group, and latest market trends in product design.
- **Task 3 – Users:** This task identifies barriers and restrictions to possible ecodesign measures due to social, cultural or infrastructural factors. This task also quantifies relevant user-specific parameters that can influence the product's environmental impacts during use.
- **Task 4 – Technologies:** This task entails a general technical analysis of products on the EU market, including a description of the existing products up to BAT (Best Available Technology) and BNAT (Best Not yet Available Technology).
- **Task 5 – Environment & Economics (Base case LCA & LCC):** This task requires one or more average EU product(s) to be defined as the "base case" for most of the environmental and Life Cycle Cost analyses that also need to be carried out within this task.
- **Task 6 – Design options:** This task identifies possible design options, their monetary consequences in terms of Life Cycle Cost for consumers, and their environmental costs and benefits. Design measures are addressed by the Least Life Cycle Costs (LLCC) and the Best Available Technology (BAT). In particular, the distance between the LLCC and the BAT indicates – in the event that a LLCC solution is set as a minimum target – the remaining space for product differentiation (competition).
- **Task 7 – Scenarios:** This task puts together the outcomes of all previous tasks. It looks at suitable policy means to achieve the improvement potential (e.g. implementing LLCC as a minimum and BAT as a promotional target, using legislation or voluntary agreements, labelling, benchmarks and possible incentives). It draws up scenarios quantifying the improvements that

can be achieved with respect to a Business-as-Usual scenario and compares the outcomes with EU environmental targets. It makes an estimate of the impact on consumers (purchasing power) and industry (employment, profitability, competitiveness, investment level, etc.). This task also includes a sensitivity analysis of the main parameters to study the robustness of the outcome, e.g. regarding energy prices and societal costs, among others.

Figure 4. Structure of the Methodology for the Ecodesign of Energy-related Products (MEErP).



Source: COWI and VHK, 2011.

Tasks 1-4 can be performed in parallel and prepare the grounds for Tasks 5-7, which should be performed in series.

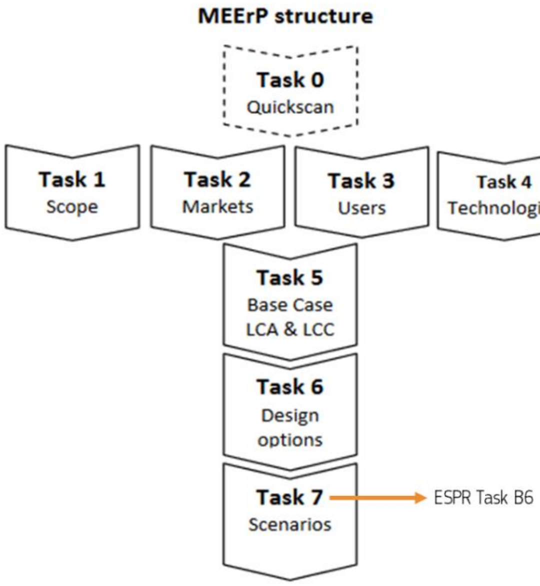
In 2013, the MEErP was supplemented by a module to assess the possibility of enhancing material efficiency aspects of products, in addition to their energy consumption. The module identifies four material efficiency parameters to be assessed within Task 2 of the MEErP: recyclability benefit rates, recycled content, lifetime and Critical Raw Material Index.

In addition, a new revision of the MEErP has recently been completed, in particular to update, when and where necessary, some of the data used in the analysis and to ensure that it is still fit for purpose, in line with the policy developments of the last years.

2.2. Interaction between the MEErP and the methods for the definition of classes of performance and labels

The methods developed under the scope of this report are suggested to be integrated within the MEErP in or after Task 7 - Scenarios as shown in **Figure 5**.

Figure 5. Interaction between the MEErP and the methods presented in this report adapted from COWI and VHK, 2011 (2024).



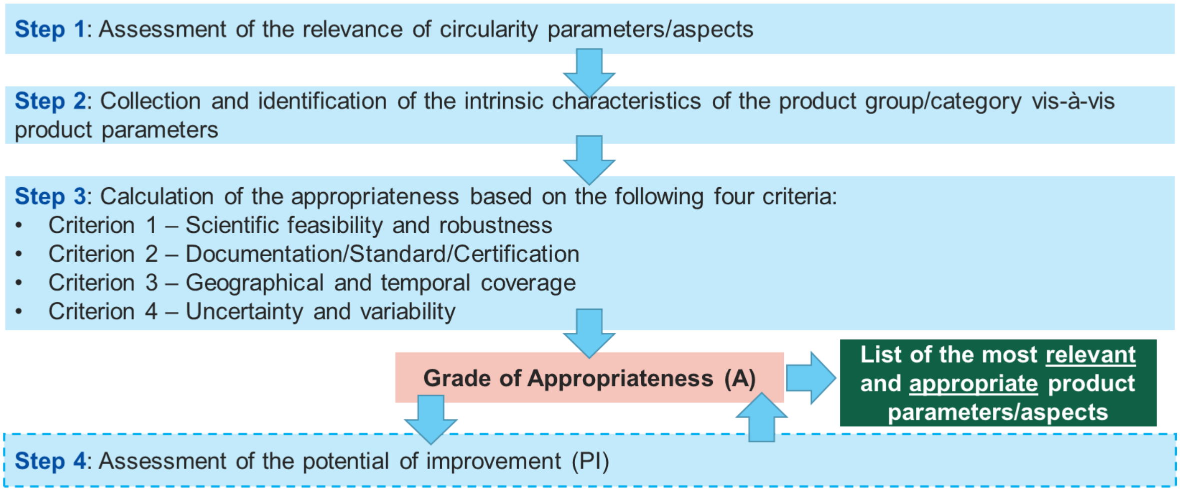
Source: adapted from COWI and VHK, 2011.

3. Method to select the product aspects and parameters appropriate for classes of performance

The aim of task 1.1 is to develop a method able to assess the appropriateness of product aspects (not only circularity aspects) and parameters for classes of performance. The method shall have a high degree of flexibility because it will be applied to a wide range of product aspects/parameters which are technically appropriate for a specific product group/category.

The method contains a four-step approach to support experts in determining the most relevant product parameters to be considered in the classes of performance.

Figure 6. Four-step method for the selection of the most relevant product parameters/aspects to be considered in the classes of performance.



Source: own elaboration

As shown in **Figure 6**, the proposed method involves three main steps and one optional step:

- The first step consists of looking at the methodology output of the report Rodriguez-Manotas et al., (2025) that addresses the relevance of circularity aspects. The list of relevant circularity aspects obtained by using the method in Rodriguez-Manotas et al., (2025) will be used.
- The second step focuses on gathering data and information about intrinsic characteristics of the product group/category vis-à-vis product parameters.
- The third step consists of calculating the appropriateness of the product parameters for classes of performance considering a set of criteria.
- The fourth step (optional) consists of assessing the potential for improvement of the product parameters for the specific product group/category.

3.1. Step 1: Assessment of the relevance of circularity aspects

The aim of the Rodriguez-Manotas et al., (2025) report is to develop a generic method to assess the relevance of circularity aspects and the EU Open Strategic Autonomy (OSA) dimension, and indicate how ecodesign requirements will be defined, considering potential synergies and trade-offs.

Within the list of product aspects included in Article 5 of the ESPR, the following circularity aspects are considered within the scope of Rodriguez-Manotas et al., (2025) report and, therefore, of the method to assess the relevance of circularity aspects:

1. durability;
2. reliability;
3. reusability;
4. upgradability;
5. repairability;
6. possibility of maintenance
7. possibility of refurbishment;
8. water use and water efficiency;
9. resource use and resource efficiency;
10. recycled content;
11. possibility of remanufacturing;
12. recyclability;
13. possibility of recovery of materials;
14. expected generation of waste.

The method includes:

- how to assess the relevance of circularity aspects and the EU OSA;
- how to define circularity-related ecodesign requirements, considering potential synergies and trade-offs

When applying the methodology developed in Rodriguez-Manotas et al., (2025) report to a specific product group/category during a preparatory study, some of the outputs from this report (i.e. assessment of the relevance of circularity aspects) will be used for the definition of the appropriateness of a specific product aspect/parameter for classes of performance. In other words, the methodology developed in Rodriguez-Manotas et al., (2025) report will serve as a method to preselect a list of circularity aspects relevant for a specific product group/category. More specifically, the relevant output will be the list of related circularity aspects and the parameters on which the study team focused for the definition of ecodesign requirements.

The product aspects remaining outside the scope of the Rodriguez-Manotas et al., (2025) report for the assessment of the relevance are as follows:

- Presence of Substances of Concern: The evaluation of substances of concern is specifically addressed in a separate report (Perez Camacho et al., 2025). In this report, a method has been developed to assess and prepare restriction measures, and to define and track substances of concern within products. The evaluation of substances of concern is always relevant and shall be done following the approach proposed in Perez Camacho et al., (2025).
- Energy Use and Energy Efficiency: Energy-related products are comprehensively regulated by the Ecodesign Directive (Directive 2009/125/EC) and the Energy Labelling Regulation (Regulation (EU) 2017/1369). These regulations establish methods for calculating energy efficiency, set efficiency classes, and dictate how this information should be presented. The interaction between the Energy Label and the ESPR label is discussed in Chapter 7. In the context of non-energy-related products, considerations of energy use and efficiency refer to that during extraction of raw materials, transportation, manufacturing and end-of-life and are not always deemed relevant. Conversely, energy use and energy efficiency are always relevant for energy-related products.

- Environmental Impacts, including Carbon Footprint (CF) and Environmental Footprint (EF): The European Commission has recommended the Product Environmental Footprint (PEF) method as a standardised approach for measuring the environmental performance of products, which is outlined in Commission Recommendation (EU) 2021/2279. The PEF utilises Life Cycle Assessment (LCA) techniques to determine the environmental impacts of goods or services. The EF, and sometimes the CF, are considered ideal proxies to represent the overall environmental sustainability of a product. Consequently, the EF is always relevant for summarising and evaluating the overall environmental sustainability of a product.

Due to their importance, these product aspects will not be subject to the relevance assessment process and will always be treated as relevant, unless otherwise indicated by the study team based on its expert judgement.

3.2. Step 2: Collection and identification of the intrinsic characteristics of the product group/category vis-à-vis product parameters

This step needs to be performed to determine the intrinsic characteristics of the product group/category and the variability of the product performance (e.g. if all products perform similarly without statistically significant differences or if the performance varies significantly within the same product group), which can influence a specific product parameter. This information shall, if possible, be collected when applying the general framework of the MEErP in Tasks 1, 2, 3 and 4.

When performing the literature research and the data-gathering exercise, any official sources such as technical reports, impact assessment studies and any other official studies funded by the European Commission should be prioritised. Then information and data from professional associations, generic scientific literature such as peer-reviewed scientific articles and specialised website pages should be collected. If necessary, a lack of publicly available data could be covered by asking stakeholders for specific information. The following is a non-exhaustive list of the information that needs to be collected:

- **Intrinsic characteristics of a product group/category**, which refer to the fundamental qualities or attributes that are inherent to the products within that group or category.
- **Functionality**: The basic function or purpose of the products in the category. For example, the main function of a smartphone is to provide communication. But a significant percentage of users regularly use their smartphones for functions beyond calling and texting for communication purposes, such as internet browsing, using apps, taking photos, and social media.
- **Quality**: The overall durability, reliability and craftsmanship of the products in the category or any other product aspects/parameters that reflect the quality of the product category:
    - **Design**: The aesthetic and ergonomic aspects of the products, including shape, colour and style.
    - **Price range**: The typical cost spectrum for the category, from budget to luxury items.
    - **Target market**: The specific consumer segment that the product category is aimed at.
    - **Usage patterns**: How and in what context the products are typically used (e.g. daily, occasionally, professionally, recreationally).
    - **Technology level**: The degree of technological advancement and innovation represented in the product category.

— **Quantitative (i.e. mass) and/or qualitative (i.e. type of materials) properties** of the product category/group.

— **Methods** to quantify the specific product parameter.

— **Recognised standards** (national, European or international standards), which focus on the specific product aspect/parameter.

— **Data/information required (quantitative or qualitative)** to describe and define a class of performance for the specific product parameter and general statistics on functionalities of the product category/group. When gathering this information, refer to manufacturer data, consumer reports, and sectoral data providers for the most accurate and up-to-date statistics on product functionalities. Here are some examples of general statistics that could be associated with different product categories:

- Washing machines:
  - Average number of cycles: Depending on the quality and durability, a washing machine might have an estimated lifespan of around 5 000 to 8 000 cycles (JRC et al., 2017).
  - Average load capacity: Varies, but common household units range from 5 kg to 12 kg per load (JRC et al., 2017).
  - Water consumption per cycle: Can range from about 40 to 80 litres for older models, with newer, more efficient models using as little as 15 to 30 litres per cycle (Stamminger et al., 2020).
  - Energy efficiency: Modern washing machines are rated on a scale (e.g. A) to denote their energy efficiency, with higher-rated machines consuming less electricity per cycle.
- Smartphones:
  - Average battery life: Depending on usage, a smartphone battery can last anywhere from 8 to 48 hours on a single charge (Singh et al., 2020; Cordella et al., 2021).
  - Average lifespan: The average consumer might replace their smartphone every 2 to 3 years, although the devices themselves can function longer (Cordella et al., 2021).
- Refrigerators:
  - Average lifespan: Typically between 10 to 15 years, depending on the model and maintenance (Baxter, 2019).
  - Energy consumption: Average annual energy consumption can vary widely, with newer models generally being more energy-efficient, often using less than 240-300 kW per year (Baxter, 2019).
  - Cooling efficiency: Measured by how well and how quickly it can cool contents and maintain the temperature.
- Laptops:
  - Battery life: On average, a laptop might offer anywhere from 4 to 8 hours of use on a full charge, with some models boasting up to 10-20 hours (Woidasky and Cetinkaya, 2021).
  - Average lifespan: Generally, a laptop may last around 3 to 5 years before performance begins to degrade or technology becomes outdated (Woidasky and Cetinkaya, 2021).

- Televisions:
  - Average lifespan: Modern LED TVs can last around 60 000 to 100 000 hours of viewing time, which roughly translates to 4 to 7 years of typical use (Desjardin, 2024).
  - Energy consumption: Measured in watts, with more efficient models consuming less power; average consumption ranges from 30 W to 100 W for LED TVs (Desjardin, 2024).
- HVAC systems (Heating, Ventilation, and Air Conditioning):
  - Average lifespan: Can range from 15 to 25 years for heating systems and 10 to 15 years for air conditioning units (Eric, 2023).
  - Energy efficiency: Rated by SEER (Seasonal Energy Efficiency Ratio) for air conditioners and AFUE (Annual Fuel Utilization Efficiency) for heaters.
- Apparel:
  - Durability: Number of washes before a garment starts to fade or wear out, which can range from a few cycles for low-quality items to over 100 for higher-quality ones.
  - Fabric strength: Tensile strength tests can determine how much force a fabric can withstand before it tears.
- Furniture:
  - Weight capacity: For chairs and tables, the average weight they can support, often ranging from 100 to 500 kilograms.
  - Lifespan: The expected durability, which can vary greatly, with some furniture lasting 5-10 years and high-quality items lasting several decades (Cooper et al., 2021).

— **Requirements already in place**.

— **Market/economic considerations** such as market composition and structure of the value chain (MEErP Task 2).

The information shall be collected for the calculation of the appropriateness in Step 3. To properly assign the right score considering the different criteria, the study team should make sure to collect all the information needed looking at the methodological questions in each criterion.

3.3. Step 3: Calculation of the appropriateness

Once the relevant product aspects/parameters have been selected (Step 1), and the intrinsic characteristics of the product group/category vis-à-vis product parameters have been identified (Step 2), Step 3 can begin. In Step 3, a set of criteria shall be used to assess the measurability, the availability of methods and standards, and the availability and quality of the data required to describe and define a class of performance for a specific product aspect/parameter.

The following criteria were adapted from a study conducted by Sala et al. (2018). The assessment of the data, the measurability and the methods behind a specific product parameter shall be performed following the four criteria below:

— **Criterion 1 – Scientific feasibility and robustness**

— **Criterion 2 – Documentation/Standards/Certifications**

— **Criterion 3 – Geographical and temporal coverage**

— **Criterion 4 – Uncertainty and variability**

1. **Scientific feasibility and robustness**

   - What is the type of data/information required (quantitative vs. qualitative data) to describe and define a class of performance for the specific product parameter?
   - Does the scientific/technological literature provide examples of indicators/indexes that are used for assessing the product parameter?
   - Are there available data that define or can be used to evaluate the performance of the product parameter?
   - Is the product parameter measurable?
   - Are there any methods to measure/calculate the performance of the product parameter?
   - What is the science behind the methods to measure the product parameter?
   - Is the method scientifically robust?

2. **Documentation/Standards/Certifications**

   - Does the documentation allow the method to be understood and reproduced?
     - Publication and accessibility (how much effort is needed to retrieve the method documentation? Is the method available free of charge? Is the method available online? Is it available in English?
   - Is there any ISO/EN standard that focuses on the specific product aspect/parameter? In the case of any European or international standards, are there any national standards from individual Member States?
   - Does the standard give methods/guidelines on how to calculate/obtain an indicator/index for the specific product parameter?
     - Is the method/guideline transparent? Can the method/guideline be reproduced?
   - Is there any certification that targets the specific product aspect/parameter for the specific product group/category?

3. **Geographical and temporal coverages**

   - Are the data available representative of EU MS + EFTA countries?
   - What is the temporal coverage of the available data?

4. **Uncertainty and variability**

   - What are the uncertainties of the available data?
   - What is the statistical variation of the indicator among products in the same product category?

At the end of Step 3, the study team shall assess the overall grade of appropriateness of a specific product parameter/aspect for a class of performance taking into account Step 1, Step 2 and Step 3. The general grade of appropriateness (A) of the circularity aspect/product aspect for a class of performance for the product category can be defined as high (A3), medium (A2) or low (A1). Moreover, if a product aspect/parameter has a grade of appropriateness (A) equal to A0, this means it is not applicable.

3.3.1. Scoring procedure

Once the relevant information has been collected for each of the criteria, the following scoring procedure shall be followed to calculate the appropriateness of a specific product aspect/parameter. For some sub-criteria where the scoring process is not straightforward, guidelines were developed to help the practitioner with the scoring procedure (**Table 1**).

Table 1. Scoring procedure to assess the scores within each sub-criteria.

Criterion 1 – Scientific feasibility and robustness (SFR)			
Sub-criteria	**Scoring guide**	**Result**	**Score**
Sub-criterion 1.1 - Data type requirement	-	Quantitative	1
		Qualitative	0.5
		None	0
Sub-criterion 1.2 - Availability of scientific indicators	In the case of one or more quantitative indicators with scientific consensus[3]	Available	1
	In the case of one or more quantitative indicators with no scientific consensus	Partially available	0.5
	In the case of qualitative indicators	Not available	0
Sub-criterion 1.3 - Data measurability	The data can be quantified or categorised in a reliable and valid way. This means there are standardised metrics, scales or definitions in place that make it possible to collect and analyse the data.	Measurable	1
	The data cannot be quantified or categorised due to a lack of clear metrics, scales or definitions. This might be the case for abstract concepts without established measurement methods or for phenomena that are highly subjective and variable. If the data is too ambiguous or inconsistent, or lacks a framework for measurement, it would be considered not measurable.	Not measurable	0
Sub-criterion 1.4 - Scientific robustness of the method	The method consistently produces reliable, valid and accurate results. It has been tested and confirmed across various conditions and populations. The findings are replicable and have been peer-reviewed and validated by the scientific community. The method has demonstrated high levels of precision, sensitivity and specificity.	Robust	1
	The method fails to provide consistent and reliable results. It has not been adequately tested or has shown poor validity and accuracy. The method's findings are not replicable, have not been subjected to rigorous peer review. It lacks precision, sensitivity and specificity.	Not robust	0
Criterion 2 – Documentations/Standards/Certifications (DSC)			
Sub-criteria	**Scoring guide**	**Result**	**Score**

[3] Scientific consensus refers to a collective agreement among the majority of scientists/practitioners/experts in a particular field of study, based on a general convergence of evidence and scientific understanding. In general terms, this consensus is reached after various hypotheses and theories have been tested and retested, peer-reviewed, and scrutinised against experimental data and observations. However, scientific consensus is not static; it can change with new evidence or reinterpretations of existing evidence. So, the evidence supporting the decision shall be based on the most recent information available.

Sub-criterion 2.1 - Accessibility of documentation	The document is available to the public without restrictions; it is provided in multiple formats (e.g. PDF, HTML, Word) to accommodate different user needs. It is free or available at a nominal cost that does not create a barrier to access. It is available in multiple languages, or at least in the primary language of the intended audience.	Accessible	1
	The document is available to the public but may have some restrictions (e.g. registration required, limited number of downloads). It may have a cost associated with it that could be a barrier to some users, but waivers or discounts are available. It is available in the primary language of the intended audience but lacks multiple language options.	Partially accessible	0.5
	The document is not available to the public or does not exist.	Not accessible	0
Sub-criterion 2.2 - Existence of relevant standards or certifications	A standard or a certification for the intended purpose exists. The full text of the standard or certification is available. The latest version of the document is accessible. There are no significant barriers to accessing the document, such as high costs or restrictive licensing. The document is readily available from an official or recognised source.	Yes	1
	A standard or a certification exists, but not specifically for the intended purpose. Only certain sections or a summary of the standard or certification requirements are available, but not the entire document. The document may be an outdated version, rather than the most current one.	Partial	0.5
	A standard or a certification does not exist.	No	0
Sub-criterion 2.3 - Methods/guidelines on how to calculate/obtain an indicator/index are included in a standard	-	Yes	1
	-	No	0
Criterion 3 – Geographical and temporal coverage (GTC)			
Sub-criteria	**Scoring guide**	**Result**	**Score**
Sub-criterion 3.1 - Geographical coverage of data[4]	Data availability for 4, 3 or 2 subregions.	EU + EFTA-wide	1
	Data availability for 1 subregion.	Limited	0.5
	Data availability outside the EU + EFTA territory.	Not representative	0
	Data collected within the last 1-2 years.	Current	1

[4] The European Union's (EU) territory can be divided into different subregions for various administrative, statistical, and geopolitical purposes. One common way to categorise the EU is based on geographical direction: western, eastern, northern and southern Europe. These divisions are not strictly defined and can change depending on context, but for this specific purpose we refer to the following groupings:

a) Western Europe: This subregion includes countries like Germany, Austria, France, Belgium, the Netherlands, Luxembourg, Liechtenstein and Switzerland.

b) Eastern Europe: This subregion is made up of countries that lie to the east of Germany and Austria. It includes Member States such as Poland, the Czech Republic, Slovakia, Hungary, Romania and Bulgaria.

c) Northern Europe: This subregion covers the EU Member States in the northern part of Europe, including Denmark, Sweden, Finland, the Baltic States (Estonia, Latvia and Lithuania), Ireland and the United Kingdom (although the UK is no longer part of the EU following Brexit). It is important to note that while Norway and Iceland are part of the geographical region of northern Europe, they are not members of the EU.

d) Southern Europe: This subregion encompasses EU countries located in the southern part of Europe, including Italy, Spain, Portugal, Greece and Malta, as well as Cyprus, which, despite its geographical location in the eastern Mediterranean, is culturally and politically aligned with southern Europe.

Sub-criterion 3.2 - Temporal coverage of data			
	Data collected within the last 3-5 years.	Somewhat outdated	0.5
	Data collected more than 6 years ago.	Outdated	0
Criterion 4 – Uncertainty and Variability (UV)			
Sub-criteria	**Scoring guide**	**Result**	**Score**
Sub-criterion 4.1 - Level of data uncertainty	The data is considered highly reliable and accurate. The sources are well established, and the methods of data collection and analysis are robust, leading to a high degree of confidence in the results. The margin of error is small, and any potential confounding factors are well controlled. There is strong consensus among experts about the validity of the data.	Low uncertainty	1
	The data has some degree of reliability and accuracy, but there are known issues that introduce doubt. These could be larger margins of error, less control over confounding variables, or less consensus among experts. The data is still useful, but conclusions drawn from it should be considered with a degree of caution.	Medium uncertainty	0.5
	The data is unreliable, with significant potential for error or bias. The methods of data collection and analysis are not robust, leading to a low degree of confidence in the results. There may be a lack of consensus among experts, or the data might be based on unverified sources. Conclusions drawn from this data are highly speculative and should be treated with scepticism.	High uncertainty	0
Sub-criterion 4.2 - Statistical variation of the indicator	The numerical indicator shows considerable dispersion around the mean or median value. This could be indicated by a large standard deviation, variance or range in the data. The values may be spread out over a wide interval, suggesting that the indicator is subject to substantial fluctuation and less predictability.	High variation	1
	The numerical indicator shows little dispersion around the mean or median value. This would be indicated by a small standard deviation, variance or range. The values are concentrated and consistently close to the average, suggesting that the indicator is relatively stable and predictable.	Low variation	0

Source: own elaboration

Now, the scores should be aggregated within each criterion to get a criterion score:

(1) Criterion Score = Sum of scores / Number of sub-criteria

Finally, the overall appropriateness score should be calculated by averaging the criterion scores:

(2) Appropriateness Score (A) = (SFR + DSC + GTC + UV) / 4

The score will range from 0 to 1. Depending on the score, the appropriateness can be categorised as follows:

Table 2. Description of levels of appropriateness (A)

Code	**Grade of appropriateness**	**Range**	**Description**

A_3	**High**	$0.5 \leq A < 1$	The product aspect/parameter is appropriate for a class of performance.
A_2	**Medium**	$0.2 \leq A < 0.5$	In the event that the appropriateness of the product aspect/parameter for a class of performance for the product category is medium, the experts can decide based on their experience whether to establish a class of performance for the product aspect/parameter. Otherwise, the experts can conduct a further (optional) step (Step 4) in which the potential for improvement (PI) will be assessed, and requiring them to gather further information to inform their decision.
A_1	**Low**	$A < 0.2$	A class of performance cannot be established for the product aspect/parameter for the product category.
A_0	**Not applicable**	Not applicable	The product aspect/parameter is not appropriate for a class of performance for the product category.

