INDICATORS AND METHODS FOR MEASURING TRANSITION TO CLIMATE NEUTRAL CIRCULARITY

Task 5: Case-study group 1

Report for: DG RTD, Directorate B – Healthy Planet, Unit B1: Circular Economy & Biobased Systems

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1. INTRODUCTION

The transition to a circular economy (CE) needs to occur on multiple levels, from households and individual consumers to national and cross-border ecosystems. Measuring and monitoring the development of this transition is an ambitious task and is ideally supported by indicators relevant to all steps in that process.

This case-study is one of 19 developed for a research project into "*Indicators and methods for measuring transition to climate neutral circularity, its benefits, challenges and trade-offs*". It provides a detailed summary of the development and testing programme conducted for Group 1 of the 'Electronics and ICT' sub-policy area during Task 5 of the project. The main purpose of this case-study is:

1. Provide an overview of the testing and monitoring method adopted for each indicator.
2. Outline the key results and performance of each indicator.
3. Highlight any challenges or lessons learnt from the identification, planning, delivery and analysis of the relevant methodology for each indicator.

The aim of Task 5 is to take the learnings of all other Tasks thus far and develop and test the new indicators identified in Tasks 3 and 4 as having potential to enable a deeper understanding of the 3 facets of circularity for the five key approaches. This case-study is a direct output of Task 5.

This case-study focuses on the following 4 indicators outlined in Table 1.

Table 1. Overview of case-study group 1

URN		Indicator name	Methodology	Level of implementation				
				European Union (EU)	National	City / Region	Companies	Household
EICT1	**1**	Percentage of citizens opting for sustainable alternatives instead of new purchases for Electronic or ICT products.	• Citizen's survey			**x**		
EICT2	**2**	Real recycling rate of electronic and ICT equipment.	• Desk-based research • Stakeholder engagement		**x**			
EICT3	**3**	ICT equipment and services purchased by the public sector that are either second-hand/refurbished or acquired through renting/leasing models.	• Desk-based research			**x**		
EICT5	**4**	Share of Consumer electronics fulfilling ecodesign criteria.	• Desk-based research		**x**		**x**	

2. INDICATOR 1: PERCENTAGE OF CITIZENS OPTING FOR SUSTAINABLE ALTERNATIVES INSTEAD OF NEW PURCHASES FOR ELECTRONIC OR ICT PRODUCTS

This indicator aims to measure the percentage of citizens opting for sustainable alternatives such as self-repair, paid repair, purchase of second-hand product, or product renting/leasing/borrowing instead of new purchases for electronic or information and communication technology (ICT) products (excluding batteries) at a city level.

Opting for sustainable alternatives to purchasing new products is highly relevant to the CE as it works towards extending product lifespans and keeping them at their highest value for as long as possible. Further, it helps to negate the need for new products to be manufactured, often using virgin materials, whilst also reducing the overall number of goods produced and therefore minimising waste production.

The benefits to the EC of monitoring this indicator include:

- Helps to gain a better understanding of sustainable behaviours by consumers, including potential reasoning behind these behaviours.
- Helps to gain a better understanding of local differences associated with sustainable behaviours.
- Allows for future changes in behaviour to be observed and analysed.
- Focuses on a range of principles including refuse, rethink, reduce and repair.
- Aligns with existing EU legislation such as 'Right to repair'1.

2.1 KEY METHODOLOGY

2.1.1 Testing method

The system boundary for this indicator is outlined as any sustainable alternative to purchasing new electrical items and/or communication devices (excluding batteries), including but not limited to self-repair, third party repair, borrowing, and second-hand purchases.

A citizen's survey was used to measure this indicator. This methodology was selected with an aim of quantifying the behaviours and opinions of citizens across different cities, allowing for analysis of the current values associated with the indicator, as well as allowing progress to be mapped over time with further consistent and systematic surveys. To ensure statistically reliable and useful outputs, the results from the survey were weighted to account for city population sizes to accurately represent the EU Member State as a whole.

Whilst the original data collection plan stated that citizens in Amsterdam and Cologne would be participating in the citizen survey, it was ultimately decided to disseminate the survey across a single Member State – Germany. The main driver behind this was to achieve efficiencies when disseminating the survey, and due to the fact Germany is a highly developed nation, meaning the likelihood of citizens purchasing and upgrading electronics and ICT equipment is likely higher than that of other less economically developed countries.

2.1.2 Data collection method

In order to test this indicator, the following data inputs were requested from respondents for 2023:

- Whether they chose an alternative to purchasing new electrical items and communications equipment (excluding batteries), and if so, what alternative.
- Reason(s) for choosing an alternative to buying a new electrical item.
- Reason(s) for not choosing an alternative to buying a new electrical item.

[1] European Commission, Right to repair. (Official website of the European Union, 2023). Right to repair: Making repair easier for consumers (europa.eu). Accessed March 2024.

To gather the above data inputs from respondents, Ricardo developed the line of questioning for this survey, which was then disseminated across German citizens by YouGov[2].

A sample size of 2,273 was received for the 'Vehicles Electronics ICT survey'. Table 2 shows the breakdown of the respondents at a regional level.

Table 2. Breakdown of responses per region/city

Name of region/city	Percentage of sample (%)
Bremen, Hamburg, Niedersachsen, Schleswig-Holstein	16
Nordrhein-Westfalen	22
Hessen, Rheinland-Pfalz, Saarland	14
Baden-Württemberg	13
Bayern	16
Berlin	4
Brandenburg, Mecklenburg-Vorpommern, Sachsen-Anhalt	8
Sachsen, Thüringen	8
TOTAL	**100**

Table 3 shows a breakdown of the respondents by monthly household income.

Table 3. Breakdown of responses per household income

Monthly household income (€)	Percentage of sample (%)
Less than 500	3
500 – 1,000	6
1,000 – 1,500	9
1,500 – 2,000	9
2,000 – 2,500	10
2,500 – 3,000	8
3,000 – 3,500	7
3,500 – 4,000	7
4,000 – 4,500	6
4,500 – 5,000	5
5,000 – 10,000	9
10,000 and above	3
Prefer not to say	17
TOTAL	**100**

[2] YouGov, YouGov UK. (YouGov, n.d.). https://yougov.co.uk/. Accessed March 2024.

2.1.3 Calculations

Calculations were not needed to investigate this indicator due to the use of the citizen's survey.

2.1.4 Timeline

Table 4 below presents the timeline for this case study.

Table 4. Gantt chart for EICT1

WC	18-Dec	25-Dec	01-Jan	08-Jan	15-Jan	22-Jan	29-Jan	05-Feb	12-Feb	19-Feb	26-Feb	04-Mar	11-Mar	18-Mar	25-Mar
Task 1 - Agree on EICT items to be included															
Task 2 - Develop online survey															
Task 3 - Disseminate online survey															
Task 4 - Explore backup datasets (if necessary)															
Task 5 - Create Excel model															
Task 6 - Survey analysis & calculations															
Task 7 - Analysis of themes															
Task 8 - Case study write up															
Review period														Ricardo	
Key deliverables				Online survey									Initial draft case study		Draft case study

Legend

Task progress | Christmas holiday | Review period | Key deliverable

2.1.5 Data gaps and mitigation

During the course of testing this indicator, no data gaps were identified due to the use of the citizen's survey.

2.1.6 Quality review of analysis

To ensure robust and high-quality analysis of the data, the following QA procedure was conducted:

- Prior to work beginning, the Project Director reviewed the proposed research methodology and ensure that the data collection plan is fit for purpose. Only once the research team had addressed any comments from the review process did they proceed to the data collection phase.
- In relation to the survey development and dissemination, the Project Manager reviewed the line of questioning for this indicator to ensure that it was clear, followable and able to generate reliable and robust results. In addition to this, respondents were also required to answer each question before being able to move on to ensure data validation of the survey.
- Once the survey has closed and the results had been analysed, the Quality Assurance Manager conducted a thorough internal quality assurance process on the MS Excel data set which pulled together the data from the survey and subsequent calculations. Any incoming data and assumptions were clearly logged, presenting survey data, user inputs, calculations, assumptions and results.

2.2 KEY ANALYSIS RESULTS

2.2.1 Analysis

Figure 1 below shows that on average across all regions surveyed, when asked whether they have chosen any alternatives to purchasing new household electrical items and communications equipment (excluding batteries), 20% selected that they had chosen 'self-repair', 18% had chosen 'second-hand purchase', 14% selected 'borrowing (e.g. from friends or family), and 10% stated they had used 'third party repair'. Conversely, 17% of respondents said that they had only purchased new household electric items and communications equipment, and a further 28% said they did not purchase any of these items or alternatives in 2023.

Berlin was the only area that had an alternative to a new purchase as its mode response, 'borrowing (e.g. from friends or family)' in this case being selected by 32% of respondents, whilst only 22% of respondents from Berlin only purchased new items in 2023.

As 60% of respondents selected either 'Not applicable – I only purchased new household electrical items and communication equipment' (27%), 'Not applicable - I did not purchase any household electrical items at all in 2023' (28%), and 'Don't know' (5%), it can be determined that 40% of the citizens involved in the survey opted for sustainable alternatives instead of new purchases for electronic or ICT products.

Figure 1. Alternatives to purchasing new household electrical items and communication equipment (excluding batteries) in 2023, per region/city

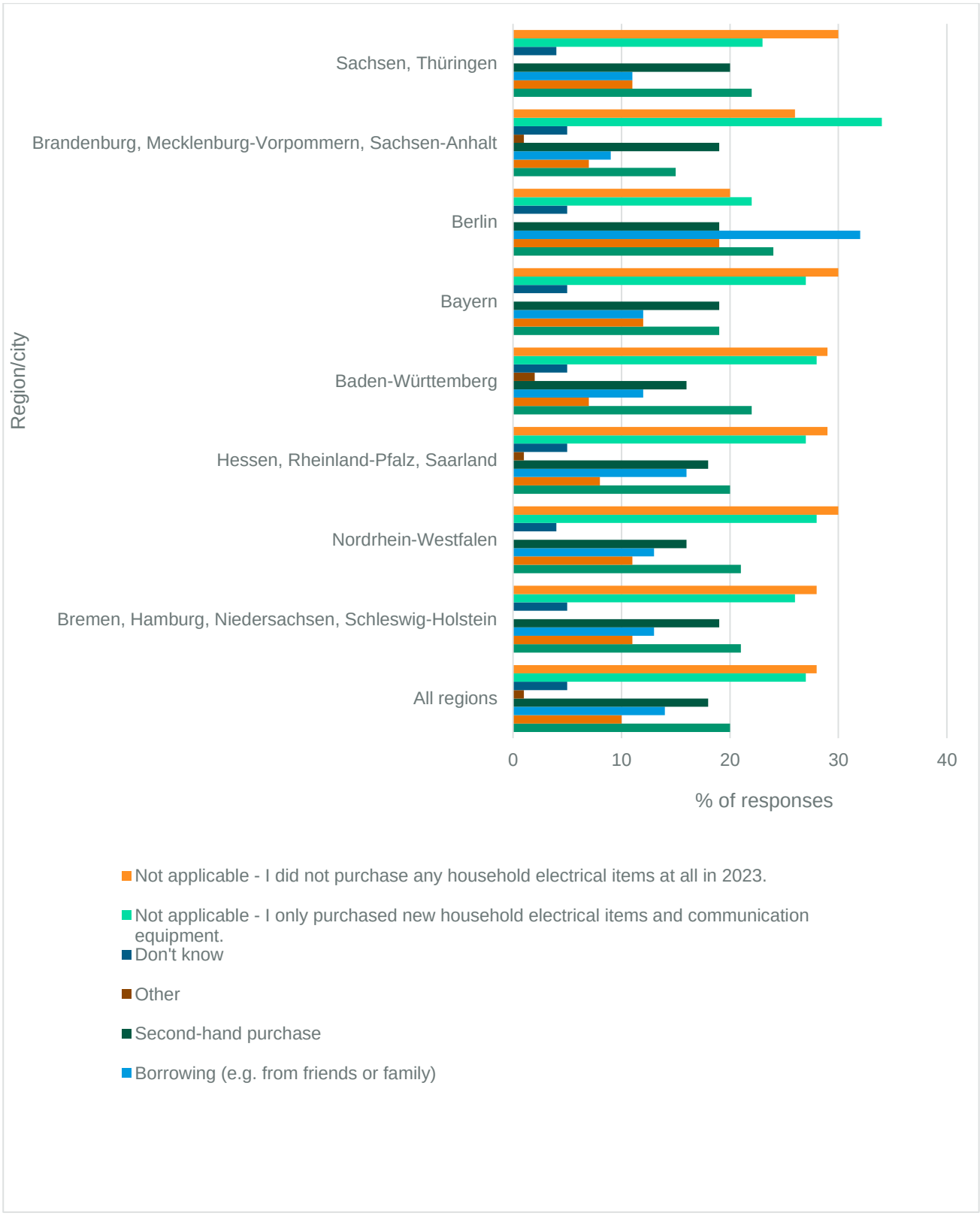


Figure 2 below shows a similar picture to Figure 1, with eleven of the thirteen income brackets having ‘not applicable – I only purchased new household electrical items and communication equipment’ as their mode response. The two outliers to this trend were those respondents with a monthly household income of €4,000-5,000, who were most likely to have instead chosen a ‘second-hand purchase’, and those with a monthly household income of €10,000 or more, who were most likely to have engaged in ‘third party repair’ as an alternative.

Figure 2. Alternatives to purchasing new household electrical items and communication equipment (excluding batteries) in 2023, in relation to monthly household income

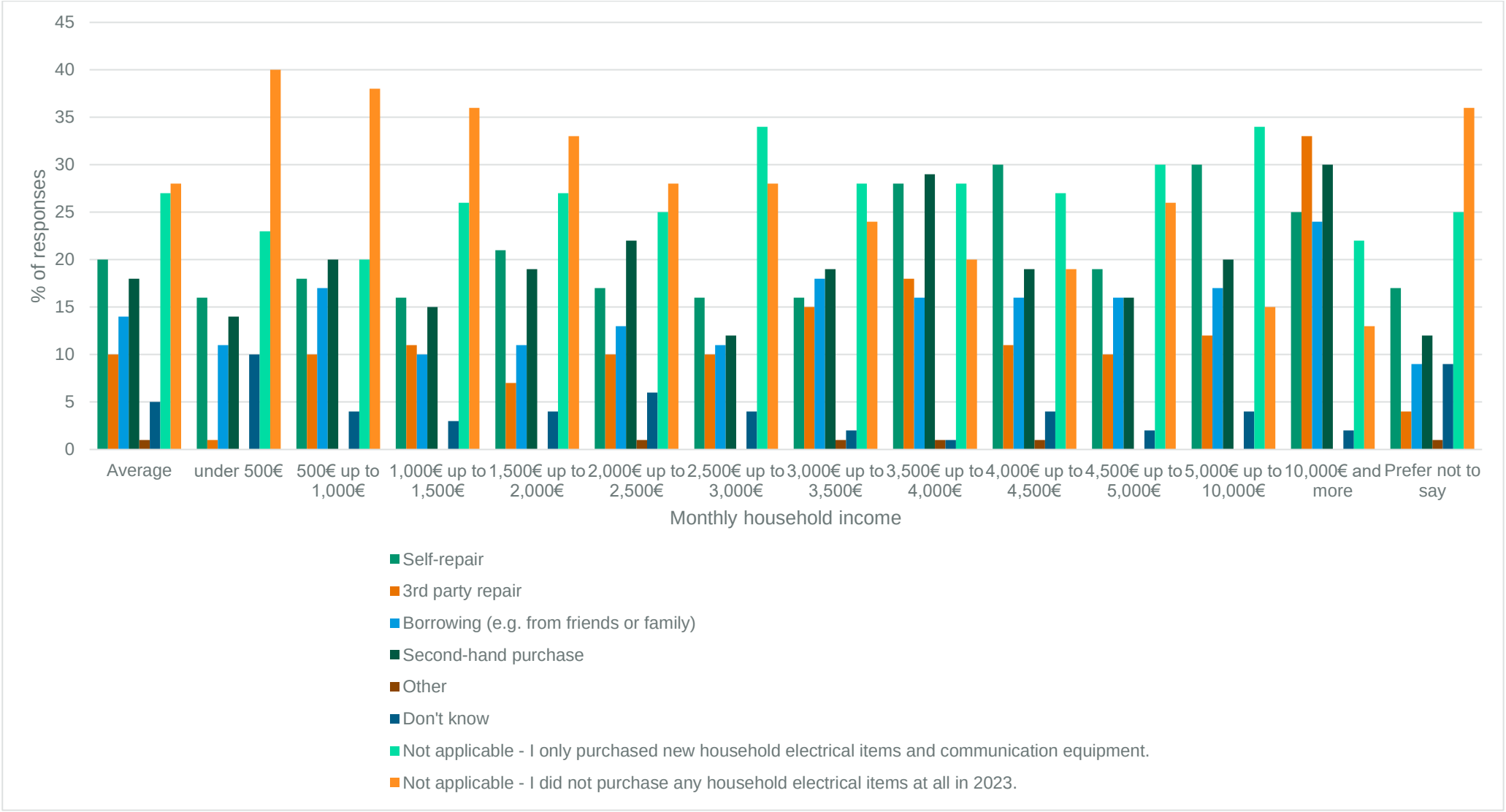


Figure 3 below shows that across all regions surveyed, the most common reason for respondents to have chosen alternatives to purchasing new electrical items and communication equipment was 'cost', with 64% of those surveyed selecting this response. This was seen across the majority of regions/cities, with only 'convenience' receiving a higher score in Berlin (61%), whilst 'sustainability' matched 'cost' in the Bremen, Hamburg, Niedersachsen, Schleswig-Holstein region with 58% of respondents selecting this answer. Following 'cost', 'sustainability' was the next most common response, with 51% of respondents across all regions selecting this, with 'convenience' receiving 31%.

Figure 3. Reasons for choosing alternatives to buying new electrical items and communication equipment in 2023, per region/city

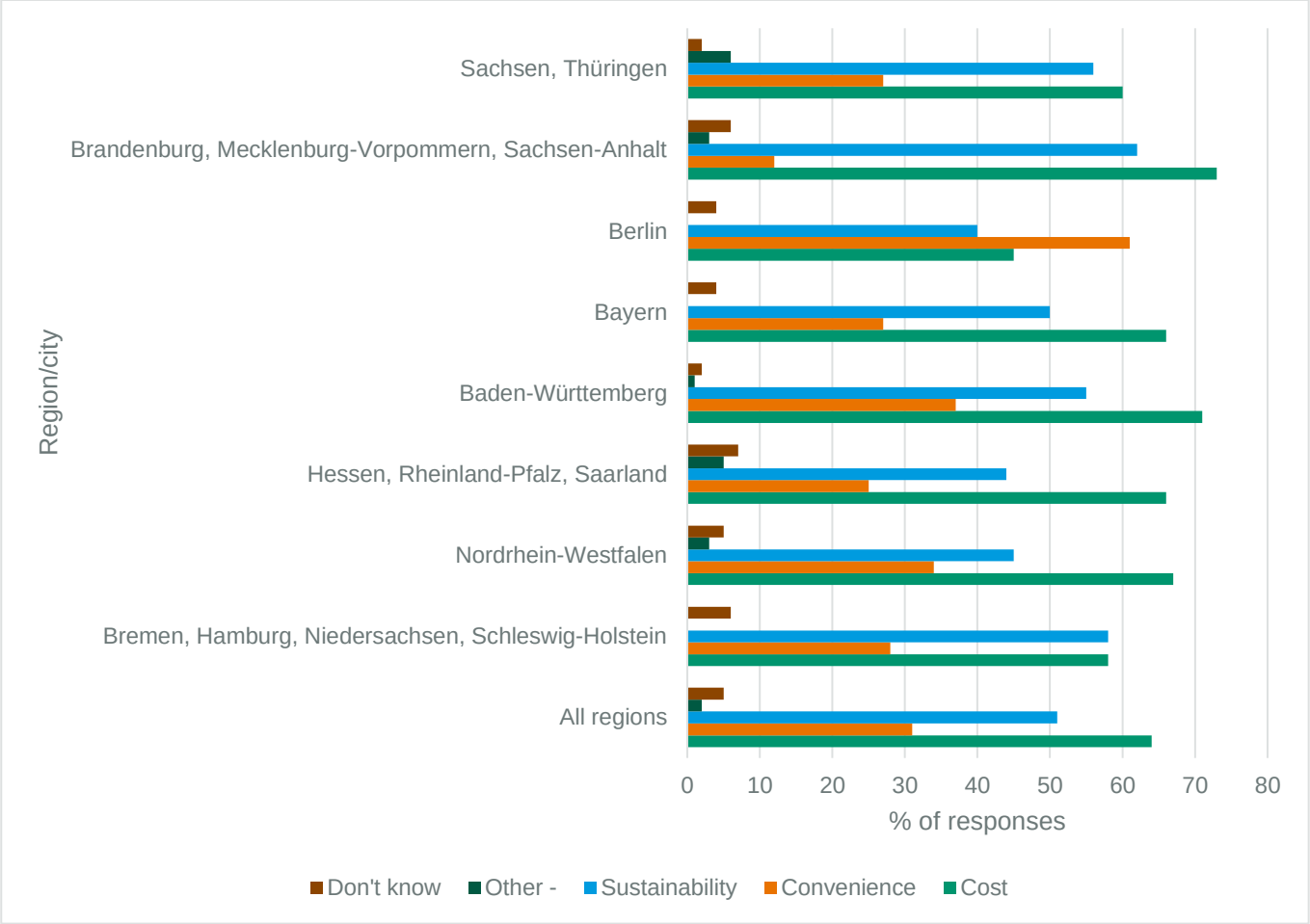


Figure 4 below shows that cost was the main driving factor in the decision to choose an alternative to purchasing new equipment for the vast majority of respondents across all income brackets, with twelve of the thirteen income brackets having this option as their most common response. It was only those with a household income of more than €10,000 a month that more frequently selected a different response, with 78% stating that 'sustainability' was a reason for choosing an alternative.

Figure 4. Reasons for choosing alternatives to buying new electrical items and communication equipment in 2023, in relation to household income

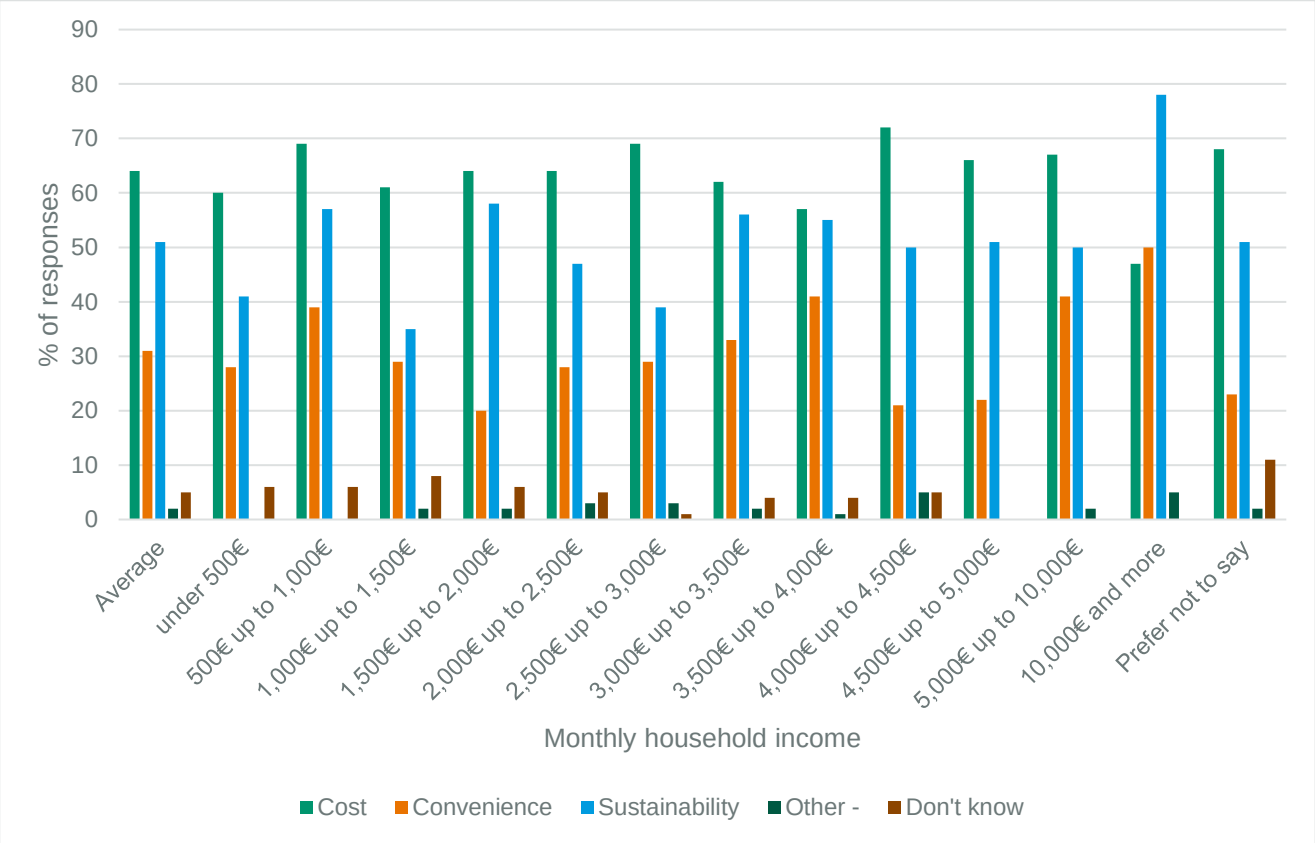


Figure 5 below shows that across all areas, 39% of respondents that did not choose an alternative to purchasing new electrical items and communication equipment stated that ‘quality/performance concerns’ was part of their reasoning behind this decision. This was also the most selected response for all areas except Baden-Württemberg (37%) and Brandenburg, Mecklenburg-Vorpommern, Sachsen-Anhalt (35%), both of which instead had ‘Not applicable – I don’t have any reason in particular for not choosing alternatives to buying new electrical items’ as their most common response.