Source: own elaboration

3.4. Step 4: Potential for improvement (PI)

This step aims to evaluate the potential for improvement (PI) of a specific product aspect/parameter for a product group/category. In other words, the PI evaluates in a general way the level of enhancement of the specific parameter in relation to a product group/category due to the establishment of a potential requirement.

1. **Define key performance indicators (KPIs)**

Identify the KPIs that will measure the success of the improvement. For example, if improving a product's technical lifetime, a KPI could be the average product lifespan before failure. Metrics could include minimum energy consumption, waste generation, water usage, etc. For the example used in this section, the lifespan and the water usage have been chosen. Data on the product aspects referred to shall be based on products placed on the EU market.

2. **Baseline data**

Gather data on the current performance with respect to the KPIs. For example, in the case of the lifespan, collect data and identify the average current lifespan of the product, e.g. 2 years. In the case of the water usage, the current average of products placed on the EU market could be measured at 60 m^3/device*year, based on current technology.

3. **Identify targets**

Set target values for the KPIs based on benchmarks or desired outcomes and calculate the difference between the current performance and the target. Determine the theoretical maximum performance based on best-case scenarios, technological limits and considering any potential requirements. If possible, the theoretical maximum should be validated through testing and feedback from manufacturers and stakeholders. This is needed in order to know the upper bound of potential improvement.

For instance, the average product lifespan may reach a 20% increase. If the current average product lifespan is 2 years, and the target is 2.4 years (a 20% increase), the gap is 0.4 years.

The theoretical maximum water usage could for instance be set at 50 m^3/device*year, based on best-in-class technology and processes.

4. **Potential for improvement (PI) calculation**

Calculate the potential for improvement (PI) that is currently unmet using the formula:

(3) PI (%) *= [(Theoretical Max - Current Performance) / (Theoretical Max)] * 100*

PI for lifespan (%) = [(2.4 - 2) / 2.4] * 100 = 16.67%

PI for water usage (%) = [(50 - 60) / 50] * 100 = -20%

Given that the percentage for the water usage is negative, this can be converted to a positive potential improvement by taking the absolute value. This happens when the PI formula is applied to a "lower is better" indicator, while for a "higher is better" indicator the result is positive.

5. **Analysis and decision-making**

Considering as an example the results obtained from the PI for lifespan, the study team now know that there is 16.67% overall potential for improvement when considering operational aspects for that specific product aspect/parameter. Based on this result and considering the information collected in Steps 1, 2 and 3, the study team can identify and, if necessary, prioritise parameters that will help achieve the desired improvements.

<u>How can an acceptable improvement be defined?</u> In general, any improvement that positively impacts the efficiency, effectiveness or sustainability of a product group can be viewed as beneficial. However, here are some general guidelines to consider[5]:

- **Marginal improvement**: A small improvement of around 1-5% can be considered marginal in most cases. In highly optimised systems or competitive industries, even small improvements, such as 1-5%, can be significant. For example, in high-volume manufacturing and well-optimised product groups, these small percentages can lead to a competitive advantage.
- **Moderate improvement**: An improvement in the range of 5-15% can be considered good in many business operations, as it can indicate a notable enhancement without requiring a complete overhaul of existing systems.
- **Significant improvement**: An improvement of 15-30% might be considered significant and a strong indicator of effective product aspect/parameter optimisation.

[5] The percentages reported in the general guidelines are indicative, because they depend on the product type, the parameter type, the starting point and the ambition level.

— **Breakthrough improvement**: Any improvement above 30% may be considered breakthrough or exceptional.

As a general guideline, a product parameter that goes through the PI assessment, after undergoing the previous three-step analysis, should be considered appropriate if it shows at least a significant improvement (an improvement of 15-30% or more). However, it should be kept in mind that what is considered a marginal or breakthrough improvement should be aligned with specific objectives, and the potential for improvement that exists within a particular area. For instance, cutting costs by 10% might be outstanding for a mature industry, but less impressive for a start-up that is rapidly scaling up and optimising. Additionally, improvements should not compromise quality, or other critical factors. It is important to set realistic and clear goals, measure improvements accurately, and consider both short-term gains and long-term sustainability when assessing the impact of changes.

Furthermore, when considering potential improvements, it is crucial to evaluate the feasibility and the cost-benefit ratio of achieving such improvements. A high percentage improvement might be possible, but could require an investment that outweighs the benefits. Therefore, when setting targets for potential improvements, it is essential to consider industry benchmarks, the current maturity level of the product group, and the strategic importance of the improvement to the overarching ESPR goals.

The PI approach faces certain limitations, primarily due to the challenge of assessing the significance of improvements in a circularity parameter solely based on its magnitude. This difficulty arises because evaluating the magnitude of such improvements without considering their overall impact on environmental benefits can be misleading. Consequently, determining what constitutes a significant improvement in a circularity parameter requires a more comprehensive evaluation. In instances where stakeholder consultation is deemed necessary, it becomes crucial to involve both industry representatives and experts specialising in the specific product group under consideration. These stakeholders possess the knowledge and expertise needed to provide valuable insights into what qualifies as a significant improvement for the particular circularity parameter in question. By collaborating with these stakeholders, a more informed and context-specific decision can be made, ensuring that the improvement aligns with both the circularity goals and the broader environmental benefits associated with the product group. This collaborative approach helps to ensure that the PI step is effectively tailored to the unique characteristics and requirements of each product group, ultimately leading to more meaningful and impactful sustainability outcomes.

If a more detailed and quantitative approach is considered more appropriate and an LCA model already exists for the product group in question, the decision can be based on a sensitivity analysis. Sensitivity analysis is used to assess how variation in the inputs to a model can affect the variability of the model outputs. This helps to identify which parameters have the most influence on the environmental impact results and how much an improvement in a parameter, for example lifetime, will affect the environmental impacts.

4. A new method to develop classes of environmental performance

The development of a new method to build classes of environmental performance for the Product Environmental Footprint (PEF) score and for the 16 EF single environmental indicators builds on the approach already included in Commission Recommendation (EU) 2021/2279 (**Figure 7**). The proposed method for the classes of performance is so far expressed in five categories, A, B, C, D and E, with A being the best and E being the worst and C as the midpoint. The proposed approach for developing classes of performance concerning environmental impacts is designed to be versatile and comprehensive. This methodology can be applied in two significant ways. Firstly, it is applicable at the level of the overall score, which involves aggregating data from all 16 Environmental Footprint (EF) impact categories into a single score. This aggregated score provides a broad overview of environmental performance, allowing for an assessment that considers the cumulative effects of all impact categories combined. Secondly, the approach is also applicable at the level of individual impact categories. This means that each of the 16 EF impact categories can be examined separately, allowing for a focused evaluation of performance within each specific environmental domain. By employing this approach, it is possible to identify how a product group performs in each distinct area of environmental impact, thus offering a detailed and precise understanding of environmental performance.

Overall, this dual applicability ensures that the approach can provide both an aggregated-level perspective of total environmental performance as well as disaggregated-level insights showing the environmental performances at the single impact category, facilitating a comprehensive evaluation of environmental performance.

Figure 7. Environmental impact indicators in the EF method.

Source: PEF (https://publications.jrc.ec.europa.eu/repository/handle/JRC129907)

4.1. Classes of environmental performance for the PEF score (Commission Recommendation (EU) 2021/2279)

First, the single overall score of the representative product BM (base model), calculated from the second PEF representative product (RP), represents the midpoint of Class C.

Second, the upper limit and lower limit of the lowest category A and highest category E are identified through a sensitivity analysis on the model of the RP (on each representative product if there are several). The sensitivity analysis will identify the most relevant parameters contributing to the single overall score. Once these parameters are identified, based on industry data provided by the Technical Secretariat members, the theoretical best product (calculated by assigning the best technically feasible value for each parameter) and the theoretical worst product (calculated by assigning the worst technically feasible value for each parameter) are identified. They help to define the upper limit of category A (overall score (OS)-best product BP) and lower limit of category E (OS-worst product (WP)).

Once the two extremes and the midpoint of Class C are identified, the remaining limits of the different categories are identified according to the table below:

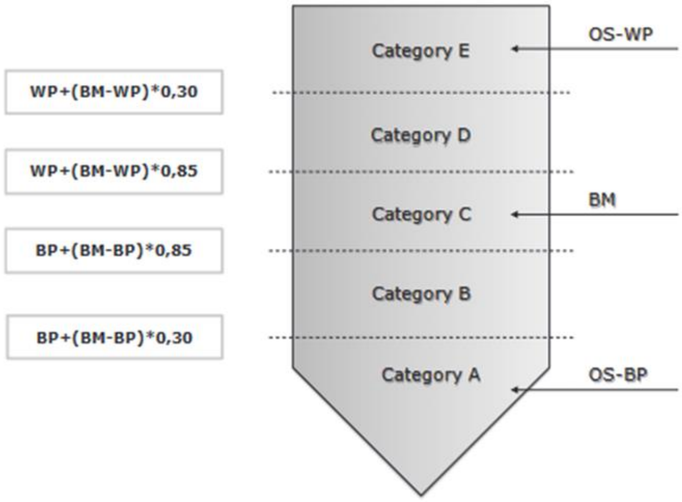
Table 3. Existing limits of classes of performance for the PEF score.

Category	Class of performance boundaries
A	OS < BP+(BM-BP)*0.30
B	BP+(BM-BP)*0.30 ≤ OS < BP+(BM-BP)*0.85
C	BP+(BM-BP)*0.85 ≤ OS < WP+(BM-WP)*0.85
D	WP+(BM-WP)*0.85 ≤ OS < WP+(BM-WP)*0.30
E	OS ≥ WP+(BM-WP)*0.30

Source: Commission Recommendation (EU) 2021/2279

where OS-BP is the single overall score of the best product, OS-WP is the single overall score of the worst product, BM is the single overall score of the representative product (benchmark value), OS is the single overall score of a specific product calculated based on a PEF study carried out in compliance with the PEFCR.

Figure 8. PEF classes of performance.



Source: Commission Recommendation (EU) 2021/2279

In order to improve this method, either the equations used in the existing structure should be altered/changed or a different structure should be proposed. This could mean changing the formulas and especially the factors 0.3 and 0.85 so that the allocation of the space and hence the products that fall into this category could change. However, changes could also occur in the way the other parameters are derived, that is to say BP, WP, BM and OS.

The improvement could be reflected in the setting of more stringent rules, so that less products acquire a good score, or others that are more relaxed, so that more products can achieve a better score. An alternative structure could be one that resembles this one but with fewer or more classes. Reducing the number of categories could lead to a traffic light system (green for good, yellow for intermediate, red for bad) and this would require defining new equations, keeping the benchmark value BM and allowing for a percentage of deviation from that. Such a structure facilitates the consumers' understanding by making the perception of the product easier and faster to comprehend. However, such a structure might not provide enough information/ granularity to distinguish between products that fall into the same colour categorisation but with non-negligible differences. Increasing the number of categories, on the other hand, would allow these products to be distinguished but it might be more complicated for a consumer to understand especially when buying everyday products, when the time spent on the purchase decision is short. Conversely, when buying a refrigerator, consumers can afford more time to investigate and make good use of this additional information due to the importance of this purchase as an investment in their households.

4.2. Proposed approach for the development of the classes of environmental performance for the PEF score and the impact categories

To effectively classify products depending on their environmental performance, a systematic approach is employed using the single overall PEF score or an individual impact category. This approach involves, firstly, the calculation of the metric (single score or one of the 16 EF categories) of the representative base model (BM), which is derived from calculations involving the representative product (RP), which serves as a pivotal reference point. This calculated score is designated as the midpoint of Class C within the performance classification system. By establishing the midpoint of Class C, the BM score provides a benchmark for understanding the relative positioning of other products within the performance spectrum. Secondly, to delineate the boundaries of the classes of performance, a sensitivity analysis is conducted on the model of the RP. This analysis is crucial in identifying the most significant parameters that contribute to the overall score. If multiple representative products exist, each undergoes this sensitivity analysis to ensure a comprehensive understanding of the influencing factors. The insights gained from this analysis enable the identification of parameters that have the greatest impact on the product's performance score. Once the key parameters are identified, industry data supplied by members of the Technical Secretariat is utilised to determine the theoretical best and worst products. The theoretical best product is calculated by assigning the best technically feasible value to each of the significant parameters identified in the sensitivity analysis. Conversely, the theoretical worst product is determined by assigning the worst technically feasible value to each of these parameters. These theoretical products are instrumental in setting the performance category limits. The theoretical best product helps define the upper limit of category A, representing the highest standard of performance achievable. Specifically, this is calculated by adjusting the overall score (OS) of the base model to reflect the best product (BP) parameters. Similarly, the theoretical worst product establishes the lower boundary of category E, which signifies the least desirable performance level. This is calculated by modifying the OS to incorporate the worst product (WP) parameters.

Note that if the Delegated Act following the Preparatory Study proposes minimum performance requirements on specific aspects/parameters, the new WP for these aspects/parameters (after the DA enters into force) will become the value of those minimum performance requirements, as the previously existing worst performing products will be excluded from the market. The average of the market is also expected to change because of this exclusion, thus resulting in a new value for the BM. Since the setting of minimum performance requirements changes the values of the boundaries of the performance classes (via the changing of both the WP and BM values), the values of those boundaries should be recalculated and the updated values should be stated in the DA as well.

To ensure that the best and worst data or products are identified correctly, it is essential to engage in a process of refining the outputs based on the inputs received from various stakeholders. This involves a systematic approach where stakeholder feedback and insights are analysed and incorporated into the evaluation process.

The proposed approach for creating classes of environmental performance for both the Product Environmental Footprint (PEF) score and the individual impact categories is grounded in a thorough analysis of how data may be structured and distributed for specific metrics. These metrics could include a single aggregated score such as a point system (Pt), or more specific measures like the impact category climate change expressed in kilograms of CO_2 equivalent (kg CO_2eq). By examining the potential patterns and distributions of these data within a particular product group, the approach aims to provide an adaptable and flexible classification system.

In order to refine this classification process, the class boundaries outlined in the previous method suggested by the PEF have been adjusted. These adjustments ensure that the classifications are more aligned with the actual data distributions and variations observed within a product group. This approach hinges on the application of the formulas reported in **Table 3**, but substituting the parameters 0.3 and 0.85 with four different dynamic parameters (fi) to define the limits of classes of performance. The underlying principle of this approach is to find the appropriate fi parameters such that fi will change based on the distribution of the specific sample. Data regarding the Product Environmental Footprint (PEF) score and the individual impact categories are scarce or not readily available. Moreover, most of the real-world data concerning performance indicators tend to follow a distribution pattern that resembles a bell-shaped curve in many instances. This pattern, known in statistical terms as a bell-shaped curve, often serves as a suitable approximation for these data sets. Given this context, the fi parameters for the analysis are determined by considering the characteristics of the Gaussian data distribution, which is more commonly referred to as the normal distribution. This statistical approach is chosen because the Normal distribution provides a useful framework for analysing data that exhibit this kind of distribution pattern, allowing for more accurate and reliable calculations of the fi parameters.

The Gaussian distribution is a fundamental probability distribution in statistics, characterised by its bell-shaped curve, which describes the spread of a dataset around its mean. Considering the properties of the Gaussian distribution, a system of class boundaries has been created that can effectively categorise data into five distinct classes: A, B, C, D and E. To tailor this system to different datasets, a set of manually assigned parameters, denoted as f1, f2, f3 and f4, are utilised to calculate the precise boundaries for each class.

The boundaries for each class are calculated using the formulas in **Table 4**.

Table 4. Updated formulas to calculate the boundaries for ach classes

Class	**Boundaries**
A	OS < BP + (BM – BP) * f1
B	BP + (BM – BP) * f1 ≤ OS < BP + (BM – BP) * f2
C	BP + (BM – BP) * f2 ≤ OS < WP + (BM – WP) * f3
D	WP + (BM – WP) * f3 ≤ OS < WP + (BM – WP)* f4
E	WP + (BM – WP)* f4 ≤ OS

Source: own elaboration

where:

f1, f2, f3 and f4 are parameters that can have values between 0.1 and 0.9.

4.2.1.1. Selection of fi parameters

To determine the most suitable fi parameters, various combinations were analysed. An attempt was made to use the Gaussian data distribution also known as the Normal distribution and reduce the range of plausible values for fi parameters.

The ranges mentioned below were the selected ones for each parameter.

Table 5. The fi parameter ranges identified

Parameter	**Range**
f1	0.1 – 0.6
f2	0.5 – 0.9
f3	0.5 – 0.9
f4	0.1 – 0.7

Source: own elaboration

An increment of 0.1 was used to assign different values to each parameter, which gave a total of 180 different plausible combinations. A template was created in Excel to calculate the class boundaries for a given set of data after normalisation and transformation. The class population (the number of metrics/products falling into each class), the percentage of the population in each class and the class width were calculated too for all 180 combinations of fi parameters.

4.2.1.2. Criteria for best combination of f parameters

The following criteria were applied to identify the best combination of fi parameters:

1. The sum of the populations of Class A and Class B is less than the sum of the populations of Class D and Class E.
2. The population of Class C is greater than the population of all other classes.
3. The population of Class B is greater than Class A, and the population of Class D is greater than Class E.

The proposed criteria are merely a subset of the possible criteria for defining the classes of performance. It is possible, for instance, that for leptokurtic distributions, characterised by a very pointed peak, even if all of the aforementioned criteria are met, Class C may be overpopulated (>50%). The application of this method is contingent upon the distribution; consequently, new criteria may be established, or some of the proposed criteria may be overlooked. Some other criteria that could be used are:

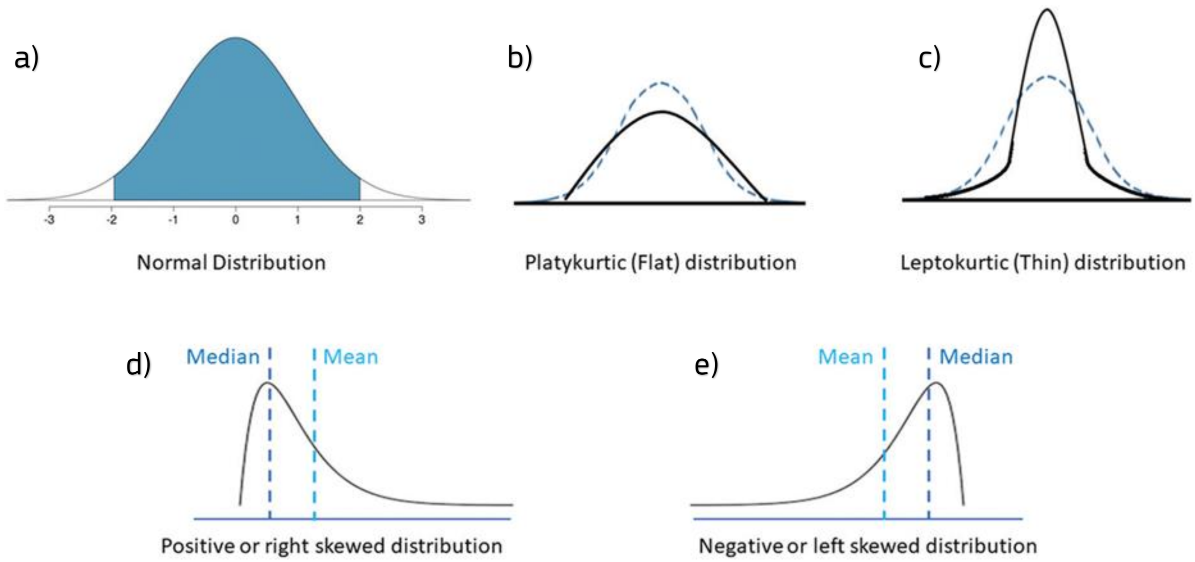
— The population of Class A is less than 10%.

— The sum of the populations of Class A and Class B is less than 50%.

— The population of one class must be less than 60%.

Real-life data may exhibit a variety of distributions; as such, a range of distributions were taken into consideration. The distributions examined included those with a flattened peak, known technically as platykurtic distributions, where the data points are spread more evenly and the peak is less pronounced. On the other hand, leptokurtic distributions, characterised by a very pointed peak, were also analysed; these distributions indicate data that cluster more tightly around the mean. Additionally, the study considered both positively skewed (right-skewed) and negatively skewed (left-skewed) distributions. In positively skewed distributions, the tail on the right side is longer or fatter, suggesting that the majority of data points lie to the left of the mean. Conversely, negatively skewed distributions have a longer or fatter tail on the left side, indicating that most data points are situated to the right of the mean.

Figure 9. Types of distributions: (a) Normal or Gaussian distribution, (b) Platykurtic (flattened peak) distribution, (c) Leptokurtic (pointed peak) distribution, (d) Positive or right-skewed distribution, (e) Negative or left-skewed distribution



Source: Ahmed and Dhooria, 2020

In **Table 6** the combinations of fi parameters that satisfied all three criteria across all tested datasets are reported. The datasets used were normalised distributions with the shape of all five types of distributions reported in Figure 9.

Table 6. Combinations of fi parameters and potential results in terms of how products could be distributed through classes considering a normal distribution (min=0, max=1 and mean=0.5)

#	Combination of fi				Population of classes				
	f1	f2	f3	f4	Class A	Class B	Class C	Class D	Class E
1	0.1	0.5	0.8	0.2	4.70 %	19.90 %	35.30 %	31.90 %	8.20 %
2	0.1	0.5	0.8	0.3	4.70 %	19.90 %	35.30 %	27.40 %	12.70 %
3	0.1	0.5	0.8	0.4	4.70 %	19.90 %	35.30 %	22.90 %	17.20 %
4	0.1	0.5	0.9	0.4	4.70 %	19.90 %	31.00 %	27.20 %	17.20 %

Source: own elaboration

In order to establish classes of environmental performances, it is recommended to utilise one of the predefined combinations of fi parameters. These combinations serve as a basis for categorising performance levels effectively. In many cases, especially when there is an absence of sufficient data to verify how the classes are populated, it is advisable to use the combination labelled as number 2. This suggestion stems from comprehensive testing and analysis involving 180 distinct combinations of fi parameters. Each combination was scrutinised across a variety of distribution types to ensure robustness and adaptability.

The distributions examined included those with a flattened peak, known technically as platykurtic distributions, leptokurtic distributions, characterised by a very pointed peak, positively skewed (right-skewed) and negatively skewed (left-skewed) distributions.

For study teams who are thinking about using alternative fi parameters, it is highly recommended to explore the Excel file *Template CoP v1*[6]. This file outlines the methodology employed in selecting the proposed fi parameters. By reviewing this document, the study team can gain deeper insights into the rationale and statistical considerations that guided the selection process. Importantly, the file is designed to be interactive; if the specific distribution of the data set is already known in advance, the study team can input this distribution into the Excel file. This feature allows for a tailored analysis, enabling the extrapolation of fi parameters that are more finely tuned to the particular characteristics of the known distribution.

To ensure that the best and worst data or products are identified correctly, it is essential to engage in a process of refining the outputs based on the inputs received from various stakeholders. This involves a systematic approach where stakeholder feedback and insights are analysed and incorporated into the evaluation process.

[6] The template for establishing classes of performance can be found via the following path "Z:\30 Publications (public)\NEW PUB_REQUESTs\JRC143463_V Senatore_ESPR Methodology\Template CoP v1.xlsx" (accessible to EC employees only).

5. Method to develop classes of performance for circularity indicators and indexes

When evaluating the effectiveness of programmes, policies or initiatives, performance measurement is a critical tool. It allows one to assess progress, identify areas for improvement, and make data-informed decisions. This chapter delves into the nuances of establishing performance classes for circularity indicators.

When establishing classes of performance for an aspect/parameter, it can be done in the form of an indicator (which is a measurement or value that indicates with a proper unit of measurement the status of the specific product aspect/parameters) or through an aggregated index (clustering several indicators). There are some differences to consider due to the nature of single metrics compared to composite measures. Here are some key distinctions:

— **Nature of measure**:

- Indicator: An indicator is a single metric that measures a specific aspect of performance (e.g. durability, reparability). It is straightforward and targets one dimension. As an example, considering the product parameter "technical lifetime", this can be used as a measure of the product's durability. In this case, the technical lifetime of the product has been used to reflect the circularity aspect “durability”.
- Aggregated index: An aggregated index combines multiple indicators into a dimensionless score. It represents a multidimensional construct that aims to capture a broader concept by aggregating different aspects.

— **Complexity of aggregation**:

- Indicator: For a single indicator, classification is relatively simple as it involves setting thresholds or performance bands based on the range of possible values or based on normative standards or benchmarks.
- Aggregated index: For an aggregated index, classification must consider the methodology used to combine individual indicators. The complexity of the index requires careful consideration of how the performance bands of the composite score reflect the underlying indicators.

— **Normalisation and weighting:**

- Indicator: Individual indicators do not usually require weighting against other indicators, but they may need to be normalised to allow comparison across different scales or units.
- Aggregated index: Aggregated indexes often involve normalisation and weighting of individual indicators to ensure each contributes appropriately to the overall index. Decisions about weighting can significantly affect the classification.

— **Interpretation and use:**

- Indicator: Classes of performance for a single indicator can be more easily interpreted because they are tied to one specific measure.
- Aggregated index: Classes of performance for an aggregated index may be more challenging to interpret, as they reflect a combination of factors. Users of the index must understand what the composite score represents and how changes in individual indicators affect the overall classification.

— **Sensitivity and robustness:**

- Indicator: Classes of performance of a single indicator are sensitive to changes in that specific measure.
- Aggregated index: Classes of performance for an aggregated index may be more robust to changes in any single indicator, depending on the aggregation method and weighting. However, it could also be sensitive to changes if certain indicators have a disproportionate influence on the overall index.

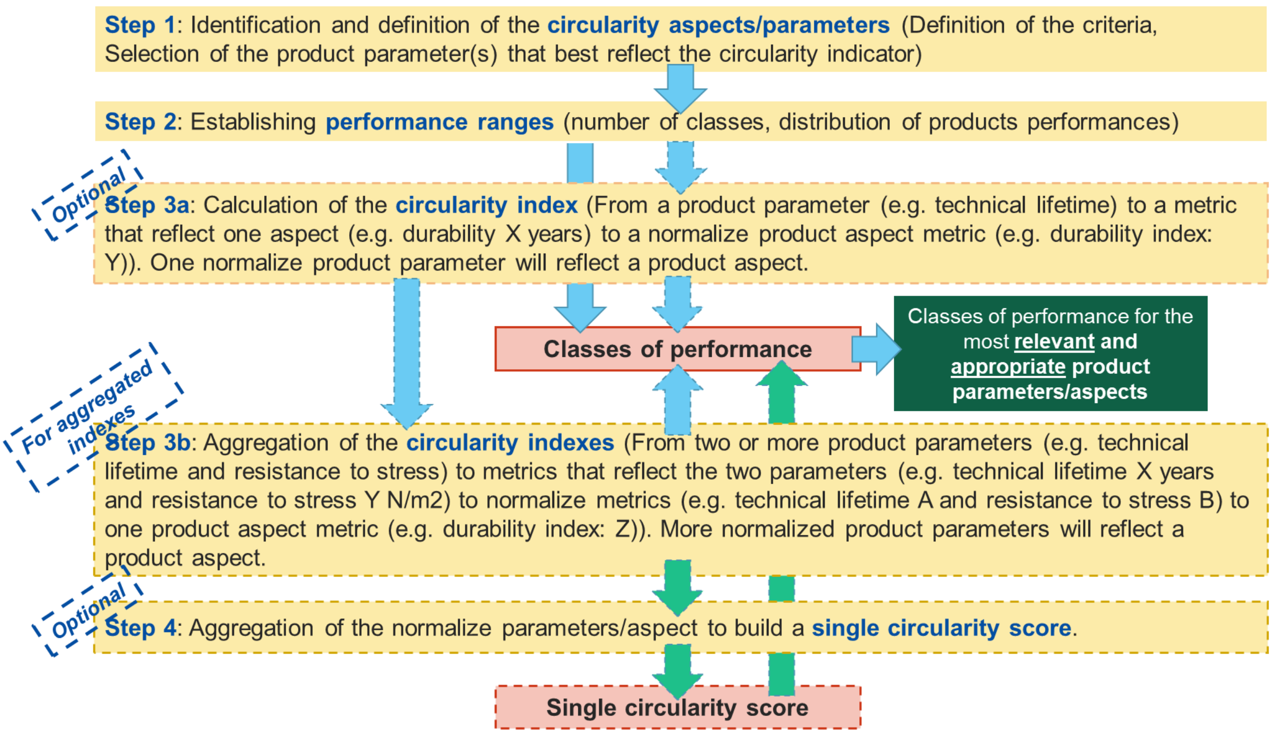
— **Thresholds and cut-off points:**

- Indicator: Establishing classes of performance for an indicator may involve setting clear, empirically based thresholds.
- Aggregated index: For an aggregated index, determining cut-off points for classes of performance can be more arbitrary or subjective, as it involves synthesising across multiple dimensions.

In addition, when several product aspects are identified as relevant and to prevent the definition of classes of performance for each of them, which may be misleading for the consumer, the indicators or indexes could be aggregated as a single circularity score.

In all cases, the process of establishing classes of performance should be transparent, methodologically sound, and relevant to the stakeholders. It is also important to validate the classes against real-world outcomes to ensure that they meaningfully represent different levels of performance. **Figure 10** shows a four-step methodology for the development of the classes of performance for circularity aspects/parameters, either in the form of indicators, aggregated indexes or a score.

Figure 10. Four-step methodology for the development of the classes of performance for circularity aspects/parameters and indexes. Dashed boxes and arrows indicate optional steps.



Source: own elaboration

5.1. Step 1: Identification and definition of the circularity indicators

Taking into account the result of task 1.1, in which the relevant product aspects for the definition of classes of performance are identified, the circularity indicators that will be used to measure them shall be chosen.

The following is a non-exhaustive list of product aspects and parameters which could be analysed using the next step of the methodology:

— Durability: technical lifetime, guaranteed lifetime, resistance to stress or aging mechanism and indication of real use information on the product (e.g. printed pages, charging cycles).

— Reliability: mean time between failures.

— Reparability: modularity and number of materials and components used.

5.1.1. Definition of the criteria

Identify the key factors that contribute to the product parameter/aspect in the product category/group. Make a comprehensive list of criteria specific to your product category/group. In the event that no specific criteria can be identified, an option could be to use the ENSOS quality criteria or some of them:

— Easy (E): this criterion emphasises that the indicator should be straightforward to develop at a reasonable cost and easy to measure;

— Noteworthy (N): this criterion ensures that the indicator is significant in relation to the target objective and of importance;

— Simple (S): this criterion indicates that the indicator should be clear to a non-specialist audience, unambiguous and understandable;

— Optimal (O): this criterion suggests that the indicator should be ideal or most favourable after achieving agreement among stakeholders;

— Solid (S): this criterion indicates that the indicator should be comprehensive, reliable, scientifically defensible and capable of being verified.

5.1.2. Selection of the product parameter(s)/indicator(s) that best reflect the circularity aspect

The method proposed to select the product indicator(s) that best reflect the circularity aspect for a specific product group is the Analytic Hierarchy Process (AHP).

The AHP is a structured technique for organising and analysing complex decisions, based on mathematics and psychology. When applying the AHP, the following steps should typically be followed:

1. **Define the problem**.
2. **Structure a hierarchy** from the top (the goal of the decision) through the intermediate levels (criteria on which subsequent levels depend) to the lowest level (which is usually a set of the alternatives).
3. Construct a set of pairwise comparison matrices for the **calculation of the criteria's weights**. Each element in an upper level is used to compare the elements in the level immediately below with respect to it.

4. **Calculation of the options priorities vector** with respect to each criterion. Use the geometric mean to derive priorities for each comparison matrix.
5. **Aggregate the priorities** across the different levels to produce a set of overall priorities for the decision.

The AHP method could be applied as follows:

<u>Sub-step 1 - Define the problem</u>

The goal is to choose the best parameter(s) that reflects a circularity aspect for a product group. In the following paragraphs, the product aspect durability has been chosen as an example.

<u>Sub-step 2 - Structure the hierarchy</u>

- Level 1: Overall Goal (Select the best parameter that reflects durability).
- Level 2: Criteria (ENSOS - Easy, Noteworthy, Simple, Optimal and Solid).
- Level 3: Alternatives/Options (Technical lifetime, Guaranteed lifetime, Resistance to stress or aging, Resistance to water).

<u>Sub-step 3 - Calculation of the criteria's weights</u>

Upon the establishment of a hierarchy with three levels, the Analytic Hierarchy Process (AHP) involves identifying how each factor on the second level ranks in terms of its importance relative to the primary objective at the top level. This process begins by conducting a set of pairwise evaluations between the criteria. In total, with a count of N criteria, it is necessary to perform N(N-1)/2 such comparative assessments. The subjective assessments concerning the significance of each criterion are quantified by employing a nine-point scale that is clearly defined, with a value of 1 indicating no preference between two criteria and a value of 9 showing an extremely strong preference for one criterion over another. These pairwise evaluation outcomes are systematically presented in a matrix format, as demonstrated in **Table 7**. Once the matrix for pairwise comparisons is in place, the following action is to ascertain the true priority or weight of each criterion. The procedure for determining the weights of the criteria involves calculating the geometric mean of the values in each row, followed by the subsequent normalisation of the new values obtained, which are then added to the pairwise comparison matrix, as seen in **Table 8**.

In the Analytic Hierarchy Process (AHP), a key step is the comparison of the various criteria to assess their relative importance. Because these criteria are often qualitative in nature, AHP uses a structured method to translate subjective judgments into quantitative data that can be analysed.

This translation is achieved through the use of a nine-point scale, known as the Saaty scale after the AHP's creator, Thomas L. Saaty. Respondents are asked to compare pairs of criteria and express their judgments on how much more important or preferred one is over the other. The scale provides a range of values to quantify these judgments:

- Equal Importance: When two criteria are compared and they are deemed equally important or preferred for the decision at hand, they are given a score of 1.
- Moderate Importance: If one criterion is considered slightly more important than another, it might be given a score of 3.
- Strong Importance: When one criterion is deemed significantly more important, it may be assigned a score of 5.

— Very Strong Importance: If one criterion is considered very significantly more important than another, a score of 7 might be appropriate.

— Extreme Importance: In cases where the preference for one criterion over another is the highest, a score of 9 is used.

Intermediate values (2, 4, 6, and 8) are used to capture nuances between the main judgments when the evaluator feels that the difference in importance or preference is between the two adjacent main judgments.

The ENSOS criteria shall be compared against each other in terms of their contribution to that objective. The Saaty scale from 1 to 9 shall be used. When prioritising one criterion over another, for example valuing 'Noteworthy' as more significant than 'Optimal' as shown in **Table 7**, the degree of significance attributed in this case is 'Moderate'. Consequently, within the matrix, the cell where the 'Noteworthy' row intersects with the 'Optimal' column should be assigned a value of 3, while the cell where the 'Optimal' row intersects with the 'Noteworthy' column should receive a value of 1/3.

Table 7. Pairwise comparison of the criteria and calculation of the geometric mean

	Noteworthy	**Optimal**	**Simple**	**Easy**	**Solid**	**Geo Mean**
Noteworthy	1	3	4	2	1/2	1.65
Optimal	1/3	1	2	1/2	1/3	0.65
Simple	1/4	1/2	1	1/3	1/4	0.40
Easy	1/2	2	3	1	1/5	0.90
Solid	2	3	4	5	1	2.60
Sum of the geometric mean for each criteria						6.20

Source: own elaboration

To calculate the weighting factors from the pairwise comparisons, normalise the elements in the last column labelled 'Geo Mean' by dividing them by the sum of the geometric means obtained for each criterion (rows) (**Table 8**).

Table 8. Normalisation and calculation of the criteria weights

	Noteworthy	**Optimal**	**Simple**	**Easy**	**Solid**	**Normalisation**	**Weights**
Noteworthy	1	3	4	2	1/2	1.65/6.20	0.27
Optimal	1/3	1	2	1/2	1/3	0.65/6.20	0.10
Simple	1/4	1/2	1	1/3	1/4	0.40/6.20	0.06
Easy	1/2	2	3	1	1/5	0.90/6.20	0.15
Solid	2	3	4	5	1	2.60/6.20	0.42
The sum of the weights must be 1							1.00

Source: own elaboration

Sub-step 4 - Calculation of the options priorities vector with respect to each criterion

Subsequently, the priority of each option (third level) with respect to the decision criteria (second level) also needs to be determined. The relative importance of each option is also established through a pairwise comparison (based on the same nine-point semantic scale) of the relative performance ratings for all combinations of options, separately for each decision criterion considered in the analysis. Overall, with M options there are M(M-1)/2 pairwise comparisons for each criterion. The same procedure, involving the computation of the normalised geometric means of the pairwise comparison matrices of the options (one matrix for each decision criterion considered in the analysis), is then implemented to determine the priority (or score) of each option with reference to each criterion.

First, a pairwise comparison of the different indicators is conducted based on a relevant criterion. Then, the geometric mean is calculated for each row (**Table 9**).

Table 9. Pairwise comparison of the different indicators based on a relevant criterion and calculation of the geometric mean

C_1=Noteworthy	Technical Lifetime	Guaranteed Lifetime	Resistance to Stress	Resistance to Water	Geo Mean
Technical Lifetime	1	3	4	2	2.21
Guaranteed Lifetime	1/3	1	2	1/2	0.76
Resistance to Stress	1/4	1/2	1	1/3	0.45
Resistance to Water	1/2	2	3	1	1.32
Sum of the overall scores obtained for each criteria					**4.74**

Source: own elaboration

The geometric means are then normalised to obtain the priority vector (**Table 10**).

Table 10. Normalisation and calculation of the priority vector for the different indicators based on a relevant criterion

C_1=Noteworthy	Technical Lifetime	Guaranteed Lifetime	Resistance to Stress	Resistance to Water	Normalization	Priority Vector
Technical Lifetime	1	3	4	2	2.21/4.74	0.47
Guaranteed Lifetime	1/3	1	2	1/2	0.76/4.74	0.16
Resistance to Stress	1/4	1/2	1	1/3	0.45/4.74	0.10
Resistance to Water	1/2	2	3	1	1.32/4.74	0.28
The sum of the priority values must be 1						1.00

Source: own elaboration

Since only one criterion, "Noteworthy", is being considered, the priority vector represents the result of the analysis.

The circularity indicator with the highest priority is considered the most relevant. In this case, the priorities suggest that "Technical Lifetime" and "Resistance to Water" are the most relevant indicators for durability, with "Guaranteed Lifetime" and "Resistance to Stress" following.

Keep in mind that this example is overly simplified and only considers one criterion. It would be necessary to repeat this process for each of the ENSOS criteria, then combine the priority vectors using the weights of the criteria to get an overall ranking as explained in Sub-step 5.

Sub-step 5 - Aggregate the priorities

Once the priority vectors and the weights of the criteria have been determined, the overall priority V of an option "a" with respect to the overall goal of the analysis and N decision criteria is calculated by summing together the products of each criterion weight and the priority vector of an option a. Mathematically this is expressed as:

$$(4)\ V(a) = \sum_{j=1}^{N} w_j \times x_j(a) = w_1 \times x_1(a) + w_2 \times x_2(a) + \cdots + w_N \times x_N(a)$$

where:

— x_j (a) is the local priority of option "a" with reference to the j-th criterion; and

— w_j is the weight of the j-th criterion.

Considering the example in **Table 11** and applying formula (4), the evaluation of the overall priority V of the option "Technical lifetime (TL)" taking into account the N=5 criteria, is:

Table 11. Priority vectors for each indicator (option) and weighting factors for each criterion

Weights of the criteria		Priority vectors: Technical Lifetime (TL)	Guaranteed Lifetime (GL)	Resistance to Stress (RS)	Resistance to Water (RW)
0.27	**C_1=Noteworthy**	0.47	0.16	0.10	0.28
0.10	**C_2=Optimal**	0.50	0.20	0.20	0.10
0.06	**C_3=Simple**	0.30	0.30	0.25	0.15
0.15	**C_4=Easy**	0.20	0.30	0.15	0.35
0.42	**C_5=Solid**	0.40	0.20	0.30	0.10

Source: own elaboration

$$V(TL) = 0.27 \times 0.47 + 0.10 \times 0.50 + 0.06 \times 0.30 + 0.15 \times 0.20 + 0.42 \times 0.40 = 0.39$$

$$V(GL) = 0.21$$

$$V(RS) = 0.21$$

$$V(RW) = 0.19$$

The output of the AHP is a ranking of the indicators in terms of their suitability as a durability indicator, based on the ENSOS criteria. The circularity indicator with the highest priority would be considered the best choice for reflecting durability. The most suitable circularity indicator to reflect durability for the specific product group is technical lifetime.

To make this process clear and actionable, the study team would need to do the following:

- Conduct the pairwise comparisons using input from stakeholders to reflect a consensus view.
- Discuss and iterate as necessary to ensure the rankings make sense and are defensible.

5.2. Step 2: Establishing performance ranges/thresholds for circularity aspects/parameters

Based on the results from Step 1, Step 2 shall define ranges/thresholds for each product parameter (e.g. technical lifetime) utilised to define the performance of a single circularity aspect (e.g. durability). For example, if technical lifetime is the key factor resulting from the step above, performance classes for durability based on the technical lifetime should be created.

Box 1. Minimum performance requirements (Article 7, ESPR)

Article 7 outlines a principle for the establishment of these classes, particularly in reference to the minimum performance requirements. The purpose of such a provision is to ensure that when a new system of classification is introduced, it effectively establishes a minimum standard that must be followed. This prevents the introduction of any new products or services that do not at least meet the basic level of performance deemed necessary at the time the classifications are put in place. It also implies that the lowest class is not just arbitrarily set, but it corresponds to what is considered the minimum acceptable performance at the time the regulation is implemented.

Number of classes

The number of classes depends on the following:

- **The type of product group/category in question**. When dealing with a variety of product categories in the same product group, it is important to consider the inherent characteristics and distinctions among them. Different types of product categories included in the same product group may have diverse features, uses, consumers or market segments. The complexity and breadth of the product group will influence how much the classes should be adapted for each product category to effectively categorise them. For example, in the case of apparel there are 10 categories, each relatively different.
- **The indicators used**. Indicators refer to the metrics used to differentiate and classify products (e.g. technical lifetime used to differentiate products based on the durability indicator). These could be based on qualitative or quantitative measures. Different indicators can have different uncertainty, which then has an impact on the definition of performance ranges because a range should be wider than the uncertainty.
- **The potential future design options (DOs)** which will include requirements based on the relevant product aspects. Design options are the various paths that product development can take, including different features, materials or technologies that may be incorporated into future product designs. When considering potential future design options, it is important to create classes that are flexible enough to accommodate these variations but distinct enough to be meaningful. If a classifying system is being set up with the foresight of future design innovations, it

might lead to the creation of additional classes to ensure that new requirements based on evolving product aspects can be effectively integrated or considering the top class empty.

Since the number of classes depends on the factors reported previously, a case-by-case analysis shall be performed. However, the case-by-case analysis shall be performed taking into account a specific product group/category, a specific aspect used for the class of performance and the future DOs. However, the aim of this report is to give a general method that should set clear guidelines and be flexible enough to be adjusted for all types of product groups and all the possible indicators.

Taking the above-mentioned into consideration and with the aim of providing a starting point, five classes of performance are proposed. Also, to strength this decision, it is known that the more performance classes, the lower the uncertainty in the data must be to effectively distribute products across them. For this reason, five classes seems a better choice as a first proposal for circularity aspects than the seven classes in the energy labels (due to the uncertainty of the data) at this stage, without considering a specific product and a specific circularity indicator. The study team should decide the number of classes for the specific circularity indicator based on the type of product, the indicator used, the potential DOs and the level of product differentiation and distribution through classes.

It is of paramount importance to guarantee horizontal harmonisation among classes of performance developed for the same circularity indicator but employed in different product groups/categories. This implies that if five classes were selected for the durability of product group X, the same number of classes should be used for product group Y. If evidence indicates that this harmonisation is not feasible, the study team could modify the number of classes for product Y, for instance due to an inability to achieve an adequate level of product differentiation and distribution through classes.

Nomenclature

To align with other existing labels, the nomenclature that has been proposed is letters from A, as best performing product or not yet available products, to E, the worst performing products. What has been suggested is only a starting point; the study team should decide the best nomenclature for the specific circularity indicator.

Definition of classes' width

Indeed, a high degree of precision in product environmental performance data would be required to avoid possible misallocation of product ratings if narrow classes were implemented. Every threshold being surrounded by a zone of uncertainty as wide as the uncertainty in the underlying data, a class of performance needs to be at least as wide as the uncertainty.

Influence of ecodesign requirements

The anticipatory component is crucial in setting thresholds for classes of performance. In view of the potential requirements, a model should be developed to project the statistical distribution of present data to the future potential distribution. It is recommended that the analysis is based on two scenarios: a Business-as-Usual (BaU) scenario and an Ecodesign Requirements (EcoR) scenario. The BaU scenario creates a base-case scenario that forecasts what would happen if no requirements were established. On the other hand, the EcoR scenario creates a scenario that forecasts what would happen with the establishment of ecodesign requirements that will influence the specific indicators for which classes of performances will be developed. Products will adapt and change their performance when requirements are set, so, in order to anticipate the variation, a model based on present data taking into account potential requirements and future design options should be built to model the future scenario with the future distribution of products' performance among classes.

A sensitivity analysis should always be performed to identify how changes in thresholds could affect the distribution of the products within all classes.

Proposed methods to establish classes of performance

Different methods have been proposed to establish classes due to the different characteristics of the product categories and the different nature of the product aspects/parameters. All the considerations reported in these paragraphs about the number of classes, the top class emptiness, the wideness of classes considering uncertainty, etc. shall be reflected in the following proposed methods and serve as general rules.

In the event that a minimum performance requirement is set for the specific products aspect and for the specific product group, the products that shall be considered are the ones respecting the minimum performance requirements as reported in Article 7 of the ESPR. In other words, the lower limit of Class E would be the minimum performance requirement for the specific product aspect/parameter and for the specific product group.

Three main methods to establish thresholds and so classes have been identified:

- Fixed middle class taking into account a Representative Product (RP).
- Fixed intervals based on min and max values.
- Fixed percentage of products in each class.

These three methods are also suitable for defining classes of performance for aggregated metrics, such as the circularity index, and for environmental impact indicators, such as the carbon footprint. It is recommended that the study team adopts the most appropriate method for the product group under study and the specific circularity indicator.

These methods should be understood as indicative and flexible. They provide a starting point for defining classes, but the thresholds can be adjusted on a case-by-case basis to accommodate different criteria.

Evolution of the methods due to the availability of data

Data availability is expected to change by 2030 or even earlier. With the implementation of the DPP, there will be a significant increase in the amount and granularity of data related to product performance, life cycle and environmental impact. The increase in the amount and granularity of data related especially to circularity aspects and parameters will increase the robustness of the classes of performance developed based on the proposed methods.

5.2.1. Fixed middle class taking into account a Representative Product

This method has been inspired by the classes of environmental performance for the Product Environmental Footprint (PEF) score. As a starting point, a Representative Product should be defined which will be the base model (BM). The BM should serve as a benchmark upon which to build the classes. In this method, five classes of performance are identified, from Class A being the best class, to which will correspond the best performing (BP) products, to Class E being the worst class, to which will correspond the worst performing (WP) products.

Since this method is based on a score that goes from 0 (BP) to 1 (WP), normalisation is necessary. Normalisation transforms the different indicators to a common scale ranging from 0 to 1.

The proposed normalisation method is the min-max approach: min-max normalisation is one of the most common ways to normalise data. For every feature, the minimum value of that feature gets transformed into a 0, the maximum value gets transformed into a 1, and every other value gets transformed into a decimal between 0 and 1. The data is normalised by using the formula below:

$$(5)\text{Normalised Value } = \frac{\text{Actual Value } - \text{ Minimum Value}}{\text{Maximum Value } - \text{ Minimum Value}}$$

In the case of a dataset where higher numbers represent better circularity performance (e.g. durability) to convert it to a “lower is better” scale, it can be simply done by subtracting each data point from a fixed number that is higher than all data points. For example, if the highest value in the dataset is 1, 1 could be used as the fixed number.

(6) Transformed value = 1 – Normalised Value

The classes of performance are identified at the level of a single circularity indicator (CI), and the thresholds between classes are identified as follows:

- The midpoint (Class C) should be defined by the score of the BM for the specific circularity indicator. When defining the BM, the average (mean) value of the circularity indicator shall also be identified. The median should be taken into account if the distribution of the specific indicator is known to be skewed to the right or left. These values are identified and collected based on industry data provided and any other relevant sources.
- The upper limit of the best class (A) is calculated considering the theoretical best product (BP). The BP is identified by assigning the best technically feasible value for the identified circularity aspect and taking into account BAT (Best Available Technology) and BNAT (Best Not yet Available Technology). This helps to define the upper limit of class A (CA-BP).
- The lower limit of the worst class (E) is calculated considering the theoretical worst product (WP). The WP is identified by assigning the worst technically feasible value for the identified circularity aspect or in the case of a minimum performance requirement for a specific product aspect/parameter, this requirement shall be used to identify the WP. This helps to define the lower limit of class E (CA-WP).

Once the two extremes and the midpoint are identified, the remaining limits of the different categories are identified according to **Table 12**.

Table 12. Establishing the limits of performance classes

Class	Boundaries
A	OS < BP + (BM – BP) * f1
B	BP + (BM – BP) * f1 ≤ OS < BP + (BM – BP) * f2
C	BP + (BM – BP) * f2 ≤ OS < WP + (BM – WP) * f3
D	WP + (BM – WP) * f3 ≤ OS < WP + (BM – WP)* f4

E	WP + (BM – WP)* f4 ≤ OS

Source: own elaboration

where:

f1, f2, f3 and f4 are parameters that can have values between 0.1 and 0.9.

5.2.1.1. Selection of fi parameters

In **Table 13** are reported the combinations of fi parameters identified in Section 4.1.

One of these combinations should be used to build classes of performance for the circularity indicators. Most likely, in the absence of data to verify the class population, the proposed combination of fi parameters is number 2. Tests were done analysing 180 different combinations of fi parameters across different types of distributions such as a flattened peak (platykurtic), a very pointed peak (leptokurtic), a positive or right-skewed and a negative or left-skewed distribution.

Table 13. The fi parameters identified

#	**Combination of f**			
	f1	**f2**	**f3**	**f4**
1	0.1	0.5	0.8	0.2
2	0.1	0.5	0.8	0.3
3	0.1	0.5	0.8	0.4
4	0.1	0.5	0.9	0.4

Source: own elaboration

More detail about this method of building classes of performance is reported in Section 4.2.

Should the study team wish to utilise different fi parameters, it is recommended that they refer to the Excel file *'Template CoP v1'*, which contains the computational steps employed in the calculation of the proposed fi parameters. In addition, if the specific distribution of the parameters is already known *a priori*, further analyses can be carried out by feeding the file with a new distribution to extrapolate better fi parameters for a specific distribution.

5.2.2. Fixed intervals based on min and max values

This is the most straightforward method which allows the maximum grade of flexibility in defining classes of performance. The flexibility is given by the fact that any number of classes can be used considering the main principles reported at the beginning of Section 5.2. Potentially, this simple and intuitive method could be applied for any type of indicator or index. One of the requirements to make this method applicable is the availability of data for the specific parameter for which classes of performance will be developed. As a minimum data requirement, at least the minimum and maximum value of the indicator shall be known.