Figure 5. Reasons for not choosing alternatives to buying new electrical items and communication equipment in 2023, per region/city.

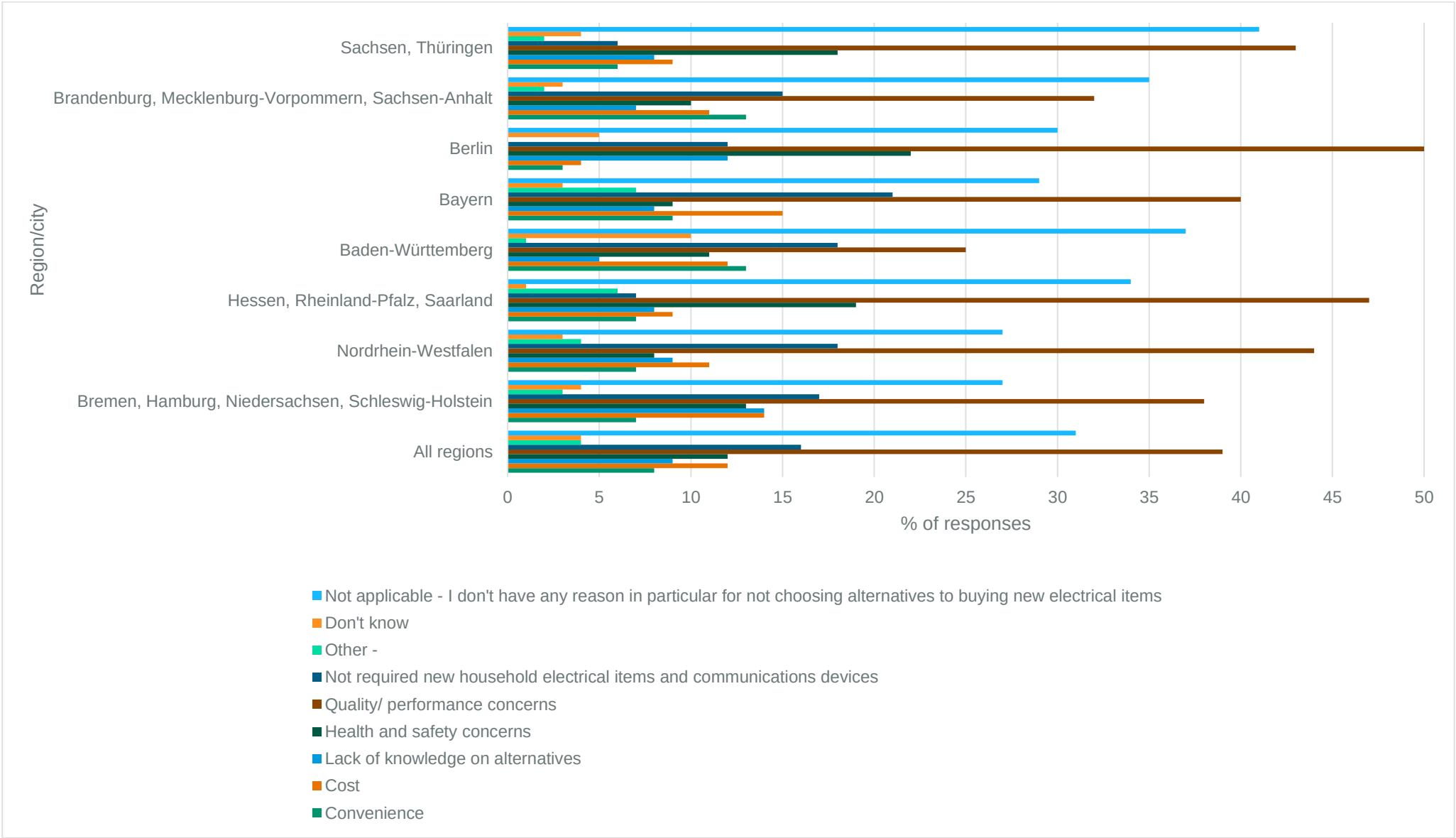
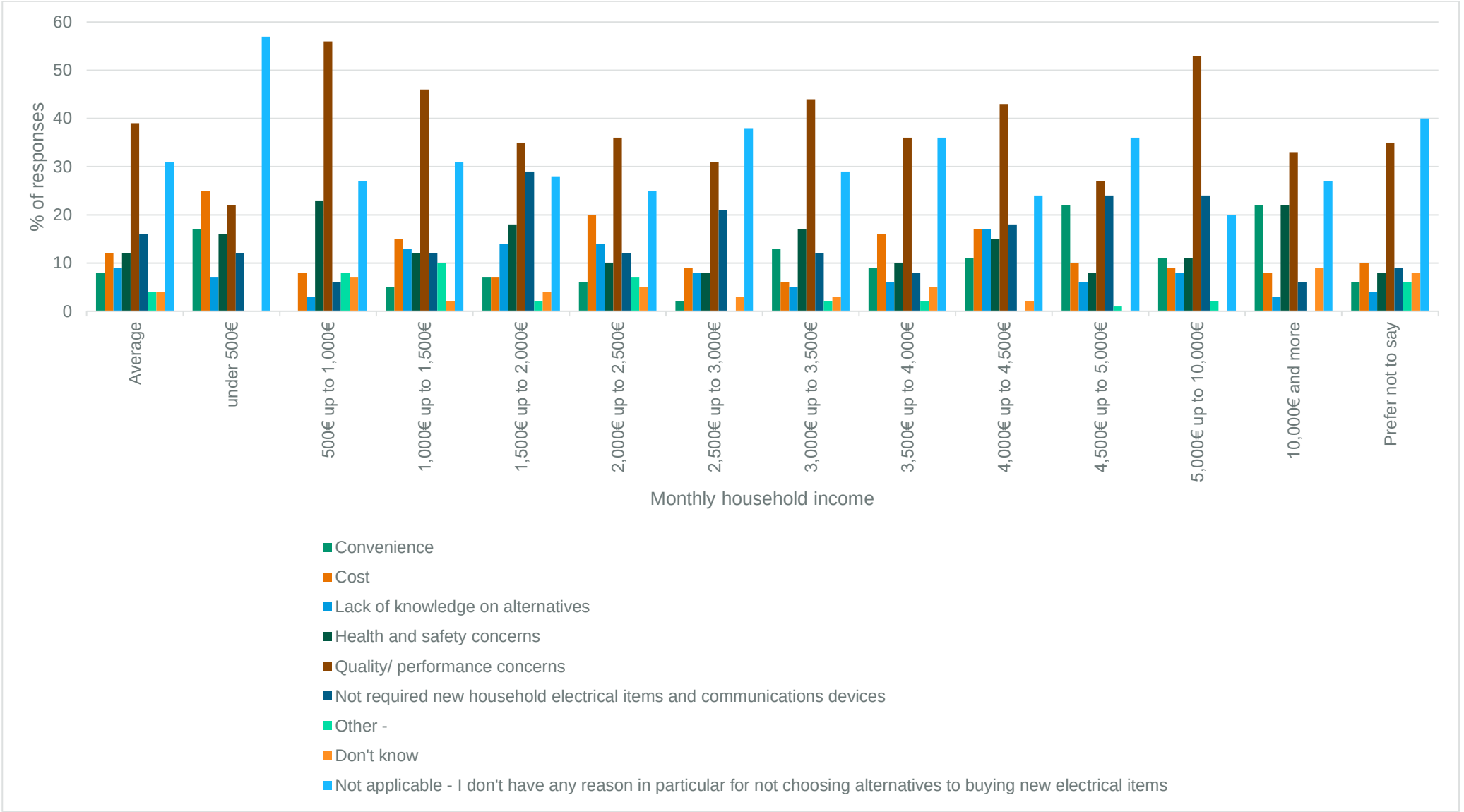


Figure 6 shows similar results when looking at responses in relation to household income. Indeed, respondents from nine of the thirteen income brackets have ‘quality/performance concerns’ as their most frequently selected response, with the remaining income brackets selecting ‘not applicable - I don't have any reason in particular for not choosing alternatives to buying new electrical items’ most frequently. Out of the options available to participants, only 8% of respondents across all income thresholds stated ‘convenience’ was part of their reasoning to not choose an alternative to purchasing new electric items and communications equipment, closely followed by ‘lack of knowledge on alternatives’, which was selected by 9% of respondents across all income categories.

Figure 6. Reasons for not choosing alternatives to buying new electrical items and communication equipment in 2023, in relation to household income.



2.2.2 Limitations

Due to time and resource restraints, regional data was only collected and analysed within one EU Member State (i.e. Germany). This meant that only results from the specific regions within were compared Germany, rather than specific regions within various EU Member States.

After an initial review of the proposed questions for the citizens survey, it was recommended by YouGov (the survey disseminator) to offer a range of answers to respondents (i.e. cost, convenience, etc.) rather than allowing them free reign and offering a blank text box. Due to the experience that YouGov have in carrying out this type of survey, this recommendation was followed. Whilst this allowed responses to be grouped easier, there is also a chance that is lead respondents to the options already available and discouraged other answers, despite the presence of an 'Other' option in the survey that allowed participants to provide further answers in their own words, which did receive a low level of use.

The use of self-reported data may have impacted the accuracy of the results attained in the citizen survey. There is likely to be some desirability bias in the responses, resulting in participants overreporting their engagement in sustainable practices as they perceive these actions as being socially favourable.

2.2.3 Performance

During Task 4 of this study, the original indicator (named "Percentage of citizens who have chosen alternatives to buying new products") was given a score of 11 in the RACER evaluation process due to the fact there is potential for bias within the indicator, but it is likely to be useful for measuring consumer habits and is highly relevant towards gaining a better understanding of circularity.

Following Task 5, the indicator was awarded a score of 12 owing to performing better for the criterion 'Ease'. This improvement in the 'Ease' score was awarded due to the relative simplicity of developing and disseminating the citizen's survey via YouGov and the large sample size that was received as a result. As was seen during Task 4 of the study, the indicator scored lower on 'Acceptability', 'Credibility', and 'Robustness' due to the lack of an EU defined methodology and consistent dataset, as well as a current lack of incentive for stakeholders to report on this indicator. However, it was once again decided that the indicator was highly relevant, due to it supporting gaining a better understanding of circularity, as well as its alignment with existing EU legislation such as 'Right to repair'.

Table 5. RACER evaluation

Stage of project	RACER criterion					Score
	Relevance	Acceptability	Credibility	Ease	Robustness	
Task 4 (original RACER assessment)	3	2	2	2	2	11
After Task 5 (following testing)	3	2	2	3	2	12

2.3 CHALLENGES AND LESSONS LEARNED

2.3.1 Challenges

A challenge faced by the team was the task of disseminating the citizen's survey and in turn receiving reliable and trustworthy results from a large enough sample in a relatively small period of time. In order to overcome this challenge, it was decided that the team would still have full control over the questions being asked, but that a third-party organisation would be commissioned to disseminate the survey. Whilst this did overcome the challenge the team was facing; it also came at an extra cost which should not be overlooked when considering future data collection associated with this indicator.

2.3.2 Lessons learned

Lessons learnt were recorded throughout the process of creating and testing this indicator, which may be applied to inform future assessments of indicators:

- For indicators which are based on data from citizen surveys, a judgement needs to be made at the early stages of testing as to what level of data granularity is required. There is a direct trade-off between the level of granularity asked for and the burden on the respondent to answer the questions. Asking for actual numbers within an open-ended question format is a more burdensome approach and could lead to missing data, however it would result in more granular data. In comparison, using numerical ranges within a closed-ended question format would provide less granular data, but would alternatively be easier/quicker for the respondent to complete, which would likely result in higher response rates.
- For indicators which rely upon survey data from citizens or households, going through a third-party supplier was found to be the most effective approach to ensure high response rates. Indeed, YouGov were able to provide a response rate of 2,273 which allowed the team to make robust and evidence-led conclusions from the data.

2.4 CONCLUSIONS AND RECOMMENDATIONS

It is recommended that this indicator is considered for further development, with minor work required to facilitate its progress.

Minimising the amount of new product purchases is expected to be vital for the EC to achieve 'true circularity'. Key to this is increasing the number of second-hand purchases, repairs, and sharing between citizens. Frameworks such as 'Ecodesign for Sustainable Products Regulation'[3] highlight the fact that encouraging sustainable alternatives to purchasing new products is rising in importance and coming to the forefront of legislator's plans. This shows the relevance of developing robust indicators that can be used to reliably monitor the success of policy instruments associated with the uptake of sustainable alternatives to purchasing new products.

A citizen's survey was used to collect the data required to measure the percentage of citizens opting for sustainable alternatives instead of new purchases for electronic or ICT products. Through disseminating this survey via a third party (YouGov in this case), the data had good availability, robustness and directness, and the approach has the potential to be easily replicated on a yearly basis to monitor progression. One downside of using a citizen's survey is the fact that objectiveness cannot be guaranteed, as participants are making their own assessments when responding. However, this has been mitigated by the large survey size that was involved in the survey, and the fact that the analysis was conducted on average responses rather than at an individual level. Whilst YouGov was used in the testing of this indicator, it may be more cost efficient to integrate the questions into the regularly circulated EU-wide consumer surveys that the EC currently conduct. It is also recommended that a regular interval for data collection is established, allowing trends to be tracked overtime, as well as providing ongoing insights into consumer behaviours and the effectiveness of policies promoting sustainable practices.

As well as tracking the effectiveness of future policies, it is also recommended that the impacts of existing policies such as the Right to Repair are evaluated. Quantifying the impact of this would help in assessing its effectiveness, whilst also providing valuable insights when assessing improvements around the indicator.

A large proportion of respondents (31%) stated that they did not have a reason for not choosing alternatives but chose not to anyway. This may have been due to not understanding the benefits of choosing alternatives or simply preferring to do what they are comfortable with and are used to doing, and it is therefore recommended that a public-facing guidance document is produced to try and change this behaviour. The document should detail benefits of sustainable alternatives, examples and options available, and contacts/resources that may be useful (e.g. repair centres or self-repair websites). Once this guidance document has been published, the figures regarding the uptake of sustainable alternatives can be revisited on an annual basis to monitor its impact.

Due to the informal nature of many of the sustainable alternatives available to consumers and therefore the difficulty in measuring the use of these alternatives, it has not been deemed necessary to define targets to support the implementation of this indicator. Should targets be implemented in future, it is recommended that

[3] European Commission, Ecodesign for Sustainable Products Regulation. (Official website of the European Union, n.d.). https://commission.europa.eu/energy-climate-change-environment/standards-tools-and-labels/products-labelling-rules-and-requirements/sustainable-products/ecodesign-sustainable-products-regulation_en#related-links. Accessed March 2024.

they are tailored to individual Member States to account for the diverse economic and infrastructural landscapes seen across different nations.

It is also recommended that legislation is implemented to incentivise the uptake of sustainable alternatives to purchasing new electronic and ICT devices. This encouragement may come in the form of tax breaks on repairs of electrical items, similar to the VAT reduction that is currently applicable on minor repair services of bicycles, shoes and leather goods throughout EU Member States such as Ireland, Luxembourg and the Netherlands.

Following the testing of this indicator, it was found that its original name 'Percentage of citizens opting for sustainable alternatives instead of new purchases for electronic or ICT products' was fit for purpose and that no variation was needed.

Whilst there is not any direct crossover with this indicator and those within the new EU monitoring framework for CE[4], quantifying the percentage of citizens opting for sustainable alternatives instead of new purchases for electronics and ICT products at a regional/city level would indirectly support improvements across the following macro level indicator:

- **Material footprint:** i.e. a quantification of the demand for material extractions triggered by consumption and investment by households, governments and businesses across the EU. Increasing the use of sustainable alternatives will help to reduce the material footprint of EU Member States by minimising the number of new goods that are needed on the market to meet demand.
- **Total waste generation per capita:** i.e. the total waste generated in a country (including major mineral wastes), divided by the average population of the country. Increasing the use of sustainable alternatives will reduce the number of goods on the market, thereby reducing waste generation when these goods reach the end of their life.
- **Generation of municipal waste per capita:** i.e. the waste collected by or on behalf of municipal authorities and disposed of through the waste management system. Increased uptake in sustainable alternatives will reduce the number of new goods placed on the market, thereby reducing municipal waste generation when these goods reach end of life.
- **Consumption footprint:** i.e. the environmental impacts of the EU and EU Member States consumption by combining data on consumption intensity and environmental impacts of representative products, with the indicator covering mobility as an area of consumption. Increasing the uptake of sustainable alternatives to new purchases will reduce the consumption footprint of EU Member States as citizens will be purchasing fewer products.

[4] Monitoring framework - Eurostat (europa.eu)

Table 6. Summary of recommendations for ICT1

Type of recommendation	Recommendation	RACER criteria addressed	Timeline	Key stakeholders or partners
Data collection	Surveys should be integrated into existing EC conducted EU-wide surveys.	Ease	Short (0.5 – 1.5 years)	• **Responsible:** EC. • **Accountable:** EC. • **Consulted:** National governments, citizens. • **Informed:** Citizens.
Data collection	Collect data at regular intervals to allow for trends and policy impacts to be tracked.	Credibility	Long (5+ years)	• **Responsible:** EC. • **Accountable:** EC. • **Consulted:** National governments, citizens. • **Informed:** Citizens.
Data collection	Survey could be broken down into further granularity to allow for the tracking of different trends.	Credibility	Medium (1.5 – 5 years)	• **Responsible:** EC. • **Accountable:** EC. • **Consulted:** National governments, citizens. • **Informed:** Citizens.
Policy evaluation	Evaluate new and existing policy to assess its impacts on the indicator.	Robustness	Medium (1.5 – 5 years)	• **Responsible:** EC. • **Accountable:** EC. • **Consulted:** National governments. • **Informed:** National governments.
Legislation	Incentives encouraging alternatives to purchasing new household electrical items and communications equipment.	Acceptability	Medium (1.5 – 5 years)	• **Responsible:** EC. • **Accountable:** EU Member States. • **Consulted:** Electrical and communication item manufacturers, retailers and repairers. • **Informed:** All stakeholders within EU electronics and ICT industry, citizens.

Type of recommendation	Recommendation	RACER criteria addressed	Timeline	Key stakeholders or partners
Development of guidance	Development of public facing guidance to encourage sustainable alternatives to purchasing new electrical items.	Acceptability	Short (0.5 – 1.5 years)	• **Responsible:** EC. • **Accountable:** EU Member States. • **Consulted:** Electrical and communication item manufacturers, retailers and repairers. • **Informed:** All stakeholders within EU electronics and ICT industry, citizens.

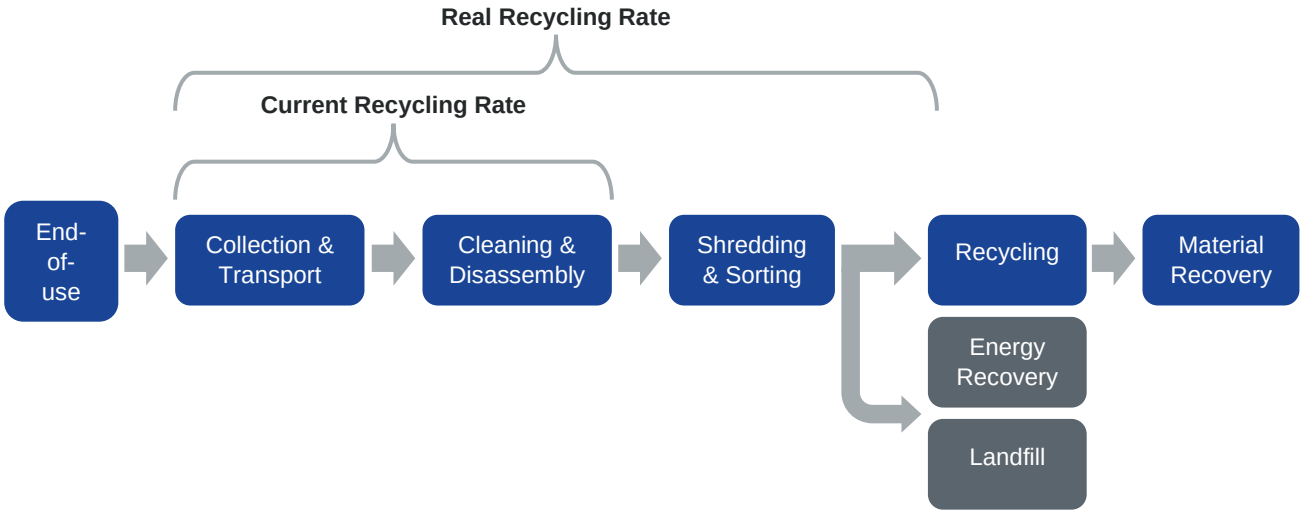
3. INDICATOR 2: REAL RECYCLING RATE OF ELECTRONIC AND ICT EQUIPMENT

Currently, Eurostat data reports on the collection of Waste Electrical and Electronic Equipment (WEEE) and the cumulative tonnage sent to recycling facilities, with the 'recycling rate' calculated as the ratio of the latter to the former (Eurostat, 2021). Hence, this represents the proportional mass of WEEE entering recycling facilities within a Member State relative to the total mass collected, but not what it is actually recycled. Therefore, the rate currently reported is likely an overestimation of the true extent to which materials are recycled into resource suitable for second life applications. In contrast, the 'real' or 'actual' recycling rate reflects the ratio of the mass of recyclate output from recycling facilities compared to the total mass collected.

The total mass of material decreases throughout the recycling process following the boundary of the current recycling rate definition, as material deemed unsuitable for recycling is diverted to alternative waste streams such as landfill and energy recovery, following pre-recycling shredding and sorting processes (Figure 7). Reasons for material being removed from the recycling waste stream at this point in the process could include technical recycling challenges such as material contamination, degradation or processing inefficiencies, or economic infeasibility.

The European Commission (EC) has proposed to introduce a single EU calculation method for measuring real recycling rates for municipal waste, at the input into the final recycling process (The European Parliament and the Council of the European Union, 2012). Therefore, this indicator aims to increase the extent of the scope of the current recycling rate definition, to capture pre-recycling material loss and to re-calculate the recycling rate as the ratio of material mass directly after sorting to the mass collected, under the condition that the waste is guaranteed to be effectively reprocessed into a product or material of value as part of the final recycling process.

Figure 7. WEEE recycling process flow, showing calculation scopes of the recycling rate currently reported by Eurostat and the proposed real recycling rate.



Unlike the rate currently reported, which focuses on collection and diversion from landfill, the real recycling rate focuses on the quantity of waste converted into new products or materials. Calculating the real recycling rate involves tracking the flow of materials through the entire recycling process, accounting for losses due to a number of factors.

The benefits of measuring this indicator include:

- The real recycling rate offers a more accurate and realistic picture of the effectiveness of recycling operations within Member States and considers the material actually recycled, as opposed to simply being collected for recycling. By highlighting the gap between collected materials and those

successfully recycled, the real recycling rate can inform targeted improvements in recycling technologies, systems, and policies.

- By calculating the respective real recycling rates of a range of product categories the EU will be able to understand which types of product are less commonly recycled and plan interventions to improve the design of these products.
- Increased levels of recycling will result in a reduced environmental impact of the sector.

3.1 KEY METHODOLOGY

3.1.1 Testing method

The key methodologies employed to measure this indicator were desk-based research and surveying of waste management stakeholders, in order to collect material mass data at the required processing stages. According to Article 11, Paragraph 4 of the Directive 2012/19/EU on Waste Electrical and Electronic Equipment, this data should already be internally collected by waste treatment facilities but is not believed to currently be reported publicly, so it was anticipated that this data would be readily available (The European Parliament and the Council of the European Union, 2012).

The system boundary for the dividend of this indicator is the material mass immediately following pre-recycling sorting and separation processes, as the input to the final recycling process. The indicator divisor is to remain as the total mass of WEEE collected in the Member State, used to determine the recycling rate currently reported on Eurostat.