The main principle for defining classes of performance is to define the intervals. Below is one method to divide a set of data into intervals.

— In the first step, calculate the range: subtract the lowest value in the dataset (D) from the highest:

$$(7)\ range = \max D - \min D$$

— In the second step, calculate the class interval width by defining the number of classes and using the following formula:

$$(8)\ width = \frac{range}{number\ of\ classes}$$

— In the third step, define all the class intervals. Each interval is defined by a lower limit and an upper limit. Products that fall in a class interval are greater than or equal to the lower limit and less than the upper limit (this happens when the class of performance boundary is for a “higher is better” indicator):

$$lower\ limit\ \leq x < upper\ limit$$

The lower limit of the first interval is the lowest value in the dataset. Add the class interval width to find the upper limit of the first interval and the lower limit of the second variable. Keep adding the interval width to calculate more class intervals until you equal the highest value.

In the case of availability of data for the specific indicator, further adjustments based on the share of products falling into each class can be made to guarantee the appropriate population of classes, which can potentially be guided by specific criteria developed by the study team. This method could be applied iteratively to check how changing the number of classes or any other thresholds/parameters affects the distribution of products among all the classes.

5.2.3. Fixed percentage of products in each class

The method proposed is a general framework that can be applicable to a range of indicators and products. This approach will rely on the fact that the number of products in each class will be fixed. The class boundaries should be set in an iterative way based on the fixed share of products included in the specific class.

As an example, the evaluation of the technical lifetime of electronic appliances to define performance classes for a single aspect such as durability has been assumed. The classes will be defined based on the expected operational lifespan of a product.

Firstly, the number of classes shall be defined. For the purposes of this practical example, five classes (A to E) have been selected.

Secondly, the percentage of products in each class shall be defined. For this example, the products will be distributed as follows:

— Class A: empty or <10%;

— Class B: 10% < I <15% of products;

— Class C: 25% < I <35% of products;

— Class D: 35% < I <40% of products;

— Class E: 10% < I <20% of products.

Lastly, the thresholds shall be set in an iterative way to guarantee the distribution of products defined in the previous step. The final result is as follows:

— Class A: >10 years (Best, aspirational or not yet available or rare)

  - Characteristics that products could have: May include advanced features such as modularity, easy reparability, availability of spare parts, and strong manufacturer warranties.

  - Availability: Not yet available or represents a very small portion of the market (aspirational target for future products).

- Class B: 8-10 years (High-end, 10% of products, BAT)
  - Characteristics that products could have: Good build quality, high reliability, often come with better warranties, and potentially have some features promoting longevity.
- Class C: 6-8 years (Mid-range, 30% of products)
  - Characteristics that products could have: Average build quality and reliability, standard warranty, and a balance between cost and longevity.
- Class D: 4-6 years (Standard, 40% of products)
  - Characteristics that products could have: Basic functionality with an emphasis on cost-effectiveness rather than extended lifespan.
- Class E: <4 years (Low-end, 20% of products)
  - Characteristics that products could have: Often inexpensive with lower build quality and minimal warranty, these products are designed with price rather than durability in mind.

It is important to note that these classes are arbitrary and must be adjusted based on actual market data, product categories, technological advancements and minimum requirements.

The definition of class boundaries for the aforementioned methods in Sections 5.2.1, 5.2.2 and 5.2.3 shall be revised in accordance with the following scenario. Note that if the Delegated Act following the Preparatory Study proposes minimum performance requirements on specific aspects/parameters, the new WP for these aspects/parameters (after the DA enters into force) will become the value of those minimum performance requirements, as the previously existing worst performing products will be excluded from the market. The average of the market is also expected to change because of this exclusion, thus resulting in a new value for the BM. Since the setting of minimum performance requirements changes the values of the boundaries of the performance classes (via the changing of both the WP and BM values), the values of those boundaries should be recalculated, and the updated values should be stated in the DA as well.

5.3. Step 3: Normalisation and aggregation into indexes

Creating a comprehensive circularity metric for a product aspect that reflects one product parameter or encompasses various product parameters involves several steps, including the selection of product aspects, which implies the identification of the relevant and appropriate product parameters, and data collection, which have been well explained in previous sections.

The process of computing the circularity index is a procedure that transforms product indicators into standardised metrics, which collectively provide a measure of the product. This comprehensive index is derived through a series of steps, each designed to refine and standardise the information into a format that can be easily assessed and compared.

A particular indicator, such as years of technical lifetime, is a raw measurement that specifies the expected duration of the product's optimal functioning under standard usage conditions. Similarly, another durability-related indicator may capture the product’s resistance to stress (for example, the number of stress cycles or load levels it can withstand before failure). For instance, for a household appliance, the technical lifetime might be the number of years the appliance is expected to operate without significant degradation or the need for major repairs, while the resistance-to-stress parameter could describe how well critical components withstand repeated mechanical or thermal loads.

If the product parameters capture and reflect specific circularity aspects (e.g. technical lifetime and resistance to stress both reflecting the aspect of durability), these parameters should be used jointly to express the circularity aspect (durability for X years and resistance to stress level Y). In this case, because more than one parameter is used to describe the same product aspect, they may need to be aggregated into a single durability-related score. Conversely, if it is just one parameter that reflects one product aspect, normalisation is not mandatory because there is no need to aggregate it with other parameters.

Following this, the next step is to normalise the two parameters in order to create a durability index. This involves scaling the raw metrics (e.g. years of technical lifetime and resistance-to-stress values) onto a consistent range that allows for comparison across different products or categories and enables their aggregation. The normalisation process might, for instance, result in a combined durability index in which the two normalised parameters are aggregated to obtain a dimensionless metric that represents the product's durability. This score could be on a scale from 0 (most durable) to 1 (least durable).

In case it is just one parameter that reflect one products aspect the normalization is not mandatory because there is no need to aggregate together other parameters.

Below is a general approach to creating such an index focusing on normalisation methods, inversion of metrics, how weighting factors can be obtained and aggregation:

- **Normalisation**: Since the indicators may have different units or scales, normalisation is necessary to allow for aggregation. Normalisation transforms the different indicators to a common scale, typically ranging from 0 to 1 or -1 to 1, where higher values represent better circularity performance. However, in the case of the environmental footprint (e.g. PEF score), lower values represent better performances.

  All the normalisation methods analysed have been reported in Annex 5. The data is normalised by using the formula below:

$$(5)\ \text{Normalised Value} = \frac{\text{Actual Value} - \text{Minimum Value}}{\text{Maximum Value} - \text{Minimum Value}}$$

- **Simple inversion**: After the normalisation, in the event that the indexes that need to be aggregated have different scales such as “lower is better” or “higher is better”, all of them should be converted into the “lower is better” scale. This can be done by simply subtracting each data point from a fixed number that is higher than all data points. For example, if the highest value in the dataset is 1, 1 could be used as the fixed number.

  (6) Transformed value = 1 – Normalised Value

  This will flip the “higher is better” scale to a “lower is better” scale.

- **Weighting factors**: Develop weighting factors to reflect the relative importance of each indicator within the overall circularity aspect. Weighting can be based on expert opinions, stakeholder input or statistical methods such as factor analysis.
  - Delphi Method: A structured technique that relies on a panel of experts to reach a consensus on the weighting of different indicators;
  - Analytic Hierarchy Process (AHP): A decision-making tool used to prioritise indicators based on pairwise comparisons and hierarchical structuring; or

- a combination of the two previous methods.

— **Aggregation**: Combine the normalised and weighted indicators to calculate the overall aggregated metric. This could be done through a simple weighted sum or more complex methods that account for interactions between indicators.

(9) Aggregated metric = Σ (Normalised Value_i * Weight_i)

5.4. Step 4: Definition of a single circularity score

The aggregation of normalised aspects to create a single circularity score involves combining various sustainability metrics into a comprehensive one that reflects the overall circularity of a product. Circularity refers to the degree to which activities are aligned with the principles of the circular economy, which aims to minimise waste, maximise resource efficiency and product lifetime, and promote the reuse and recycling of materials.

To build a single circularity score, the steps below should be followed:

— **Identification of parameters**: Determine the parameters that reflect circular practices relevant for the product in question, such as material recyclability, product lifespan, repairability, energy efficiency, resource sourcing, and waste generation (method in Chapter 3).

— **Normalisation**: Normalise each indicator to ensure that they are comparable. This can involve converting them into a common scale, typically ranging from 0 (the best) to 1 (the worst).

— **Weighting**: Assign weights to each parameter based on their relative importance in contributing to overall circularity. This step requires expert judgment or stakeholder input.

— **Aggregation method**: Choose an aggregation method to combine the normalised and weighted parameters. Common methods include summation, averaging, or more complex mathematical models that take into account interactions between parameters.

— **Calculation of circularity score**: Use the chosen aggregation method to calculate the circularity score. This score provides a singular value that can be used to assess and compare the circularity performance.

It is important to note that while a single score can be useful for simplicity and comparison purposes, it may also oversimplify the complexities inherent in circular economy practices. Therefore, Step 4 is considered optional and will be used when political positions suggest it or when the study team decides to use it, accompanied by positive feedback from stakeholders.

5.5. Process to review classes of performance

5.5.1. The example of the Energy label

The European Union's Energy label is a key tool for promoting energy efficiency and informing consumers about the energy performance of products. To ensure that the Energy Label remains relevant and encourages continuous improvement in product energy performance, the classes of performance indicated on the labels are subject to periodic reviews.

These periodic reviews are essential for the following reasons:

— **Technological advancements**: As technology evolves, products become more energy-efficient. What was once considered top-tier performance may become the standard over time. Reviews ensure that the label's classes reflect current technologies.

- **Market shifts**: As more products enter the highest energy efficiency classes, these classes can become crowded, reducing the incentive for further innovation. Regular updates can rescale the classes to redistribute products and maintain differentiation.
- **Consumer clarity**: The labels must remain clear and helpful to consumers. If too many products cluster at the top of the scale, it becomes harder for consumers to make informed choices. By reviewing and adjusting the classes, the labels continue to facilitate easy comparison between products.
- **Policy goals**: Energy labels are part of wider policy measures to reduce energy consumption and greenhouse gas emissions. Reviews ensure that the labels align with evolving policy objectives and climate targets.

The EU's framework for energy labelling is governed by the Energy Labelling Regulation (Regulation (EU) 2017/1369). This Regulation sets out the principles for reviewing and updating the energy labels. Reviews are typically scheduled every few years (at least every 5 years) or when it is observed that a significant number of products within a category achieve the top energy efficiency class, usually "A".

The review process involves a range of stakeholders, including industry representatives, consumer organisations, and Member States. It can result in the rescaling of energy efficiency classes, where the parameters for each class are redefined to ensure that the highest classes remain an incentive for the most energy-efficient products. The process may also lead to the introduction of new measurement methods and updated labelling requirements to better reflect the energy consumption during actual use.

The Commission may further rescale the labels if:

a) 30% of the units of models belonging to a product group sold within the Union market fall into the top energy efficiency class (A) and further technological development can be expected; or

b) 50% of the units of models belonging to a product group sold within the Union market fall into the top two energy efficiency classes (A and B) and further technological development can be expected.

As a result of these reviews, consumers can expect energy labels to consistently provide accurate, up-to-date information that reflects the latest in energy-efficient technology and helps them make environmentally conscious purchasing decisions.

For specific product groups, the review process can be triggered more frequently if it is observed that a significant number of products on the market achieve the highest energy efficiency classes, causing a clustering effect that diminishes the label's ability to differentiate products based on their energy performance.

The aim of these reviews is to ensure that the energy labels remain a useful tool for consumers to make informed decisions and to continue driving manufacturers toward innovation and energy efficiency improvements. The rescaling process may involve creating additional, more stringent energy efficiency classes (e.g. A+++, A++, A+) or redefining the existing classes to adjust to the improved performance standards of the products.

In summary, while there is a minimum review period of 5 years set out in legislation, the actual frequency of Energy Label reviews for specific product categories can be more flexible and is driven by market trends and technological progress.

5.5.2. Indicators signalling the need for a review and update of classes of performance in the context of the ESPR label

When considering a change in the classes of performance, particularly in the context of the ESPR label, certain indicators can be used to signal that a review and potential update may be necessary. These indicators can include the following:

- **Penetration rate of top-class products**: A high percentage of products achieving the highest class can indicate that the criteria for this class are no longer stringent enough to differentiate the best performers.
- **Technological innovation rate**: The speed at which new, more sustainable technologies are being introduced and adopted can necessitate a recalibration of classes of performance.
- **Average improvement of the specific product parameter reflecting a specific circularity indicator**: If the average improvement across a product group is significant, it can be a sign that the product groups need updating.
- **Shifts in minimum performance standards**: Changes in regulations that raise the minimum required efficiency for products can also trigger a review of the classes.
- **Market dynamics**: Changes in consumer demand for more environmentally sustainable products, as well as shifts in manufacturers' production towards higher efficiency, can serve as indicators.
- **Resource savings potential**: If new analysis shows that greater resource savings are possible than previously understood, this could signal a need to adjust classes to incentivise further reductions in resource consumption.
- **Differential performances**: Significant differences in circularity performance among products within the same class can be a sign that the class range is too broad and needs tightening.

Using these indicators can help the regulatory bodies to decide when to review and potentially update the classes of performance to ensure that performance classes continue to drive improvements in environmental sustainability and help consumers make informed decisions.

5.6. Potential impacts due to the establishment of classes of circularity performance

The establishment of classes of performance can significantly influence the environmental requirements for a product group in several ways:

- **Setting environmental benchmarks**: Establishing performance classes for circularity aspects encourages manufacturers to meet certain environmental standards. By creating a class for environmentally superior products, regulators and the market can drive improvements in CO_2 emission, energy efficiency, resource conservation, pollution reduction, etc.
- **Driving innovation**: Performance classes can motivate manufacturers to innovate and develop new technologies that not only meet technical performance requirements but also excel in environmental performance. This can lead to the creation of products that are both technologically advanced, circular and environmentally friendly.
- **Informing regulatory standards**: Policymakers can use the established classes to inform and update regulatory standards, such as emissions standards, or waste reduction targets. Products that do not meet minimum environmental performance requirements might be phased out or subjected to additional regulations.

— **Guiding consumer choice**: Performance classifications that include circularity and environmental considerations help consumers make informed decisions. When circularity and environmental performance are clearly labelled and promoted, consumers can choose products that align with their values and contribute to a reduced environmental footprint.

— **Competitive differentiation**: Companies can use higher environmental and/or circularity performance classes as a marketing tool to differentiate their products in the marketplace. This can lead to increased competition among manufacturers to not only meet but exceed environmental standards, thereby raising the overall environmental and circularity performance of the product group.

— **Encouraging best practices**: Classes of environmental performance can serve as a platform for sharing best practices and technologies across the industry. This can help spread environmentally friendly innovations and encourage more sustainable production methods.

— **Life cycle thinking (LCT)**: Performance classes can take into account the environmental impact of a product throughout its life cycle, from raw material extraction to disposal. This holistic view can lead to the integration of life cycle considerations into product design and manufacturing processes.

— **Compliance and enforcement**: Clear performance classes can make it easier for regulators to monitor compliance with environmental requirements and enforce regulations more effectively. This can lead to better environmental outcomes as companies strive to meet established criteria.

— **Addressing market failures**: By highlighting environmentally superior products, performance classes can correct market failures where the environmental costs of products are not reflected in their price. This can lead to more sustainable consumption patterns and incentivise manufacturers to internalise the environmental costs of their products.

5.7. Defining and assessing the best use of classes of performance considering consumer expectations and behaviour

The implementation of classes of performance for circularity aspects/parameters requires a nuanced approach to ensure they effectively communicate the sustainability and circularity attributes of products to consumers. These classes should be defined with a focus on comprehensibility, ensuring that the product aspects/parameters are accessible and easily understood by the average consumer. This involves clear labelling and the use of straightforward, non-technical language. Added advantages, such as the potential for cost savings or positive social impacts, should be highlighted to align with consumer expectations and incentivise behaviour that favours circular economy principles. Moreover, the product aspects/parameters must be advertised clearly, allowing consumers to readily identify the circularity performance class of a product. This can be achieved through prominent placement on packaging, in marketing materials, and across digital platforms. To assess the effectiveness of these classes, consumer feedback should be considered, along with studies on purchasing patterns and the overall impact on the promotion of circular economy practices. Ultimately, the success of these performance classes depends on their ability to resonate with consumers and drive more sustainable consumption choices.

Also, defining and assessing the best use of classes of performance in a product involves understanding consumer expectations and behaviour, and aligning those insights with the performance classes' features. Here is a methodological approach for achieving this (**Figure 11**):

1. **Identify the classes of performance** (done in "Step 2: Establishing performance ranges for circularity aspects/parameters" of Chapter 5):

- Determine the key performance classes or features relevant to the product. These might include durability, recyclability, reliability, etc.

2. **Consumer research**:

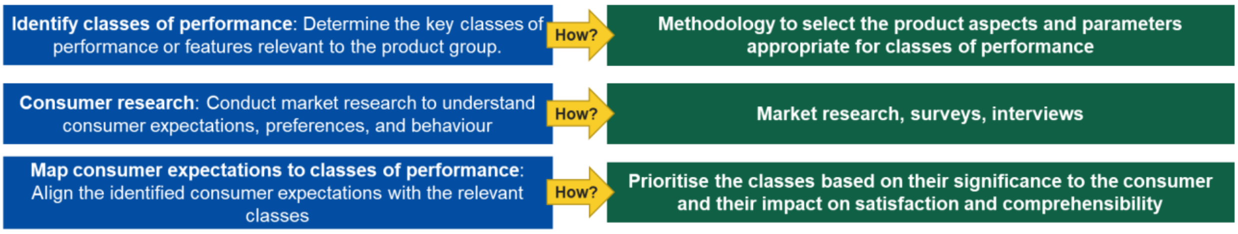
   - Conduct market research to understand consumer expectations, preferences and behaviour. Conduct this research dividing the market into segments based on demographic, psychographic and behavioural criteria. Understand how different segments may prioritise performance classes differently.
   - Use surveys, focus groups and interviews to gather data.
   - Analyse online reviews and social media to capture consumer sentiment and feedback.

3. **Map consumer expectations to classes of performance**:

   - Align the consumer expectations identified with the relevant classes of performance.
   - Prioritise the classes based on their significance to the consumer and their impact on satisfaction.

Throughout this process, it is important to maintain a balance between meeting consumer expectations and keeping a sound and technical approach.

Figure 11. Methodological approach to assess the best use of classes of performance considering consumer expectations and behaviour



Source: own elaboration

6. Classes of technical performance

Introducing circularity requirements into product design is an important step towards sustainability, but it comes with its own set of challenges. Circularity aims to create products that are recyclable, reusable and maintainable, reducing waste and the need for new resources. However, this approach can sometimes come into conflict with the technical performance of a product, which encompasses the technical specifications that define how well a product performs its intended function (see Annex 2 for examples of some technical indicators for different products).

Despite these potential challenges, it is possible to maintain a clear and simple understanding of a product's technical performance without resorting to complex classifications. Rather than creating various performance categories that could lead to confusion, a more straightforward method is to provide a number for specific performance indicators that take the product's specific use into account. By doing this, consumers can easily compare the technical performance of different products based on relevant and transparent measures.

A prime example of this approach in action is the Energy label system. This label offers a simple value that reflects a specific functionality of the product rating, such as washing efficiency index for washing machine and rinsing effectiveness in the case of dryers, under standardised conditions. This information enables consumers to quickly compare the technical performances of different appliances without needing to delve into the detailed technical data behind each value and without using a scoring system.

It is important to recognise that there are limitations to simplifying the communication of technical performance in this way, as the diversity of technical specifications across products can be vast and complex. Each product category may have unique requirements and benchmarks that need to be considered. These issues are further explored in the following sections, where a deeper analysis is provided on the intricacies involved in balancing the adoption of circular principles with the need to maintain high technical performance in products.

Considering the issues that have been identified, the decision is to neither recommend nor proceed with the development of classes of technical performance. The following section outlines the limitations of having classes of technical performance.

6.1. Limitations of having classes of technical performance

6.1.1. Intrinsic limitations and interaction with classes of performance for circularity aspects/parameters

Creating a method to develop classes of technical performance for a product group involves categorising products based on various performance-related characteristics (see Annex 2). This process is complex and has several limitations, which need to be analysed critically. Below are some of the main limitations:

I. Defining performance criteria:

- Subjectivity: Determining what constitutes "performance" can be subjective, varying according to different users, applications or contexts. Different users may have different expectations and requirements for a product based on how they intend to use it. For example, a professional gamer will have different performance needs for a computer compared to a casual user. Performance classes must therefore be flexible enough to account for these varying use cases (Variability in use cases).

- Multidimensionality: Performance often encompasses multiple dimensions, such as speed, efficiency, durability, making it difficult to find a one-size-fits-all set of criteria. The performance indicators chosen to establish classes should be relevant to the primary functions and uses of the product. For instance, the robustness of a smartphone might be a key performance indicator for outdoor enthusiasts but less critical for other users (Customisation of performance indicators).

II. Measurement challenges:

- Quantification: Some performance aspects may be difficult to quantify or measure precisely.
- Standardisation: Lack of industry-wide standards for measuring performance can lead to inconsistencies.

III. Product diversity:

- Variability: Products within a group can be highly diverse, with different features and capabilities that are not directly comparable.
- Evolution: Products evolve over time, and what is considered high performance today may be obsolete tomorrow. Performance classes should be designed to be flexible enough to adapt to new uses that may emerge over time, as well as to the evolution of technology and consumer expectations (Flexibility in classification).

IV. Data availability and reliability:

- Accessibility: Obtaining relevant and comprehensive data for all products in a group can be challenging.
- Data quality: The data used for classification must be accurate and reliable; otherwise, the resulting performance classes will be flawed.

V. Interdependencies and trade-offs:

- Complex relationships: Products may exhibit trade-offs, where improvement in one aspect of performance leads to a compromise in another.
- System context: The performance of a product may depend on its interaction with other products or systems, complicating the classification.

VI. User perspective and needs:

- Customer expectations: Different users may prioritise different aspects of performance, making a universal classification system less useful to individual users.
- Use cases: Products might perform differently in various scenarios or use cases, which can impact their classification.

Developing a robust method to classify products into technical performance classes requires a careful balance of these considerations. It involves an iterative process of defining criteria, collecting data, testing, and refining the system, with ongoing input from stakeholders to ensure relevance and usefulness.

The suggestion that technical performance classes could undermine the promotion of the most environmentally sustainable products within a given product group/category warrants a critical examination. The issue under discussion is the potential consequence of an emphasis on technically proficient products, which may inadvertently result in the marginalisation of those products that demonstrate superior environmental performance.

Technical performance often relates to attributes (e.g. camera performance: megapixels; processing power: GHz; breathability: moisture vapour transmission rate (MVTR)) and is typically at the forefront of consumer considerations when evaluating products. However, environmental sustainability is a multifaceted concept that encompasses factors like resource efficiency, emissions during production and use, product lifespan, etc. These factors are not always as immediately perceptible to consumers as technical specifications.

If the ESPR is to truly align with its sustainability goals, it must ensure that environmental performance is not overshadowed by technical performance. This means creating a framework where the two are not competing but are instead complementary. The suggested approach would involve showing the classes of performance of circularity aspects/parameters and depending on the product group/category, where necessary, a number advertising the technical performance (e.g. camera performance: 200 megapixels; processing power: 3.5 GHz; breathability (MVTR): 5 000 g/m²/day) might be included on the label. Moreover, such a system could encourage manufacturers to innovate in ways that do not sacrifice environmental performance for technical gains.

Moreover, consumers play a pivotal role in this dynamic. Having labels with classes of environmental performance and/or circularity performance empowers and guides consumers to make choices that reflect a product's overall sustainability rather than just its technical superiority.

In conclusion, while showing performance classes serves a purpose in distinguishing products, a critical rethinking of the main aim of the classes for technical performance is necessary. This will ensure that the ESPR fosters an environment where the most environmentally sustainable products are given the prominence they deserve, driving the market towards genuine sustainability.

6.1.2. Sufficiency

The rationale behind forgoing the development of classes based on technical performance is rooted in the sufficiency perspective. This approach underscores the importance of questioning not just how products are made, but also why certain functionalities are pursued and to what extent they are actually necessary. By doing so, it challenges the continual pursuit of technological advancements for incremental efficiency gains, which may inadvertently contribute to increased overall consumption—a phenomenon known as the rebound effect.

It is increasingly clear that reaching environmental sustainability requires not only efficiency (reduced environmental impact per functionality) but also sufficiency measures (reduced environmental impact through reduced or changed functionality) (André, 2024).

Emerging evidence suggests that achieving environmental sustainability requires a dual approach that includes not just efficiency but also sufficiency strategies. Efficiency measures aim to lower the environmental impact of consumption per unit of functional output, while sufficiency measures seek to reduce overall consumption levels and the demand for functional output.

Sufficiency, therefore, encourages a deeper examination of consumption patterns and product use. It calls for a reassessment of what is considered “enough” in terms of product functionality and performance. This could mean prioritising products that meet basic needs with minimal environmental impact, rather than those that offer additional features which may go beyond what is necessary and contribute to greater resource use and waste. Moreover, sufficiency-oriented strategies can lead to diverse benefits, such as fostering innovation in product design that prioritises durability, reparability and adaptability. It also aligns with circular economy principles by promoting the longevity of products and discouraging disposability. In this context, the concept of sufficiency aligns with the need to decouple economic growth from environmental degradation, urging consumers, manufacturers and policymakers to redefine notions of quality, value and progress.

In summary, the avoidance of classes of technical performance is advocated within the framework of sufficiency to encourage a more holistic approach to sustainability. This approach not only addresses the efficiency of products but also questions the necessity of the functions they provide. By doing so, it aims to curtail the overall environmental footprint by reducing the demand for excessive functionality and encouraging a culture of mindful consumption. Thus, sufficiency acts as a critical counterbalance to efficiency, ensuring that efforts to mitigate environmental impact are not undermined by unchecked consumption.

"There's those thinking, more or less, less is more. But if less is more, how you keeping score?[7]"

[7] Hannan, J. (2007). Society. On Into the Wild. J Records.

7. Assessment of the usefulness of the ESPR label for consumers and other economic actors and interactions with other labels and the DPP

7.1. Context

Product labelling serves as a crucial marketing instrument and a key channel for dialogue among various societal entities, such as businesses and consumers, both directly and through intermediaries, as well as regulatory bodies and the public. While product labels are no longer the sole trusted source for conveying consumer information, they remain a potent means of communication. The advantages of delivering information to consumers, particularly through labels, are undeniable.

In the ESPR, Article 16 focuses on the specifications for labels that provide consumers with important information about products. This article outlines the obligations for creating and displaying such labels, which are essential for enabling customers to make informed choices based on a product's sustainability.

Firstly, when a product's information must be included on a label, as directed by the delegated acts under Article 4, the content, design and display method of the label must be clearly defined. The content is essential for conveying the necessary information; the design must ensure that the label is visible and legible, thus easily read by customers; and the display method should be suitable for all forms of selling, including online retail, as per Article 32. There may also be provisions for the use of electronic means to generate these labels, which can enhance their accessibility and accuracy.

Secondly, if the label needs to indicate a product’s performance class, the design must be straightforward and intuitive, enabling customers to effortlessly compare the performance of different products based on relevant parameters. This approach encourages consumers to make choices that favour more sustainable products.

Thirdly, for energy-related products already subject to the Energy labels as per Regulation (EU) 2017/1369, there may be situations where additional information that is more relevant and comprehensive is necessary. Furthermore, it may be that the most relevant information to be conveyed is not energy consumption and use of other resources or information on the functional performance of the product group. In such cases, if incorporating this additional information into the existing energy label could confuse customers or overly burden the economic operators, the Commission may assess the situation and decide to require a separate label in line with the ESPR. This ensures clarity in communication and prioritises the conveyance of the most relevant product data.

Article 16(3) of the ESPR states that the decision to establish an ESPR label instead of an Energy label for an energy-related product is a step-by-step process: identification of the most relevant and comprehensive information to be communicated through a label, which cannot be included in an energy label, an assessment that the establishment of a label for this information will not cause confusion for customers or increase the administrative burden for economic operators. If the above leads to the conclusion that this information is the most relevant information to be communicated indefinitely via a label, an ESPR label can be established instead of an energy label.

Lastly, when establishing the label requirements, the Commission shall also mandate the inclusion of data carriers or similar means to provide customers with access to further information. This could include a product passport, offering a detailed overview of the product's sustainability features. The Commission is responsible for adopting Implementing Acts that set common standards for label layouts as per Article 7(6), point (c), ensuring consistency across labels and helping to facilitate better consumer understanding. These acts will be adopted following the examination procedure outlined in Article 67(3).

In general, labels equip consumers with product details which enable consumers to make educated decisions at the point of purchase, including whether to buy a product and how to use it optimally. For manufacturers and businesses, effective and responsible labelling is a strategic asset that not only facilitates the transmission of crucial product information but also allows them to showcase their product's advantages over competitors'. This is particularly relevant when there are extra costs associated with these benefits, and companies must persuade consumers to accept a higher price than that of similar market offerings. Nonetheless, the ideal scenario where labelling benefits both the consumer and the business does not always materialise.

In reality, there is frequently a disconnection in the market, and various stakeholders contend that labelling is not achieving its intended impact. One reason for this shortfall could be a fundamental disinterest among consumers in the information provided by labels. Even when consumers are interested, they may struggle to use labels effectively due to the overload of information, which can be incomprehensible, confusing or poorly presented.

Bearing in mind what has been discussed previously, there is a need to focus on some specific aspects when considering introducing a new label (the ESPR label):

- How to deal with small and medium-sized enterprises (SMEs). The costs of introducing labelling changes will generally be higher for SMEs and ways of minimising these costs need to be considered.
- Ensuring the presentation of labels is suitable. Consumers are often dissatisfied with this aspect of labelling, finding labels difficult to read and thus to understand.
- The potential use of logos or symbols. Whilst attractive in relation to the internal market, minimising the space needed for multi-lingual labelling and ensuring a common understanding across Europe, there may be practical difficulties in development and implementation.
- An awareness that the ESPR label will deal with ‘consumers’ and not ‘the consumer’, i.e. in relation to a specific labelling issue there may be no one-size-fits-all situation and different approaches for the provision of the information may be needed to reach all target groups.
- There is only a finite amount of space on labels and there may be a need to prioritise what should go on a label and what might be better provided elsewhere (i.e. off-pack, potentially in the DPP).

A literature review on Environmental Product Information (EPI) and Generalised Environmental Labelling (GEL) is reported below, followed by the general method to assess whether a label is useful for consumers and other economic actors, taking account of interactions with other labels and with the Digital Product Passport, and of expected impacts on environmental and market aspects.

7.2. Literature review on Environmental Product Information (EPI) and Generalised Environmental Labelling (GEL)

7.2.1. General considerations about EPI and GEL

The Green Claims Directive proposal, currently under co-decision, establishes guidelines for environmental claims and labelling. This initiative is designed to empower consumers to make informed purchasing choices by providing them with accurate and verified information. The proposed Directive outlines regulations for voluntary green claims made by businesses to consumers, ensuring that these claims are supported by reliable assessments. This approach is intended to prevent misleading information and avoid trade-offs between various environmental impacts. Furthermore, the proposal seeks to ensure that environmental labels are dependable and transparent, and that they are based on third-party certification schemes with strong governance structures. A key component of the proposal is the requirement for companies to have their claims verified by EU-accredited verifiers before presenting them to consumers, known as ex-ante verification. By validating the substantiation prior to making claims, the Directive aims to eliminate misleading and unsubstantiated claims from reaching consumers. The proposal also focuses on enhancing trust in credible labels. Owners of labelling schemes will be responsible for obtaining ex-ante verification of their labels and governance. Companies certified under these verified labelling schemes will be allowed to display the label without needing further ex-ante verification. In situations where EU legislation provides more specific rules regarding environmental claims for certain sectors, such as financial services, or specific product categories, like batteries, those specific regulations will take precedence. This means there will be no changes to existing labels such as the EU Ecolabel, energy efficiency label, or organic farming label.

Environmental Product Information (EPI) emerges as a pivotal element for sustainable development across numerous nations. EPI broadly refers to the dissemination of information about a product's or service's environmental performance to stakeholders. Such disclosures drive sustainable consumption and production by guiding consumers toward more environmentally friendly options (François-Lecompte et al., 2017). Research shows that consumers actively seek out environmental information when making purchases (François-Lecompte et al., 2017). Moreover, consumers are willing to pay more for green products (40% are willing to pay more for a product with a verified green claim or label, 48% of consumers prefer buying a product with a green label than a product without one) (BEUC, 2023)[8]. This information typically falls into one of three categories as per ISO standards:

— Type 1 - Environmental labelling (ISO 14024)
    - These are voluntary labels awarded by a third-party body.
    - Type 1 labels are based on a multi-criteria approach, considering the entire life cycle of the product.
    - The standards for these labels are created through a consensus process, where different stakeholders are involved.

[8] https://www.beuc.eu/green-maze

- These labels often take the form of eco-labels or environmental seals, indicating that a product meets a set of environmental performance criteria.
- Examples include the EU Ecolabel, Nordic Swan Ecolabel and the Blue Angel in Germany.

— Type 2 - Environmental declarations (ISO 14021)

- Type 2 labels are self-declared environmental claims made by manufacturers, importers, distributors or retailers.
- These claims can include statements, symbols or graphics on product packaging or in product literature.
- The claims must be accurate, not misleading, and substantiated by evidence.
- Examples of Type 2 labels include recyclable, energy-efficient, or made with recycled content.

— Type 3 - Environmental declarations (ISO 14025)

- Type 3 labels provide quantified environmental data of a product, based on a predefined set of parameters and an independent third-party assessment.
- They are based on a life cycle assessment (LCA) according to ISO 14040 and ISO 14044.
- This type of labelling is often referred to as an Environmental Product Declaration (EPD).
- EPDs are used in business-to-business communication, providing a clear and transparent basis for comparing the environmental performance of products.
- They are particularly useful in sectors like construction materials, where they can inform about the environmental impact of products like insulation, windows, flooring, etc.

According to the Green Claims Directive, all voluntary labels and labelling schemes must adhere to the new regulations. Claims, including labels, can only be made if they are supported by assessments based on widely recognised scientific evidence. These assessments must demonstrate that the environmental benefits are substantial and clearly identify any trade-offs between different environmental impacts. Additionally, environmental labels and labelling schemes are required to be reliable, transparent, verified by third parties, and subject to regular reviews.

Table 14. ISO 14020 classification of environmental labels.

www.ecolabel.eu	ISO 14024 Environmental labels and declarations (Type I environmental labelling)
www.recycle-more.co.uk	ISO 14021 Self-declared environmental claims (Type II environmental labelling)
EPD® www.environdec.com	ISO 14025 Environmental labels and declarations (Type III environmental declarations)

Source: adapted from Andrea Blengini and Shields, 2010

While Types 1 and 2 assist consumers in identifying sustainable products, they fall short in enabling comprehensive product comparisons or a full understanding of the environmental impact due to inconsistent formats and reliability issues, particularly with Type 2. Empowering consumers to influence the production system requires the introduction of a labelling scheme that indicates the environmental impact of every product in a category (Gonçalves and Silva, 2021). Such a scheme, corresponding to Type 3 information, would quantify a product's impact using a multicriteria and life cycle approach. This quantification includes all substance and energy flows throughout a product's life cycle, from raw material extraction to end-of-life treatment. Environmental consulting firms, employing standardised methods and sector benchmarks, typically conduct these assessments to ensure uniform and trustworthy scoring.

The Generalised Environmental Labelling (GEL) system is designed to educate consumers about a product's impact through a scoring system on the packaging. The current Green Claims Directive proposal prohibits the use of GEL unless it is issued by the EU. In the Green Claims Directive proposal, the Commission suggests prohibiting claims or labels that provide an aggregated scoring of environmental impacts—essentially an overall environmental impact assessment of a product or service—unless these are based on a methodology established in EU law. The Council's position allows labels with aggregated scoring to be based on national methodologies if no EU rules are available, provided that the aggregated score is accompanied by information on the ranges and available levels. On the other hand, the European Parliament proposes removing the ban entirely, permitting labels with aggregated scores as long as they are based on methods that are scientific, independent, reproducible and employ a life-cycle approach.

The Commission's proposal highlights concerns about the overall aggregation of various impact categories into a single score or rating. This practice allows companies to offset negative impacts with more positive ones, potentially misleading consumers about the true environmental performance of a product. Additionally, if different labels employ their own aggregation methodologies, it could lead to unfair situations for companies, as their products might receive varying ratings from different labels. This inconsistency can also confuse consumers, who might find the same product rated as Class A in one store and Class B in another. These issues strengthen the case for a harmonised and robust aggregation methodology to be developed at the EU level.

In general, an advantage of GEL is that it facilitates sustainable consumption by enabling consumers to choose the most sustainable products or avoid the most detrimental ones. GEL incorporates specific environmental criteria, such as the EU's energy label for household electronic appliances or Australia's water efficiency label for various water-consuming products. These instances demonstrate the effectiveness of labelling schemes when enforced and mandated by regulatory bodies (François-Lecompte et al., 2017).

It is vital to acknowledge the need for proactive engagement by public authorities to implement GEL. Regulatory frameworks, particularly with sanctions for non-compliance, must back the tool. The initiative demands uniform adherence to assessment standards by all providers within a product category, even when these standards may not favour their products. Moreover, companies require access to assessment standards and methods to produce these labels. Thus, public authorities are responsible for creating and maintaining a comprehensive database of standards. Their role is crucial in overseeing and regulating the GEL scheme to guarantee its effectiveness. Consequently, GEL represents a form of environmental governance that relies on a controlled top-down intervention rather than a market-driven bottom-up approach (François-Lecompte et al., 2017).

7.2.2. Examples of environmental labels (EL)

In 2007, the French government envisaged imposing product Environmental Labelling (EL) to enable consumers to compare the environmental impact of all the items within a product category. In a competitive context, such an instrument is expected to democratise sustainable consumption, especially because it allows consumers to exclude the products with the highest environmental impact from their consideration (François-Lecompte et al., 2017). The goal of the French government was to guide consumers towards environmentally friendly products and encourage producers to adopt sustainable practices. However, the initiative faced resistance, leading to a voluntary, rather than mandatory, rollout of the system. The French case provides insights into the obstacles faced and offers recommendations for public authorities seeking to promote EL or similar systems in the future. The key obstacles which contributed to the failure of the French EL include a lack of support for the mandatory system, active opposition from established stakeholders, an overly ambitious schedule, and a shift in focus from environmental communication to precise measurement of product impact (François-Lecompte et al., 2017). The French government's attempt to create a mandatory EL system offers valuable lessons on the importance of consensus-building, reducing implementation costs, and demonstrating the efficacy of environmental labelling schemes.

Launched in 1978 in Germany, the Blue Angel was the world's first sustainability label. In the following years, numerous other labels emerged: The Environmental Choice in Canada in 1988, the Nordic Swan Ecolabel in Norway, Sweden, Finland, Iceland and Denmark, as well as the Eco Mark in Japan in 1989, the Green Seal in the USA in 1990, Eco Mark in India in 1991 and the EU Ecolabel in 1992. Some of these pioneering labels are still role models today. They have proved to be recognised and used by consumers to drive consumption decisions in a more sustainable direction (François-Lecompte et al., 2017).

The literature has put forward evolutionary psychology explanations, including self-interest, social imitation (copying the behaviour of others), future discounting (valuing the present more than the future) and individuals' tendency to disregard concerns they cannot see or feel and thus experience (Korteling et al., 2023). As for the latter, the evolutionary basis relates to how the brain developed in an ancestral world, in which a physical and instinctual link between behaviour (e.g. I pollute my cave) and the environment (the cave becomes uninhabitable) existed. The evolutionary consequence was that, since early humans did not face distant, slow-moving environmental problems, the brain did not evolve to register danger when confronted with threats that are not within our sensory range (Van Vugt et al., 2014). This early environment contrasts today's world of consumption with its frequent disconnect between behaviour (e.g. I buy a manufactured product in the store) and its environmental consequences (the factory is poisoning the river downstream) (Kumari et al., 2022). Thus, in a world of packaged and manufactured goods, it is more difficult to appeal to our evolved sensory mechanisms to motivate environmental action (Van Vugt et al., 2014). As a consequence, in the modern world of consumption, where tangible links and visceral cues are difficult to implement at the point of sale in a typical retail environment, the challenge is to employ proxy stimuli that appeal to pro-environmental behaviour and peoples' innate love for nature (biophilia). One strategy for using such stimuli is to have consumers focus on distant environmental problems by presenting them with statistics (Kumari et al., 2022) and, possibly, by linking such statistical and facts-based information with other visual measures at the retail level (e.g. a pro-environmental product label with carbon or water footprint numbers).

Comparative survey analysis from Japan and the UK has also investigated consumer knowledge regarding sustainability issues, attitudes and preferences, comparing different label claims (including information on packaging's recycling and reusability, eco-friendly packaging, carbon emissions labelling), to show that, in terms of relative desirability, recycling claims were the most desired label claims in both countries, and that water footprint knowledge was low in both countries (Guenther et al., 2012). This finding regarding recycling claims had previously also been identified for UK consumers, while highlighting that consumers placed most value on attributes such as price, quality and taste.

The recently published Flash Eurobarometer 535[9] indicates a growing awareness and trust among citizens in the EU Ecolabel. The survey, which gathered responses from over 25 000 citizens across the 27 EU Member States, reveals several key findings:

- 38% of EU citizens now recognise the EU Ecolabel logo, marking an increase of 11 percentage points since 2017.
- 73% consider the environmental impact of a product to be 'very important' or 'rather important' when making purchasing decisions.
- 38% of citizens report that they "sometimes" or "often" purchase products bearing the EU Ecolabel.
- 60% have intentionally bought products because of their lower environmental impact.
- 56% believe the EU Ecolabel guarantees environmental excellence.
- 69% think that all products with the label meet strict environmental criteria.

It is important to highlight that, according to the ESPR, the EU Ecolabel and other nationally or regionally officially recognised EN ISO 14024 type I ecolabels can still be put on products bearing ESPR labels - provided that the criteria developed under those labelling schemes are at least as strict as the ecodesign requirements. Moreover, the EU Ecolabel could be used as proof of compliance with ecodesign requirements when the ESPR and EU Ecolabel cover the same product groups and the same requirements.

This means that, when developing ESPR labels for product groups eligible for the EU Ecolabel or other nationally or regionally officially recognised EN ISO 14024 Type 1 ecolabels, the possibility of their coexistence on the products should be considered.

7.2.3. Final considerations

Considering the evaluation of the usefulness of labels based on the literature review provided, the conclusion can be drawn that environmental product information (EPI) and generalised environmental labelling (GEL) play a crucial role in promoting sustainable development and influencing consumer behaviour.

The evidence suggests that consumers actively seek environmental information, which indicates a demand for transparency regarding the environmental performance of products. However, the current labelling systems, such as Type 1 and Type 2 labels, have limitations in their ability to enable comprehensive product comparisons and a full understanding of environmental impacts due to format inconsistencies and reliability issues – the latter regarding Type 2 ecolabels. This is one of

[9] https://europa.eu/eurobarometer/surveys/detail/3072

the reasons for proposing the Green Claims Directive, which is to address unreliable ecolabelling schemes and ensure they are supported by a transparent and trustworthy governance framework.

The introduction of a Type 3 labelling scheme, which quantifies a product's environmental impact using multicriteria and life cycle approaches, is a significant advancement. It allows consumers to make more informed decisions by comparing the environmental impacts of products within the same category, thereby facilitating sustainable consumption.

The adoption and implementation of GEL can be seen as effective when supported by regulatory frameworks and public authority engagement, ensuring uniformity and credibility. Labels like the EU's Energy label and Australia's water efficiency label exemplify the positive outcomes of such regulatory-backed schemes.

Furthermore, historical examples of environmental labels, such as the Blue Angel and the EU Ecolabel, demonstrate their enduring influence on consumer choices and the potential to drive a shift towards more sustainable consumption patterns.

The literature also underscores the psychological challenges in connecting consumer behaviour with environmental consequences in a modern context, suggesting that labels can serve as proxy stimuli that appeal to pro-environmental behaviour. The incorporation of statistical information and visual cues on labels, such as carbon and water footprint data, can help bridge the gap between consumer actions and their environmental impacts.

Lastly, comparative studies indicate that consumers value certain label claims, such as recycling information, more highly than others, which highlights the importance of understanding consumer preferences and knowledge gaps to design more effective labelling strategies.

In conclusion, environmental labels, particularly when standardised and supported by regulations, are a valuable tool for educating consumers and incentivising sustainable production and consumption. The success of such labels, however, depends on their ability to communicate meaningful and reliable information that resonates with consumers and motivates them to make environmentally conscious choices. For the aforementioned reasons, the ESPR label will undergo an assessment process where its usefulness and effectiveness will be evaluated, and the information inserted will be carefully chosen balancing the level of detail and the comprehensibility of the label. Moreover, the development of the ESPR label will align with the requirements set forth by the Green Claims Directive. When developing ESPR labels for product groups eligible for the EU Ecolabel or other nationally or regionally officially recognised EN ISO 14024 type I ecolabels, the possibility of the coexistence of such labels on the products should be considered (see the following chapters).

7.3. Method to evaluate the usefulness of the ESPR label

To develop a method to assess the usefulness of the ESPR label from the perspective of both consumers and economic operators, several key factors that contribute to a label's effectiveness must be considered. The method should be multifaceted, combining both qualitative and quantitative data, and should encompass the following steps:

For consumers:

— **Understandability**

- What: Based on the information reported on the label, assess whether the label's language and terms are easily understood by consumers.

- How: Conduct surveys or focus groups to determine if consumers can interpret the label correctly.

— **Visibility and legibility**

- What: Evaluate the label's design for visibility and legibility, including font size, colour contrast and placement on the product.
- How: Perform eye-tracking studies to measure how quickly and easily consumers can locate and read the label.

— **Relevance and comprehensiveness**

- What: Assess whether the label includes all the necessary information for consumers to make an informed choice.
- How: Gather feedback on whether the information provided on the label is considered relevant to the consumer's decision-making process.

— **Information overlap**

- What: Avoid overlap of information with other established mandatory labels.
- How: Cross-checking of the type of information included on other mandatory labels.

— **Behavioural impact**

- What: Study consumer purchasing behaviour before and after the introduction of the label to gauge its influence.
- How: Conduct controlled experiments to see if the label leads consumers to choose more sustainable or higher-performing products.

— **Accessibility**

- What: Determine if additional information is easily accessible through QR codes, websites or other data carriers for those seeking more detail.
- How: Measure the usage rates of these additional information channels.

For economic operators:

— **Cost and feasibility**

- Analyse the financial impact of label implementation, especially for SMEs, to ensure costs are not prohibitive.
- Explore the availability of subsidies or incentives to offset labelling costs.
- Asses the methodological complexities of the LCA approach required for the environmental impact assessment of the product.

— **Impact on sales and market position**

- Monitor sales data to assess the label's impact on product appeal and market share.
- Conduct market research to understand how labels affect brand perception and competitiveness.

— **Operational efficiency**

- Evaluate the ease of integrating new labelling requirements into existing production and packaging processes.
- Assess the level of effort required to maintain compliance with labelling standards.

Cross-analysis:

After collecting data from both perspectives, perform a cross-analysis to identify commonalities and discrepancies. This analysis should consider the following:

— **Consumer satisfaction vs. Economic burden:**
  - Balance consumer demand for information with the economic impacts of providing such information.
  - Investigate how the label influences consumer behaviour through market research, surveys and behavioural studies.
  - Analyse whether the label leads to more sustainable consumption patterns and if it effectively drives demand for products with lower environmental impacts.
  - Assess the administrative and financial burden placed on economic operators to comply with labelling requirements.
  - Consider the potential for the label to drive innovation and product improvement among manufacturers and retailers.

— **Effectiveness vs. Efficiency:**
  - Weigh the effectiveness of the label in changing consumer behaviour against the efficiency of economic operators in implementing these changes.

Outcome:

The outcome of this assessment method should be a comprehensive understanding of a label's usefulness for a specific product group, highlighting areas for improvement and ensuring that labels serve their intended purpose of informing consumers while being economically viable for operators.

The assessment method needs to be iterative, with regular reviews to adapt to changes in consumer behaviour, market trends and regulatory landscapes. Continuous engagement with both consumers and economic operators is crucial for the label's ongoing relevance and effectiveness.

7.4. Interaction of the ESPR label with other relevant labels and the Digital Product Passport (DPP)

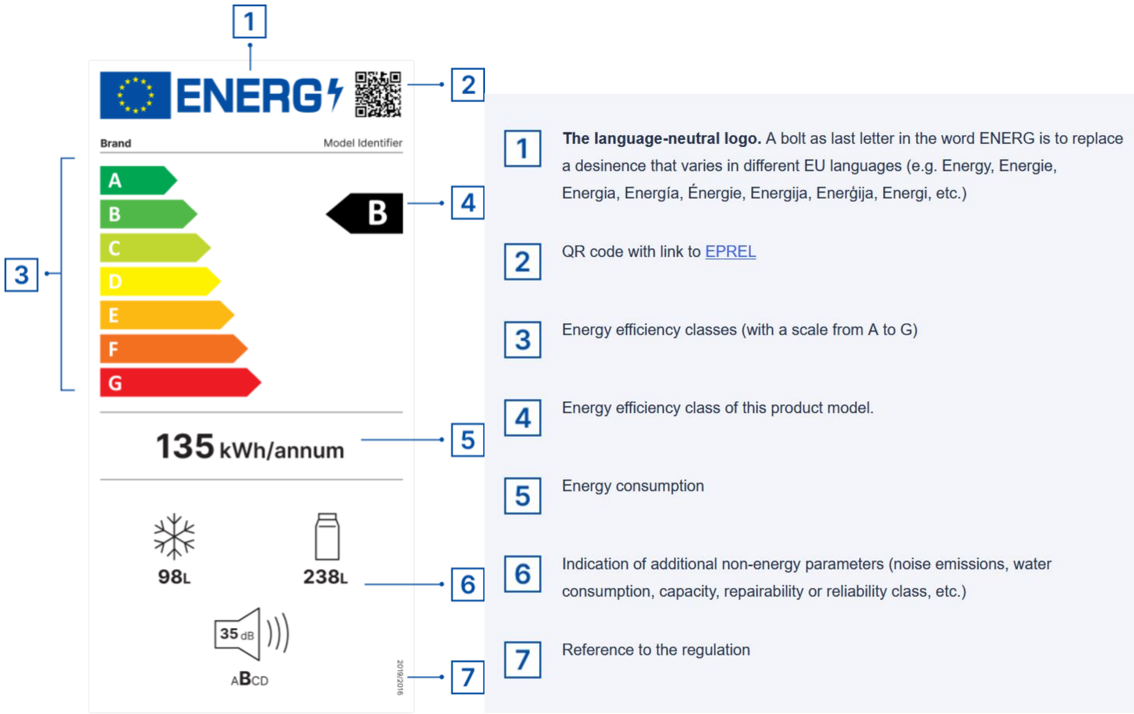
7.4.1. Energy label

Energy labels are informative tags or stickers attached to products, particularly appliances and electronics, that provide consumers with essential information about the product's energy consumption and efficiency. These labels are designed to guide purchasing decisions, encourage energy conservation and reduce environmental impact.

Energy labelling programmes have been introduced worldwide since the late 20th century in response to growing concerns over energy conservation and environmental protection. The Energy Star programme, launched in the United States in 1992, is one of the earliest and most recognised labelling schemes. The European Union introduced its energy label in 1995, which has since undergone revisions to improve clarity and effectiveness.