The Netherlands was selected as the primary geographical scope for testing this indicator, due to its single, centralised compliance scheme for WEEE processing (WEEE Forum, 2024). It was anticipated that this would simplify data collection when compared to Member States which have multiple compliance schemes, as is permitted by EU regulation (Directorate General for Internal Market, Industry, Entrepreneurship and SMEs, 2024). In terms of the metric currently reported by Eurostat, the Netherlands has an average level of electronics recycling (Eurostat, 2021).

3.1.2 Data collection method

Data requests were sent to waste management associations in the Netherlands to understand the amount of electronic waste processed by waste recycling facilities following pre-recycling sorting. The list of stakeholders contacted is shown in Appendix 0, with the template email used to make initial contact to all stakeholders included in Appendix 6.1. The stakeholders contacted fall under the following categories: waste management associations, compliance schemes, government bodies and national waste registers.

The data was requested to be provided at an annual frequency, in “tonnes of or proportion of collected WEEE that is actually recycled”, for the most recent full calendar year for which this data could be provided. It was additionally requested that this data be broken down by the six waste categories defined in Annex III of the Directive 2012/19/EU on Waste Electrical and Electronic Equipment where possible, rather than the previously defined list of 10 equipment categories:

1. Temperature exchange equipment.
2. Screens, monitors, and equipment containing screens having a surface greater than 100 $cm^{2.}$
3. Lamps.
4. Large equipment (any external dimension more than 50 cm).
5. Small equipment (no external dimension more than 50 cm).
6. Small IT and telecommunication equipment (no external dimension more than 50 cm).

Annex I and II of the Directive also cover inclusions and exclusions for the types of WEEE to be included in this data, with example exclusions being: batteries, military equipment and medical devices (The European Parliament and the Council of the European Union, 2012).

Data from Eurostat was sourced directly by Ricardo for mass of WEEE collected using the database ‘Waste electrical and electronic equipment (WEEE) by waste management operations - open scope, 6 product categories (from 2018 onwards)’, with the following filters selected (Eurostat, 2021):

- Geopolitical entity – Netherlands.

- Time – 2019-2021 (to correspond to available data sourced from waste management stakeholders).
- Waste management operations – Waste Collected and Recycling (used to calculate current recycling rate for comparative purposes).
- Unit of measure – Tonne.

Due to concerns over a lack of responses from the contacted stakeholders, a decision was made to contact stakeholders from two additional Member States: Sweden and Germany. These Member States were selected due to good availability of waste management contacts. However, due to a lack of success in sourcing the required data from both the original and these alternative case study locations, a contingency methodology was developed. A review of relevant literature was conducted to source typical material composition breakdowns of WEEE, followed by material recovery factors from recycling processes applicable to electronics waste. These data points were then used to calculate material specific recycling rates from the available Eurostat data. The most recent full year of Eurostat data was selected (2021) for the original reporting Member State (Netherlands) for the contingency calculations and analysis.

3.1.3 Calculations

- The original methodology aimed to collect the following data points:
- Total mass of WEEE actually recycled within the reporting Member State and reporting period, M_{RR} (tonnes) – from waste management stakeholders.
- Total mass of WEEE collected within the reporting Member State and reporting period, M_C (tonnes) – from Eurostat.

The indicator would then have been calculated using the following formula, where R_{RR} represents the real recycling rate indicator as a percentage:

$$R_{RR} = \frac{M_{RR}}{M_C} \times 100$$

However, as described in Section 3.1.2, a contingency methodology was utilised which collected the following alternative data points:

- Typical material compositions of key material categories within each of the 6 WEEE categories, by weight, C (wt.%) – from literature (sources and raw data detailed in Appendix 1.1).
- Typical material recovery factors from recycling processes applicable to the key WEEE material categories identified, R_M (%) – from literature (sources and raw data detailed in Appendix 6.3).
- Total mass of WEEE sent to recycling facilities within the reporting Member State and reporting period, M_R (tonnes) – from Eurostat.

The indicator was then estimated using the following formula, where n represents each of the key material categories:

$$R_{RR} \approx \frac{M_R}{M_C} \times \sum_{i=0}^{n} (C_i \times R_{M_i})$$

This calculation was performed for each of the six WEEE categories, and a weighted average was then used to estimate the total real recycling rate across all categories.

3.1.4 Timeline

Table 2 below presents the project timeline.

Table 7. Gantt chart for EICT2

Task	15th Jan	22nd Jan	29th Jan	5th Feb	12th Feb	19th Feb	26th Feb	4th Mar	11th Mar	18th Mar
Data requests sent to Dutch waste management stakeholders										
Data requests sent to Swedish and German waste management stakeholders										
Desk-based research of Eurostat figures										
Contingency desk-based research into WEEE material composition and recovery factors										
Analysis of data										
Reporting										

3.1.5 Data gaps and mitigation

Table 8 summarises the key data gaps encountered in testing this indicator, the associated strategy employed to mitigate the impacts of these gaps and the resultant level of confidence in the collected data.

Table 8. Overview of identified data gaps, limitations and mitigation efforts

	Description of data gap	Mitigation efforts	Level of confidence
1	Primary data on material mass balance and/or real recycling rate from waste management stakeholders.	• After the initial data request was sent to the list of identified waste management stakeholders in the Netherlands, follow-up emails were sent to recipients who had not responded. A meeting was held with a single stakeholder group who did express interest in providing data to support the case study, but this was not received within the project timeframe despite a number of reminders being issued. • As an effort to mitigate this issue, an extended list of stakeholder groups was produced, spanning two additional Member States – Sweden and Germany. Data requests were sent to these groups, and follow-up emails sent where necessary. As with the initial stakeholder group, no satisfactory data was received within the project timeframe. • The contingency method of using literature sources to research material recovery rates and WEEE material compositions was therefore developed and employed to test the indicator using secondary data. However, a number of assumptions made in this process reduce the level of confidence in these results as a true representation of the real recycling rate of the chosen case study nation. These are listed in Section 0.	Low

3.1.6 Quality review of analysis

To ensure robust and high-quality results, the following data validation and quality control procedures were conducted:

- Prior to work beginning, the Project Director reviewed the proposed research methodology and ensured that the data collection plan was fit for purpose. Once the research team had addressed any comments from the review process, they proceeded to the data collection phase.
- The Quality Assurance Manager held responsibility for the quality of the final case study output. The Project Manager assisted the Quality Assurance Manager in judging the quality of the output and suggesting ways to improve.

3.2 KEY ANALYSIS RESULTS

3.2.1 Analysis

As can be seen in the results presented in Table 9 and Figure 8, there is a significant variance between the recycling rate currently reported by Eurostat and that which has been estimated in this case study, across each of the six WEEE categories.

Categories 5 and 6, including WEEE such as household appliances, tools, sports and telecommunication equipment, amongst other equipment sub-categories, are shown to have a higher variance between the two presented recycling rates of almost 33%. On the other hand, the variance between the real and current recycling rates of the solar panels category is reduced to 21%. These results may be a product of the increased diversity of equipment (and therefore material compositions within the waste stream assigned to each category) within categories 5 and 6, adding complexity to pre-recycling processing and sorting operations and reducing the overall mass of recycled material.

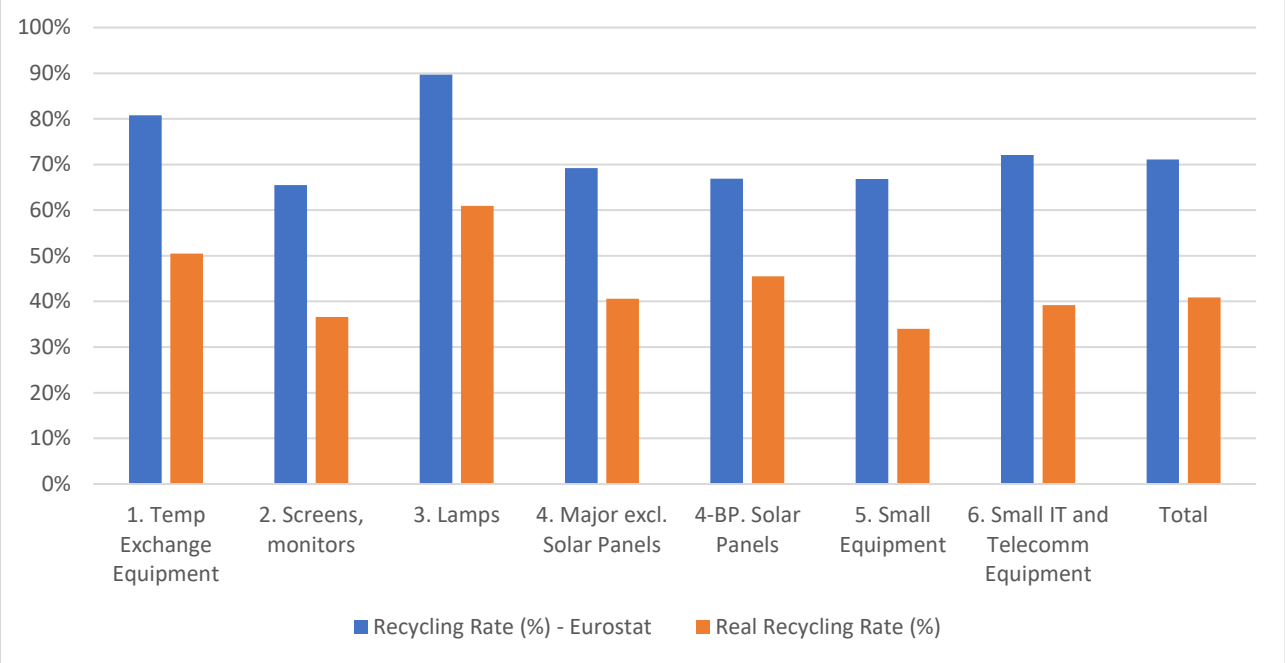
Additionally, the smaller physical size and more complex design of category 5 and 6 equipment may hinder disassembly processes, particularly where hybrid or composite materials are used – further reducing the real recycling rate. This underscores the need for design considerations in the manufacturing phase to enhance end-of-life recyclability. The relatively lower variance in the recycling rates for solar panels, category 4-BP, suggests that targeted recycling technologies, which are likely more available for solar panels, can lead to better recycling outcomes. This trend highlights the importance of developing and investing in recycling technologies tailored to specific types of WEEE.

The ranking of recycling rate magnitude within the six categories remain largely consistent between the two measures, with an exception being category 4-BP and 6 changing positions. These findings could be used to reprioritise efforts to improve recycling processes, to maximise material recovery from the categories with the lowest real recycling rate. On the other hand, the consistency in ranking between the reported and real recycling rates across the other categories suggests that, while the efficiency of recycling processes may vary, the relative challenges facing recycling operators across waste categories remains consistent. This could indicate inherent material or product design challenges that persist, regardless of the recycling process's efficiency. It should be acknowledged however, that due to the data gaps and associated mitigation strategies identified elsewhere in this report, these are low confidence conclusions which should undergo further validation.

Table 9. Results from the real recycling rate contingency calculation method, for the Netherlands in 2021

Quantity	1. Temp Exchange Equipment	2. Screens, monitors	3. Lamps	4. Major excl. Solar Panels	4-BP. Solar Panels	5. Small Equipment	6. Small IT and Telecomm Equipment	Total
Recycling Rate (%) - Eurostat	80.8%	65.5%	89.7%	69.2%	66.9%	66.8%	72.1%	71.1%
Real Recycling Rate (%)[5]	50.5%	36.6%	60.9%	40.6%	45.5%	34.0%	39.2%	40.9%
Variance (%)	-30.3%	-28.9%	-28.8%	-28.6%	-21.4%	-32.8%	-32.9%	-30.2%

Figure 8: Graph of results from the real recycling rate contingency calculation method, for the Netherlands in 2021



3.2.2 Limitations

The limitations included:

[5] Calculations shown in Appendix 6.4.

- As WEEE is a highly varied waste stream, material compositions were sourced from literature for each of the six equipment categories defined by the Directive 2012/19/EU. However, within each of those categories there remains a large degree of variability in material compositions. For example, it was found that the reported composition of glass in Category 2 equipment (comprising screens and monitors) varied between 0% and 49% by weight. This variability may be due to technology and material science developments over time or trends in consumption, which again may be dependent on the country in which the products were purchased, used and disposed of. The composition values used are an average of as broad a range of sources within each WEEE category as was feasible to collect within the project timeframe, and therefore may not be representative of the true material compositions in the chosen reporting year and Member State.
- Similarly, recycling recovery rates are likely to change over time and from country-to-country, as developments take place in both the design and construction of electronic and electrical products with end of life (EoL) considerations increasingly prioritised, and the methods used to process them at EoL become more established. The values used in this case study are an average of values listed in sources spanning a number of years and reporting Member States, and so are unlikely to be an accurate representation of the material composition and recovery factors in the Netherlands in 2021, the sample Member State and year used to source the mass of WEEE collected values from Eurostat.
- Additionally, it was discovered that there is a lack of data available detailing material mass balance before and after pre-recycling sorting – the original boundary defined for this indicator. Therefore, the mass balance after the final recycling process was sourced and compared to the collected WEEE mass. The assumption in the original methodology, that all material at the post-sorting stage in the waste treatment process is effectively recycled into a material or product of value, assumes that the efficiency of the final recycling process is 100% (i.e. all material entering the process is regenerated into second life material, which is a simplified assumption). This suggests that extending the scope of the indicator to measure the recycled mass at the end of the final recycling process is a more appropriate measure of true resource circularity, as it takes into consideration the material utilisation of the technologies and processes employed by the waste treatment facilities at a greater number of stages.
- The literature research concluded that there are four primary material categories in each of the WEEE categories: ferrous and non-ferrous metals, polymers and glass. Of course, other materials are used such as ceramics, chemical products and components that cannot distinctly be categorised into any individual material category as they are of a hybrid or composite construction. The calculations performed assumed that this ‘Other’ material category is essentially non-recyclable and is diverted to alternative, non-recycling waste treatment processes following sorting. However, this is likely to be an oversimplification of the sorting and recycling processes employed in a developed waste treatment facility so the overall recycling rates may indeed be higher than those reflected in the final results.
- Additionally, there is likely to be variability in material recovery rates within each of the material categories identified. This is likely to be especially true for the ‘polymers’ category, which of course includes a number of thermoplastic and thermosetting polymers, with the most common types being acrylonitrile butadiene styrene (ABS), high impact polystyrene (HIPS), polycarbonate (PC) and polypropylene (PP). The technologies employed in the recycling processes for each of these polymer types vary, as do the material recovery rates. This may also apply to the other material categories identified – metals (ferrous and non-ferrous), glass and other including ceramics and hazardous substances. However, to simplify the research stage of the testing process and to produce indicative results to illustrate the effect of increasing the scope of the recycling rate measure, a single recovery rate figure was used for each material category and these same rates were applied to all WEEE categories.
- The contingency methodology relies on several assumptions regarding material compositions and recovery rates, derived from literature and secondary data sources. These assumptions, while necessary due to data gaps, could significantly influence the estimated real recycling rates. For example, assuming a uniform recovery rate for all plastics does not reflect the true diversity and recyclability of the polymers used in WEEE.

3.2.3 Performance

Table 10 summarises the Relevance, Acceptability, Credibility, Ease and Robustness (RACER) evaluation of the indicator at the end of before and after completion of Task 5, where 1 (red) corresponds to a poor score, 2 (orange) a neutral score and 3 (green) a good score Explanations for the differences in scoring against the acceptability and robustness criteria are as follows:

- **Acceptability –** On the whole, the responses from contacted stakeholders when requested to support data collection suggest that the benefits of measuring this indicator are understood, but availability of mass balance data within recycling facilities is likely limited to within the waste treatment facilities themselves. Government bodies, compliance schemes and waste registers seemingly do not have access to this data or are unwilling to provide this data due to concerns over confidentiality.
- **Robustness –** The varying possible definitions of recycling rate, resulting from the stages at which recycled material mass can be measured within the waste treatment process flow, result in complexity in sourcing real recycling rate statistics from published reports. Whilst access to primary mass balance data at each stage of the process flow is therefore the preferred method of calculating the indicator, this data is not readily accessible at a national scale. Proxy calculations to estimate the indicator, such as the contingency method employed in this case study, are prone to inaccuracy due to a number of factors, such as the complexity of the WEEE waste stream composition and material-specific recovery factors.

Table 10. RACER evaluation

Stage of project	RACER criterion					Score
	Relevance	Acceptability	Credibility	Ease	Robustness	
Task 4 (original RACER assessment)	3	3	3	1	3	13
After Task 5 (following testing)	3	2	3	1	2	11

3.3 CHALLENGES AND LESSONS LEARNED

3.3.1 Challenges

The primary challenge faced with the original indicator test method was a lack of response from contacted stakeholders. Of the stakeholders who did reply, many stated that their organisation either did not have access to the mass balance data required, were not obligated to report these figures or could not out of concerns over confidentiality or commercial sensitivity with respect to the waste management facilities. The stakeholder group who did agree to provide the requested data did not do so within the project timeframe. Various measures were taken to try to mitigate the effect of this challenge, including issuing follow-up emails to stakeholders and expanding the geographical scope of the case study to an additional two Member States.

Ultimately however, a contingency method was used to estimate indicative results, although there were also a number of challenges with this method. Within each of the limitations explained in Section 0, assumptions were made that reduce the accuracy of the method in truly assessing the recycling performance of the chosen case study Member State within the chosen reporting period. In fact, due to these generalisations, the results are only dependent upon the collected WEEE tonnage (the variable M_C described in Section 3.1.3) and not the reporting Member State or period, as the material composition and recovery rates are independent of when and where the waste is processed. Additionally, real recycling rates are likely dependent on technological and market changes, impacting composition and volume of WEEE. These factors can influence the types of materials used in electronics, the availability and efficiency of recycling processes, and the demand for recycled materials – all variables not currently captured to an acceptable level by the contingency method suggested in this report.

3.3.2 Lessons learned

The key lessons learned from conducting this case study are summarised below:

- Requesting recycling mass balance data from waste management facilities or municipality-level supervisory authorities, rather than from government bodies, national waste registers or national compliance schemes, is likely to result in a higher stakeholder engagement rate and increase the availability of the required data.
- The contingency method of using secondary data proposed in this report has many inherent limitations, due to the complexity and time-dependency of the waste stream and waste treatment processes employed by EU Member States. Improvements could be made to address these assumptions, including

collection of annual primary data from each of the reporting Member State on material composition by WEEE category and recycling recovery rate.

- Extending the scope at which the indicator is to be measured to the mass balance after the final recycling process (rather than after the final pre-recycling sorting process) is a more appropriate measure of true resource circularity, as it takes into consideration the material utilisation of the technologies and processes employed by the waste treatment facilities at a greater number of stages It is also likely to result in an increased response rate from primary and secondary data sources.

3.4 CONCLUSIONS AND RECOMMENDATIONS

It is recommended that this indicator is considered for further development, with significant work required to facilitate its progress.

The key result from this case study is that there is significant variance between the recycling rate currently reported by Eurostat and that which has been estimated in this case study, across each of the 6 WEEE categories. Categories 5 and 6, including a diverse range of WEEE sub-categories such as household appliances, tools and sporting equipment, are shown to have a higher variance between the two presented recycling rates whilst there is a reduced variance within the photovoltaics category. These results may suggest that more homogeneous waste streams present fewer challenges within the pre-recycling processing and sorting operations, thus increasing the overall mass of recovered material.

Additionally, there may be some positive correlation between the physical size of equipment within the waste stream and the real recycling rate, owing to the added complexities of disassembling smaller equipment, particularly where hybrid or composite materials are used. The ranking of recycling rate magnitude within the WEEE categories remains largely consistent between the two measures, although these findings should be re-evaluated once the accuracy of the real recycling rate has been improved. These findings could be used to reprioritise efforts to improve recycling processes, to maximise material recovery from the categories with the lowest real recycling rate.

It is important to note that a mass-based recycling rate may not capture the intricacies of the waste management system, as certain critical materials may be recovered in relatively small quantities but high economic values. Future iterations of this indicator could consider moving to a value-based recycling rate.

A number of challenges were encountered in the data collection phase of testing the indicator, including a low response rate from engaged waste management stakeholders, and low access to the required mass balance data from stakeholders who did respond. Ultimately, a contingency method was employed to estimate recycling rates, based on a review of secondary data, with a number of assumptions made which limit the confidence in the results and associated findings. It is therefore recommended that a number of improvements are made to the current method of calculating real recycling rates across the EU, to enable robust and reliable usage of the proposed indicator. These recommendations are summarised in Table 11.

When considering this metric for further development, it is recommended that its name be updated to “Actual recycling rate of electronic and ICT equipment” to avoid any confusion regarding the word ‘real’.

Table 11. Summary of recommendations for EICT2

Type of recommendation	Recommendation	RACER Criteria addressed	Timeline	Key stakeholders or partners
Data collection	Request recycling mass balance data from waste management facilities or municipality-level supervisory authorities, rather than from government bodies, national waste registers or national compliance schemes. It is anticipated that this data is more available compared to at the national level.	Credibility and Ease	Short (0.5 – 1.5 years)	EC, member state waste management organisations, municipality-level supervisory authorities
Data collection	Collect annual primary data from each of the reporting nations on material composition by WEEE category and recycling recovery rate, to estimate recycling rate using a similar method to the contingency method proposed in this report.	Robustness	Short (0.5 – 1.5 years)	EC, member state waste management organisations, municipality-level supervisory authorities
Data reporting	Develop a standardised data reporting format across Member States to ensure consistency and comparability of data.	Credibility, Ease and Robustness	Medium (1.5 – 5 years)	EC
Indicator scope	Expand scope of indicator to measure recycling rate following the final recycling process, to account for material loss in as many stages of the process flow as possible. Engage with key industry stakeholders to ensure this is practicable.	Relevance and Acceptability	Medium (1.5 – 5 years)	EC, member state waste management organisations
Target-setting	Develop targets for minimum post-sorting recycling rates, to encourage and quantify developments in sorting and recycling operations, in addition to waste collection. Benchmarks should be established to guide the development of these targets.	Relevance and Credibility	Medium (1.5 – 5 years)	EC
Legislation	Develop legislation to mandate that WEEE recycling mass balance data following pre-	Relevance	Long (> 5 years)	EC

Type of recommendation	Recommendation	RACER Criteria addressed	Timeline	Key stakeholders or partners
	recycling sorting and post-recycling is reported at the national level. Amend existing directives (WEEE Directive, Waste Framework Directive) or introduce new regulations mandating the detailed reporting of post-recycling outcomes for WEEE. This could include material-specific recycling efficiencies, the fate of recovered materials (e.g. re-introduction into manufacturing, downcycling, or disposal) and losses during the recycling process.			

4. INDICATOR 3: ICT EQUIPMENT AND SERVICES PURCHASED BY THE PUBLIC SECTOR THAT ARE EITHER SECOND-HAND/REFURBISHED OR ACQUIRED THROUGH RENTING/LEASING MODELS

Green Public Procurement (GPP) is defined by the EC as “a process whereby public authorities seek to procure goods, services and works with a reduced environmental impact throughout their life cycle when compared to goods, services and works with the same primary function that would otherwise be procured" (Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, 2008). Public procurement accounts for approximately 14% of the EU’s Gross Domestic Product (GDP), or an estimated €2 trillion per year, and spans the purchase of goods and services in key sectors such as energy, transport, health and education (Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs, n.d.). Implementing sustainable practices within public procurement therefore represents a significant opportunity in terms of environmental impact reduction, social benefits and progress towards a CE.

The EC has developed voluntary GPP criteria and recommendations to reduce the environmental impact of procured good and services for a number of product categories, including electronics and ICT equipment. Within these criteria, there is a focus on the purchasing of products following eco-design criteria such as design for durability, repairability and efficiency (Directorate-General for Environment, European Commission, 2022). It should be noted that, whilst GPP criteria are currently voluntary, there are proposals to implement some mandatory legal requirements that are relevant to this indicator, including the Proposal for Eco-design for Sustainable Products Regulation which includes requirements related to GPP (Directorate-General for Environment, 2022). Additionally, there is an indicator in the revised EU CE monitoring framework, targeting GPP. The indicator measures the share of public procurement procedures above the EU thresholds (in number and value), which include environmental elements (European Commission, 2023).

This indicator seeks to quantify an alternative measure of sustainability – the value of equipment and services purchased by the public sector that are either second-hand, refurbished or acquired through renting and leasing models. In doing so, it aims to provide a capability to track public spending over time and increase understanding of reuse and refurbishment of electronics equipment within EU Member States. Currently, Eurostat reports on financial innovation indicators within public sector procurement, but no metrics related to refurbished or rented equipment or procurement within the electronics and ICT sector are reported (Eurostat, 2017). On an EU level, it is expected that a small proportion of public institutions are purchasing electronics as a service, and even fewer are purchasing reused or refurbished electronics. This indicator aims to validate that assumption.