The Energy label (**Figure 12**) is well-known by citizens - it is recognised by 93% of consumers and considered by 79% when buying labelled products, according to a Special Eurobarometer 492 survey.

Figure 12. Energy Label content and characteristics



Source: https://energy-efficient-products.ec.europa.eu/ecodesign-and-energy-label/understanding-energy-label_en

An energy label typically includes several key components:

- The energy efficiency rating, usually depicted as a scale from A to G, with A being the most efficient.
- An estimate of the annual energy consumption of the product.
- Product-specific information, such as:
  - noise levels: for certain products, such as washing machines, dishwashers and refrigerators, the noise level during operation is indicated in decibels (dB);
  - water consumption: for appliances like washing machines and dishwashers, the label might include information on annual water consumption;
  - capacity: Information on the size or capacity of the product, such as the volume for refrigerators or the number of place settings for dishwashers.
  - performance ratings: other performance-related ratings, such as the cleaning efficiency for dishwashers or the spin-drying efficiency for washing machines;
  - cooling and heating performance: for air conditioners and heaters, their effectiveness in cooling or heating a space may be indicated;
  - reparability, resistance to stress and reliability classes: for smartphones and tablets, resistance to accidental drops or scratches, protection from dust and water, durability of batteries and disassembly and repair.
- Product-specific information for different compartments and functions, such as:
  - for refrigerators, the energy consumption and capacity of different compartments (e.g. fridge vs. freezer);

- for ovens, energy consumption for different functions (e.g. fan vs. conventional);
- temperature range: for heating and cooling devices, the operational temperature range might be included.

— QR code: since May 2021, the label has included a QR code that links to the European Product Database for Energy Labelling (EPREL). Consumers can scan this code to access additional technical specifications and information.

Energy labels cover a wide range of product categories, including but not limited to:

— household appliances (e.g. refrigerators, washing machines, dishwashers);

— heating and cooling equipment (e.g. air conditioners, heaters);

— lighting products (e.g. light bulbs, luminaires);

— electronic devices (e.g. televisions, computers, smartphones).

Each product category has a tailored energy label that accounts for the specific energy use and efficiency characteristics relevant to that type of product.

Different regions have developed their own energy labelling schemes, with varying standards and classifications. For instance, Japan has the Top Runner programme, and Australia and New Zealand utilise the Energy Rating Label. Despite these differences, there is a general global trend toward harmonising energy labelling to facilitate international trade and enable consumers to make consistent comparisons.

EU energy labels face several challenges, including keeping pace with technological advancements, ensuring consumer understanding of the labels, and preventing "greenwashing" by manufacturers. Future directions in energy labelling may involve incorporating broader environmental impact assessments, such as environmental footprint and recyclability, into the labels.

EU energy labels are a vital tool for promoting energy efficiency and environmental consciousness among consumers and manufacturers alike. By providing transparent and standardised information, they support the principles of a circular economy, helping to reduce waste and conserve resources. As technology and environmental awareness evolve, energy labelling schemes will continue to adapt and play a crucial role in driving sustainable consumption and production patterns.

The following paragraphs present two examples of EU energy labels: tyres and smartphones and tablets. These examples were selected due to the unique information presented on the labels, including durability and reparability classes for smartphones and tablets, and wet grip indicators for tyres.

Tyres label

The tyres label (Tyre Labelling Regulation (Regulation (EU) 2020/740)) is part of EU efforts to increase the safety and economic and environmental efficiency of road transport by promoting fuel-efficient and safe tyres with low noise levels. The label was introduced in November 2012 and updated with a new version that came into effect on the 1st May 2021.

The tyre label includes the following key pieces of information (**Figure 13**):

— Fuel efficiency (Rolling resistance): This is rated on a scale from A (most efficient) to E (least efficient) and indicates how the tyre's rolling resistance affects fuel consumption and CO_2 emissions. Lower rolling resistance means less energy is required to move the vehicle, leading to better fuel efficiency and lower emissions.

— Wet grip: This rating also uses a scale from A (highest grip) to E (lowest grip) and assesses the tyre's performance in terms of braking distances on wet roads. A higher rating means shorter braking distances and better performance in wet conditions.

— Snow grip: This is indicated with a pictogram that shows a snowflake inside a mountain. If present, it signifies that the tyre meets specific snow grip requirements and is suitable for severe snow conditions.

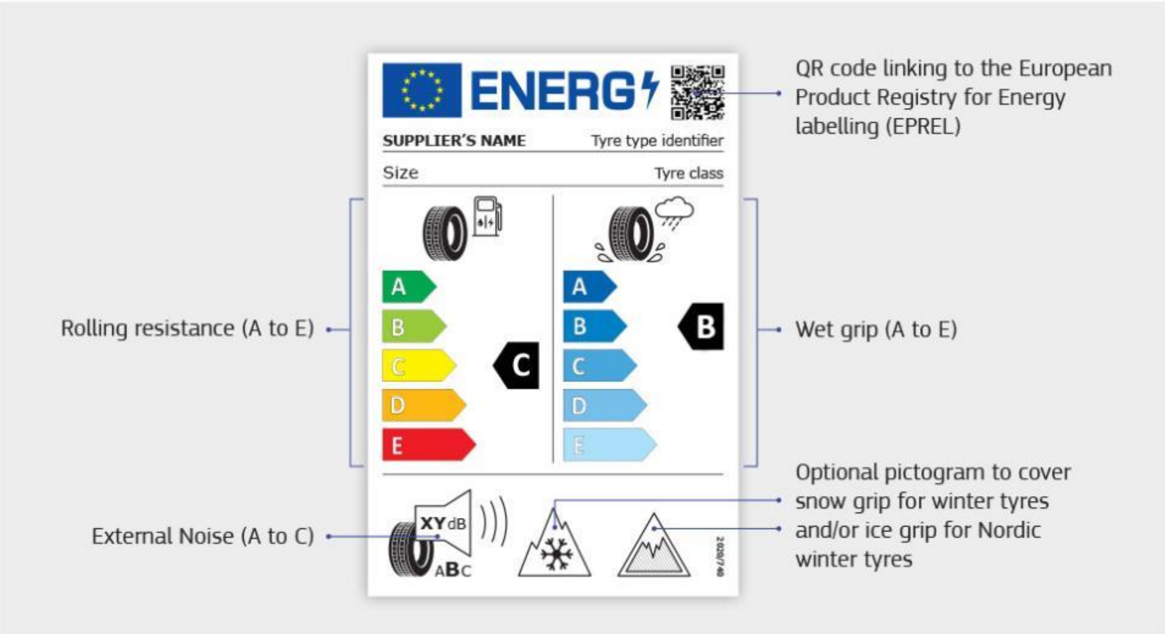
— Ice grip: Similar to the snow grip indicator, the ice grip pictogram (which features two interlocking icicles) is included for tyres that have been certified for exceptional performance on icy roads. This is particularly relevant for countries with severe winter conditions.

— External rolling noise: Measured in decibels (dB), this indicates the external noise generated by the tyre when it is in motion. The label also includes one, two or three sound waves next to the decibel value, with one wave representing the best performance (lowest noise level) and three waves indicating the worst.

— Tyre size: The label indicates the size of the tyre.

— QR code: Since May 2021, the label has included a QR code that links to the European Product Database for Energy Labelling (EPREL). Consumers can scan this code to access additional technical specifications and information.

Figure 13. Contents and characteristics of the tyres label



Source: https://energy-efficient-products.ec.europa.eu/product-list/tyres_en

The tyre label is mandatory for all tyres sold in the EU, whether produced in the EU or imported. It must be clearly displayed on the tyre tread or an accompanying label when the tyre is on display for sale or lease. The label must also be included in all technical promotional literature, including websites, for tyres sold within the EU.

Durability and reparability index for tablets and smartphones

Regulation (EU) 2023/1669 of 16 June 2023 supplementing Regulation (EU) 2017/1369 of the European Parliament and of the Council aims to limit the environmental impact of smartphones and tablets placed on the EU market by establishing ecodesign requirements.

Main features

— The ecodesign requirements are set out in Annex II; these include rules on:

  - **resistance** to accidental drops or scratches, protection from dust and water;
  - **durability of batteries** – batteries should withstand at least 800 cycles of charge and discharge while retaining at least 80% of their initial capacity;
  - **disassembly and repair** – including obligations for producers to make critical spare parts available to repairers within 5-10 working days, and until 7 years after the end of sales of the product model on the EU market;
  - **operating system upgrades** – for at least 5 years from the date of the end of placement on the market of the last unit of a product model;
  - **non-discriminatory access** for professional repairers to any software or firmware needed for the replacement.

— Regulation (EU) 2023/1669 specifies which conformity assessment procedures apply.

— EU Member States' national authorities must apply the verification procedures laid down in Annex IV when carrying out market surveillance checks.

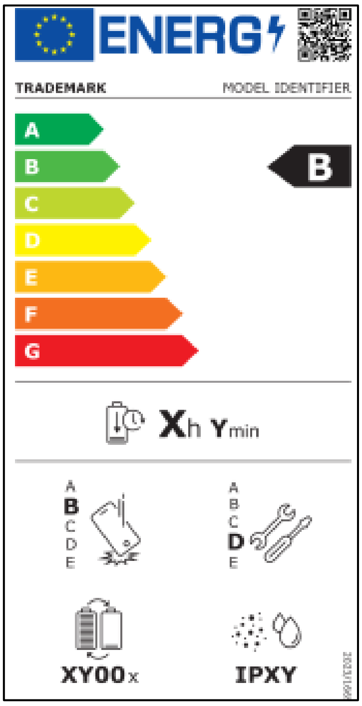
— Regulation (EU) 2023/1669 specifically forbids devices designed to alter performance under testing.

— Annex V sets out indicative benchmarks for the best performing products and technology available on the market.

The European Commission introduced a new Energy label addressing circularity aspects such as the reparability of smartphones and tablets (**Figure 14**). It contains a reparability index, which indicates on a scale of A-E how easily the devices can be repaired. The index reflects criteria such as the number of steps required for disassembly, the availability of spare parts or the period in which the equipment is provided with software updates.

The label aims to support customers in their purchasing decisions and to encourage producers to design their products innovatively and sustainably.

Figure 14. Energy Label for smartphones and tablets



Source: https://energy-efficient-products.ec.europa.eu/product-list/smartphones-and-tablets_en

7.4.2. Analytical framework to address the interaction between the Energy label and the ESPR label

Box 2. Interaction between the ESPR label and the Energy Label as per Regulation (EU) 2024/1781

Recital 47 of Regulation (EU) 2024/1781: *Regulation (EU) 2017/1369, which sets a framework on energy labelling, applies, in parallel to this Regulation ((EU) 2024/1781), to energy-related products. Energy labels are a successful instrument as regards providing the appropriate information to consumers for energy-related products. Classes of performance determined under this Regulation should, where appropriate, be incorporated in the energy label as supplementary information as provided for in Article 16 of Regulation (EU) 2017/1369. In cases where relevant information on a product's performance in relation to a product parameter cannot be included as supplementary information in the energy label, the Commission should, where appropriate, be able to require the establishment of a label in accordance with this Regulation instead of the energy label, in which the relevant information of the energy label can be so incorporated.*

Article 16 (3). For energy-related products that are subject to energy labels established pursuant to Regulation (EU) 2017/1369 where information on a relevant product parameter, including on classes of performance referred to in Article 7(4) of this Regulation, cannot be incorporated in the energy label, and provided such information is considered to be more relevant and comprehensive than the information covered by the energy label, the Commission, after assessing the risk of confusion for customers, the administrative burden for economic operators and the best way to communicate that particular information, may, if appropriate, require the establishment of a label in accordance with this Regulation instead of the energy label established pursuant to Regulation (EU) 2017/1369.

To decide whether and how to incorporate classes of performance from Regulation (EU) 2024/1781 into the energy label as supplementary information, or to establish a new label that combines relevant information from the energy label, a systematic methodology has been developed. The following steps detail this methodology:

7.4.2.1. Scope and assessment

- Identify the energy-related products covered by both Regulation (EU) 2017/1369 (Energy labelling) and Regulation (EU) 2024/1781 (ESPR). If the product group for which the ESPR envisages a label is covered by the Energy labelling Regulation as well, it is necessary to understand which of the following two options is most suitable:
    - I. Incorporation of classes of performance and any other additional information from the ESPR label into the Energy label as supplementary information.
    - II. Establishment of a new label (ESPR label) in the form of a hybrid that combines relevant information from the ESPR and the Energy label.
- Assess the type of information currently provided by the Energy label and determine what additional information, as per Regulation (EU) 2024/1781, could be relevant to consumers.
  A product covered by the Energy Label has as its primary focus the energy efficiency. Conversely, the ESPR label must address the overall environmental impacts of products through the product aspects and parameters listed in Article 5 of and Annex to the ESPR, respectively, thus also considering the environmental footprint and circularity features.
    - For circularity aspects/parameters, the suggested approach will be to integrate in the existing Energy label the classes of performance of at least the two most relevant circularity aspects/parameters. In the case of lack of available space on the label, these classes of performance should be prioritised and replace other non-energy parameters included, such as technical performance or noise, which should be moved to the supplementary information accessible through the QR code. All the other information that should have been included on the ESPR label but could not be due to lack of space or information

overload on the Energy label shall be integrated in the supplementary information accessible through the QR code.

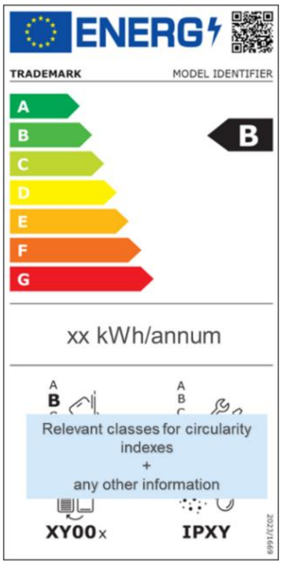
- For the environmental footprint, the EF score should be displayed. When the environmental impact due to energy consumption in the use phase is ≥ 50% of the overall environmental impact calculated through LCA, the energy efficiency could be used as a good proxy instead of the EF score.

7.4.2.2. Criteria mapping

There are two main potential options that can be considered due to the interaction between the Energy Label and the ESPR label:

— Option 1: The environmental impact due to energy consumption in the use phase is ≥ 50% of the overall environmental impact calculated through LCA. In this case, the energy efficiency could be used as a good proxy instead of the EF score to reflect the overall impact of the product. Relevant information about circularity aspects and classes developed shall be placed in the space of the label reserved for the indication of additional non-energy parameters (**Figure 15**).

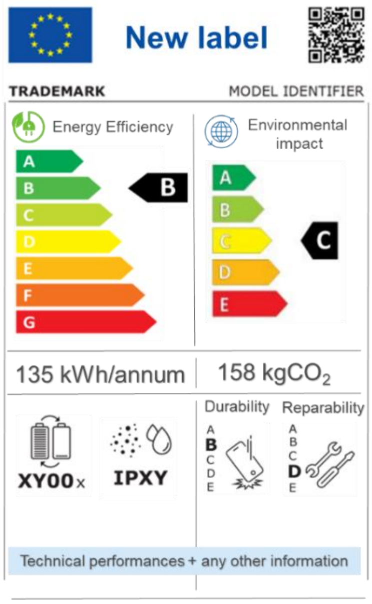
Figure 15. Energy Label including relevant information about circularity aspects



Source: adapted from https://energy-efficient-products.ec.europa.eu/product-list/smartphones-and-tablets_en

— Option 2: The environmental impact due to energy consumption in the use phase is < 50% of the overall environmental impact calculated through LCA. In this case, the energy efficiency could not be used as a good proxy instead of the EF score to reflect the overall impact of the product. Thus, the new label should display both the energy efficiency class and the EF score (**Figure 16**). This new format risks confusing the end-user due to the overload of information. To better evaluate the feasibility of Option 2, a stakeholder consultation is needed.

Figure 16. New label (ESPR label) including information from the Energy Label and the ESPR label



Source: own elaboration

7.4.2.3. Stakeholder consultation

Engagement with stakeholders, including manufacturers, consumer organisations, environmental groups and standard-setting bodies, is relevant to gather input on the practicality and utility of adding supplementary information to Energy Labels or to assess the feasibility of a new label on which information from both the Energy label and ESPR label are merged. Moreover, consumer research should be conducted to understand how the information included on the label might influence purchasing decisions and what format would be most comprehensible.

7.4.2.4. Development of supplementary information guidelines

Based on the assessment and stakeholders' feedback, guidelines should be developed for the inclusion of supplementary information on energy labels (in the case of Option 1) or to better navigate in a new label layout (in the case of Option 2). This should include clear definitions, measurement standards and display formats.

7.4.3. EU Ecolabel

The EU Ecolabel Regulation (Regulation (EC) No 66/2010) provides a framework for the setting of voluntary environmental criteria for selected product groups with the aim of reducing the negative life cycle environmental impacts associated with their production and consumption.

EU Ecolabel product groups relevant to the ESPR are the following:

— **Cleaning products**: dishwasher detergents, hand dishwashing detergent, hard surface cleaning products, industrial and institutional dishwasher detergents, industrial and institutional laundry detergents and laundry detergents.

— **Clothing and textile products**: footwear and textile products.

— **Covering products**: hard covering and wood-, cork- and bamboo-based floor coverings.

— **Do it yourself products**: paints, varnishes and related products.

— **Electronic equipment**: electronic devices such as televisions, computer monitors and signage displays.

— **Furniture and mattresses**.

— **Gardening**: growing media and soil improvers.

— **Lubricants**: any lubricant that falls under the sub-categories of Total Loss Lubricants (TLL), Partial Loss Lubricants (PLL) or Accidental Loss Lubricants (ALL).

— **Paper products**: graphic paper, printed paper, envelopes, paper carrier bags, wrapping paper, stationery products, tissues, toilet paper and napkins.

— **Personal and animal care products**: absorbent hygiene (includes products such as baby nappies, feminine sanitary pads, panty liners and tampons, nursing pads, absorbing sheets, disposable absorbent components in some reusable products and adult incontinence products), animal care products group (includes soaps, shampoos and washing agents for use on animals), cosmetic products group (covers rinse-off products such as soap, shampoo, conditioner, shaving cream and toothpaste, as well as leave-on products including creams, oils, hairstyling products, decorative cosmetics and deodorants/antiperspirants) and reusable menstrual cups made of silicone or other elastomers.

As reported on the Ecolabel facts and figures web site[10], since March 2024, there has been a steady upward trend in the issuance of licences and products, with most EU Ecolabel product categories experiencing growth. The current number of EU Ecolabel-awarded licences and products is at an all-time high. This rise indicates a sustained interest in eco-friendly products among businesses, consumers and retailers. Compared to the figures from March 2024, there has been a significant increase in:

— the total number of awarded products, which has grown by 3 219 products, representing a 3% increase; and

— the total number of awarded licences, which has increased by 240 licences, marking a 9% rise.

The results of the Flash Eurobarometer 535 survey[11] highlight consumer preferences for purchasing ecolabelled products. The most frequently bought EU Ecolabel goods and services include detergents (23%), paper (23%), absorbent hygiene products (22%) and cosmetics (21%). Consumers typically purchase these ecolabelled products in supermarkets (66%), organic shops (24%) or online (24%).

Box 3. Interaction between the ESPR label and the EU Ecolabel as per Regulation (EU) 2024/1781

Recital 48 *of* Regulation (EU) 2024/1781: *Consumers need to be protected from misleading information that could hamper their choices for more sustainable products. For that reason, it should be prohibited to place on the market or put into service products that bear or are accompanied by labels which are likely to mislead or confuse customers by mimicking the labels provided for in this Regulation, or that are accompanied by any other information which is likely to mislead or confuse customers with regard to the labels provided for in this Regulation. The EU Ecolabel and other nationally or regionally officially recognised EN ISO 14024 type I ecolabels are not to be considered misleading or confusing labels, provided*

[10] https://environment.ec.europa.eu/topics/circular-economy/eu-ecolabel/businesses/ecolabel-facts-and-figures_en

[11] https://europa.eu/eurobarometer/surveys/detail/3072

that the criteria developed under those labelling schemes are at least as strict as the ecodesign requirements.

As reported in Recital 48 of Regulation (EU) 2024/1781, the criteria developed under the EU Ecolabel should be at least as strict as the ecodesign requirements within the ESPR framework. This suggests that the standards for environmental performance set by the EU Ecolabel are as rigorous, if not more so, than those set by the ESPR framework.

- **EU Ecolabel**: The European Union Ecolabel is a voluntary label that indicates that a product or service has met high environmental standards throughout its life cycle, from production to disposal. The criteria to achieve this label are comprehensive and cover various aspects of environmental impact, such as energy efficiency, reduction of harmful substances, sustainability of resources, etc.
- **ESPR**: This is a framework for setting mandatory ecodesign requirements for all kind of products (e.g. energy-using, energy-related products and non-energy-related products) sold in the EU. The Regulation aims to improve the sustainability, circularity, energy efficiency and other environmental aspects of products by setting design requirements that manufacturers must meet before placing their products on the European market.

The statement reported in Recital 48 of Regulation (EU) 2024/1781 implies that the EU Ecolabel's criteria are designed to ensure that products not only meet but potentially exceed the mandatory requirements set by the ESPR framework.

It is worth noting that while the ESPR is mandatory for products that fall under its scope, the EU Ecolabel is a voluntary scheme that manufacturers can choose to apply for to demonstrate their commitment to environmental excellence.

The ESPR is focused on setting requirements for the product aspects (Article 5 of the ESPR) and parameters (Annex I to the ESPR). These requirements can include things like the following:

- **Performance requirements** (Article 6 of the ESPR): These can be minimum or maximum requirements in relation to a specific parameter or a combination thereof and non-quantitative requirements that aim to improve performance in relation to one or more of such product parameters.
- **Information requirements** (Article 7 of the ESPR): Information on the performance of the product in relation to one or more of the product parameters referred to in Annex I, including a reparability score, a durability score, a carbon footprint or an environmental footprint. When setting the information requirements, where appropriate in view of the specificity of the product group, classes of performance shall be established. Products must come with the ESPR label which shall clearly indicate information on some specific products aspects and when appropriate classes of circularity aspects/parameters.

The EU Ecolabel considers factors such as the following:

- Resource use and sustainability: The EU Ecolabel might require that a paper product is made from a certain percentage of recycled materials or sourced from sustainably managed forests.
- Reduction of hazardous substances: The Ecolabel imposes strict limits on the use of chemicals that are harmful to the environment or human health, which might not be covered by Ecodesign requirements.
- Durability and reparability: Products with the EU Ecolabel might be designed to last longer and be more easily repaired, reducing waste and the need for frequent replacement.

— Water usage: For products like washing machines and dishwashers (at the moment not covered by the EU Ecolabel), the EU Ecolabel criteria could set stringent standards for water efficiency that surpass the Ecodesign requirements.

7.4.4. Analytical framework to address the interaction between the EU Ecolabel and the ESPR label

The following is a methodological approach that ensures both complementarity and synergy in achieving environmental objectives addressing the interaction between the EU Ecolabel and the ESPR label.

The proposed approach foresees two scenarios:

Scenario 1 (revision of the EU Ecolabel criteria in parallel to or immediately after the entry into force of the ESPR requirements): Ideally, when ESPR criteria are established for a product group that are already covered by the EU Ecolabel, the criteria for the EU Ecolabel will be simultaneously reviewed and revised. This simultaneous revision process is designed to ensure both coherence and complementarity between the two labels. By aligning the criteria for the EU Ecolabel with the newly established ESPR requirements, the EU Ecolabel can maintain its role as a mark of environmental excellence setting criteria at least as strict as the ESPR requirements while ensuring that both systems work together effectively. This approach not only avoids potential conflicts or redundancies between the two sets of criteria but also enhances the overall environmental performance and market relevance of the labelled products. Through this harmonised process, both the ESPR label and the EU Ecolabel can better achieve their shared objectives of promoting sustainable product development and encouraging higher environmental standards across the market.

Moreover, this alignment ensures that the EU Ecolabel not only represents superior environmental performance but also simplifies the compliance process for manufacturers and businesses. They can use their EU Ecolabel certification as a form of proof that their products meet or exceed the mandatory ESPR requirements.

Ensuring methodological consistency is crucial when evaluating and comparing environmental standards and labels. In the theoretical scenario where the ESPR sets a carbon footprint benchmark at 1 kg CO_2eq and the EU Ecolabel establishes a stricter benchmark at 0.5 kg CO_2eq, it may initially appear that the EU Ecolabel is more stringent. However, if the accounting methods and the underlying data used to calculate these carbon footprints are not consistent, the numbers become incomparable. Different methodologies might employ varying assumptions, boundaries, data sources, or calculation techniques, leading to discrepancies in the results. As a result, the apparent strictness or leniency of a particular standard or label can be misleading. Without a unified approach to how the metrics are calculated, the intended stringency of these benchmarks loses its significance, as stakeholders cannot confidently assess whether one standard is indeed more rigorous than another. To address this issue, it is essential to harmonise the methodologies and data sources used across different standards and labels. This includes establishing uniform guidelines for data collection, setting consistent boundaries for assessments and adopting standardised calculation procedures. By doing so, the resulting measurements become truly comparable, allowing methodological consistency.

Scenario 2 (no revision of the EU Ecolabel criteria after the entry into force of the ESPR requirements): The development of ESPR criteria will proceed without any simultaneous updates to the EU Ecolabel criteria, nor will there be immediate revisions following the enforcement of ESPR requirements for a specific product group. If this is the case, the following three steps shall be used as a guide to assess the interaction between the EU Ecolabel and the ESPR label:

7.4.4.1. Identification of overlaps

Conduct a thorough analysis of both the EU Ecolabel criteria and the requirements established by the ESPR and the classes of performance defined for specific circularity parameters within a product group. The objective of this analysis is to identify areas where the two sets of criteria overlap. By doing so, commonalities and potential redundancies can be identified between the EU Ecolabel's voluntary criteria and the mandatory requirements set by the ESPR.