The benefits of measuring this indicator include:

- It would allow the EU public sector to demonstrate a best-practice approach to procurement that could then be emulated by the private and third sectors.
- It would provide an understanding of the current market and trends in the market for circular electronics and an indication of which product types have the most barriers to circularity.
- Encouragement of reuse and refurbishment of electronics will likely increase employment in the sector, contributing socially and economically to the local area.

4.1 KEY METHODOLOGY

4.1.1 Testing method

The methodology employed to test this indicator was desk-based research of public procurement records, and engagement with public procurement stakeholders to supplement where necessary. Public procurement records from public-sector organisations were accessed and reviewed for any equipment or services classified as second-hand, refurbished or purchased through renting and leasing agreements. EU procurement data was also accessed through Tenders Electronic Daily (TED) (Publications Office of the European Union, 2024).

For any information that was not available following the initial review, public procurement officials were contacted to support the case study by providing additional data or for interviews to understand the required data points.

The system boundary for this indicator is for public procurement of existing EU GPP product categories (Directorate-General for Environment, European Commission, 2022):

- Computers, monitors, tablets and smartphones.
- Data centres, server rooms and cloud services.
- Imaging equipment, consumables and print services.
- Electrical and electronic equipment used in healthcare sector – this product category has existing criteria but has been deemed outdated and not fit for purpose until further review of changes to the technological and regulatory landscape within this sector has been performed (Delre, La Placa, Alfieri, Faraca, & Kowalska, 2022).

Poland was selected as the primary geographical scope for testing this indicator, due to its high reported turnover and number of enterprises attributed to the repair of computers and personal and household goods (Eurostat, 2024). The reporting period was selected to be the most recent year for which complete data was available.

4.1.2 Data collection method

The required data points to test this indicator were:

- Total publicly purchased ICT equipment and services in the reporting year by value, P_{ALL} (Euros).
- Publicly purchased ICT equipment that is second-hand or refurbished by value, P_S (Euros).
- Publicly purchased ICT equipment that is purchased via a renting or leasing model by value, P_R (Euros).

Second-hand equipment is defined as any equipment that has been used prior to procurement. Rented or leased equipment is any equipment not purchased for an outright cost but through a regular payment, or for where it is clear that at the end of a defined period, the equipment is returned to the supplier. The two variables are independent of one another (i.e. P_S can include equipment purchased or rented, and P_R can include equipment that is of new or second-hand condition). A complete list of product inclusions is based on existing GPP product categories, including desktop computers, data centres and printing equipment. A full list of included products can be found in Appendix 6.5.

A data request was sent to the Polish Procurement Office (Public Procurement Office, 2024) aiming to understand how best to source the required data points and for guidance on how best to search the Polish public procurement database (Public Procurement Office, 2024). It was expected that there would be a time delay in receiving feedback from the contacted representatives. As such, the office was contacted at the start of the research process to gauge interest and capacity to participate in the research. This initial contact was made prior to the review of the procurement records in order to mitigate the risks of a delayed response.

Unfortunately, no satisfactory response was received from the initial stakeholder engagement despite follow-up efforts made, so a decision was made to contact stakeholders from two additional cities: Dublin in Ireland and Madrid in Spain. These cities were selected to investigate whether stakeholders at a municipality rather than national level would be more responsive. Additionally, the procurement websites of these cities provided a good level of information regarding the types of contract agreements detailed, and language barriers were minimal. Again, after a period of waiting, follow-up emails were sent but no satisfactory response was received.

Alternative stakeholders were then contacted for Catalonia in Spain and the combined region of Oslo and Viken in Eastern Norway. These regions were selected as their public procurement records contained more information regarding rental status and technical information about the procured equipment upon initial review. A more thorough review of records was conducted prior to contact with the stakeholders, to extract data on the awarded value, method of procurement (i.e. outright purchase, rental or lease) and equipment condition (i.e. new or second-hand) where available. This raw data is shown in Appendix 6.6. The stakeholders were then contacted to clarify information not contained within the records in the relevant databases. Unfortunately, no response was received from either stakeholder within the project timeframe.

The list of stakeholders contacted is shown in Appendix 6.7, with the template email used to make initial contact to all stakeholders included in Appendix 7. The stakeholders contacted were all government bodies or procurement officers.

4.1.3 Calculations

The indicator was calculated using the following formula, where P_{SUST} represents the sustainable procurement rate indicator as a percentage:

$$P_{SUST} = \frac{P_S + P_R}{P_{ALL}} \times 100$$

4.1.4 Timeline

Table 12 below presents the project timeline.

Table 12. Gantt chart for EICT3

Task	15th Jan	22nd Jan	29th Jan	5th Feb	12th Feb	19th Feb	26th Feb	4th Mar	11th Mar	18th Mar
Data requests sent to Polish public procurement stakeholders										
Desk-based review of public procurement records										
Data requests sent to Irish and Spanish public procurement stakeholders										
Analysis of data										
Reporting										

4.1.5 Data gaps and mitigation

Table 13 summarises the key data gaps encountered in testing this indicator, the associated strategy employed to mitigate the impacts of these gaps and the resultant level of confidence in the collected data.

Table 13. Overview of identified data gaps, limitations and mitigation efforts

	Description of data gap	Mitigation efforts	Level of confidence
1	All three required data points for the following regions and cities: Poland, Dublin in Ireland and Madrid in Spain.	• Initial contact with the selected group of stakeholders was made prior to the review of the procurement records in order to mitigate the risks of a delayed response. • Follow-up emails were sent to the stakeholders after a review of public procurement records to ensure required data was not readily accessible. Unfortunately, no suitable data was sourced for each of these three regions/cities, so additional regions were considered.	Low
2	Equipment condition (i.e. whether or not equipment was	• Following a review of the public procurement records for each of these regions and extraction of as much relevant data as possible, it was clear that details on condition of procured equipment were lacking. Emails were sent to relevant contacts	Medium

	Description of data gap	Mitigation efforts	Level of confidence
	procured new or second-hand) for the following regions and cities: Catalonia in Spain and Oslo and Viken in Norway.	at each of the procurement offices requesting additional information, which unfortunately was not received during the project timeframe. Although it is expected that the proportion of second-hand equipment procured is marginal, even compared to rented equipment, this volume is unknown and so reduces the level of confidence in the results.	

4.1.6 Quality review of analysis

To ensure robust and high-quality results, the following data validation and quality control procedures were conducted:

- Prior to work beginning, the Project Director reviewed the proposed research methodology and ensured that the data collection plan was fit for purpose. Once the research team had addressed any comments from the review process, they proceeded to the data collection phase.
- The Quality Assurance Manager held responsibility for the quality of the final case study output. The Project Manager assisted the Quality Assurance Manager in judging the quality of the output and suggesting ways to improve.

4.2 KEY ANALYSIS RESULTS

4.2.1 Analysis

As can be seen in the results presented in Table 14 and Figure 9, the overall rate of sustainable public procurement of electronics and ICT equipment and services is relatively low at 33% and 12% respectively for Catalonia and Oslo and Viken, with the caveat that the equipment condition for the majority of the reviewed records is unknown. In fact, equipment condition is only stated in records accounting for 12% and 1% by value for all relevant Catalan and Norwegian records, respectively. In both regions, the procurement of rented or leased equipment contributes more significantly to the sustainable procurement rate than the purchase of second-hand or refurbished equipment. This could indicate a preference or greater acceptance for leasing models over purchasing second-hand equipment in public procurement processes. Of the records where preferred equipment condition is described, acceptance of second-hand or refurbished equipment is only expressed in 30% of records by value within the Catalan sample, and in 0% within the Norwegian sample. The calculations performed therefore assume that for the remaining records where this is not mentioned, the equipment was acquired in a new condition.

The difference in the sustainable procurement rate between Catalonia (33%) and Oslo and Viken (12%) could reflect local procurement policies or awareness levels. This could suggest that regional strategies and policies significantly impact the adoption rates of sustainable procurement practices. The source data is shown in Appendix 6.6.

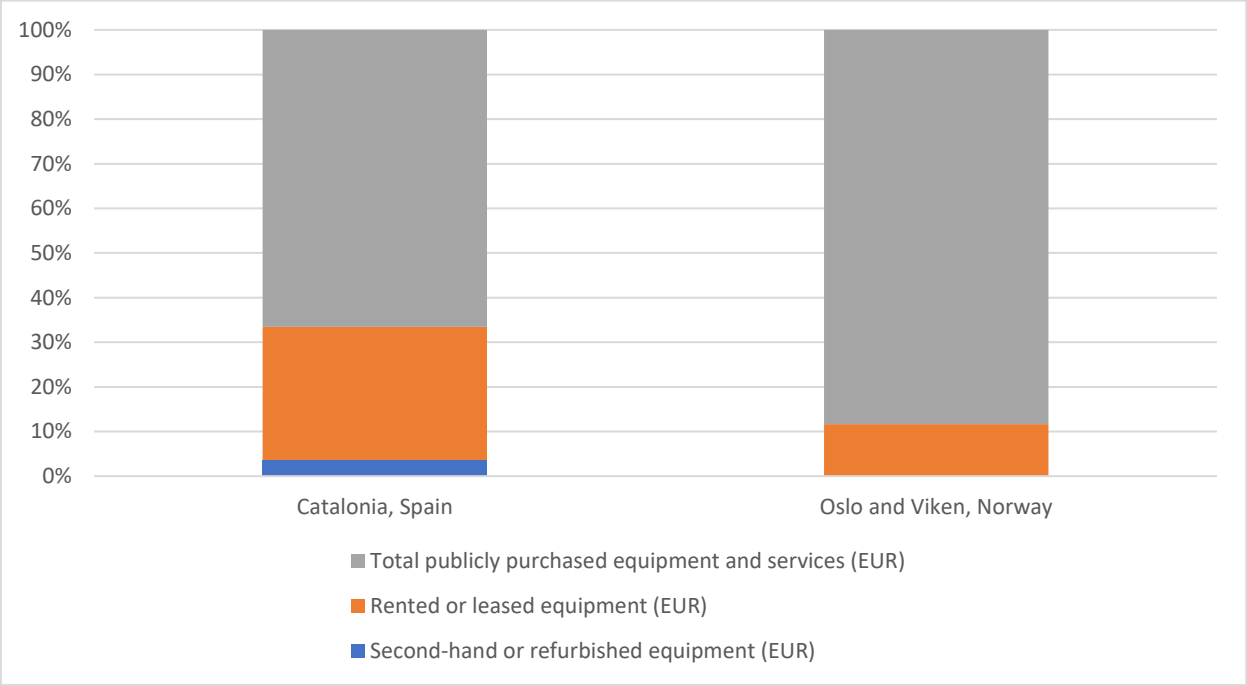
Of the 11 records reviewed from the Catalan procurement database, a single record accounts for 38% of the total awarded contract value. This contract, “Mixed Supply, assembly and sceno-technical equipment works Teatre La Unió”, details the procurement of number of equipment batches of unknown condition, via outright purchase. Only one of these batches is applicable to the product category inclusion list detailed in Appendix 6.5. Therefore, this single contract was removed from this analysis. This highlights how high-value contracts can significantly skew data and potentially mask the overall trends in sustainable procurement practices. The contract value of the Norwegian records reviewed was more evenly distributed, with no single contract exceeding 19%.

Of the records with a leasing procurement method identified, the procured equipment is a combination of large screens, lighting systems and printing, copying and scanning machines. This may suggest that leasing models are more prevalent or preferred in equipment within these technology areas, perhaps due to the physical size of the procured equipment.

Table 14. Sustainable procurement results for the two investigated regions for 2023

Procurement Category	Catalonia, Spain	Oslo and Viken, Norway
Second-hand or refurbished equipment (EUR)	67,226.50	0.00
Rented or leased equipment (EUR)	554,293.70	8,180,758.60
Total publicly purchased equipment and services (EUR)	1,855,737.40	70,195,217.81
Sustainable procurement rate (%)	**33%**	**12%**
Equipment condition stated in records by value (EUR)	222,219.87	636,276.68
Equipment condition stated in records by value (%)	12%	1%
Of records with condition specified (used %)	30%	0%

Figure 9: Graph of sustainable procurement results for the two investigated regions for 2023



4.2.2 Limitations

The limitations included:

- As described above, information on the equipment condition was very rarely mentioned in the reviewed procurement records. In fact, equipment condition was not stated in records accounting for 88% and 99% by value for relevant Catalan and Norwegian records, respectively. The calculations performed assume that for the records where this is not mentioned, the equipment was acquired in a new condition – however, this may not be an accurate assumption. The assumption that equipment was new if its condition was not stated could significantly skew the sustainable procurement rate, so conclusions drawn from this limited analysis should be considered low confidence. This assumption does not account for cases where refurbished or second-hand equipment is procured without explicitly stating the condition.
- In order to extract the required data from the reviewed records, supporting documentation such as technical specifications had to be manually reviewed for a high volume of procurement records. Each of these documents varied in length and format, and there is a chance that required information may have been missed or incorrectly reported. Additionally, although each of the procurement records offered good

translation options, the supporting documentation had to be manually translated using a third-party resource. There is therefore a risk that the accuracy of this translation may impact the accuracy of the data extracted.

- The reliance on manual review and extraction of data from procurement records and supporting documents introduces a level of subjectivity, particularly in interpreting ambiguous descriptions of equipment condition or specifications. This subjectivity could affect the consistency and accuracy of the data.
- Filters were applied in each of the procurement databases to only display records for procurement of the relevant electronics categories in Appendix 6.5. However, the filters in each case did not align with the GPP product categories used to define the inclusion list. The applied filters are shown in Appendix 6.9. Additionally, within individual contracts, it was not uncommon for multiple product categories to be specified, with many contract values including a proportion allotted to products that fall outside of the inclusion list. A manual check was conducted during the review of each record to ensure that it only contained applicable equipment, or to extract the awarded value allotted to only relevant products, but due to the quantity of records reviewed, there is a possibility that some records were included or excluded erroneously.
- The review of EU procurement records using the TED database, following the review of each region's procurement database, was not comprehensive due to time restrictions during the testing phase of this case study. This may mean that some electronics and ICT procurement, from records stored within the TED database but not within each regional database, may not be included in the results.
- The indicator's focus on procurement method and equipment condition could inadvertently encourage practices that are not truly sustainable, such as leasing equipment that is less energy efficient or refurbishing in ways that extend lifespan but increase overall resource consumption or emissions intensity. The indicator might need to be part of a broader set of metrics to fully capture the sustainability of procurement practices (such as energy efficiency, lifecycle emissions, end of life management etc.), and should be considered in addition to the alternative GPP criteria and requirements described elsewhere in this report.

4.2.3 Performance

Table 15 summarises the Relevance, Acceptability, Credibility, Ease and Robustness (RACER) evaluation of the indicator at the end of before and after completion of Task 5, where 1 (red) corresponds to a poor score, 2 (orange) a neutral score and 3 (green) a good score. The initial assessment proved to be a fairly accurate assessment of this indicator and as such there is only minimal variation in scoring. Justifications for each criterion are given below:

- **Relevance –** Accurate calculation of the proposed indicator would measure, and in turn could be used to incentivise, circular public procurement of a key product sector at the high value-added levels of reuse, refurbishment and Product-Service Systems (PSS). This has implications for wider circularity such as increasing procurement of products that have been designed with longevity and durability prioritised. A proposed indicator named 'Green Public Procurement', which assesses public procurement including environmental elements more broadly, is included in the EC Circular Economy Monitoring Framework which further supports the relevance of the indicator presented in this report (Eurostat, 2024). Therefore, the scoring was updated from 1 to 3.
- **Acceptability –** The low response rate from the contacted procurement stakeholders suggests that there is little motivation or requirement for public procurement databases to record the required information to calculate the indicator, as expected in task 4.
- **Credibility –** The methodology to calculate the indicator is straightforward and easy to communicate to stakeholders, requiring 3 data points of the same measurement unit (Euros, or alternative local currency). Therefore, the score was left unchanged at 3.
- **Ease –** As discussed, the key variables required to calculate the indicator are not readily identifiable within procurement records. In many cases, supporting technical documentation must be reviewed in order to extract the information, which is a time-consuming and error-prone process. Procurement method is specified more often than equipment condition, which is rarely stated explicitly and stakeholder engagement to verify and supplement extracted information proved to be challenging for all member states contacted. This is why the scoring of this criterion was left unchanged at 1.

- **Robustness –** Although the indicator calculation methodology is straightforward, there is a degree of subjectivity and room for error that is introduced in the data collection process, as expected in Task 4. For example, in many cases, contracts cover procured equipment from a combination of product categories, both from within and outside of the defined inclusion list. Care must be taken to extract the contract value allotted only to applicable equipment, but due to the volume of records and supporting documentation required to determine the indicator for a member state over a full reporting year, there is an increased likelihood that some records are included or excluded erroneously.

Table 15. RACER evaluation

Stage of project	RACER criterion					Score
	Relevance	Acceptability	Credibility	Ease	Robustness	
Task 4 (original RACER assessment)	1	1	3	1	2	8
After Task 5 (following testing)	3	2	3	1	2	11

4.3 CHALLENGES AND LESSONS LEARNED

4.3.1 Challenges

The primary challenge identified in testing this indicator is that the key variables defined in Section 4.1.2, procurement method and equipment condition, are not readily identifiable within procurement records. Ideally, they would be stored as variables alongside other key information such as the bid value and publication date, but this is not the case. In some instances, this information is recorded in supporting documentation, however this is not guaranteed. Documentation was translated and manually reviewed to extract pertinent information and record equipment condition and procurement method where possible. However, inconsistencies in format and contents of this documentation raise concerns over scaling this method to larger procurement record quantities.

Where provided, supporting documentation was found to more likely specify procurement method than equipment condition, which is very rarely stated explicitly in the record as previously mentioned. A preliminary review of literature for equipment condition of publicly procured goods proved to be unsuccessful, so it was assumed that, where this variable was unspecified, the equipment was procured in a new condition.

Stakeholders were engaged to gain clarification around this missing information, but the response rate of those contacted was low, as shown in the contact log in Appendix 6.7. Various measures were taken to try to mitigate the effect of this challenge, including issuing follow-up emails to stakeholders and expanding the geographical scope of the case study to an additional four regions. The single response received suggested that regional or municipality-level procurement offices are more likely to be resource-constrained, and that data collection for this indicator is better directed at the national-level. However, at this scale, the data volume and therefore the time required to manually extract the required data becomes significant.

An additional challenge encountered was the consideration of outliers when analysing and drawing conclusions from the procurement data. High-value contracts have the potential to skew results and potentially mask trends in sustainable procurement practices. Within the Catalonian procurement records reviewed, a single contract accounted for over a third of total contract value, before it was removed from the dataset.

Furthermore, this indicator is subject to market availability of second-hand and refurbished equipment solutions. There will be significant variation in procurement practices, regulations and market readiness for solutions across Member States. This diversity could pose a challenge to the application of the indicator, the development of targets and the comparison of the indicator across Member States.

4.3.2 Lessons learned

The key lessons learned from conducting this case study are summarised below:

- Procurement method and condition of procured electronics and ICT equipment are generally not readily identifiable variables within public procurement records. In some regional procurement databases, this information is not held for any record, whilst in others it may be captured in the bid description or in supporting documentation attached to the record.
- The contents and format of supporting documentation vary from record to record, slowing manual extraction of the required data points. The documentation is typically stored in the local language of the relevant regional database, requiring a secondary translation step which further adds to the time required to complete data extraction.
- Procurement records are more likely to store information about procurement method than equipment condition, in either supporting documentation or within the records themselves.
- Regional or municipality-level procurement offices are perhaps more likely to be resource-constrained than national-level procurement offices, and therefore less likely to be able to provide supplementary information about individual procurement records. Reviewing national-level procurement databases, however, raises concerns about the ease of accurately and robustly completing the data collection required to calculate this indicator.

4.4 CONCLUSIONS AND RECOMMENDATIONS

It is recommended that this indicator is considered for further development, with significant work required to facilitate its progress.

The results calculated from the data collected in this case study suggest that the overall rate of sustainable public procurement of electronics and ICT equipment and services within the tested regions is relatively low, with the caveat that the equipment condition for the majority of the reviewed records is unknown.

The indicator received a mid-score for suitability for further development across the EU. Calculation of the indicator would measure, and in turn could be used to incentivise, circular public procurement of a key product sector at the high value-added levels of reuse, refurbishment and PSS. This has implications for wider circularity such as increasing procurement of products that have been designed with longevity and durability prioritised. The methodology to calculate the indicator is straightforward and easy to communicate to stakeholders, requiring a small number of data points of the same measurement unit. On the other hand, there is a degree of subjectivity and room for error that is introduced in the data collection process, regarding product inclusion classifications for example. Other challenges facing further development of this indicator are low engagement rates from procurement stakeholders and low availability of required data points. In many cases, supporting technical documentation must be reviewed in order to extract the information, which is a time-consuming and error-prone process.

The variables required to calculate the rate of sustainable procurement of electronics and ICT equipment and services within any given Member State, procurement method and equipment condition, are not readily identifiable within procurement records. Ideally, this information would be stored as variables alongside other key data such as the bid value and publication date, but this is not the case. In some instances, this information is recorded in supporting documentation, however this is not guaranteed. Additionally, inconsistencies in format and contents of this documentation raise concerns over scaling this method to larger procurement record quantities. It is therefore recommended that a number of improvements are made to the current method of recording procurement data, to enable robust and reliable usage of this indicator across the EU as a measure of sustainable public procurement. These recommendations are summarised in Table 16.

Following the testing of this indicator, it was found that its original name ‘ICT equipment and services purchased by the public sector that are either second-hand/refurbished or acquired through renting/leasing models’ was fit for purpose and that no variation was needed.

Table 16. Summary of recommendations for EICT3

Type of recommendation	Recommendation	RACER Criteria addressed	Timeline	Key stakeholders or partners
Legislation	Adapt legislation to require state-level procurement offices to record details of equipment condition and procurement method within bid details or supporting documentation.	Ease and Robustness	Medium (1.5 – 5 years)	EC
Legislation	Stipulate that procurement method and condition of procured equipment is recorded in national procurement databases, in readily identifiable, discrete data fields, alongside other key information such as the bid value and publication date.	Relevance, Ease and Robustness	Medium (1.5 – 5 years)	EC
Legislation	Require that procurement records are broken down into product categories such as lighting products, electronic displays, heating and cooling products, etc.	Ease and Robustness	Medium (1.5 – 5 years)	EC
Stakeholder support	Support procurement stakeholders within Member States to collect data from public sector organisations at point of entry of bid information into database systems.	Acceptability, Ease and Robustness	Medium (1.5 – 5 years)	EC, member state procurement offices, public sector bodies
Stakeholder support	Support procurement stakeholders within Member States with technical guidance regarding recording of the required data points.	Acceptability, Ease and Robustness	Medium (1.5 – 5 years)	EC, member state procurement offices
Target-setting	Development of a target minimum percentage of public procurement, by value, that meets the GPP criteria captured by this indicator. Differences in procurement practices, regulations and market readiness for second-hand and refurbished equipment solutions between Member States should be considered in the development of these targets.	Credibility	Medium (1.5 – 5 years)	EC

Type of recommendation	Recommendation	RACER Criteria addressed	Timeline	Key stakeholders or partners
Promotion	Promotion of the benefits of sustainable procurement models to both public sector buyers and suppliers to develop market availability of second-hand and refurbished equipment solutions and uptake of leasing models.	Acceptability	Medium (1.5 – 5 years)	EC, public sector buyers, equipment suppliers
System development	Development of a dedicated platform to enable Member States to self-report GPP purchases and record sustainability data such as procurement method and equipment condition.	Acceptability, Ease and Robustness	Long (> 5 years)	EC

5. INDICATOR 4: SHARE OF CONSUMER ELECTRONICS FULFILLING ECODESIGN CRITERIA

For this indicator, the definition of ecodesign is taken as “the integration of environmental sustainability considerations into the characteristics of a product, and into processes throughout its value chain” (European Parliament, 2024). Consumer electronics are defined as “electronic products that are bought by people for their own use” (Cambridge Dictionary). Finally, the term ‘producer’ is used throughout this case study to refer to any organisation that places product on the market in the EU (i.e. including those organisations that manufacture and sell their own product, organisations that sell another brand’s products, importers of product and other authorised representatives).

The EU is increasingly focused on ecodesign as a concept. Currently, 31 energy-related products are subject to a range of voluntary and mandatory criteria and energy labelling requirements (European Commission).[6] However, in 2022, a proposal for a new ecodesign regulation, the Ecodesign for Sustainable Products Regulation (ESPR), was published which would extend these requirements beyond energy-related products to almost all products placed on the market within the EU (European Parliament, 2023).

When products are manufactured with ecodesign in mind, they generally have a lower environmental impact due to factors including the products being:

- More energy efficient, therefore resulting in lower energy use over its lifecycle.
- Easier to repair or upgrade, meaning an extended lifespan.
- Easier to disassemble, meaning that materials can be effectively valorised at end of life.