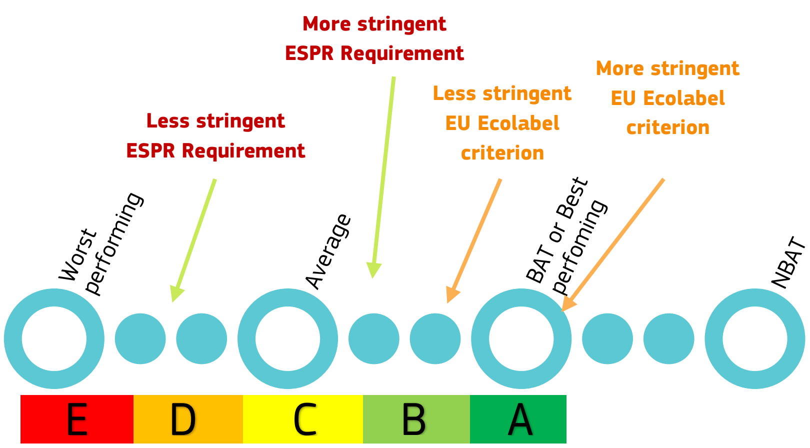
7.4.4.2. Benchmarking

Benchmarking between the ESPR label and the EU Ecolabel involves a systematic comparison to evaluate their requirements, criteria and outcomes. This process should help the alignment of the two labels. The ESPR's mandatory requirements should be used as a baseline for environmental performance. By implementing these mandatory requirements (mainly performance requirements), the ESPR aims to phase out or completely remove the lowest performing products from the market. Meanwhile, the EU Ecolabel's voluntary criteria shall exceed this baseline, setting stricter requirements, incorporating broader life cycle considerations and additional environmental performance aspects which are not covered by the product parameters in Annex I to the ESPR. This will secure the EU Ecolabel's position as a mark of environmental excellence.

7.4.4.3. Harmonisation of criteria

To ensure that the EU Ecolabel maintains its role as a mark of excellence, its criteria should be more stringent than the mandatory ESPR requirements. This is always possible when performance requirements are set for some of the product parameters. When there are product parameters for which the EU Ecolabel set criteria and for which the ESPR use these parameters as a reflection of a product aspect in defining classes of performance, the upper level of the classes shall be set considering the best performing products (more details in Section 5.2).

Figure 17. Graphical representation of the level of stringency of ESPR requirements and EU Ecolabel criteria, and interaction with the classes of performance



Source: own elaboration

7.4.5. Other labels

Textile labelling (Regulation (EU) 1007/2011)

It is imperative that all textile products are labelled or marked to indicate their fibre composition whenever the product is marketed within the European Union. These labels must be firmly attached to the product; for example, they may be sewn in.

This requirement concerns all products made up of at least 80% textile fibres, calculated by weight, such as:

- clothing;
- furniture coverings;
- mattress coverings;
- camping tents.

Textile labels are mandatory in the EU for textiles intended for sale to the end consumer. In the case of business-to-business sales, textile labels may be replaced or supplemented by accompanying commercial documents.

National authorities can check textile products for conformity with the information displayed on the label at any stage of the marketing chain, such as:

- when requesting customs clearance;
- at distributors' warehouses;
- at wholesale or retail outlets.

The textile label must:

- explain the composition of the fabric, written in decreasing percentage order;
- use clear and legible text, including uniform lettering (same font, size and style);
- contain a clear separation between the information on textile composition and other information, such as product care.

Figure 18. Example of textile labels

Source: https://www.istockphoto.com/es/vector/s%C3%ADmbolos-de-lavado-gm149401486-20728380; https://www.istockphoto.com/es/foto/etiqueta-blanca-en-la-ropa-que-indica-el-porcentaje-de-contenido-material-en-la-tela-gm1204507242-346615065.

If the textile products are sold in one or more EU countries, the text must be translated into all the official national languages where the textile products are made available to the consumer.

A textile product can be only described as "100%", "pure" or "all" if it is composed exclusively of one fibre type. It can be chosen whether to use those terms or to refer, for example, to a 100% cotton shirt simply as "cotton".

The types and names of textile fibres that can be used is limited to the list in Annex I to Regulation (EU) 1007/2011 on textile names and related labelling.

Durability index (French)[12]

The durability index represents an evolution of the reparability index, with the objective of incorporating measures of robustness and durability. Initially, the index was intended to cover smartphones, televisions and washing machines.

This new index, which will be applied to televisions and washing machines, will provide consumers with a comprehensive assessment of the durability of products, thanks to a rating from 1 to 10 accompanied by a colour code. The objective of this measure is to empower consumers by enabling them to make more informed decisions regarding the durability and reliability of the products under consideration.

Figure 19. French durability index label

Source: https://getenviropass.com/durability-index/

A Council of State decree specifies the details of the index. Three decrees define the display methods and calculation parameters for each product category.

The reparability index was developed to provide consumers with a quantifiable metric that quantifies the ease with which a product can be repaired in the event of a malfunction. The index is a tool designed to promote the repair of appliances over their replacement. It is important to note that reparability is distinct from durability, which is defined as reliability + reparability. This distinction is a crucial concept to understand.

It is imperative to acknowledge that consumers prioritise reliability in goods. While an item may possess the capacity for repairability, if it exhibits frequent malfunctions consumers will inevitably seek alternative solutions and discontinue its utilisation.

[12] https://www.ecologie.gouv.fr/politiques-publiques/indice-durabilite

The index therefore extends the indicators of the reparability index by including robustness in the assessment. The aim is not only to check how easy it is to repair, but also the longevity and resistance of the goods to everyday wear and tear. This approach facilitates a more comprehensive and nuanced evaluation of the durability of the products under consideration.

The calculation of the durability index for each product group is based on two families of criteria:

— One relates to the **reparability**, taking into account the accessibility of technical documentation, ease of dismantling, and the availability and price of spare parts:
  - **Documentation**: A score determined by the manufacturer's commitment to make technical documents available free of charge, in x number of years, to repairers and consumers.
  - **Disassembly, tools, and fasteners**: A score determined by how easy it is to disassemble the product, the type of tools needed, and the characteristics of the fasteners.
  - **Availability of spare parts**: A score determined by the length of time the manufacturer commits to makes spare parts available for the product and the time it takes to deliver them.
  - **Price of spare parts**: A score determined by the ratio of the sale price of spare parts to the price of the product.

— The other relates to **reliability**, which takes into account resistance to stress and wear, ease of maintenance and servicing, and the existence of a commercial guarantee and a quality process:
  - **Resistance to stress and/or wear:** Depending on the type of equipment, this criterion may refer to one or more durability tests (wear tests) carried out on the item or its main components. It may also refer to sub-criteria relating to resistance to external stresses (corrosion).
  - **Maintenance and upkeep:** It is commonly said that 50% of breakdowns can be avoided by observing the conditions of use and maintenance of the articles.
    - Maintenance: This criterion is used to check the conditions under which the equipment and/or its major subassemblies can be maintained in a nominal functional state, including software functions.
    - Upkeep: This criterion corresponds to the ability of the equipment or the main components of the equipment to be maintained in a functional state that complies with its intended use and the vendor's description. Depending on the category of equipment, this includes the ease of access to information on maintenance procedures, the quality and level of detail of the information on maintenance procedures, and the ease with which maintenance procedures can be carried out.
  - **Durability guarantee and quality approach:** This third criterion focuses on the warranty conditions offered by the manufacturer and its quality approach.
    - Duration of commercial durability guarantee: This sub-criterion involves noting the period of the commercial guarantee of durability (not to be confused with the Legal Conformity Guarantee) that the producer or other marketer agrees to grant to the end user. Additional conditions for awarding points under this sub-criterion may be defined for each category of equipment.
    - Implementation of a continuous improvement process: Based on a tangible documentation system, the producer must demonstrate its ability to set up a continuous improvement system. As part of this process, manufacturers are also being asked to monitor breakdown rates.

- **Material or functional improvements:** These indicators are linked to equipment improvements, but only concern certain categories of item. These improvements will be assessed from two angles, hardware improvements and/or software improvements.
  - Software improvement: This involves assessing the manufacturer's ability to provide software enhancements that improve the functions or performance of the equipment.
  - Material improvement: In this subsection, the manufacturer assesses its ability to provide improvements of a material nature in order to increase the capabilities and performance of the equipment, an existing function or to develop another function. If necessary, the hardware improvement also includes one or more software improvements specific to its integration.

The durability index is calculated from these two scores, and is expressed as an overall score, from 0 to 10. The details of the rating are presented in the table found via the following link: https://www.ecologie.gouv.fr/politiques-publiques/indice-durabilite.

Box 4. More information about the French durability index *(https://www.ecologie.gouv.fr/)*

Who checks the calculation of the reliability score?

The responsibility for calculation lies with the builders themselves, in accordance with the guidelines laid down by the competent authorities. In terms of allocation, there is no difference for the time being, since the index will be self-monitored. It is the manufacturer itself that calculates and communicates its score to distributors or customers. The DGCCRF (Direction Générale de la Concurrence, de la Consommation et de la Répression des Fraudes – Directorate-General for Competition, Consumer Affairs and Fraud Control) may be called in or may carry out random checks on the calculations.

However, to ensure accuracy and transparency, it is desirable that verification be carried out by independent, accredited and trained third-party organisations or government agencies. An audit would ensure that manufacturers follow the guidelines accurately and honestly, reducing the risk of inflated or manipulated scores.

Verification could also include random testing of goods by third-party organisations to validate manufacturers' claims about reliability and reparability.

What are the penalties associated with the durability index?

At this stage, there is no visibility in the event of a breach of the French government index. However, there is a good chance that the environmental display sanctions will be transposed to the index. At present, any failure to comply with the index is punishable by an administrative fine of up to € 3 000 for a natural person and € 15 000 for a legal entity (see Article 3 of the Climate and Resilience Act of August 2021).

These penalties are minimal compared to the competitive advantage that can be gained by displaying an index that is inflated in relation to reality.

Which products will be covered by the durability index?

Here is the list of items for which the durability index is mandatory:

- televisions;
- washing machines.

The index is being applied to a small range of electrical and technological products for the time being, but the list of items covered should match the list of items covered by the reparability index.

Where can I find the grids used to calculate the durability index?

The calculation grids are accessible on the website: https://www.ecologie.gouv.fr/politiques-publiques/indice-durabilite.

7.4.6. Digital Product Passport (DPP) and interaction with the ESPR label

The Digital Product Passport (DPP) is a digital document introduced by the ESPR for products placed on the market or put into service within the EU covered by delegated acts setting ecodesign requirements. It must be accurate, complete and up-to-date, containing data as specified by the delegated acts, which detail what information the DPP should include, the data carriers to be used, their layout and positioning, and the level of detail (model, batch, or item level) required.

Key points reported in Articles 9, 10, 11, 12, 13, 14 and 15 of the ESPR regarding the DPP include the following:

- The DPP must be linked to a unique product identifier via a data carrier, such as a QR code or RFID tag, which should be physically present on the product, its packaging or accompanying documentation. The data carrier standards will align with Annex III or equivalent standards.
- The DPP is based on open standards for interoperability and should be machine-readable, structured, searchable and transferable. It should not include personal data without explicit customer consent.
- The DPP should be accessible to various stakeholders, including customers, manufacturers and authorities, according to their access rights. It must be stored securely by the creator or service providers and remain available for the product's expected lifetime or as specified.
- Unique identifiers for operators and facilities must comply with specified standards and be globally unique and verifiable. The Commission may establish additional rules for the management of these identifiers and data carriers.
- A digital registry will be established by July 2026 to securely store unique identifiers and other relevant data for market surveillance and customs controls. The economic operators are responsible for uploading the data to this registry.
- The Commission will create a web portal to allow stakeholders to search for and compare DPP data, ensuring access is consistent with specified rights.
- The registry will be interconnected with the EU Customs Single Window Certificates Exchange System to enable automated information exchange with national customs systems.

The DPP serves as a crucial tool for enhancing product traceability, ensuring compliance with EU regulations, and supporting sustainability and circular economy objectives.

The DPP and the ESPR label are both initiatives aimed at promoting sustainability and informing consumers about the environmental impact of products. The DPP serves as a repository of detailed product information, while the ESPR label provides a standardised way to communicate key environmental and sustainability metrics to consumers. Here is how they might interact:

- **Integration of information**: The DPP can be designed to store in-depth data about a product's environmental footprint, circularity aspects/parameters, technical performance and other non-circularity aspects. The ESPR label, on the other hand, would display a curated selection of this information as primary data, like environmental footprint classes or circularity performance classes, in a simplified and easily understandable format for consumers.
- **Data carriers**: The ESPR label must, where appropriate, include data carriers such as QR codes, which when scanned, redirect the consumer to the DPP. This connection allows consumers to access secondary, more detailed information if they wish to dive deeper into a product's sustainability attributes.

— **Information hierarchy**: The ESPR label is structured to prioritise information based on its relevance to the consumer's decision-making process. Primary information visible on the label would include the environmental footprint score (e.g. PEF score), classes of performance for circularity aspects/parameters or energy efficiency, and possibly the most relevant technical performance. In contrast, the DPP would house all detailed and secondary information, ensuring that consumers who want more comprehensive data can access it without making the label too complex.

— **Content curation**: The ESPR label's content would be carefully selected to avoid overwhelming the consumer with too much information, focusing on what matters most for the specific product group. The DPP, being a digital medium, does not have the same space constraints and can therefore include extensive data across various environmental and technical aspects.

— **Consumer guidance and transparency**: The ESPR label, through its tiered structure of information, guides consumers towards making more sustainable choices by highlighting the most important sustainability features. The DPP complements this by providing a full transparency tool that holds all the detailed information for those interested in a product's complete life cycle impact.

— **Regulatory compliance and traceability**: The ESPR label will likely be part of a regulatory framework mandating certain sustainability criteria for products on the EU market. The DPP, as a source of detailed product information, helps manufacturers demonstrate compliance with these regulations and allows for easier traceability throughout the supply chain.

In summary, the Digital Product Passport and the ESPR label work in tandem to enhance product sustainability and inform consumer choice. The ESPR label acts as the consumer-facing interface that distils complex environmental data into actionable insights, while the DPP serves as a comprehensive back-end database that stakeholders can use to manage and share detailed product information.

8. Information potentially included on the ESPR label

8.1. Context

The ESPR lays down a framework for both performance and information requirements that products must meet according to their delegated acts. Firstly, as reported in **Article 6**, products need to adhere to performance requirements that encompass a range of product aspects. These requirements are derived from the parameters detailed in Annex I to the ESPR and can include setting minimum or maximum levels for specific parameters, or they can be non-quantitative, aiming at enhancing the product's performance.

Notably, performance requirements must not impose restrictions, primarily for chemical safety reasons, on the presence of substances in products. However, they should aim to reduce significant health risks or environmental hazards where relevant. The process for establishing these performance requirements is methodically laid out in Annex II to the ESPR.

Moving on to information requirements, as reported in **Article 7**, products must comply with these as per the delegated acts. The information provided must, at a minimum, relate to the DPP and substances of concern. It should also include details on product performance parameters such as reparability and durability scores, and carbon or environmental footprints. Information should be comprehensive, guiding customers and other stakeholders on installation, maintenance, repair, and end-of-life handling to ensure environmental impact minimisation and product longevity. Furthermore, details necessary for treatment facilities for end-of-life processes must be provided, along with other relevant information that aids sustainable choices and proper handling.

The information should be clear, easily understandable, and tailored to the characteristics of the product groups and the information's intended recipients. Delegated acts may set information requirements for a product parameter regardless of whether a performance requirement is set for that parameter. In specific cases, the Commission may determine classes of performance for products, which could be based on individual parameters or aggregated scores. These classes should reflect substantial improvements in performance, with the lowest class aligning with the minimum performance standards at the time of implementation.

Information on substances of concern must be detailed and traceable throughout the product life cycle. The information should include the name or number of the substances, their location within the product, their concentration, and safe usage instructions. Additional information on disassembly and recycling should also be provided. The Commission has discretion to set thresholds for when these requirements apply and may establish deadlines, provide exemptions, or ensure consistency with existing Union law to minimise administrative burdens.

Information requirements dictate how the information is to be made available, whether on the product itself, its packaging, a label, accompanying user manual or online platforms. For tracking substances of concern, this information can be provided directly on the product or through a data carrier attached to it. Lastly, all supplied information must be in a language easily understood by customers in the Member State where the product is marketed or used.

8.2. Information included on ESPR labels

The ESPR label will be designed to provide consumers with information about the environmental performance and sustainability aspects of products. Based on the ESPR text and the general principles of environmental product labelling, the following information could potentially be included on the ESPR label:

- Environmental impact such as environmental footprint and/or carbon footprint and/or material footprint (Classes and/or scores).
- Classes of performance or general information for circularity parameters/aspects.
- Technical performance.
- Other information on relevant non circularity aspects:
  - presence of substances of concern;
  - energy use and energy efficiency.
- Data carriers.

Creating an effective ESPR label requires a delicate balance between providing essential information and maintaining simplicity to avoid overwhelming consumers. The process starts with understanding what environmental issues matter most to the target audience. This understanding then guides the selection of pertinent information for each product category, ensuring that the ESPR label reflects the environmental impacts of the product. Article 1 of the ESPR says "*This Regulation establishes a framework for setting ecodesign requirements that products have to comply with to be placed on the mark or put into service,* ***with the aim to improve the environmental sustainability of products in order to make sustainable products the norm and reduce their overall carbon and environmental footprint over their lifecycle****, and to ensure their free movement within the internal market*". It is clear that to support the overall aim of the ESPR the main information to provide on the ESPR label is the overall environmental footprint of products over their life cycle.

The design of the label is crucial; it must be clear, easily understood and facilitate comparison between products. The content of the ESPR label should be thoughtfully curated to serve the end consumer's need for clarity and guidance in selecting sustainable products. The following distinction is made between two types of information, primary and secondary.

- Primary information, which is directly visible on the label, is meticulously chosen to simplify the consumer's decision-making process. It distils complex environmental data, circularity aspects and technical parameters into easily digestible highlights that indicate the sustainability of the product. Examples of the information that could be visible on a label are: classes of performances based on the PEF score, classes of performance of energy efficiency (if relevant) and of the most important circularity index or circularity score and in very necessary cases the most relevant technical parameter based on the main functionality of the product. Data carriers (e.g. QR codes) are included in the visible primary information because they make secondary information accessible.
- Secondary information, despite its relevance, is not displayed on the label, to prevent information overload. This category includes detailed parameters such as relevant non-circularity aspects, relevant circularity aspects not included as primary information, additional technical performance parameters besides the one included in the primary information, and other related data that support the primary information. It is available for those interested in a deeper understanding of the product's attributes but is kept separate to maintain the label's simplicity and effectiveness. Additionally, for labels that include aggregated indices like the PEF (Product Environmental Footprint) score and/or aggregated circularity indexes, relevant disaggregated information on single indicators are also part of the secondary layer of information.

This tiered approach ensures that the ESPR label remains a tool for easy comparison while still providing access to comprehensive data for consumers who wish to explore further.

The following list contains various pre-identified pieces of information that could potentially be included on the ESPR label; however, the specific information relevant to each product group or category must be selected. It is crucial to assess the pertinence of this information thoroughly. The ESPR label content should be meticulously tailored to avoid overwhelming consumers with excessive details, which may lead to confusion. The evaluation should concentrate on the significance of the information for the ESPR label, with a focus on what consumers prioritise and need to know to facilitate informed decision-making.

Environmental impact (classes and/or scores)

As an example for environmental impact, a proxy is the Product Environmental Footprint score (PEF score), which is a quantifiable score that reflects the overall environmental impact of the product based on a life cycle assessment, including 16 impact categories and for which classes of performance are available.

Including the classes of performance for the PEF score on the ESPR label would help consumers quickly and easily compare products based on their environmental performance, encouraging more sustainable purchasing decisions. For the score to be effective, it must be communicated to consumers in a clear and meaningful way.

Other examples of environmental impact proxies that can replace the PEF score are the carbon footprint and the material footprint, which should only be considered if the PEF score cannot be used for convincing reasons.

Relying solely on a single score to evaluate a product's environmental performance can present some limitations. A single score, such as the PEF score, tends to aggregate multiple environmental impacts into one numerical value, which can oversimplify complex environmental issues. This approach may obscure important details about specific areas where a product may excel or need improvement, leading to a lack of transparency and potentially misleading conclusions about its overall environmental impact. For instance, a product might achieve a relatively low single score due to excellent performance in one impact category, such as carbon emissions, while performing poorly in another, like water usage impact. By compressing all these aspects into one score, stakeholders may not gain a clear understanding of the nuanced environmental profile of the product. This could result in overlooking critical environmental challenges or opportunities for improvement specific to different impact areas. To address these limitations, information on specific environmental issues based on the 16 Environmental Footprint (EF) impact categories should be included in the DPP. The EF methods provide a comprehensive framework for assessing multiple environmental impact categories, such as climate change, resource depletion, water use, etc. By incorporating detailed information from these assessments in the DPP, stakeholders can gain a more holistic view of a product's environmental performance. Integrating specific environmental data allows for a more granular analysis, highlighting particular strengths and weaknesses across different impact categories. This approach enables consumers to make more informed choices by considering how products perform in various areas of environmental significance. Ultimately, combining a single score with detailed environmental information from EF methods provides a more balanced and informative assessment.

More details about classes of performance for the PEF score can be found in Chapter 4 of this report.

Classes of performance or general information for circularity indicators

The categorisation of products into different classes of performance (e.g. durability, repairability) allows an easy comparison between products within the same category.

By including classes of performance for circularity indicators on the ESPR label, consumers would be empowered to make choices that support a more circular economy, where products are designed to generate minimal waste and to be kept in use for as long as possible. This would not only reduce environmental impacts but also potentially lead to economic benefits such as cost savings and innovation in product design and business models.

More details about classes of performance for circularity aspects/parameters can be found in Chapter 5 of this report.

Technical performance

Technical performance on an ESPR label refers to the specifications and capabilities of a product related to its function, efficiency and overall performance. Providing this information helps consumers compare products and make choices that align with their needs and values regarding technical performance. An example is a specific metric that indicates how well the product performs its intended function, which can vary widely depending on the type of product. For a vacuum cleaner, a label could include suction power in watts or airwatts as a measure of cleaning effectiveness; for laptops, it could be the processing power; for refrigerators, the cooling efficiency.

By providing detailed technical performance information on ESPR labels, consumers can assess products not only based on their environmental attributes but also on how well they will meet their performance needs. This approach ensures that sustainability does not come at the expense of functionality and that consumers can make well-rounded decisions that consider both aspects.

More details about technical performance can be found in Chapter 6 of this report.

Information on other relevant non-circularity aspects

Information on relevant non-circularity aspects refers to information related to energy use and presence of substances of concern during the life cycle of a product.

More specifically, energy use and presence of substances of concern on an ESPR label would refer to the quantification and communication of the energy consumed during the production, use and end-of-life stages or in some specific stages depending on the type of product group and the presence of substances and, in particular, substances of concern. The following specific aspects can be included under energy use and presence of substances of concern, along with examples:

— **Energy use and energy efficiency:**
  - Production energy: The amount of energy used in the manufacturing of the product.
  - Operational energy: The energy required for the product's operation during its lifetime.
  - Example: For a washing machine, the label could display the kWh consumption per wash cycle and the estimated annual energy consumption based on standard usage patterns.

— **Presence of substances of concern (that hinder circularity):**
  - Substances of concern and other substances: Details on the tracking of substances of concern in the production process and embedded in the product along its life cycle, and the measures taken as performance requirements on substances for reasons other than safety.

- Alternative substances: Information about the substitution with more sustainable and safer alternatives for certain substances, when possible.

Data carriers

Data carriers include QR codes, barcodes or other digital means to allow consumers to access additional information online, such as the Digital Product Passport which may contain detailed sustainability data and the product's environmental footprint.

Data carriers on an ESPR label refer to embedded digital tools that enable access to additional information about a product beyond what is physically printed on the label. These tools can store and provide data when scanned or accessed via a digital device such as a smartphone or computer. They are instrumental in supplying consumers with in-depth, dynamic and updatable information about the product's environmental attributes, manufacturing processes, material sourcing and other sustainability aspects. Some example of data carriers are as follows:

- Quick Response (QR) codes: A QR code can be printed on the product label which, when scanned with a smartphone camera, directs the consumer to a webpage with detailed product information.
- Radio-Frequency Identification (RFID) tags: RFID tags can be embedded in the product or label to store data that can be read by an RFID reader, providing instant access to detailed product information.
- Near Field Communication (NFC) chips: NFC chips allow for touchless data transfer when a compatible device is placed near the chip. They can be embedded into product labels or packaging.
- Barcodes: Traditional barcodes can be enhanced to include additional product information accessible via barcode scanning apps. A barcode on the packaging of electronic goods could link to a database with information about the device's energy efficiency, proper usage, and e-waste recycling options.
- Serialised URLs: Unique serialised URLs printed on the label can direct consumers to a specific webpage for that individual product, allowing for traceability and personalised information.

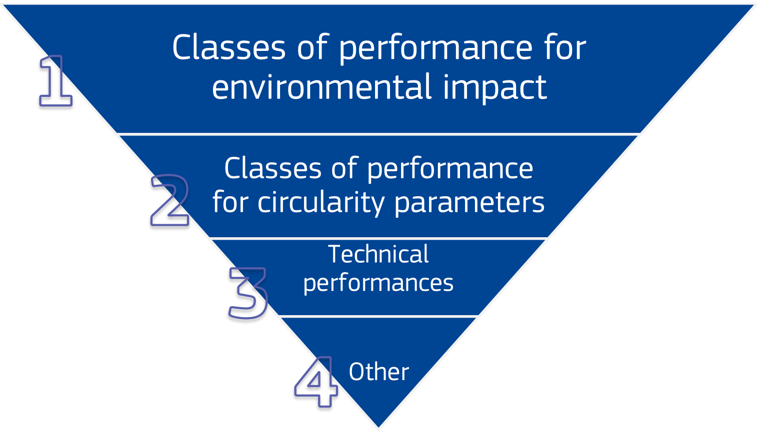
By incorporating data carriers on ESPR labels, manufacturers can provide a wealth of up-to-date information without cluttering the physical label. Consumers benefit from easy access to extensive product details that can inform their purchasing decisions and facilitate more sustainable product use and disposal.