As such, it is important for the EU to understand the current rate of adoption of ecodesign criteria, so that any product categories or producers that may be lagging behind can be identified and addressed. Currently, EU Member States are responsible for monitoring compliance with the EU’s conformity schemes, though non-compliance is not always well understood because those producers may not be willing to readily report their non-compliance.

The benefits of measuring this indicator include:

- Tracking levels of compliance will allow the EU to make interventions in the market when required.
- Greater levels of compliance with ecodesign criteria are expected to result in lower environmental impacts for the sector due to lower energy usage, extended lifespans and greater material recovery.
- If products can be kept in use for longer, fewer new products will be required, reducing resource costs and the amount of waste that is produced.
- Encouragement of ecodesign principles could lead to a rise in other circular business strategies such as product-as-a-service and takeback at end of life.

5.1 KEY METHODOLOGY

5.1.1 Testing method

The country selected for the testing of this indicator was Estonia, due to their relatively high rate of waste electrical and electronic equipment (WEEE) recycling, as well as their involvement in an EU-funded study to embed circular design thinking in the market (Interreg, 2019). Initially, the indicator was selected for testing at a national level however, this was adjusted to an organisational level in order to obtain more complete results.

The methodology selected for the indicator testing was to survey the national electronics producers register, compliance schemes and individual companies. However, this proved challenging and therefore the decision was made to transition to desk-based research, with emails sent to the organisations under study to gain a greater level of understanding as to their products and any ecodesign activities that had been undertaken.

The initial data collection plan stipulated that the scope of this indicator should be limited to those new products placed on the market in 2023. However, in practice it was often not known when a product was introduced, and this could also risk the exclusion of older product models that may not have been redesigned following the

[6] Please see Appendix 6.11 for an overview and example of specific ecodesign requirements.

implementation of ecodesign requirements. Therefore, for the purposes of testing this indicator, the full product catalogue of the organisations under study was reviewed.

In terms of product scope, there are 31 different product categories that currently have ecodesign requirements. The initial testing method was to select two product categories for study in order to better understand the intricacies of ecodesign on a smaller scale at this stage. However, due to challenges faced engaging with stakeholders, this method was revised to cover all the products sold by the organisations under study. In practice, the vast majority of these were air heating and cooling products, for which ecodesign requirements cover energy performance, energy efficiency and nitrous oxide emissions (European Commission, 2018).

5.1.2 Data collection method

The data required for this indicator is as follows:

- Name of the product.
- Type of product.
- Whether it has received a conformity assessment.
- Whether it has fulfilled ecodesign requirements.
- Which ecodesign requirements it has fulfilled.

As stated above, the initial plan for this indicator was to measure it at a national level using the Estonian Probleemtooteregister (Register of Products of Concern, or PROTO) (Estonian Ministry of Environment). PROTO is a register of all producers who either manufacture or import certain products including Electrical and Electronic Equipment (EEE). In Estonia, producers can either report directly to PROTO or via a compliance scheme, and must report the quantities of EEE placed on the market each year, while compliance schemes also report the quantities of WEEE handled and treated. PROTO and the identified compliance schemes were emailed in order to understand what information they collect and whether they would be interested in engaging further. However, there was limited response from these stakeholders. Only PROTO responded to state that they would be unable to help with this project, but stated that the Ministry of Climate may be better placed to help. An email was sent to the Ministry of Climate but again, no response gained.

Following the findings from this initial research period, it was determined that it would be time and resource-intensive to study this indicator at a national level for the scope of this project. As such, a decision was made to alter the indicator so that it would now be studied at an organisational level. PROTO was used to identify relevant producers, and emails sent out to understand their readiness to engage with the project. An example of the emails sent to producers can be found in Appendix 6.12. Again, no response was obtained from any producer, and so instead a desk-based research exercise was undertaken to review the selected producer's catalogue in order to understand what products had undergone ecodesign testing.

The chosen producer was screened for the following criteria:

1. Valid member of an Estonian compliance scheme and on the PROTO register
2. Listed on PROTO as only selling one category of product[7] to limit complexity of ecodesign criteria
3. Sells at least 50 products to ensure robust sample size
4. Has manufacturers' guidance/operations manuals/safety information provided on website

The chosen organisation was Systemair, a manufacturer of heating, cooling and ventilation equipment.

A data collection spreadsheet was set up to record the results. This document can be found in Appendix 6.13.

The desk-based research methodology comprised the following steps:

1. Produce a list of all products on sale that fall under the scope of the indicator sub-theme. This meant the inclusion of any product that carries an electrical charge or requires electrical power to function,

[7] The complete categories on PROTO are as follows: EES: "Electrical and electronic equipment"; EES1: "Heat exchange equipment"; EES2: "Screens"; EES3: "Lamps"; EES4: "Large devices (with any external dimension exceeding 50 cm)"; EES5: "Small devices (whose external dimensions do not exceed 50 cm)"; EES6: "Small information technology and telecommunications equipment (whose external dimension does not exceed 50 cm)"; EES4a: "Solar panels"; PAT; "Batteries and accumulators"; PATk: "Portable batteries and accumulators"; PATt: "Industrial batteries and accumulators"; PATa: "Motor vehicle batteries and accumulators"; REH: "Tires"; REH1: "M1 and N1 category motor vehicle tires"; REH2;"M2, M3, N2 and N3 category motor vehicle tyres"; REHe: "Special purpose motor vehicles; REHm: "Other tires"; SECTION: "Motor vehicle parts"; POL: "Agricultural plastic"; MOT: "Motor vehicles"

and the exclusion of product categories like air vents and ducts, fire dampers where no charge passes through the product, and filters. This was conducted by reviewing the producer's 'products' directories on its website and identifying the relevant items.

2. Review the information on ecodesign specifications directly available on the product's webpage.
3. If information on ecodesign compliance is not directly available, review the additional documentation to identify a declaration of conformity or any manual with compliance information included.
4. If information on ecodesign compliance is found, complete the data collection spreadsheet with the product name and link and any specific information such as the category or year of compliance.
5. If no additional information is found, complete the product name and state that the compliance status is unknown.
6. If products are specifically noted as being non-compliant or not relevant to the regulations on the product's webpage, include this in the data collection spreadsheet.

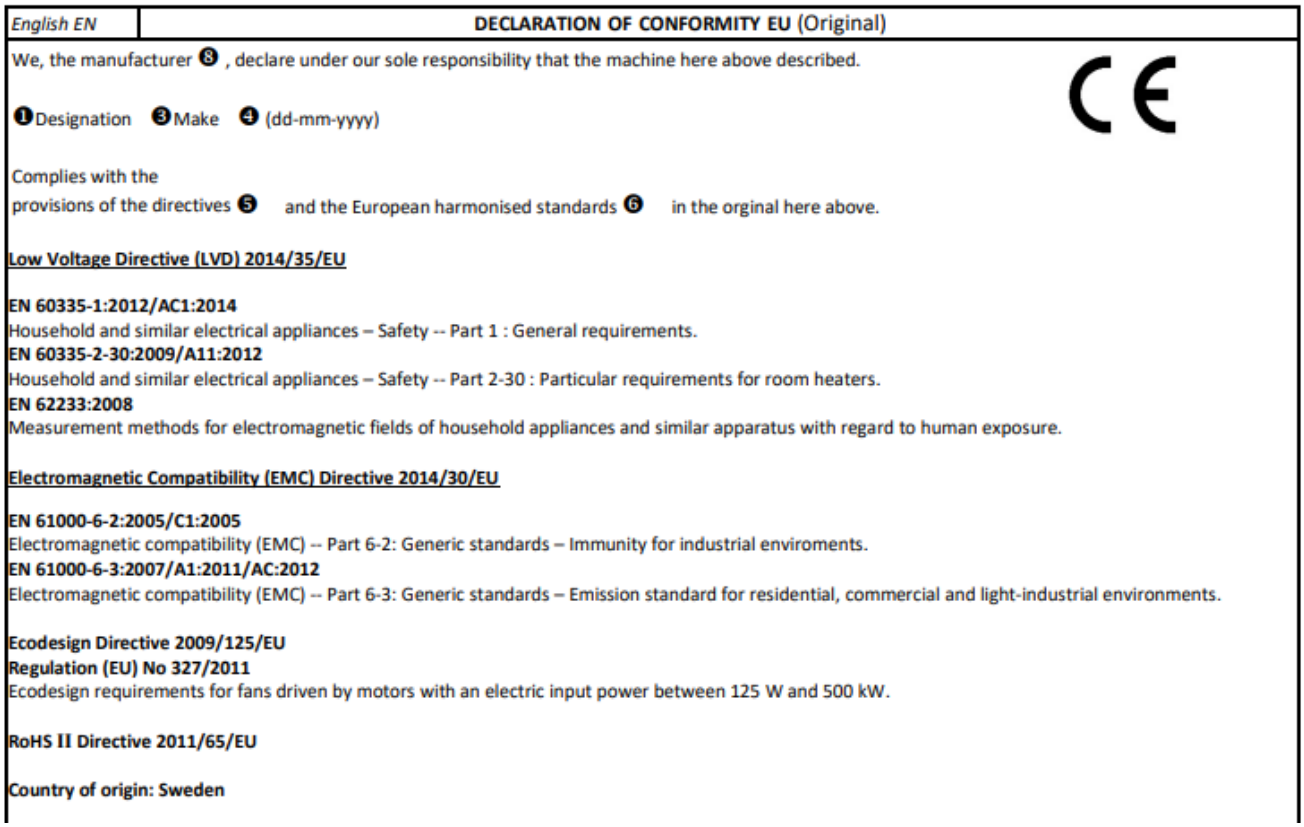
Figure 10 below presents an example of ecodesign information found on a company under study's website and Figure 11 an example of declaration of conformity.

Figure 10. Example of ecodesign information

Ecodesign

ErP compliance	2018	
Unit category	NRVU	
Drive	Integrated VSD	
Unit type	UVU	
Heat recovery type	None	
Temperature ratio (UVU)	Not applicable	
qv nom	0.3586	m^3/s
P nom	0.169	kW
Ps nom	241	Pa
Fan efficiency	51.2	%
External Leakage	5	%
Sound power (LWA)	41	dB(A)

Figure 11. Example of declaration of conformity



English EN | **DECLARATION OF CONFORMITY EU** (Original)

We, the manufacturer ❽ , declare under our sole responsibility that the machine here above described.

CE

❶Designation ❸Make ❹ (dd-mm-yyyy)

Complies with the
provisions of the directives ❺ and the European harmonised standards ❻ in the orginal here above.

Low Voltage Directive (LVD) 2014/35/EU

EN 60335-1:2012/AC1:2014
Household and similar electrical appliances – Safety -- Part 1 : General requirements.
EN 60335-2-30:2009/A11:2012
Household and similar electrical appliances – Safety -- Part 2-30 : Particular requirements for room heaters.
EN 62233:2008
Measurement methods for electromagnetic fields of household appliances and similar apparatus with regard to human exposure.

Electromagnetic Compatibility (EMC) Directive 2014/30/EU

EN 61000-6-2:2005/C1:2005
Electromagnetic compatibility (EMC) -- Part 6-2: Generic standards – Immunity for industrial enviroments.
EN 61000-6-3:2007/A1:2011/AC:2012
Electromagnetic compatibility (EMC) -- Part 6-3: Generic standards – Emission standard for residential, commercial and light-industrial environments.

Ecodesign Directive 2009/125/EU
Regulation (EU) No 327/2011
Ecodesign requirements for fans driven by motors with an electric input power between 125 W and 500 kW.

RoHS II Directive 2011/65/EU

Country of origin: Sweden

5.1.3 Calculations

Once all relevant products were identified and any fulfilment of ecodesign criteria noted, the final indicator results were calculated by summing the number of products which fulfilled the criteria.

5.1.4 Timeline

Table 17 below shows the timeline for this indicator.

Table 17. Gantt chart for EICT5

	01-Jan	15-Jan	29-Jan	12-Feb	26-Feb	11-Mar	25-Mar
T1 - Develop and agree scope of indicator							
T2 – Engagement with relevant stakeholders							
T3 - Conduct desk-based research of ecodesign products							
T4 - Conduct analysis of themes/trends							
T5 - Write up case study template							

5.1.5 Data gaps and mitigation

As noted above, there were significant challenges related to the collection of data for this metric. These are outlined in more detail below:

- **Lack of response from stakeholders:** No responses were gained from the stakeholders that were engaged with the exception of PROTO, who responded to state that they would be unable to support this study. The stakeholders were chased at least once when feasible, but this did not aid engagement. In order to mitigate this data gap, the scope of the indicator was reduced from a national level to an organisational level, and producers contacted directly. This still did not yield any results, so a desk-based research exercise was undertaken instead to gain as many meaningful insights as possible.
- **Lack of reporting of conformity information on websites:** When desk-based research was conducted; a number of producer organisations were screened out of scope of the assessment as they did not provide information on the conformity assessments undertaken on their websites.
- **Language barriers:** This may have also limited the efficiency of the stakeholder engagement and desk-based research activities. In-browser translations were sometimes available for web pages in Estonian though others were fed through Google Translate. It is acknowledged that these translations may not have provided perfect translations.
- **Unwillingness to report non-compliance:** Another data gap may have been that companies were unlikely to willingly report non-compliance. For those companies who did not publish any information on their conformity assessment, given that no response was received to the team's engagement, it is not known whether the conformity information was simply not available online or if no conformity testing had occurred in the first place. This may have resulted in over-inflated totals if the companies that have performed the relevant testing are the most likely to state as such.

Table 18. Overview of identified data gaps, limitations and mitigation efforts

	Description of data gap	Mitigation efforts	Level of confidence
1	The stakeholders contacted either did not answer, or they could not provide the information needed.	• Stakeholders contacted were chased at least once where feasible via email. • Requested to be put in touch with a colleague/ alternative contact who may have access to the requested data. • Further desk research was conducted to explore the use of alternative data sources.	Medium
2	Some stakeholders did not publish easily accessible conformity assessment information.	• Stakeholders were contacted via email to understand what additional information they could provide, but no responses were obtained. • At this stage in the testing of this indicator, these stakeholders were screened out of the assessment in favour of those with more complete records.	Medium
3	Language barriers limited efficiency of stakeholder engagement and desk-based search.	• In-browser translation functions were used for web pages in Estonian where possible. However, these translations may not be perfect. • Google Translate was used where in-browser translation was not possible.	High
4	Non-compliant stakeholders unlikely to report.	• Only stakeholders who provided compliance information on their websites were included in the results. • No further mitigation was possible due to a limited understanding of the degree of non-compliance. Further work should be undertaken to better engage with producers.	Low

5.1.6 Quality review of analysis

To ensure robust and high-quality results, the following data validation and quality control procedures were conducted:

- Prior to work beginning, the Project Director reviewed the proposed research methodology and ensured that the data collection plan was fit for purpose. Once the research team had addressed any comments from the review process, they proceeded to the data collection phase.
- The Project Manager was kept informed of the updates to the data collection plan and approved any changes before they were finalised.
- The Quality Assurance Manager held responsibility for the quality of the final case study output. The Project Manager assisted the Quality Assurance Manager in judging the quality of the output and suggesting ways to improve.

5.2 KEY ANALYSIS RESULTS

5.2.1 Analysis

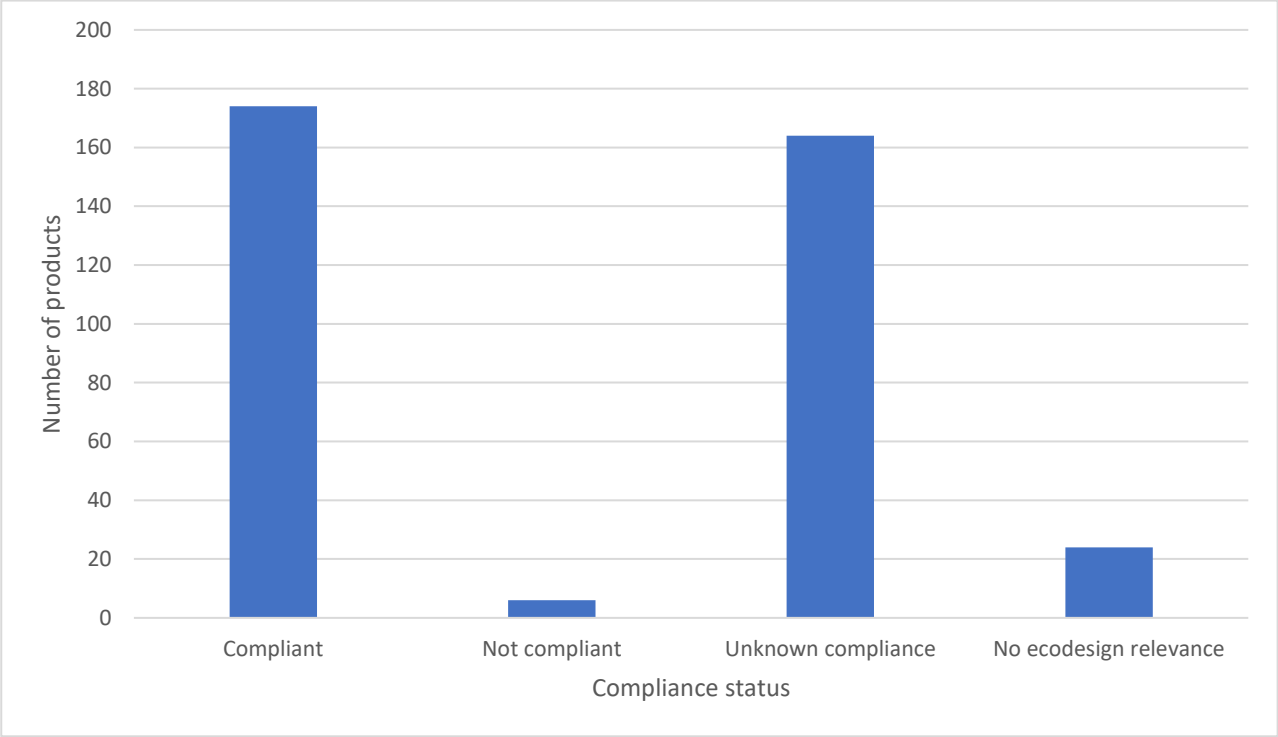
Table 19 below presents the high-level results of this indicator. A total of 368 products were assessed across the chosen organisation Systemair's product lines. As can be seen around half of the products under study for this indicator (47%) were confirmed to be compliant with the EU's ecodesign regulations. For 24 of the products (7%), the information provided specified that they were not subject to any ecodesign regulations, and in 6 cases (2%), it was explicitly noted that the products were not compliant in the EU and should therefore not be purchased for use within any EU Member States. The remaining 45% of products could not be definitively stated to be compliant or non-compliant, due to a lack of available information on the webpages.

Table 19. Results of EICT5

Compliance	Number	Percentage of total
Compliant	174	47%
No ecodesign relevance*	24	7%
Not compliant**	6	2%
Unknown compliance***	164	45%
Total	**368**	**100%**

*Notes: * Products which were specifically noted on the website as not being subject to ecodesign regulations. ** Products which were specifically noted on the website as not being compliant with ecodesign regulations and thus should not be bought for use in the EU. *** Products for which compliance could neither be confirmed nor denied.*

Figure 12. Results of EICT5



These results can be split into the various product types sold by the producer, as seen in Table 20 below.

Table 20. Results for EICT5 split by product type

Product type	Number of products	Compliant	Not compliant	Unknown compliance	No ecodesign relevance
Actuators and transformers	24	3.8%	-	1.1%	1.6%
Air conditioners	18	2.4%	-	-	2.4%
Air curtains	13	0.3%	-	2.7%	0.5%
Air Handling Units	7	1.9%	-	-	-
Air valves	10	0.3%	-	0.8%	1.6%
Axial fans	2	-	-	0.5%	-
Ceiling fans	3	-	-	0.5%	0.3%
Centrifugal fans	14	1.6%	0.3%	1.9%	-
Chillers	3	-	-	0.8%	-
Condenserless units	19	-	-	5.2%	-
Condensing units	17	0.8%	0.5%	3.3%	-
Controls	11	2.7%	-	0.3%	-
Cooker hoods	1	-	-	0.3%	-
Dampers	1	-	-	0.3%	-
Diffusers	6	-	-	1.6%	-
Domestic fans	2	-	-	0.5%	-
Duct fans	10	0.8%	0.5%	1.4%	-
Fan coil units	11	2.4%	-	0.5%	-
Fan heaters	5	0.3%	0.3%	0.8%	-

Product type	Number of products	Compliant	Not compliant	Unknown compliance	No ecodesign relevance
Freecooling	3	-	-	0.8%	-
Geothermal systems	5	0.3%	-	1.1%	-
Heat pumps	2	-	-	0.5%	-
Jet fans	1	-	-	0.3%	-
Radiant heaters	20	5.4%	-	-	-
Radiators	24	6.3%	-	0.3%	-
Residential diffusers	77	7.3%	-	13.6%	-
Roof fans	7	-	-	1.9%	-
Split systems	4	-	-	1.1%	-
Vacuum systems	23	4.3%	-	1.9%	-
Valves	20	4.9%	-	0.5%	-
VRF systems	5	1.4%	-	-	-
Total	**368**	**47%**	**2%**	**45%**	**7%**

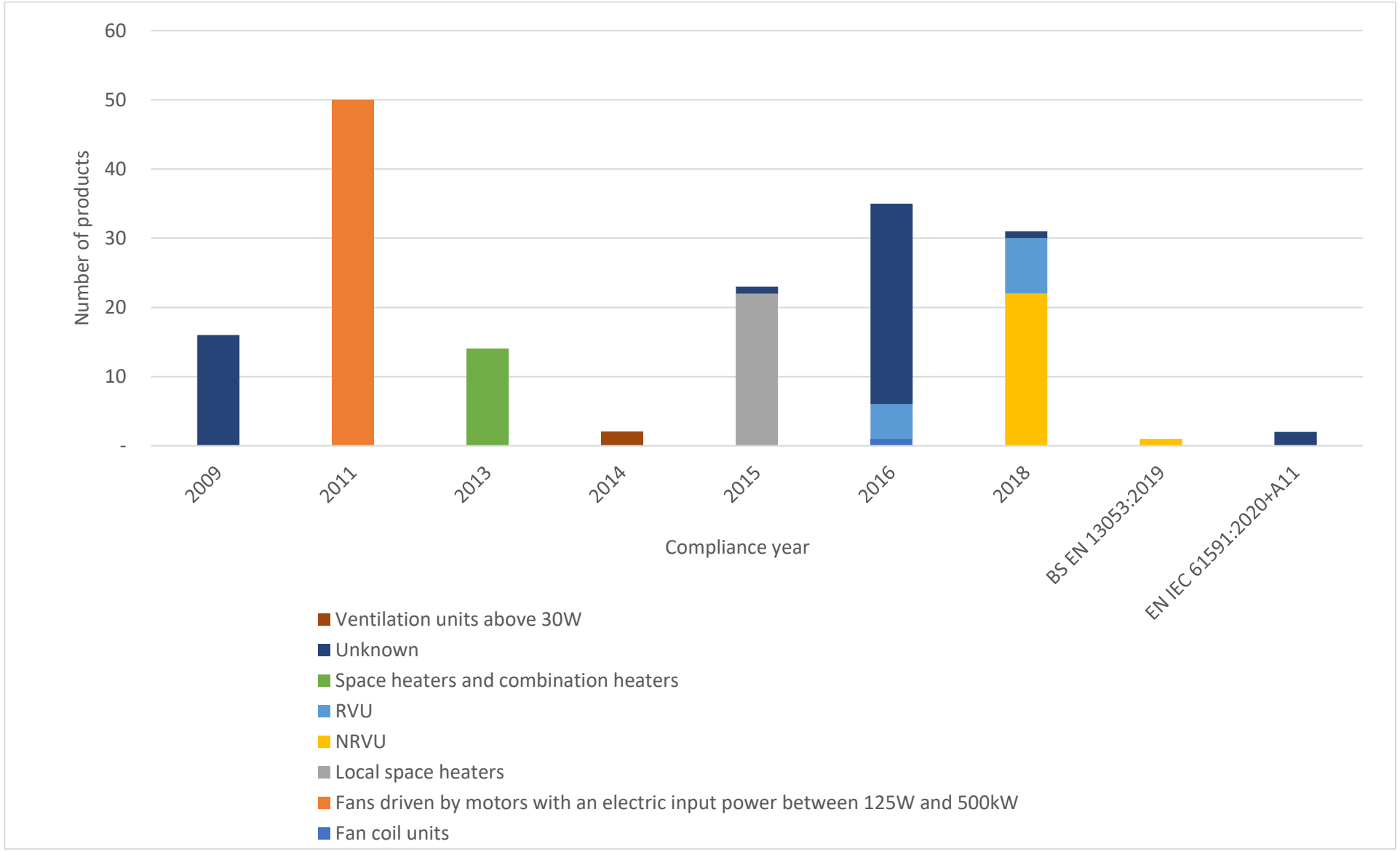
Finally, the results for the products for which compliance could be confirmed have been further split out into the specific requirements and most recent year against which the product was assessed. These results are presented in the Table 21 below.