Last but not least, as explained in the chapters above, when developing ESPR labels for product groups eligible for the EU Ecolabel or other nationally or regionally officially recognised EN ISO 14024 type I ecolabels, the possibility of coexistence of such labels on the products should be considered.

8.2.1. Prioritisation of information on the ESPR label

In structuring the content for the ESPR label, prioritisation of information is key to ensure that consumers can quickly identify the most sustainable products. At the highest level of importance, classes of performance for environmental impact take precedence. These provide a clear and immediate understanding of the product's environmental footprint, which is line with the aim of the ESPR (reduce the overall environmental footprint). Following this, classes of performance for circularity indicators/indexes are given priority. These indicators/indexes offer insight into the product's life cycle, durability, reuse, recycling potential, etc., which are critical factors in the move towards a more circular economy. If space permits on the label and if deemed relevant to the consumer, technical performance parameters are included next. These can provide information on functional attributes that might influence the sustainability of the product over its lifetime. Lastly, any other information that has been overlooked is considered for inclusion, but only if there is still space available on the label. This hierarchical approach (**Figure 20**) ensures that the most crucial information for making an environmentally responsible choice is front and centre, while additional, detailed data is accessible without cluttering the label or overwhelming the consumer.

Figure 20. Prioritisation of information visible on the ESPR label



Source: own elaboration

8.2.2. Potential structure of the ESPR label

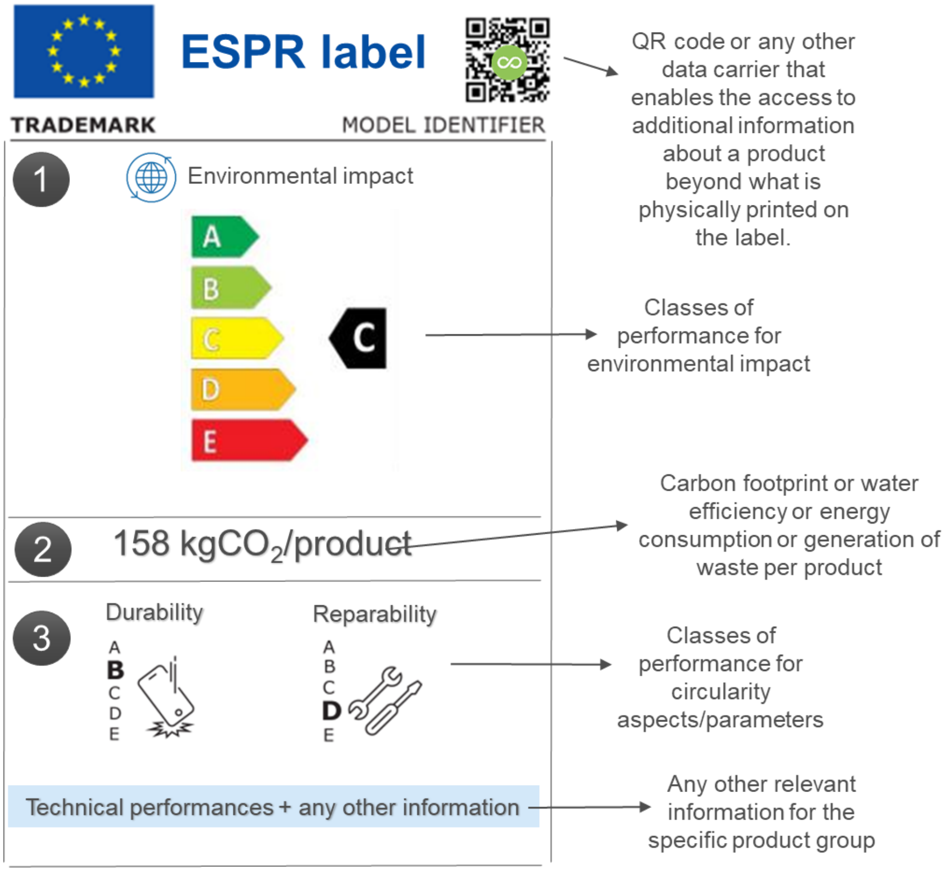
In **Figure 21** the potential structure of the ESPR label is reported with the information included. It has three main distinguishable sections:

— Section 1 is reserved for the classes of performance for the environmental impact. The default proxy for the environmental impact is the environmental footprint (EF). In the event that the carbon footprint or the material footprint is considered a better proxy for a specific product group, one of the two can be used instead of the EF. This choice should be clearly justified. The preferred option is the EF due to the well-established PEF method which allows the calculation of a score and the building of classes of performance.

— Section 2 is reserved for any other information which has a direct connection with the environmental impact such as carbon footprint (throughout the product's lifetime), water consumption (per annum), energy consumption (per annum) and generation of waste (throughout its lifetime). One of these four product parameters should be chosen depending on their relevance for the specific product group.

— Section 3 is reserved for classes of performance for circularity aspects/parameters and energy efficiency, and any other relevant information for the specific product group (e.g. technical performance).

Figure 21. Potential ESPR label content and characteristics



Source: own elaboration

Colour codes, icons and any other graphical aspects displayed in **Figure 21** serve solely to better visualise the information included on the label. Colour codes, icons and any other graphical aspects will be developed in specific studies.

9. Conclusion

The European Commission's Regulation on the Ecodesign for Sustainable Products (ESPR), which came into force on 18 July 2024, marks a significant milestone in the EU's commitment to environmental sustainability. By broadening the scope of the existing Ecodesign Directive to encompass almost all products on the market, the ESPR aims to systematically reduce the carbon and environmental footprints of products throughout their life cycles. A critical component of this framework is the establishment of a robust methodology for defining performance classes and creating an informative label, aimed at guiding consumers towards sustainable choices.

The methods proposed in this report focus on creating classes of performance for both environmental impact and circularity aspects. The report outlines a systematic method for evaluating the circularity aspects and parameters. This involves identifying and prioritising aspects and parameters that are appropriate for classes of performance. The importance of promoting a circular economy is underscored by developing classes of performance specifically for circularity aspects. This initiative is intended to incentivise manufacturers to innovate towards more circular product designs and processes. Moreover, the report refines the method for developing classes of environmental performance classes. This ensures that products are categorised based on substantial improvements in environmental sustainability, providing a clear signal to consumers about the relative environmental impacts of different products.

A significant aspect of the ESPR is its relationship with existing labelling systems, such as the Energy Label and the EU Ecolabel. The report undertakes a critical examination of this interaction to ensure that the new ESPR label complements and expands these established labels. This approach is intended to prevent consumer confusion and to enhance the clarity and utility of product information. For energy-related products for which a new label will be deemed necessary, the ESPR label provides additional information on product parameters that are not covered by the Energy Label. Conversely, when relevant and feasible, information concerning circularity parameters may be incorporated within the Energy label. In most cases, the criteria set by the EU Ecolabel will be aligned with those of the ESPR label, ensuring consistency and maintaining the high standards of sustainability required by both labels.

The report also explores the integration of the ESPR label with the Digital Product Passport. The DPP could be accessible by scanning a data carrier (e.g. a QR code) placed on the ESPR label. This digital tool provides an extensive overview of the product's sustainability information and any other relevant information, facilitating informed decision-making by consumers.

The development of a method for defining classes of performance and labels under the ESPR represents a critical step towards achieving the EU's sustainability goals. By focusing on circularity and environmental performance, the ESPR framework not only incentivises the production of environmentally friendly products but also empowers consumers to make sustainable choices.

The interaction with existing labels and the integration with the DPP further enhance the transparency and utility of product information. As the ESPR framework is implemented, it is expected that these measures will significantly contribute to the reduction of the environmental footprint of products, promoting a sustainable and circular economy within the European Union.

In conclusion, the development of flexible and adaptable methods for classes of performance, along with strategic labelling, positions the ESPR as a cornerstone of the EU's environmental policy. This report highlights the importance of these methods in driving systemic change towards sustainability and the crucial role of informed consumer choices in this transition.

References

Ahmed S, Dhooria A. 2020. Pitfalls in Statistical Analysis – A Reviewers' Perspective. *Indian Journal of Rheumatology* **15**(1): 39. doi: 10.4103/injr.injr_32_20

André H. 2024. "If less is more, how you keeping score?" Outlines of a life cycle assessment method to assess sufficiency. *Front Sustain* **5**: 1342223. doi: 10.3389/frsus.2024.1342223

Andrea Blengini G, Shields DJ. 2010. Green labels and sustainability reporting: Overview of the building products supply chain in Italy. *Management of Environmental Quality: An International Journal* **21**(4): 477–493. doi: 10.1108/14777831011049115

Baxter J. 2019. Systematic environmental assessment of end-of-life pathways for domestic refrigerators. *Journal of Cleaner Production* **208**: 612–620. doi: 10.1016/j.jclepro.2018.10.173

Calzolari T, Genovese A, Brint A. 2022. Circular Economy indicators for supply chains: A systematic literature review. *Environmental and Sustainability Indicators* **13**: 100160. doi: 10.1016/j.indic.2021.100160

Cooper T, Furmston K, Cutts A, Kaner J. 2021. *Furniture Lifetimes in a Circular Economy: A State of the Art Review Cooper*.

Cordella M, Alfieri F, Clemm C, Berwald A. 2021. Durability of smartphones: A technical analysis of reliability and repairability aspects. *Journal of Cleaner Production* **286**: 125388. doi: 10.1016/j.jclepro.2020.125388

De Oliveira CT, Dantas TET, Soares SR. 2021. Nano and micro level circular economy indicators: Assisting decision-makers in circularity assessments. *Sustainable Production and Consumption* **26**: 455–468. doi: 10.1016/j.spc.2020.11.024

Desjardin M. 2024. How long should your TV last? Reviewed. Available at https://reviewed.usatoday.com/televisions/features/how-long-should-a-tv-last. Accessed 2024 Sep 9.

Eric. 2023. Unraveling the Lifespan: How Long Do HVAC Systems Last? Mode Comfort & Air Quality. Available at https://modecomfort.com/2023/11/26/how-long-do-hvac-systems-last/. Accessed 2024 Sep 9.

François-Lecompte A, Bertrandias L, Bernard Y. 2017. The Environmental Labelling rollout of consumer goods by public authorities: Analysis of and lessons learned from the French case. *Journal of Cleaner Production* **161**: 688–697. doi: 10.1016/j.jclepro.2017.05.179

Gonçalves A, Silva C. 2021. Looking for Sustainability Scoring in Apparel: A Review on Environmental Footprint, Social Impacts and Transparency. *Energies* **14**(11): 3032. doi: 10.3390/en14113032

Guenther M, Saunders CM, Tait PR. 2012. Carbon labeling and consumer attitudes. *Carbon Management* **3**(5): 445–455. doi: 10.4155/cmt.12.50

JRC, Tecchio P, Ardente F, Niestrath P, Stamminger R, Mathieux F. 2017. *Study for the Development of an Endurance Testing Method for Washing Machines: Feasibility Study for Potentially Standardised Methods*. LU: Publications Office of the European Union. Available at https://data.europa.eu/doi/10.2760/927402. Accessed 2024 Sep 9.

Perez Camacho, M.N., Cappucci, G.M., Faraca, G., Bracalente, G., Bennett, M.J. et al., Method for the identification and tracking of substances of concern in products and for the preparation of restriction measures on the use of substances in products, Publications Office of the European Union, Luxembourg, 2025, https://data.europa.eu/doi/10.2760/9706783, JRC143683

Korteling JohanE (Hans), Paradies GL, Sassen-van Meer JP. 2023. Cognitive bias and how to improve sustainable decision making. *Front Psychol* **14**: 1129835. doi: 10.3389/fpsyg.2023.1129835

Kumari R, Verma R, Debata BR, Ting H. 2022. A systematic literature review on the enablers of green marketing adoption: Consumer perspective. *Journal of Cleaner Production* **366**: 132852. doi: 10.1016/j.jclepro.2022.132852

Rodriguez-Manotas, J., Gonzalez Torres, M., Magrini, C., Senatore, V., Lodato, C. et al., Method for the assessment of circularity aspects and integration in or relation with the Methodology for the Ecodesign of Energy-related Products (MEErP), Publications Office of the European Union, Luxembourg, 2025, https://data.europa.eu/doi/10.2760/4572606, JRC143212.

Saidani M, Yannou B, Leroy Y, Cluzel F. 2017. How to Assess Product Performance in the Circular Economy? Proposed Requirements for the Design of a Circularity Measurement Framework. *Recycling* **2**(1): 6. Multidisciplinary Digital Publishing Institute. doi: 10.3390/recycling2010006

Sala, S., Cerutti, A. and Pant, R., Development of a weighting approach for the Environmental Footprint, EUR 28562 EN, Publications Office of the European Union, Luxembourg, 2017, ISBN 978-92-79-68041-0 (print),978-92-79-68042-7 (pdf), doi:10.2760/945290 (online),10.2760/446145 (print), JRC106545.

Singh M, Trivedi J, Maan P, Goyal J. 2020. Smartphone Battery State-of-Charge (SoC) Estimation and battery lifetime prediction: State-of-art review. 2020 10th International Conference on Cloud Computing, Data Science & Engineering (Confluence): 94–101. doi: 10.1109/Confluence47617.2020.9057951

Stamminger R, Bues A, Alfieri F, Cordella M. 2020. Durability of washing machines under real life conditions: Definition and application of a testing procedure. *Journal of Cleaner Production* **261**: 121222. doi: 10.1016/j.jclepro.2020.121222

Van Vugt M, Griskevicius V, Schultz PW. 2014. Naturally Green: Harnessing Stone Age Psychological Biases to Foster Environmental Behavior. *Social Issues Policy Review* **8**(1): 1–32. doi: 10.1111/sipr.12000

Woidasky J, Cetinkaya E. 2021. Use pattern relevance for laptop repair and product lifetime. *Journal of Cleaner Production* **288**: 125425. doi: 10.1016/j.jclepro.2020.125425

List of abbreviations and definitions

Abbreviations	Definitions
AA	Administrative Arrangement
BAT	Best Available Technology
BC	Base case
BNAT	Best Not Yet Available Technology
CA	Circularity aspect
CF	Carbon Footprint
DA	Delegated Act
EC	European Commission
EF	Environmental Footprint
EL	Energy Label
EoL	End of Life
ErP	Energy-related product
ESPR	Ecodesign for Sustainable Product Regulation
EPI	Environmental Product Information
EU	European Union
GEL	Generalised Environmental Labelling
ICs	Impact Categories
ISO	International Organization for Standardization
KPI	Key Performance Information
LCA	Life Cycle Assessment
LCT	Life Cycle Thinking

Abbreviations	Definitions
MEErP	Methodology for Ecodesign of Energy-related Products (methodology for Directive 2009/125/EC)
OSA	Open Strategic Autonomy
OS-BP	Overall Score - Best Product
OS-WP	Overall Score - Worst Product
PEF	Product Environmental Footprint
PI	Potential for improvement
TP	Technical performance

List of boxes

Box 1. Minimum performance requirements (Article 7, ESPR) 45

Box 2. Interaction between the ESPR label and the Energy Label as per Regulation (EU) 2024/1781 74

Box 3. Interaction between the ESPR label and the EU Ecolabel as per Regulation (EU) 2024/1781 77

List of figures

Figure 1. Overall content of the report: “Methods for the definition of classes of performance and labels” 28

Figure 2. General workflow of Part 1 (classes of performances) with the expected outputs and results. 28

Figure 3. General workflow of Part 2 (labels) with the expected outputs and results. 29

Figure 4. Structure of the Methodology for the Ecodesign of Energy-related Products (MEErP). 31

Figure 5. Interaction between the MEErP and the methods presented in this report adapted from COWI and VHK, 2011 (2024). 32

Figure 6. Four-step method for the selection of the most relevant product parameters/aspects to be considered in the classes of performance. 33

Figure 7. Environmental impact indicators in the EF method. 45

Figure 8. PEF classes of performance. 47

Figure 9. Types of distributions: (a) Normal or Gaussian distribution, (b) Platykurtic (flattened peak) distribution, (c) Leptokurtic (pointed peak) distribution, (d) Positive or right-skewed distribution, (e) Negative or left-skewed distribution 51

Figure 10. Four-step methodology for the development of the classes of performance for circularity aspects/parameters and indexes. Dashed boxes and arrows indicate optional steps. 54

Figure 11. Methodological approach to assess the best use of classes of performance considering consumer expectations and behaviour 72

Figure 12. Energy Label content and characteristics 87

Figure 13. Contents and characteristics of the tyres label 89

Figure 14. Energy Label for smartphones and tablets 91

Figure 15. Energy Label including relevant information about circularity aspects 93

Figure 16. New label (ESPR label) including information from the Energy Label and the ESPR label 94

Figure 17. Graphical representation of the level of stringency of ESPR requirements and EU Ecolabel criteria, and interaction with the classes of performance 98

Figure 18. Example of textile labels 99

Figure 19. French durability index label 100

Figure 20. Prioritisation of information visible on the ESPR label 110

Figure 21. Potential ESPR label content and characteristics 111

Figure 22. Circular Economy levels indicators 121

List of tables

Table 1. Scoring procedure to assess the scores within each sub-criteria. 39

Table 2. Description of levels of appropriateness (A)... 41

Table 3. Existing limits of classes of performance for the PEF score.. 46

Table 4. Updated formulas to calculate the boundaries for ach classes 49

Table 5. The fi parameter ranges identified.. 49

Table 6. Combinations of fi parameters and potential results in terms of how products could be distributed through classes considering a normal distribution (min=0, max=1 and mean=0.5).......... 51

Table 7. Pairwise comparison of the criteria and calculation of the geometric mean............................ 57

Table 8. Normalisation and calculation of the criteria weights.. 57

Table 9. Pairwise comparison of the different indicators based on a relevant criterion and calculation of the geometric mean.. 58

Table 10. Normalisation and calculation of the priority vector for the different indicators based on a relevant criterion.. 58

Table 11. Priority vectors for each indicator (option) and weighting factors for each criterion.......... 59

Table 12. Establishing the limits of performance classes.. 63

Table 13. The fi parameters identified.. 64

Table 14. ISO 14020 classification of environmental labels. 80

Annexes

Annex 1. Circularity indicator

An indicator is a single metric that measures a specific aspect of performance (e.g. durability, repairability). It is straightforward and in this report targets one dimension. As an example, if we consider the product parameter "technical lifetime", this can be used as a measure of the product's durability. In this case, the technical lifetime of the product has been used to reflect the circularity aspect “durability”.

More information about circularity indicators extracted from scientific articles (Calzolari et al., (2022), Saidani et al., (2017) and De Oliveira et al., (2021)) is given below:

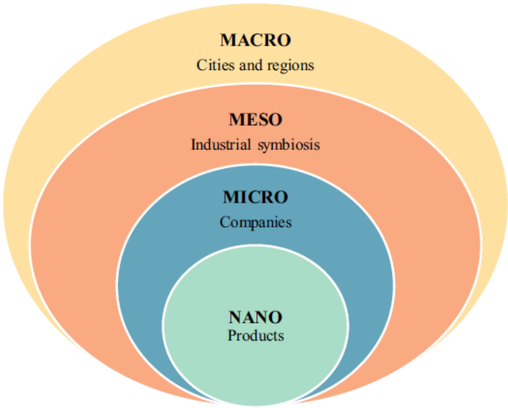
‘Decision-makers need tools to evaluate the adoption of Circular Economy (CE) practices, and operationalise profitable, efficient, circular and sustainable supply chains. Decision support tools employ many CE indicators in order to account for a variety of impacts across boundaries between firms, concerning every dimension of sustainability (i. e. economic, environmental and social). CE indicators are formed by single or multiple metrics, which can be defined as the “finest level of granularity for assessment means (Calzolari et al., 2022)’.

‘Circularity indicators may be understood as analytical tools focused on measuring the degree of association of a system (or part of one) to practices and strategies applied to develop a CE further. In that sense, higher circularity means that a specific item or system is closer to achieving the goals set by the guiding standards of a CE (Calzolari et al., 2022)’.

‘CE levels is primarily based on the division among the macro, meso, and micro circularity levels commonly applied in CE research. The macro level is the CE development in cities, provinces, or regions. It involves redesigning infrastructural systems, such as clean energy, transportation, the cultural framework, and the social system. The meso level presents CE strategies to industrial eco-parks or inter-enterprise associations known as industrial symbiosis. In turn, the micro level is related to the CE progress to consumers, a single company, or a product and its components. As the micro level has a broad scope, many metrics referred to as micro-level indicators do not cover the complexity of a CE and may lead to different interpretations of what this specific CE level is targeting during circularity assessments. Therefore, Saidani et al., (2017) introduced a new product-cantered term to the CE context, the nano level, which describes “the circularity of products, components, and materials, included in three wider systemic levels, all along the value chain and throughout their entire lifecycle”.

The implementation of circularity indicators to the nano level is a way to strictly distinguish the influence of specific products and design options from the overall company circularity (De Oliveira et al., 2021).’

Figure 22. Circular Economy levels indicators



Source: De Oliveira et al., (2021)

Annex 2. Technical performance indicators

Technical performance indicators vary widely across different product groups, as they are tailored to the specific characteristics and functionality of the products. Below are some examples of product groups and potential technical performance indicators for each.

Refrigerators:

- Cooling efficiency: Ability to maintain consistent temperatures.

Solar panels:

- Efficiency: Percentage of solar energy converted into electrical energy.

HVAC systems (Heating, Ventilation, and Air Conditioning):

- Indoor Air Quality: Effectiveness in filtering and purifying air.
- Thermal comfort: predicted mean vote (PMV) and the predicted percentage of dissatisfied (PPD).

LED light bulbs:

- Luminous efficacy: Lumens per watt, a measure of how well the bulb converts energy into light.
- Colour temperature: The warmth or coolness of the light emitted, measured in Kelvin (K).

Consumer electronics (e.g. smartphones, laptops):

- Processing power: CPU and GPU performance, measured in GHz or benchmark scores.
- Memory and Storage: RAM capacity, type of storage (SSD/HDD), and storage capacity.
- Display Quality: Resolution, pixel density (PPI), colour accuracy, and screen technology (LCD, OLED).
- Battery life: Talk time, standby time, and battery capacity in milliampere-hours (mAh).
- Camera performance: Megapixel count, sensor size, aperture, optical stabilisation, and additional features like zoom or night mode.
- Water and dust resistance: IP rating indicating the level of protection against elements.

Clothing and textiles:

- Breathability: The ability of the fabric to allow moisture vapour to be transmitted through the material.
- Water resistance: Effectiveness at repelling water, often rated by hydrostatic head measurements.
- Comfort: Subjective assessments based on fit, material softness, and ergonomic design.

Construction materials (e.g. concrete, steel):

- Compressive strength: Ability to withstand loads without deformation or failure (MPa).
- Tensile strength: Resistance to breaking under tension (MPa).
- Flexibility or elasticity: The material's ability to flex or deform before returning to its original shape.
- Corrosion resistance: Ability to resist degradation due to environmental factors.
- Thermal insulation: Effectiveness in reducing heat transfer.

Sports equipment (e.g. bicycles, golf clubs):

- Weight: Overall mass, which can affect performance and handling.
- Aerodynamics: Design efficiency with respect to air resistance.
- Strength-to-weight ratio: The equipment's strength relative to its weight, indicating durability without unnecessary bulk.
- Vibration damping: Ability to absorb shock or vibrations, contributing to comfort and performance.
- Precision: Accuracy and consistency in the equipment's performance during use.

Toys and games:

- Safety: Compliance with safety standards to prevent choking, sharp edges, or toxic materials.
- Educational value: Contribution to cognitive, emotional, or physical development.
- Playability: The ease and enjoyment with which the toy or game can be played.
- Age appropriateness: Suitability of the toy or game for the intended age group.

Each of these technical performance indicators is tailored to the specific characteristics of the product group in question. They help in assessing the quality, functionality, safety, and overall value of the products to both consumers and manufacturers. For each product group, the selection of technical performance indicators depends on the most relevant attributes that define the product's quality, functionality and efficiency. These indicators are used by consumers, manufacturer, and regulatory bodies to evaluate, compare and regulate products.

Getting in touch with the EU

In person

All over the European Union there are hundreds of Europe Direct centres. You can find the address of the centre nearest you online (european-union.europa.eu/contact-eu/meet-us_en).

On the phone or in writing

Europe Direct is a service that answers your questions about the European Union. You can contact this service:

— by freephone: 00 800 6 7 8 9 10 11 (certain operators may charge for these calls),
— at the following standard number: +32 22999696,
— via the following form: european-union.europa.eu/contact-eu/write-us_en.

Finding information about the EU

Online

Information about the European Union in all the official languages of the EU is available on the Europa website (european-union.europa.eu).

EU publications

You can view or order EU publications at op.europa.eu/en/publications. Multiple copies of free publications can be obtained by contacting Europe Direct or your local documentation centre (european-union.europa.eu/contact-eu/meet-us_en).

EU law and related documents

For access to legal information from the EU, including all EU law since 1951 in all the official language versions, go to EUR-Lex (eur-lex.europa.eu).

EU open data

The portal data.europa.eu provides access to open datasets from the EU institutions, bodies and agencies. These can be downloaded and reused for free, for both commercial and non-commercial purposes. The portal also provides access to a wealth of datasets from European countries.

Science for policy

The Joint Research Centre (JRC) provides independent, evidence-based knowledge and science, supporting EU policies to positively impact society

Scan the QR code to visit:

The Joint Research Centre: EU Science Hub
https://joint-research-centre.ec.europa.eu

Publications Office
of the European Union