The majority of products which could be confirmed to be compliant stated which specific requirements and most recent year of regulation they were compliant to. However, there were some products which, while a declaration of conformity was provided, it was not specified which requirements they were assessed against. Additionally, there were three products which were stated to be compliant, but the specific category and regulation year were not provided in lieu of the standards they were assessed against; these have been noted for completeness.

Table 21. Results of EICT5 by compliance category and most recent known year of compliance

Compliance category	2009	2011	2013	2014	2015	2016	2018	BS EN 13053:2019	EN IEC 61591:2020+A11
Fan coil units	-	-	-	-	-	0.6%	-	-	-
Fans driven by motors with an electric input power between 125W and 500kW	-	28.7%	-	-	-	-	-	-	-
Local space heaters	-	-	-	-	12.6%	-	-	-	-
NRVU	-	-	-	-	-	-	12.6%	0.6%	-
RVU	-	-	-	-	-	2.9%	4.6%	-	-
Space heaters and combination heaters	-	-	8.0%	-	-	-	-	-	-
Unknown	9.2%	-	-	-	0.6%	16.7%	0.6%	-	1.1%
Ventilation units above 30W	-	-	-	1.1%	-	-	-	-	-
Total	**9.2%**	**28.7%**	**8.0%**	**1.1%**	**13.2%**	**20.1%**	**17.8%**	**0.6%**	**1.1%**

Figure 13. Results of EICT5 by compliance category and most recent known year of compliance



5.2.2 Limitations

As stated above, a major limitation for this indicator revolves around the sensitive nature of asking organisations to potentially report non-compliance. It is thought that producers who are currently non-compliant with the ecodesign criteria will have been very unlikely to engage with the study due to the fear that admitting non-compliance could result in additional fees or penalties. This limits the conclusions that can be drawn from this indicator. Additionally, the data collection process heavily relies on self-reported data from companies, which might lead to over-reporting of compliance due to reputational concerns. Self-reporting bias can skew the results and may not accurately reflect the actual level of ecodesign compliance in the industry.

A number of the organisations that were reviewed as potential case studies did not include any conformity information on their websites and were also not responsive to emails. It is not known whether the missing conformity information exists but is stored privately, or whether the products have not undergone conformity testing. Further bespoke and sensitive engagement with stakeholders will likely be required to obtain a fuller picture of ecodesign.

Due to the relative lack of available data, it was not thought possible to undertake any extrapolation to estimate national level data because it was found that the level of uncertainty involved in this testing would not yield robust enough results.

5.2.3 Performance

The original RACER assessment for this indicator yielded a result of 9 out of 15. Following testing, this has been revised to 8 out of 15. The reasons for the changes are detailed below:

- **Relevance:** This score was kept at 3, as although there were challenges involved in the data collection process, the indicator was found to be strongly aligned with the EU's goal of promoting ecodesign thinking across all products placed on the market.
- **Acceptability:** This score was left unchanged as the lack of response from stakeholders highlighted that the indicator may have issues with acceptance from industry. In addition, ecodesign is a relatively new concept that may not be fully understood at this stage.
- **Credibility:** This score was revised down to 2 as the challenges associated with the data collection process made it difficult to obtain complete, reliable data. However, when compliance information was available, it was generally third-party verified, lending credibility to the metric.
- **Ease:** This score was left unchanged as the indicator's testing confirmed the difficulties obtaining relevant data.
- **Robustness:** This score was kept at 1 because as highlighted above, it may be difficult to understand levels of non-conformity in the market because non-compliant producers will likely be unwilling to identify themselves.

Table 22. RACER evaluation

Stage of project	RACER criterion					Score
	Relevance	Acceptability	Credibility	Ease	Robustness	
Task 4 (original RACER assessment)	3	1	3	1	1	9
After Task 5 (following testing)	3	1	2	1	1	8

5.3 CHALLENGES AND LESSONS LEARNED

5.3.1 Challenges

The main challenges associated with the testing of this indicator are as follows:

- A lack of engagement from industry could show that ecodesign as a concept is not yet widely understood, particularly as the requirements vary, sometimes significantly, between product groups. The amount of information regarding conformity assessments that is readily available online also vary significantly

business to business, showing a lack of consistency potentially due to the lack of understanding of requirements. While energy labelling is a commonly understood practice, there are no standardised ecodesign marks at this stage which could aid the data collection for this metric.

- It is difficult to understand actual levels of non-compliance in the sector because those producers whose products do not fulfil conformity assessment requirements will be unlikely to report as such due to the risk of additional fees and penalties.
- Conducting comprehensive ecodesign compliance assessments can be resource-intensive and require significant time from a company. In future iterations of this indicator, smaller organisations might struggle with the costs associated with complying with and reporting on ecodesign criteria.
- The scalability of this indicator is a significant challenge, especially when considering that the ESPR will extend ecodesign requirements to almost all product groups in the EU. As the number of products and producers grows, the complexity and resource requirements for data collection will increase substantially, and managing and analysing this vast amount of data will be extremely challenging.

5.3.2 Lessons learned

The primary lesson learned was that significantly more time would be required to engage with the industry, explain the indicator and ecodesign requirements, and give stakeholders sufficient time to collate and report the required data. In addition, if there were more resources, a deeper level of engagement with manufacturers would be possible, allowing the team to work through any challenges with data collection on a more individual basis and ensuring that the data provided was clear, comprehensive and within the scope of this indicator.

It is also important to consider the various categories of ecodesign, and the different years in which they came into force. Products whose ecodesign criteria were developed in 2011, for example, may be subject to less stringent or outdated requirements when compared to those criteria developed more recently in 2018, as advancements in technology mean that older criteria no longer represent a typical product in any given category. When the new ESPR regulation is introduced, it is expected that this will be addressed and new criteria will be more appropriate for the current electronics landscape.

5.4 CONCLUSIONS AND RECOMMENDATIONS

It is recommended that this indicator is not considered for further development.

While this indicator is closely aligned with the EU's efforts to promote and embed ecodesign thinking within industry, at this stage it is not recommended for future development. This is primarily due to the fact that it is difficult to have confidence in the robustness of the results when the indicator is reliant on those producers with non-compliant products voluntarily reporting their non-compliance. Similar challenges are faced with regard to the reporting of illegal activities such as illegal exports of electronic waste: a report on the illegal shipment of e-waste from the EU to China found that the available data has significant uncertainties which makes it difficult to accurately quantify the scale of non-compliance (European Union Action to Fight Environmental Crime, 2015).

In addition, the ESPR is expected to be adopted in the next few years (European Commission). This regulation will require ecodesign principles to be applied across almost all product groups in the EU, meaning that these principles will be a typical part of conformity assessments going forward. Therefore, an indicator that tracks the level of mandatory compliance will act more as a tool for market surveillance than a gauge of the adoption of ecodesign thinking across the sector. Additionally, extending ecodesign requirements to such a vast range of products will drastically increase the complexity and resource needed to track this indicator. The EU could consider implementing a centralised database into which all ecodesign data can be submitted and information accessed by any member of the public.

The indicator's testing found that around half of the products on sale by the organisation under study (47%) could be confirmed to be compliant with the ecodesign regulations. In some cases, the organisation specified that the product was either specifically not compliant (2%) or not relevant to the regulations (7%). The remaining 45% of products could not be confirmed as compliant or non-compliant.

It was also found that there was significant variation in the levels of information provided for each product. Indeed, some organisations clearly outlined the ecodesign considerations made and had made available documentation including declarations of conformity, manuals, safety information and other diagrams. However,

some products' webpages did not have any documentation. Therefore, it is recommended that the EC consider implementing requirements for the better provision of technical, safety and compliance information to ensure that all manufacturers are mandated to provide up-to-date information on their compliance testing. It is important to note that the new ESPR includes provisions for the implementation of digital product passports for some products. This should significantly improve the availability of data for this indicator.

It is also recommended that, to alleviate the significant challenges faced during the data collection stage which suggested that ecodesign may not be a fully understood topic, the EC develop guidance documents and engage with manufacturers to ensure that ecodesign requirements are fully understood by the industry.

Following the testing of this indicator, it was found that its original name 'Share of Consumer electronics fulfilling ecodesign criteria' was fit for purpose and that no variation was needed.

Table 23. Summary of recommendations for EICT5

Type of recommendation	Recommendation	RACER Criteria Addressed	Timeline	Key stakeholders or partners
Legislation	Ensure that ecodesign requirements are included in future legislation to clearly make ecodesign information available to members of the public.	Acceptability and Credibility	Medium (1.5 – 5 years)	• Responsible: EC • Accountable: producers • Consulted: trade associations • Informed: members of the public
Development of guidance	Develop guidance documents and engage with producers to ensure that ecodesign is fully understood by industry.	Acceptability and Credibility	Short (0.5 – 1.5 years)	• Responsible: EC • Accountable: EC • Consulted: producers, trade associations • Informed: producers, trade associations
Development of database	Design a database into which producers can input their ecodesign criteria for any individual to access	Acceptability, Ease and Robustness	Medium (1.5 – 5 years)	• Responsible: EC • Accountable: EC • Consulted: producers, trade associations • Informed: producers, trade associations

6. APPENDIX

INDICATOR 2 – STAKEHOLDER CONTACT LOG

Region	Stakeholder Type	Name	Website	Date of Initial Contact	Date of First Response	Data Received ?	Comments
Netherlands	Waste management association	Dutch Waste Management Association	Contact DWMA (wastematters.eu)	16/01/24	-	N	No response received.
Netherlands	Government body	Dutch Ministry of Infrastructure and Water Management	Contact (rijkswaterstaat.nl)	16/01/24	30/01/24	N	Response suggested that the office had no further information than the data contained in the National WEEE Register reports.
Netherlands	Compliance scheme	Royal Metal Union	Contact - Koninklijke Metaalunie	16/01/24	-	N	No response received.
Netherlands	Compliance scheme	Stichting OPEN	About us - Stichting Open (stichting-open.org)	16/01/24	02/02/24	N	Meeting held on 09/02/24 and stakeholder agreed to provide anonymised mass balance data. Unfortunately, this was not supplied within the project timeframe, despite multiple reminders.
Netherlands	National waste register	Nationaal (W)EEE Register	Contact – NWR (nationaalweeeregister.nl)	16/01/24	18/01/24	N	Response suggested that no further information was held within the organisation than that which is publicly published in annual reports. Unfortunately, these reports publish only the values reported by Eurostat (i.e. mass of WEEE sent to recycling facilities).
Netherlands	Waste management association	European Electronics Recyclers Association (EERA)	Contact 1 — European Electronics Recyclers Association	16/01/24	17/01/24	N	Response suggested that this association does not hold data on recycling rates or mass balances from their suppliers.

Region	Stakeholder Type	Name	Website	Date of Initial Contact	Date of First Response	Data Received ?	Comments
			(squarespace.com)				
Sweden	Government body	Swedish Environmental Protection Agency (EPA)	Contact (naturvardsverket.se)	08/02/24	-	N	No response received.
Sweden	Government body	Swedish EPA Statistics Office	Environment (scb.se)	08/02/24	19/02/24	N	Response suggested that there is no requirement for the Swedish EPA to store the required information. Instead, this obligation is the responsibility of the waste facilities and municipality-level supervisory authorities.
Sweden	Compliance scheme	El-Kretsen AB	About El-Kretsen | El-Kretsen	08/02/24	-	N	No response received.
Sweden	Compliance scheme	Recipo	Producer responsibility for electronics and batteries - Recipo.com	08/02/24	04/03/24	N	Response suggested that this organisation was unable to participate in the case study but did not provide an explanation as to why this was the case.
Germany	National waste register	Stiftung EAR	stiftung-ear.de/en/about-us/who-we-are	08/02/24	-	N	No response received.

6.1 INDICATOR 2 – DATA REQUEST TEMPLATE

Subject heading: Data Request: DG-RTD Study on Circular Economy Indicators

Dear XXX,

I hope this email finds you well.

My name is XXX, and I'm an Analyst within the Net Zero team at Ricardo. I am currently working with XXX (copied), my colleague in the Circular Economy team. We are leading a consortium of partners to develop and test indicators that are fit for use to measure circularity for the EU Commission's Directorate for Research and Innovation (DG-RTD).

Due to your [organisation/city/region/industry]'s work in XXX, we would like to ask if you would be interested in participating as a case study within the following EU DG-RTD study: Indicators and methods for measuring transition to climate-neutral circularity, its benefits, challenges and trade-offs'?

To do this, we would like to collect data on the following indicator: **Real recycling rate of electronic and ICT equipment**. This will require the following data, for the most recent complete calendar year: tonnes of or proportion of collected EEE waste that is actually recycled – i.e. mass of waste before and after mechanical sorting at the recycling plant. According to the Directive 2012/19/EU on waste electrical and electronic equipment, this data should already be internally reported.

Would you be interested in discussing this further with us? Or alternatively, are you able to pass this request onto a suitable team member who would be?

How will participating benefit your [organisation/city/region]?
The data and insights you provide will be analysed to understand how feasible and practical these indicators are to measure circularity across the EU.

By participating you will be able to:

- Have your say in how circularity will be measured across the EU, individual Member States and industry.
- Help to recommend a robust set of indicators that will allow your [organisation/industry/region] to monitor and improve its CE performance.
- Showcase your [city/region/industry/organisation]'s engagement in cutting edge CE research that will be presented to EU policymakers.

Please find attached a letter of support from DG-RTD which contains additional background information to the project. Do let me know if you have any questions.

Thank you for your time and assistance.

6.2 INDICATOR 2 – WEEE MATERIAL COMPOSITION DATA

Source	WEEE Category 1[8]	WEEE Material Composition (wt. %)												
		Ferrous Metals	Non-Ferrous Metals - All	Al.	Cu.	Sn.	Ni.	Pb.	Polymers - All	ABS	PS / HIPS	PC	PP	Glass
(Achilias & Antonakou, 2015)	All								25.0	30.0	25.0	10.0	8.0	
(Gramatyka & Sakiewicz, 2007)	All	8.1		2.0	20.1	4.0	2.0	2.0	30.2					
(Mroueh, Bacher, Wahlström, & Jermakka, 2013)	All	48.0		5.0	7.0				21.0					5.0
(Widmer, Oswald-Krapf, Sinha-Khetriwal, Schnellmann, & Boni, 2005)	All	47.9		4.7	7.0				10.3					5.4
(Martinho, Pires, Ribeiro, & Saraiva, 2012)	1								10.4	0.6	7.9	0.0	0.8	
(Martinho, Pires, Ribeiro, & Saraiva, 2012)	2								17.0	6.4	7.4	1.8	0.1	
(Haig, Morrish, Morton, & Wilkinson, 2012)	2	38.0		16.0	8.0	0.5			32.0					0.2
(Chancerel & Rotter, 2009)	2	12.1	5.3						40.1					1.3
(Jaunicha, DeCarolis, & Handfield, 2020)	2	17. 2		0.9	0.0				22.9					49.4
(Kang & Schoenung, 2005)	2	0.0		0.0	4.8				14.7					47.6
(Arduin, Grimaud, & Leal, 2019)	2	9.4		5.3	27.2				54.7					0.0
(Haig, Morrish, Morton, & Wilkinson, 2012)	4	24.3		7.7	4.7	0.3			51.3					0.0

[8]As defined in Section 3.1.2

Source	WEEE Category 1[8]	WEEE Material Composition (wt. %)												
		Ferrous Metals	Non-Ferrous Metals - All	Al.	Cu.	Sn.	Ni.	Pb.	Polymers - All	ABS	PS / HIPS	PC	PP	Glass
(Martinho, Pires, Ribeiro, & Saraiva, 2012)	5								49.1	18.7	5.4	1.5	12.8	
(Haig, Morrish, Morton, & Wilkinson, 2012)	5	28.3		9.3	5.3	0.2			47.8					0.0
(Chancerel & Rotter, 2009)	5	12.1	5.3						40.1					1.3
(Martinho, Pires, Ribeiro, & Saraiva, 2012)	6								14.3	4.6	1.9	2.5	0.0	
(Haig, Morrish, Morton, & Wilkinson, 2012)	6	26.0		11.0	5.5	0.4			49.0					0.2
(Chancerel & Rotter, 2009)	6	12.1	5.3						40.1					1.3
(Kang & Schoenung, 2005)	6	20.5		14.2	6.9			6.3	23.0					24.8
(Jandric, 2017)	6	24.8		12.6	4.2				26.2					

6.3 INDICATOR 2 – WEEE MATERIAL RECOVERY FACTORS

Source	WEEE Material Composition (wt. %)												
	Ferrous Metals	Non-Ferrous Metals - All	Al.	Cu.	Sn.	Ni.	Pb.	Polymers - All	ABS	PS / HIPS	PC	PP	Glass
(Achilias & Antonakou, 2015)									84	95	96		
(UNIFE Sustainable Transport Committee, 2013)	96	96											97
(Pressley, Levis, & Damgaard, 2015)	96		95										88
(Arduin, Grimaud, & Leal, 2019)	82		98	70				49					

6.4 INDICATOR 2 – REAL RECYCLING RATE CONTINGENCY CALCULATIONS

Quantity	1. Temp Exchange Equipment	2. Screens, monitors	3. Lamps	4. Major excl. Solar Panels	4-BP. Solar Panels	5. Small Equip	6. Small IT and Telecomm Equip	Total
Total WEEE collected (tonnes) - Eurostat	39,251	16,646	1,586	93,056	493	36,570	18,389	205,991
Mass sent to Recycling (tonnes) - Eurostat	31,731	10,895	1,423	64,430	330	24,414	13,257	146,480
Recycling Rate (%) - Eurostat	80.8%	65.5%	89.7%	69.2%	66.9%	66.8%	72.1%	71.1%
Ferrous Metals Composition (%)	35%	15%	35%	24%	35%	20%	20%	24%
Non-Ferrous Metals Composition (%)	23%	10%	23%	13%	23%	10%	14%	14%
Polymers Composition (%)	10%	30%	22%	51%	22%	46%	32%	39%
Glass Composition (%)	5%	20%	5%	0%	5%	1%	9%	4%
Other Composition (%)	26%	25%	15%	12%	15%	23%	26%	19%
Ferrous Metals Input (tonnes)	11,001	1,621	493	15,678	114	4,929	2,589	35,857
Non-Ferrous Metals Input (tonnes)	7,385	1,136	331	8,127	77	2,444	1,912	20,910
Polymers Input (tonnes)	3,300	3,293	308	33,074	71	11,141	4,187	56,766
Glass Input (tonnes)	1,650	2,145	74	21	17	311	1,161	5,358
Ferrous Metals Recovery Rate (%)	91%	91%	91%	91%	91%	91%	91%	91%
Non-Ferrous Metals	90%	90%	90%	90%	90%	90%	90%	90%

Quantity	1. Temp Exchange Equipment	2. Screens, monitors	3. Lamps	4. Major excl. Solar Panels	4-BP. Solar Panels	5. Small Equip	6. Small IT and Telecomm Equip	Total
Recovery Rate (%)								
Polymers Recovery Rate (%)	49%	49%	49%	49%	49%	49%	49%	49%
Glass Recovery Rate (%)	93%	93%	93%	93%	93%	93%	93%	93%
Ferrous Metals Output (tonnes)	10,040	1,480	450	14,308	104	4,498	2,363	32,723
Non-Ferrous Metals Output (tonnes)	6,622	1,018	297	7,287	69	2,191	1,715	18,749
Polymers Output (tonnes)	1,617	1,613	151	16,202	35	5,458	2,051	27,808
Glass Output (tonnes)	1,526	1,984	68	20	16	288	1,074	4,956
Total Output (tonnes)	19,804	6,096	966	37,817	224	12,435	7,202	84,236
Real Recycling Rate (%)	50.5%	36.6%	60.9%	40.6%	45.5%	34.0%	39.2%	40.9%
Variance (%)	-30.3%	-28.9%	-28.8%	-28.6%	-21.4%	-32.8%	-32.9%	-30.2%

6.5 INDICATOR 3 - PRODUCT INCLUSION LIST

Complete list of product inclusions based on existing EU GPP product categories:

- Computers, monitors, tablets and smartphones (European Commission, 2017)
  - Desktop computers
  - Integrated desktop computers
  - Desktop thin clients
  - Desktop workstations
  - Computer monitors
  - Notebook computers
  - Two-in-one notebooks
  - Mobile thin clients
  - Mobile workstations
  - Tablets
  - Smartphones
- Data centres, server rooms and cloud services (European Commission, 2017)
  - Enterprise data centres

    - Colocation data centres
    - Managed service providers (MSP) data centres
    - Server rooms/computer rooms/server closets
    - Data centres providing digital services in the cloud
- Imaging equipment, consumables and print services (European Commission, 2017)
    - Printers
    - Copiers
    - Multifunctional imaging/printing devices
    - Scanners
    - Professional imaging products
    - Print services

6.6 INDICATOR 3 - PROCUREMENT RECORD DATA

Region	Name (Translated)	Publication Date	Awarded Amount (EUR)	Procurement Method	Equipment Condition	Source
Catalonia	Framework Agreement for the Supply of Electrical and Electronic Equipment, including General Lighting, and Public Lighting Equipment	21/12/2023	301,800.00	Purchase	Unknown	Información de la publicación - Plataforma de Serveis de Contractació Pública (contractaciopublica.cat)
Catalonia	Mixed Supply, assembly and scenotechnical equipment works Teatre La Unió	26/10/2023	1,136,134.13	Purchase	Unknown	Información de la publicación - Plataforma de Serveis de Contractació Pública (contractaciopublica.cat)
Catalonia	Mixed supply contract on a lease basis without option to purchase and service design, installation, maintenance and dismantling of luminous and typical Christmas decorative elements for the Christmas holidays.	23/10/2023	74,598.50	Lease	New	Información de la publicación - Plataforma de Serveis de Contractació Pública (contractaciopublica.cat)
Catalonia	Mixed supply contract on a lease basis without option to purchase and service design, installation, maintenance and dismantling of luminous and typical Christmas decorative elements for the Christmas holidays.	23/10/2023	74,598.50	Lease	Used	Información de la publicación - Plataforma de Serveis de Contractació Pública (contractaciopublica.cat)
Catalonia	Rental of lighting equipment for the 2023 general election programmes	19/10/2023	48,278.00	Lease	Unknown	https://contractaciopublica.cat/es/detall-publicacio/200157991
Catalonia	Rental lighting equipment for municipal election programs 2023	16/10/2023	64,500.00	Lease	Unknown	https://contractaciopublica.cat/es/detall-publicacio/200154126
Catalonia	Lighting equipment rental for the Eufòria program	26/09/2023	292,318.70	Lease	Unknown	https://contractaciopublica.cat/es/detall-publicacio/200140634
Catalonia	746/2020 Supply of electrical equipment	14/09/2023	90,909.09	Purchase	Unknown	https://contractaciopublica.cat/es/detall-publicacio/200132939
Catalonia	FRAMEWORK AGREEMENT FOR THE SUPPLY OF ELECTRICAL EQUIPMENT	08/09/2023	474,000.00	Purchase	Unknown	https://contractaciopublica.cat/es/detall-publicacio/200130324

Region	Name (Translated)	Publication Date	Awarded Amount (EUR)	Procurement Method	Equipment Condition	Source
Catalonia	Supply of the necessary material to renew, adapt and modernize new technologies in the computer field of the Consell Comarcal del Tarragonès	27/06/2023	73,022.87	Purchase	New	https://contractaciopublica.cat/es/detall-publicacio/200079074
Catalonia	Supply of computer equipment	01/06/2023	74,273.66	Purchase	Unknown	https://contractaciopublica.cat/es/detall-publicacio/200070006
Catalonia	SUPPLY, INSTALLATION. INSTALLATION AND CONFIGURATION OF AN INTERACTIVE AND IMMERSIVE 3D PLATFORM FOR VISUALIZING GEOSPATIAL DATA RELATED TO MOBILITY, AS WELL AS ITS MAINTENANCE FOR A PERIOD OF 3 YEARS, WITH SUSTAINABLE PUBLIC PROCUREMENT MEASURES, PARTIALLY FINANCED BY THE EUROPEAN UNION, NEXTGENERATION EU.	29/05/2023	287,438.08	Purchase	Unknown	https://contractaciopublica.cat/es/detall-publicacio/200065778
Oslo and Viken	Procurement of power generators with assembly	29/09/2023	198751.50	Purchase	Unknown	Anskaffelse av strømaggregat med montering | Doffin, Database for offentlige anskaffelser
Oslo and Viken	HCI solution	05/09/2023	584960.86	Purchase	Unknown	HCI løsning | Doffin, Database for offentlige anskaffelser
Oslo and Viken	Electrical material	22/05/2023	313200.00	Purchase	Unknown	Elektromateriell | Doffin, Database for offentlige anskaffelser
Oslo and Viken	Open tender regarding framework agreement for leasing of digital advertising screens and cabinets for outdoor use for Viken Kollektivterminaler FKF	28/03/2023	72358.60	Lease	Unknown	Åpen anbudskonkurranse vedrørende rammeavtale for leasing av digitale reklameskjermer og kabinett til utendørs bruk for Viken Kollektivterminaler FKF |

Region	Name (Translated)	Publication Date	Awarded Amount (EUR)	Procurement Method	Equipment Condition	Source
						Doffin, Database for offentlige anskaffelser
Oslo and Viken	Electrical materials	15/03/2023	348000.00	Purchase	Unknown	Elektro materiell | Doffin, Database for offentlige anskaffelser
Oslo and Viken	Electrical installation materials and light sources	03/03/2023	522000.00	Purchase	Unknown	Elektrisk installasjonsmateriell og lyskilder | Doffin, Database for offentlige anskaffelser
Oslo and Viken	Cultural equipment for Nannestad cultural arena	07/02/2023	609000.00	Purchase	Unknown	Kulturutstyr til Nannestad kulturarena | Doffin, Database for offentlige anskaffelser
Oslo and Viken	Framework agreement for purchase of network and computer room equipment	31/01/2023	13050000.00	Purchase	Unknown	Rammeavtale på kjøp av nettverks- og dataromsutstyr | Doffin, Database for offentlige anskaffelser
Oslo and Viken	Co-purchase agreement light sources	17/01/2023	10788000.00	Purchase	Unknown	Samkjøpsavtale lyskilder | Doffin, Database for offentlige anskaffelser
Oslo and Viken	Procurement of Backup solution	22/12/2023	1305000.00	Purchase	Unknown	anskaffelse av Backupløsning | Doffin, Database for offentlige anskaffelser
Oslo and Viken	Framework agreement on the purchase of Chromebooks	14/07/2023	5220000.00	Purchase	Unknown	Rammeavtale på kjøp av Chromebooks | Doffin, Database for offentlige anskaffelser
Oslo and Viken	Framework agreement for purchase of IT equipment	03/07/2023	5220000.00	Purchase	Unknown	Rammeavtale på kjøp av IT-utstyr | Doffin, Database for offentlige anskaffelser
Oslo and Viken	Framework agreement for purchase of white goods, small electronics and PC accessories for Fredrikstad and Hvaler Municipality	08/06/2023	1740000.00	Purchase	Unknown	Rammeavtale for kjøp av hvitevarer, småelektronikk og PC-tilbehør til Fredrikstad og

Region	Name (Translated)	Publication Date	Awarded Amount (EUR)	Procurement Method	Equipment Condition	Source
						Hvaler Kommune | Doffin, Database for offentlige anskaffelser
Oslo and Viken	Prequalification: framework agreement for delivery of ICT Hardware equipment	05/06/2023	6090000.00	Purchase	Unknown	Prekvalifisering: rammeavtale for levering av IKT-Hardware-utstyr | Doffin, Database for offentlige anskaffelser
Oslo and Viken	IT equipment and related services provided to Norway	28/04/2023	3654000.00	Purchase	Unknown	IT utstyr og tilhørende tjenester levert til Norge | Doffin, Database for offentlige anskaffelser
Oslo and Viken	Framework agreement - purchase of MFPs incl. service	27/04/2023	478500.00	Purchase	Unknown	Rammeavtale - kjøp av multifunksjonsmaskiner inkl. service | Doffin, Database for offentlige anskaffelser
Oslo and Viken	IPAD for adolescence	13/04/2023	497076.68	Purchase	New	IPAD til oppvekst | Doffin, Database for offentlige anskaffelser
Oslo and Viken	Co-purchase agreement multifunction machines	17/03/2023	8108400.00	Lease	Unknown	Samkjøpsavtale multifunksjonsmaskiner | Doffin, Database for offentlige anskaffelser
Oslo and Viken	Electrical items: Home appliances, audio & video and small electrical	03/03/2023	696000.00	Purchase	Unknown	Elektriske artikler: Hvitevarer, lyd & bilde og småelektrisk | Doffin, Database for offentlige anskaffelser
Oslo and Viken	Audiovisual equipment and associated services (AV equipment)	23/12/2023	9135000.00	Purchase	Unknown	Audiovisuelt utstyr med tilhørende tjenester (AV-utstyr) | Doffin, Database for offentlige anskaffelser

Region	Name (Translated)	Publication Date	Awarded Amount (EUR)	Procurement Method	Equipment Condition	Source
Oslo and Viken	Brown and white goods and other small electrical articles	29/11/2023	200100.00	Purchase	Unknown	Brune- og hvitevarer og andre småelektriske artikler | Doffin, Database for offentlige anskaffelser
Oslo and Viken	Framework agreement for purchase of IoT loggers and sensors/monitoring equipment	05/10/2023	556800.00	Purchase	Unknown	Rammeavtale for kjøp av IoT-loggere og sensorer/overvåkningsutstyr | Doffin, Database for offentlige anskaffelser
Oslo and Viken	Equipment for sound, light and stage for the Husebyl barn	29/09/2023	77270.18	Purchase	Unknown	Utstyr til lyd, lys og scene til Husebylåven | Doffin, Database for offentlige anskaffelser
Oslo and Viken	Floor switches for Statistics Norway	30/08/2023	139200.00	Purchase	New	Etasjesvitsjer for Statistisk sentralbyrå | Doffin, Database for offentlige anskaffelser
Oslo and Viken	Parallel framework agreements for equipment for recording studios	06/07/2023	522000.00	Purchase	Unknown	Parallelle rammeavtaler på utstyr til lydstudio | Doffin, Database for offentlige anskaffelser
Oslo and Viken	Liaison equipment Sarpsborg fire and sweeping service	21/02/2023	69600.00	Purchase	Unknown	Sambandsutstyr Sarpsborg brann- og feievesen | Doffin, Database for offentlige anskaffelser

6.7 INDICATOR 3 - STAKEHOLDER CONTACT LOG

Region	Stakeholder Type	Name	Website	Date of Initial Contact	Date of First Response	Data Received ?	Comments
Poland	Government body	Poland Public Procurement Office	Contact - Public Procurement Office - Gov.pl website (www.gov.pl)	16/01/24	-	N	No response received.
Dublin, Ireland	Government body	Dublin City Council	Procurement & stores management | Dublin City Council	08/02/24	19/02/24	N	Response suggested that the council was not able to participate in the case study due to resource constraints.
Ireland	Government body – procurement database	Irish Office of Government Procurement	European Dynamics - Welcome to eTenders	19/02/24	-	N	No response received.
Madrid, Spain	Government body – procurement database	Contratación Centralizada	Catalogue - Centralized Procurement (contratacioncentralizada.gob.es)	08/02/24	-	N	No response received.
Catalonia, Spain	Government body – procurement database	Catalonia's Public Procurement Platform	Electronic platform for public procurement (contractaciopublica.cat)	28/02/24	-	N	No response received.
Oslo and Viken, Norway	Government body – procurement database	Norwegian Agency for Public and Financial	Public Procurement – Information in	28/02/24	-	N	No response received.

Region	Stakeholder Type	Name	Website	Date of Initial Contact	Date of First Response	Data Received ?	Comments
		Management (DFØ)	English | Anskaffelser.no				

6.8 INDICATOR 3 - DATA REQUEST TEMPLATE

Subject heading: Data Request: DG-RTD Study on Circular Economy Indicators

Dear XXX,

I hope this email finds you well.

My name is XXX, and I'm an Analyst within the Net Zero team at Ricardo. I am currently working with XXX (copied), my colleague in the Circular Economy team. We are leading a consortium of partners to develop and test indicators that are fit for use to measure circularity for the EU Commission's Directorate for Research and Innovation (DG-RTD).

Due to your [organisation/city/region/industry]'s work in XXX, we would like to ask if you would be interested in participating as a case study within the following EU DG-RTD study: Indicators and methods for measuring transition to climate-neutral circularity, its benefits, challenges and trade-offs'?

To do this, we would like to collect data on the following indicator: **Share of publicly purchased ICT equipment (and services) that is second-hand/refurbished or purchased via a renting/leasing model (PSS), as a percentage of total value purchased**. This will require the following data, for the most recent full calendar year:

- Total publicly purchased ICT equipment and services in the reporting year, by value.
- Publicly purchased ICT equipment that is second-hand/refurbished, by value.
- Publicly purchased ICT equipment that is purchased via a renting/leasing model, by value.

In the first instance, an overview of how and where XXX's public procurement information is recorded and stored would be greatly appreciated.

Would you be interested in discussing this further with us? Or alternatively, are you able to pass this request onto a suitable team member who would be?

How will participating benefit your [organisation/city/region]?
The data and insights you provide will be analysed to understand how feasible and practical these indicators are to measure circularity across the EU.

By participating you will be able to:

- Have your say in how circularity will be measured across the EU, individual Member States and industry.
- Help to recommend a robust set of indicators that will allow your [organisation/industry/region] to monitor and improve its CE performance.
- Showcase your [city/region/industry/organisation]'s engagement in cutting edge CE research that will be presented to EU policymakers.

Please find attached a letter of support from DG-RTD which contains additional background information to the project. Do let me know if you have any questions.

Thank you for your time and assistance.

6.9 INDICATOR 3 - APPLIED DATABASE FILTERS

Filters applied to the Catalan procurement database:

- Current Phase – Implementation-related publication
- Execution date – 2023
- Common Procurement Vocabulary (CPV) codes
    - 30200000-1 – Computer equipment and supplies
    - 31000000-6 – Electrical machinery, appliances, equipment and consumables; Lighting
    - 32000000-3 – Radio, television, communication, telecommunication and related equipment

Filters applied to the Norwegian procurement database:

- Result – Announcement of conclusion of contract
- Main element of contract – Supplies
- Date of transmission – 01/01/23 to 31/12/23
- Place of execution – Eastern Norway: Akershus, Buskerud, Oslo, Østfold
- CPV codes
    - 30200000 – Computer equipment and supplies
    - 31000000 – Electrical machinery, appliances, equipment and consumables; Lighting

  32000000-3 – Radio, television, communication, telecommunication and related equipment

6.10 INDICATOR 4 - OVERVIEW OF RELEVANT ARTICLES FROM DIRECTIVE 2009/125/EC

The following text, paraphrased from the EU Directive 2009/125/EC establishing a framework for the setting of ecodesign requirements for energy-related products (European Parliament, 2009 (amended 2012)), sets out the basic requirements for compliance with the regulation, including the documenting and reporting of conformity assessments.

Article 3: Placing on the market and/or putting into service

- Producers should only place products on the market if they comply with the relevant implementing measure and have a CE marking
- Member States should organise a market surveillance instrument that conducts compliance checks and collects all relevant information from producers
- Market surveillance activities should be reported to the commission
- Consumers should be able to report observations on product compliance to the relevant authorities

Article 4: Responsibilities of the importer

- If the producer of the product is outside of the country, the importer is responsible for the points in Article 3.

Article 5: Marking and the EC declaration of conformity

- Any relevant product must have a CE marking and EC declaration of conformity before it is placed on the market
- The EC declaration of conformity shall contain the name and address of the producer, description of the model, references of the harmonised standards or technical standards and specifications used, reference to any other legislation and the identification of the person who has authorised the conformity assessment
- Any markings that are likely to mislead consumers are prohibited, and information should be provided in their official language as well as at least one other official EU language

Article 6: Free movement

- If a product is compliant with all relevant provisions, Member States cannot prohibit its sale
- If a product is on display, for example at a trade fair, that is not compliant with all relevant provisions, provided there is a clear indication that the product will not be placed on sale until it is compliant, Member States cannot prevent this display

Article 7: Safeguard clause

- When a product is found to be non-compliant, the producer is responsible for ensuring the product complies and ending the infringement
- Member States shall take the necessary measures upon finding a non-compliant product, which may include prohibiting its sale until compliance is established
- If non-compliance continues, Member States should make a decision on whether to restrict or prohibit its sale or ensure it is withdrawn from the market
- Any decision should be communicated to the Commission and the producer, including reasons for the decision and the non-compliance, and legal remedies and timescales

Article 8: Conformity assessment

- Before a product is placed on the market, it must have had a conformity assessment with all requirements from the relevant implementing measure
- Member States can choose between the internal design control and management system set out in Annex IV and V of the regulation
- Organisations that are compliant with certain regulations and harmonised standards can be presumed to be compliant
- Where products are non-compliant, Member States should publish a substantiated assessment that allows for corrective action
- When products have had conformity assessments, producers should maintain all relevant documents for at least 10 years after the last of that product has been manufactured

Article 9: Presumption of conformity

- Any product that bears the CE marking can be presumed to be compliant with the relevant implementing measure
- If harmonised standards are used for a product group, so long as the standard is recognised by the EU, the product can be presumed to be compliant with the relevant implementing measure
- Any product that bears the Community Ecolabel marking can be presumed to be compliant with the relevant implementing measure so far as those requirements are met by the ecolabel
- The Commission may decide that other ecolabels can be presumed to be compliant with the relevant implementing measure

Article 10: Harmonised standards

- If a harmonised standard is considered to be unsatisfactory, the Member State should inform the Commission which will make a decision as a matter of urgency

Article 11: Requirements for components and sub-assemblies

- If a producer purchases components from another manufacturer for use in a relevant product, the manufacturer should provide all required information to the producer

Article 12: Administrative cooperation and exchange of information

- Member States should ensure that authorities cooperate with each other and provide relevant information when required

Article 13: Small and medium-sized enterprises

- Member States should ensure that SMEs are supported in the adoption of this regulation and take into account initiatives which could help SMEs to integrate environmental aspects in their product design

Article 14: Consumer information

- Manufacturers must ensure that consumers are provided with information on the sustainable use of the product and, when required, the product's ecological profile and benefits of ecodesign

Article 15: Implementing measures

- If a product fulfils the following criteria, it should be covered by an implementing measure which sets out ecodesign requirements
    - The product represents a significant volume of sales (for example, more than 200,000 per year)
    - The product has a significant environmental impact when considering the quantities sold
    - The product has significant potential for improvement in its environmental impact without excessive costs
- Draft implementing measures should consider the life cycle of the product and all significant environmental impacts, and have an associate assessment which considers the impact on the environment, consumers and manufacturers
- Implementing measures should have no significant negative impact on the functionality of the product, health, safety and environmental impact, affordability and life-cycle cost of the product, administrative burden for manufacturers, or the industry's competitiveness
- The laid out requirements should ensure that market surveillance can be conducted

6.11 INDICATOR 4 - EXAMPLE OF SPECIFIC ECODESIGN REQUIREMENTS

Each of the 31 product groups covered by the Ecodesign Directive then has an associated implementing measure which lays out the specific ecodesign requirements for the product type, including energy efficiency measures as well as provisions to extend the lifespan of the relevant products. An example of these specific requirements can be found below. These requirements were outlined in the EU Regulation No 1254/2014 with regard to the energy labelling of residential ventilation units (European Parliament, 2014) and Regulation No 1253/2014 with regard to ecodesign requirements for ventilation units (European Parliament, 2014) and have been reproduced from a guidance document produced by the EC (Guidelines accompanying Regulation (EU) No 1254/2014 with regard to the energy labelling of residential ventilation units and Regulation (EU) No 1253/2014 with regard to ecodesign requirements for ventilation units, 2016).

The implementation of ecodesign requirements for ventilation units took place in two stages: stage 1 from January 2016 and stage 2 from January 2018. The table below specifies the requirements for residential ventilation units for stage 1 and stage 2.

Table 24. Ecodesign requirements for RVUs per stage

Stage 1	Stage 2
Specific energy consumption (SEC) ≤ 0 kWh/ (m^2 .a)	
Sound power level (L_{WA}) ≤ 45 dB	
All ventilation units, except dual use units, shall be equipped with a multi-speed drive or variable speed drive	
All bidirectional ventilation units shall have a thermal by-pass facility	
	VUs with a filter shall be equipped with a visual filter change warning signal

Specific requirements, notes and calculations can all be found within Regulation 1253/2014.

In terms of information requirements, manufacturers must ensure that product information, including but not limited to the supplier name, model number, specific energy consumption in kWh/(m2.a), maximum flow rate in m3/h, reference flow rate in m3/s and electric power input of the fan drive[9], is available in all technical documentation and on any websites on which the product is sold. The manufacturer must also ensure that

[9] Full information requirements can be found in Annex IV of Regulation 1253/2014

detailed instructions are made available which cover the manual disassembly of magnet motors, electronic parts, batteries and larger plastic parts.

6.12 INDICATOR 4 - EXAMPLE EMAIL

Dear Sir/Madam,

I hope this email finds you well.

My name is **xx**, a Consultant within the Circular Economy team at Ricardo. We are currently leading a consortium of partners to develop and test indicators that are fit for use to measure circularity for the EU Commission's Directorate for Research and Innovation (DG-RTD).

Due to your organisation's work in electronics compliance, we would like to ask if your network would be interested in participating as a case study within the following EU DG-RTD study: Indicators and methods for measuring transition to climate-neutral circularity, its benefits, challenges and trade-offs'?

To do this, we would like to collect data on the following indicator: Share of consumer electronics put on market fulfilling ecodesign criteria. This will require a brief (30 minute) interview to understand what compliance testing is undertaken in Estonia and the products placed on the market in the following product categories:

Electronic computer displays

Refrigerators with a direct sales function

Would you be interested in discussing this further with us? Or alternatively, are you able to pass this request onto a suitable team member who would be?

How will participating benefit your organisation?

The data and insights you provide will be analysed to understand how feasible and practical these indicators are to measure circularity across the EU.

By participating you will be able to:

Have your say in how circularity will be measured across the EU, individual Member States and your industry.

Help to recommend a robust set of indicators that will allow your organisation to monitor and improve its CE performance.

Showcase your organisation's engagement in cutting edge CE research that will be presented to EU policymakers.

Please find attached a letter of support from DG-RTD which contains additional background information to the project. Do let me know if you have any questions.

Thank you for your time and assistance.

6.13 INDICATOR 4 - DATA COLLECTION

The table below details the products that were reviewed from the producer, Systemair.

Table 25. Systemair product lines and compliance information

Product name	Product category	Ecodesign compliance year	Compliance category
MUB Insulated duct fans · Systemair	Duct fans	2018	NRVU
MUB-EX Insulated duct fans · Systemair	Duct fans	N/A	N/A
MUB CAV/VAV Insulated duct fans · Systemair	Duct fans	2018	NRVU
MUB/F Insulated duct fans · Systemair	Duct fans	N/A	N/A

Product name	Product category	Ecodesign compliance year	Compliance category
MUB/T Insulated duct fans · Systemair	Duct fans	Not ErP relevant	Not ErP relevant
MUB+FILTER Insulated duct fans · Systemair	Duct fans	Not ErP relevant	Not ErP relevant
PRIO Circular Duct Fans · Systemair	Duct fans	Not ErP relevant	Not ErP relevant
Prio Silent XP Circular Duct Fans · Systemair	Duct fans	Not ErP relevant	Not ErP relevant
K Circular Duct Fans · Systemair	Duct fans	2018	NRVU
KVK DUO Insulated duct fans · Systemair	Duct fans	2018	NRVU
KVK Basic Insulated duct fans · Systemair	Duct fans	2016	RVU
KVK Insulated duct fans · Systemair	Duct fans	2018	NRVU
RS Rectangular Duct Fans · Systemair	Duct fans	2018	NRVU
BKF Rectangular Duct Fans · Systemair	Duct fans	2018	NRVU
KV Circular Duct Fans · Systemair	Duct fans	2018	NRVU
RVK Circular Duct Fans · Systemair	Duct fans	2016	RVU
RVK-EX Circular Duct Fans · Systemair	Duct fans	N/A	N/A
KD Circular Duct Fans · Systemair	Duct fans	Not ErP relevant	Not ErP relevant
RVF Circular Duct Fans · Systemair	Duct fans	2018	NRVU
KE/KT Rectangular Duct Fans · Systemair	Duct fans	2018	NRVU
KTEX Rectangular Duct Fans · Systemair	Duct fans	Not ErP relevant	Not ErP relevant
KPB Insulated duct fans · Systemair	Duct fans	N/A	N/A
TLP Insulated duct fans · Systemair	Duct fans	2018	RVU
BKF-120 Rectangular Duct Fans · Systemair	Duct fans	2018	NRVU
DVC Roof Fans · Systemair	Roof fans	2018	NRVU
DVS Roof Fans · Systemair	Roof fans	2018	NRVU
DV-EX Roof Fans · Systemair	Roof fans	Not ErP relevant	Not ErP relevant
DVV Roof Fans · Systemair	Roof fans	Not ErP relevant	Not ErP relevant
DVV-EX Roof Fans · Systemair	Roof fans	Not ErP relevant	Not ErP relevant
DVV/T Roof Fans · Systemair	Roof fans	2018	NRVU
DVG-H/T Roof Fans · Systemair	Roof fans	Not ErP relevant	Not ErP relevant
DVG Roof Fans · Systemair	Roof fans	2018	NRVU
DVG-V/T Roof Fans · Systemair	Roof fans	Not ErP relevant	Not ErP relevant
DVN Roof Fans · Systemair	Roof fans	Not ErP relevant	Not ErP relevant
TFC Roof Fans · Systemair	Roof fans	2018	NRVU
TFS Roof Fans · Systemair	Roof fans	2018	RVU
DVP Roof Fans · Systemair	Roof fans	Not ErP relevant	Not ErP relevant
TFE Roof Fans · Systemair	Roof fans	2016	RVU
TOE/TOV Roof Fans · Systemair	Roof fans	2018	NRVU
DHS Roof Fans · Systemair	Roof fans	2018	NRVU
ZRS Roof Fans · Systemair	Roof fans	Not ErP relevant	Not ErP relevant
MRH Roof Fans · Systemair	Roof fans	Not ErP relevant	Not ErP relevant

Product name	Product category	Ecodesign compliance year	Compliance category
AXC Axial Fans · Medium pressure smoke extract Axial Fan for a long lasting performance. · Systemair	Axial fans	N/A	N/A
AXC-G Axial Fans · Systemair	Axial fans	N/A	N/A
AXC(B) Axial Fans · Efficient smoke extract Axial Fan - Certified for 300 °C · Systemair	Axial fans	N/A	N/A
AXC(B) - G Axial Fans · High pressure smoke extraction Axial Fan for Garages and Industrial applications · Systemair	Axial fans	N/A	N/A
AXC(F) Axial Fans · Efficient smoke extract Axial Fan - Certified for 400 °C · Systemair	Axial fans	N/A	N/A
AXC(F) - G Axial Fans · Systemair	Axial fans	N/A	N/A
AXC-EX Axial Fans · Explosion proof Axial Fan for special atmospheres - ATEX certified · Systemair	Axial fans	N/A	N/A
AXC-H Axial Fans · Systemair	Axial fans	N/A	N/A
AXCBF Axial Fans · Systemair	Axial fans	N/A	N/A
AXCBF-EX Axial Fans · Bifurcated axial fan with ATEX certification for special atmoshperes · Systemair	Axial fans	Not ErP relevant	Not ErP relevant
AW Axial Fans · Systemair	Axial fans	2018	NRVU
AW-EX Axial Fans · Systemair	Axial fans	Not ErP relevant	Not ErP relevant
AR Axial Fans · Systemair	Axial fans	N/A	N/A
BF Silent Domestic Fans · Systemair	Domestic fans	2018	RVU
BF X Domestic Fans · Systemair	Domestic fans	2018	RVU
BF QW Domestic Fans · Systemair	Domestic fans	2018	RVU
BF MX Domestic Fans · Systemair	Domestic fans	2018	RVU
VEF EC Extract EC fans · Systemair	Domestic fans	2016	RVU
IF Domestic Fans · Systemair	Domestic fans	2018	RVU
DMV Domestic Fans · Systemair	Domestic fans	2014	Ventilation units above 30W
KBR Centrifugal Fans · Systemair	Centrifugal fans	Not ErP relevant	Not ErP relevant
KBT Centrifugal Fans · Systemair	Centrifugal fans	Not ErP relevant	Not ErP relevant
EX Centrifugal Fans · Systemair	Centrifugal fans	Not ErP relevant	Not ErP relevant
KBR/F Centrifugal Fans · Systemair	Centrifugal fans	N/A	N/A
PRF Centrifugal Fans · Systemair	Centrifugal fans	Not ErP relevant	Not ErP relevant
PRF-EX Centrifugal Fans · Systemair	Centrifugal fans	N/A	N/A
AXZENT Centrifugal Fans · Systemair	Centrifugal fans	Not ErP relevant	Not ErP relevant
DKEX Centrifugal Fans · Systemair	Centrifugal fans	Not ErP relevant	Not ErP relevant
KVB/F Centrifugal Fans · Systemair	Centrifugal fans	N/A	N/A
CE / CT Centrifugal Fans · Systemair	Centrifugal fans	2016	RVU
Blandovent Ceiling Fans · Systemair	Ceiling fans	N/A	N/A

Product name	Product category	Ecodesign compliance year	Compliance category
ICF Ceiling Fans · Systemair	Ceiling fans	N/A	N/A
IV Jet Fans · Systemair	Jet fans	N/A	N/A
AJ Jet Fans · Systemair	Jet fans	Not ErP relevant	Not ErP relevant
IHS (B) Jet Fans · Systemair	Jet fans	N/A	N/A
SAVE Air Handling Units · Discover the Space-Saving Solution for Fresh Air: SAVE Air Handling Units · Systemair	Air Handling Units	2018	RVU
Topvex FSU Air Handling Units · Topvex compact air handling unit · Systemair	Air Handling Units	2018	NRVU
Topvex FCU Air Handling Units · Topvex false ceiling air handling unit · Systemair	Air Handling Units	2018	NRVU
Geniox Core Air Handling Units · Geniox Core Air Handling Unit: The Perfect match with a small footprint · Systemair	Air Handling Units	N/A	N/A
Geniox Go Air Handling Units · Geniox Go Air Handling Unit: The perfect preconfigured unit for your project · Systemair	Air Handling Units	BS EN 13053:2019	NRVU
Geniox Air Handling Units · Geniox Air Handling Unit: The Perfect Blend of Efficiency and Sustainability · Systemair	Air Handling Units	2014	Ventilation units above 30W
KA Air Handling Units · Systemair	Air Handling Units	N/A	N/A
BA Unit Air Handling Units · Systemair	Air Handling Units	No	No
Sense Air Handling Units · Breathe easy with a Sense Air Handling Unit from Systemair · Systemair	Air Handling Units	N/A	N/A
HHFlex Air Handling Units · High quality, ultimate flexibility · Systemair	Air Handling Units	N/A	N/A
RoofLine Air Handling Units · Systemair	Air Handling Units	N/A	N/A
CompactLine Air Handling Units · Systemair	Air Handling Units	N/A	N/A
SUE Air Handling Units · Systemair	Air Handling Units	2018	NRVU
TUNE-R-AHU Dampers · Systemair	Air Handling Units	N/A	N/A
BOR-C Residential Diffusers · Air supply diffuser I BOR-C Residential diffusers · Systemair	Residential diffusers	N/A	N/A
BOR-S Residential Diffusers · Systemair	Residential diffusers	N/A	N/A
BOR-R Residential Diffusers · Systemair	Residential diffusers	N/A	N/A
BALANCE-E Air Valves · Systemair	Air valves	N/A	N/A

Product name	Product category	Ecodesign compliance year	Compliance category
TFF Air Valves · Supply air diffuser I TFF Air valves · Systemair	Air valves	N/A	N/A
Genius Heat Pumps and Multi Units · Systemair	Heat pumps	N/A	N/A
MONOLIT - B Cooker Hoods for SAVE and central units · Systemair	Cooker hoods	EN IEC 61591:2020+A11	Unknown
CLASSIC - B Cooker Hoods for SAVE and central units · Systemair	Cooker hoods	EN IEC 61591:2020+A11	Unknown
SLIMLINE - B Cooker Hoods for SAVE and central units · Systemair	Cooker hoods	2009	Unknown
VACU vacuum cleaner Vacuum Cleaner · Systemair	Vacuum systems	N/A	N/A
SYSHP MINI SPLIT Air Cooled Heat Pumps · Systemair	Cooker hoods	2009	Unknown
602 - B Cooker Hoods for SAVE and central units · Systemair	Cooker hoods	2009	Unknown
OPAL Cooker Hoods for SAVE and central units · Systemair	Cooker hoods	2009	Unknown
STIL Cooker Hoods for SAVE and central units · Systemair	Cooker hoods	2009	Unknown
TENDER Cooker Hoods for SAVE and central units · Systemair	Cooker hoods	2009	Unknown
MONOLIT - EC Cooker Hoods for EC fans · Systemair	Cooker hoods	2009	Unknown
SLIMLINE - EC Cooker Hoods for EC fans · Systemair	Cooker hoods	N/A	N/A
MONOLIT - AC Cooker Hoods for AC fans · Systemair	Cooker hoods	2009	Unknown
AE Step Controlled Valves · Systemair	Air valves	N/A	N/A
GEO heat exchanger Geothermal Systems · Systemair	Geothermal systems	N/A	N/A
OPTIMA-LV-R Variable Air Volume Controllers · Systemair	Air valves	N/A	N/A
OPTIMA-S-FC Variable Air Volume Controllers · Systemair	Air valves	N/A	N/A
OPTIMA-R-FC Variable Air Volume Controllers · Systemair	Air valves	N/A	N/A
OPTIMA-R-LPC_BM Variable Air Volume Controllers · Systemair	Air valves	N/A	N/A
OPTIMA-R-PC_BM Variable Air Volume Controllers · Systemair	Air valves	N/A	N/A
OPTIMA-R-FC_S Variable Air Volume Controllers · Systemair	Air valves	N/A	N/A
OPTIMA-R-FC_BM Variable Air Volume Controllers · Systemair	Air valves	N/A	N/A
OPTIMA-R-FM Variable Air Volume Controllers · Systemair	Air valves	N/A	N/A

Product name	Product category	Ecodesign compliance year	Compliance category
OPTIMA-RES-A Variable Air Volume Controllers · Systemair	Air valves	N/A	N/A
OPTIMA-S-FM Variable Air Volume Controllers · Systemair	Air valves	N/A	N/A
OPTIMA-S-FC_BM Variable Air Volume Controllers · Systemair	Air valves	N/A	N/A
OPTIMA-S-FC_S Variable Air Volume Controllers · Systemair	Air valves	N/A	N/A
OPTIMA-S-PC_BM Variable Air Volume Controllers · Systemair	Air valves	N/A	N/A
OPTIMA-S-LPC_BM Variable Air Volume Controllers · Systemair	Air valves	N/A	N/A
NOTUS-R Constant Air Volume Controllers · Systemair	Air valves	N/A	N/A
NOTUS-S Constant Air Volume Controllers · Systemair	Air valves	N/A	N/A
TUNE-R Dampers · Systemair	Dampers	N/A	N/A
TUNE-S Dampers · Systemair	Dampers	N/A	N/A
TUNE-R-EX Dampers · Systemair	Dampers	N/A	N/A
TUNE-S-AHU Dampers · Systemair	Dampers	N/A	N/A
TUNE-R-B Dampers · Systemair	Dampers	N/A	N/A
TUNE-EATR Dampers · Systemair	Dampers	N/A	N/A
BURE Variable Geometry Diffusers · Systemair	Diffusers	N/A	N/A
BIA Variable Geometry Diffusers · Systemair	Diffusers	N/A	N/A
SYSAQUA R32 L Air Cooled Chillers · Systemair	Chillers	N/A	N/A
SYSAQUA R32 H Air Cooled Heat Pumps · Systemair	Heat pumps	N/A	N/A
SYSAQUA BLUE L Air Cooled Chillers · Systemair	Chillers	2009	Unknown
SYSAQUA BLUE H Air Cooled Heat Pumps · Systemair	Heat pumps	2009	Unknown
SYSAER R32 Rooftop Units · Systemair	Split systems	N/A	N/A
SYSHP MINI Air Cooled Heat Pumps · Systemair	Heat pumps	N/A	N/A
SYSCROLL AIR EVO HP (INVERTER) Air Cooled Heat Pumps · Systemair	Heat pumps	2009	Unknown
SYSPLIT OUTDOOR Split Systems · Systemair	Split systems	2016	Unknown
SYSAER Rooftop Units · Systemair	Split systems	N/A	N/A
SYSCOIL COMFORT Fan Coil Units · Systemair	Fan coil units	No	No
SYSQUARE Fan Coil Units · Systemair	Fan coil units	2009	Unknown
HAWAIR Fan Coil Units · Systemair	Fan coil units	N/A	N/A

Product name	Product category	Ecodesign compliance year	Compliance category
DUCTYS Fan Coil Units · Systemair	Fan coil units	N/A	N/A
VH Fan Coil Units · Systemair	Fan coil units	N/A	N/A
SysTemp P Precision air conditioners · Systemair	Air conditioners	N/A	N/A
SysTemp G Precision air conditioners · Systemair	Air conditioners	N/A	N/A
SysTemp R Precision air conditioners · Systemair	Air conditioners	N/A	N/A
SYSAQUA H Air Cooled Heat Pumps · Systemair	Heat pumps	No	No
AQVH Air Cooled Heat Pumps · Systemair	Heat pumps	N/A	N/A
VLH Air Cooled Heat Pumps · Systemair	Heat pumps	N/A	N/A
SYSCROLL AIR EVO HP Air Cooled Heat Pumps · Systemair	Heat pumps	No	No
SYSCROLL AIR HP Air Cooled Heat Pumps · Systemair	Heat pumps	2009	Unknown
SYSAQUA L Air Cooled Chillers · Systemair	Chillers	No	No
AQVL Air Cooled Chillers · Systemair	Chillers	N/A	N/A
SYSCROLL AIR EVO CO Air Cooled Chillers · Systemair	Chillers	2009	Unknown
SYSCROLL AIR CO Air Cooled Chillers · Systemair	Chillers	No	No
SYSCREW AIR EVO HSE CO Air Cooled Chillers · Systemair	Chillers	2018	Unknown
SYSCREW AIR CO Air Cooled Chillers · Systemair	Chillers	N/A	N/A
WQH Water Cooled Heat Pumps · Systemair	Heat pumps	N/A	N/A
SYSCREW WATER EVO HP Water Cooled Heat Pumps · Systemair	Heat pumps	N/A	N/A
WQL Water Cooled Chillers · Systemair	Chillers	N/A	N/A
SYSCREW WATER EVO CO Water Cooled Chillers · Systemair	Chillers	N/A	N/A
SYSLOOP EVO Water Source Heat Pumps · Systemair	Heat pumps	N/A	N/A
SYSLOOP 15-30 Water Source Heat Pumps · Systemair	Heat pumps	N/A	N/A
SYSLOOP 70-135 Water Source Heat Pumps · Systemair	Heat pumps	N/A	N/A
SYSHRW Water Source Heat Pumps · Systemair	Heat pumps	N/A	N/A
SYSCW-AR R513A Water Source Heat Pumps · Systemair	Heat pumps	N/A	N/A
SYSCROLL AIR RE Condensing units · Systemair	Condensing units	N/A	N/A

Product name	Product category	Ecodesign compliance year	Compliance category
SYSAQUA RE Condensing units · Systemair	Condensing units	N/A	N/A
AQVC Condensing units · Systemair	Condensing units	N/A	N/A
VLC Condensing units · Systemair	Condensing units	N/A	N/A
SYSCROLL AIR EVO RE Condensing units · Systemair	Condensing units	2009	Unknown
WQRC Condenserless units · Systemair	Condenserless units	N/A	N/A
SYSCREW WATER EVO RC Condenserless units · Systemair	Condenserless units	N/A	N/A
SysFreeCool Freecooling · Systemair	Freecooling	N/A	N/A
SYSPLIT MULTI Split Systems · Systemair	Split systems	2016	Unknown
SYSPLIT WALL OUT Split Systems · Systemair	Split systems	2016	Unknown
SYSPLIT CASSETTE Split Systems · Systemair	Split systems	2016	Unknown
SYSPLIT CEILING Split Systems · Systemair	Split systems	2016	Unknown
SYSPLIT WALL PRIME Split Systems · Systemair	Split systems	2016	Unknown
SYSPLIT WALL CUTE Split Systems · Systemair	Split systems	2016	Unknown
SYSPLIT DUCT Split Systems · Systemair	Split systems	2016	Unknown
SYSVRF AIR EVO HP VRF Systems · Systemair	VRF systems	2016	Unknown
SYSVRF2 AIR EVO A HP VRF Systems · Systemair	VRF systems	2016	Unknown
SYSVRF2 (M) AIR EVO HP VRF Systems · Systemair	VRF systems	2016	Unknown
SYSVRF2 CASSETTE VRF Systems · Systemair	VRF systems	2016	Unknown
SYSVRF2 CASSETTE 1W VRF Systems · Systemair	VRF systems	2016	Unknown
SYSVRF2 CEILING VRF Systems · Systemair	VRF systems	2016	Unknown
SYSVRF2 FLOOR EB VRF Systems · Systemair	VRF systems	2016	Unknown
SYSVRF2 WALL VRF Systems · Systemair	VRF systems	2016	Unknown
SYSVRF2 DUCT VRF Systems · Systemair	VRF systems	2016	Unknown
SYSVRF2 DUCT HP VRF Systems · Systemair	VRF systems	2016	Unknown
SYSVRF2 CASSETTE MINI VRF Systems · Systemair	VRF systems	2016	Unknown

Product name	Product category	Ecodesign compliance year	Compliance category
SYSPLIT CONSOLE Split Systems · Systemair	Split systems	2016	Unknown
SYSVRF3 CASSETTE MINI VRF Systems · Systemair	VRF systems	2016	Unknown
SYSVRF3 CASSETTE VRF Systems · Systemair	VRF systems	2016	Unknown
SYSVRF3 CASSETTE 1W VRF Systems · Systemair	VRF systems	2016	Unknown
SYSVRF3 CEILING VRF Systems · Systemair	VRF systems	2016	Unknown
SYSVRF3 WALL VRF Systems · Systemair	VRF systems	2016	Unknown
SYSVRF3 DUCT VRF Systems · Systemair	VRF systems	2016	Unknown
SYSVRF3 MINI AIR EVO R32 HP VRF Systems · Systemair	VRF systems	2016	Unknown
SYSVRF3 AIR EVO-S HP R VRF Systems · Systemair	VRF systems	2016	Unknown
SYSVRF3 M AIR EVO HP R VRF Systems · Systemair	VRF systems	2016	Unknown
Pamir 2500 Commercial Air Curtains · Systemair	Air curtains	2011	Fans driven by motors with an electric input power between 125W and 500kW
Pamir 3500 Commercial Air Curtains · Systemair	Air curtains	2011	Fans driven by motors with an electric input power between 125W and 500kW
Pamir 4200 Commercial Air Curtains · Systemair	Air curtains	2011	Fans driven by motors with an electric input power between 125W and 500kW
Arden 3500 Commercial Air Curtains · Systemair	Air curtains	2011	Fans driven by motors with an electric input power between 125W and 500kW
Arden 4200 Commercial Air Curtains · Systemair	Air curtains	2011	Fans driven by motors with an electric input power between

Product name	Product category	Ecodesign compliance year	Compliance category
			125W and 500kW
PA2200C Commercial Air Curtains · Systemair	Air curtains	2011	Fans driven by motors with an electric input power between 125W and 500kW
PA3200C Commercial Air Curtains · Systemair	Air curtains	2011	Fans driven by motors with an electric input power between 125W and 500kW
AR3200C Commercial Air Curtains · Systemair	Air curtains	2011	Fans driven by motors with an electric input power between 125W and 500kW
Sierra Commercial Air Curtains · Systemair	Air curtains	2011	Fans driven by motors with an electric input power between 125W and 500kW
Tatra Industrial Air Curtains · Systemair	Air curtains	2009	Unknown
PAECS Cold Storage Air Curtains · Systemair	Air curtains	2011	Fans driven by motors with an electric input power between 125W and 500kW
Scand Revolving Doors Air Curtains · Systemair	Air curtains	2011	Fans driven by motors with an electric input power between 125W and 500kW
Portier Commercial Air Curtains · Systemair	Air curtains	2011	Fans driven by motors with an electric input power between 125W and 500kW
AR200 Commercial Air Curtains · Systemair	Air curtains	2011	Fans driven by motors with an electric input power between 125W and 500kW

Product name	Product category	Ecodesign compliance year	Compliance category
ADA Commercial Air Curtains · Systemair	Air curtains	2011	Fans driven by motors with an electric input power between 125W and 500kW
PA1508 Commercial Air Curtains · Systemair	Air curtains	2011	Fans driven by motors with an electric input power between 125W and 500kW
CL Linea DX eco set Commercial Air Curtains · Systemair	Air curtains	N/A	N/A
Pamir 5000 Industrial Air Curtains · Systemair	Air curtains	2011	Fans driven by motors with an electric input power between 125W and 500kW
UF600 Industrial Air Curtains · Systemair	Air curtains	2011	Fans driven by motors with an electric input power between 125W and 500kW
PAEC2500 Cold Storage Air Curtains · Systemair	Air curtains	2011	Fans driven by motors with an electric input power between 125W and 500kW
PAEC3200 Cold Storage Air Curtains · Systemair	Air curtains	2011	Fans driven by motors with an electric input power between 125W and 500kW
ADA Cool Cold Storage Air Curtains · Systemair	Air curtains	2011	Fans driven by motors with an electric input power between 125W and 500kW
Ruwen Revolving Doors Air Curtains · Systemair	Air curtains	2011	Fans driven by motors with an electric input power between 125W and 500kW

Product name	Product category	Ecodesign compliance year	Compliance category
FC Direct Air Curtains Controls for Air Curtains · Systemair	Controls	2015	Local space heaters
FC Smart Air Curtains Controls for Air Curtains · Systemair	Controls	2015	Local space heaters
FC Pro Air Curtains Controls for Air Curtains · Systemair	Controls	2015	Local space heaters
FC Building Air Curtains Controls for Air Curtains · Systemair	Controls	2015	Local space heaters
FCBC Controls for Air Curtains · Systemair	Controls	N/A	N/A
FCLAP Controls for Air Curtains · Systemair	Controls	N/A	N/A
FCBAP Controls for Air Curtains · Systemair	Controls	N/A	N/A
FCDC Controls for Air Curtains · Systemair	Controls	N/A	N/A
FC Sensors Controls for Air Curtains · Systemair	Controls	N/A	N/A
FCSC Controls for Air Curtains · Systemair	Controls	N/A	N/A
SIRe Competent Air Curtains Controls for Air Curtains · Systemair	Controls	N/A	N/A
SIRECC Controls for Air Curtains · Systemair	Controls	N/A	N/A
SIREWTA Controls for Air Curtains · Systemair	Controls	N/A	N/A
SIREUR Controls for Air Curtains · Systemair	Controls	N/A	N/A
SIREOTX Controls for Air Curtains · Systemair	Controls	N/A	N/A
SIRERTX Controls for Air Curtains · Systemair	Controls	N/A	N/A
SIREUA/B1 Controls for Air Curtains · Systemair	Controls	N/A	N/A
SIRECJ Controls for Air Curtains · Systemair	Controls	N/A	N/A
SIRe Basic Controls for Air Curtains · Systemair	Controls	N/A	N/A
SIRe Advanced Air Curtains Controls for Air Curtains · Systemair	Controls	N/A	N/A
SIREB1X Controls for Air Curtains · Systemair	Controls	N/A	N/A
PAMP Speed Controls · Systemair	Controls	N/A	N/A
AGB Door Contacts · Systemair	Controls	N/A	N/A
PA2DR Door Contacts · Systemair	Controls	2013	Space heaters and combination heaters

Product name	Product category	Ecodesign compliance year	Compliance category
ADACR Speed Controls · Systemair	Controls	N/A	N/A
MDC Door Contacts · Systemair	Controls	2013	Space heaters and combination heaters
VLP Modulating Valve system · Systemair	Valves	N/A	N/A
VPFC Modulating Valve system · Systemair	Valves	N/A	N/A
VR Valve kit Valve Kits · Systemair	Valves	N/A	N/A
VKF Valve Kits · Systemair	Valves	N/A	N/A
VMT Valve Kits · Systemair	Valves	N/A	N/A
VOT Valve Kits · Systemair	Valves	N/A	N/A
VLSP On/off Valve Systems · Systemair	Valves	N/A	N/A
ST23024 Actuators and Transformers · Systemair	Actuators and transformers	N/A	N/A
SD20 Actuators and Transformers · Systemair	Actuators and transformers	N/A	N/A
SD230 Actuators and Transformers · Systemair	Actuators and transformers	N/A	N/A
SDM24 Actuators and Transformers · Systemair	Actuators and transformers	N/A	N/A
CB Control Box Other controls · Systemair	Controls	2013	Space heaters and combination heaters
SBMS Other controls · Systemair	Controls	N/A	N/A
PAMLK Other controls · Systemair	Controls	2013	Space heaters and combination heaters
UF Other controls · Systemair	Controls	N/A	N/A
Cordilla Commercial Air Curtains · Systemair	Air curtains	2011	Fans driven by motors with an electric input power between 125W and 500kW
Infrared Heater IH Patio Heaters · Systemair	Radiant heaters	2011	Fans driven by motors with an electric input power between 125W and 500kW
Tiger Portable Fan Heaters · Systemair	Fan heaters	2011	Fans driven by motors with an electric input power between 125W and 500kW

Product name	Product category	Ecodesign compliance year	Compliance category
Champ Wall Mounted Fan Heaters · Systemair	Fan heaters	2011	Fans driven by motors with an electric input power between 125W and 500kW
SWH Wall Mounted Fan Heaters · Systemair	Fan heaters	2011	Fans driven by motors with an electric input power between 125W and 500kW
PFS Fan Convectors · Systemair	Fan heaters	2015	Local space heaters
GLIESE Panel Heaters · Systemair	Radiant heaters	2011	Fans driven by motors with an electric input power between 125W and 500kW
Panther FC 6-15 Wall Mounted Fan Heaters · Systemair	Fan heaters	2011	Fans driven by motors with an electric input power between 125W and 500kW
Thermocassette HC Panel Heaters · Systemair	Radiant heaters	N/A	N/A
Ribbed Pipe Radiators Radiators · Systemair	Radiators	2015	Local space heaters
Elztrip EZ300 Heavy Duty Panel Heaters · Systemair	Radiant heaters	2011	Fans driven by motors with an electric input power between 125W and 500kW
Elektra C Demanding Environments · Systemair	Fan heaters	2011	Fans driven by motors with an electric input power between 125W and 500kW
Infracalm INC Patio Heaters · Systemair	Radiant heaters	2011	Fans driven by motors with an electric input power between 125W and 500kW
Infrared Heater IHC Patio Heaters · Systemair	Radiant heaters	2011	Fans driven by motors with an

Product name	Product category	Ecodesign compliance year	Compliance category
			electric input power between 125W and 500kW
Infrasmart IHS Patio Heaters · Systemair	Radiant heaters	2015	Local space heaters
Infralu IHAL Patio Heaters · Systemair	Radiant heaters	2015	Local space heaters
Infraglas IHG Patio Heaters · Systemair	Radiant heaters	2015	Local space heaters
Infraswift Patio Heaters · Systemair	Radiant heaters	N/A	N/A
Infraflex Patio Heaters · Systemair	Radiant heaters	N/A	N/A
Infradark Patio Heaters · Systemair	Radiant heaters	N/A	N/A
Infratower IHA Patio Heaters · Systemair	Radiant heaters	2015	Local space heaters
Infrapalm IHPA Patio Heaters · Systemair	Radiant heaters	2015	Local space heaters
Thermoplus ECVTN Panel Heaters · Systemair	Radiant heaters	2011	Fans driven by motors with an electric input power between 125W and 500kW
Thermocassette CTS Panel Heaters · Systemair	Radiant heaters	2015	Local space heaters
Thermocassette HPZ Panel Heaters · Systemair	Radiant heaters	2015	Local space heaters
Elztrip EZ100 Panel Heaters · Systemair	Radiant heaters	2011	Fans driven by motors with an electric input power between 125W and 500kW
Elztrip EZ200 Panel Heaters · Systemair	Radiant heaters	2011	Fans driven by motors with an electric input power between 125W and 500kW
Infrared Heater IR Heavy Duty Panel Heaters · Systemair	Radiant heaters	2011	Fans driven by motors with an electric input power between 125W and 500kW
K21 Portable Fan Heaters · Systemair	Fan heaters	2011	Fans driven by motors with an electric input power between

Product name	Product category	Ecodesign compliance year	Compliance category
			125W and 500kW
CAT Wall Mounted Fan Heaters · Systemair	Fan heaters	2011	Fans driven by motors with an electric input power between 125W and 500kW
Panther FC 20-30 Wall Mounted Fan Heaters · Systemair	Fan heaters	2011	Fans driven by motors with an electric input power between 125W and 500kW
Panther T Wall Mounted Fan Heaters · Systemair	Fan heaters	2011	Fans driven by motors with an electric input power between 125W and 500kW
SWL Wall Mounted Fan Heaters · Systemair	Fan heaters	N/A	N/A
SWS Wall Mounted Fan Heaters · Systemair	Fan heaters	2011	Fans driven by motors with an electric input power between 125W and 500kW
Panther Wall Mounted Fan Heaters · Systemair	Fan heaters	2011	Fans driven by motors with an electric input power between 125W and 500kW
SWK Wall Mounted Fan Heaters · Systemair	Fan heaters	2016	Fan coil units
SWT Ceiling Mounted Fan Heaters · Systemair	Fan heaters	2011	Fans driven by motors with an electric input power between 125W and 500kW
Elektra H Demanding Environments · Systemair	Fan heaters	2011	Fans driven by motors with an electric input power between 125W and 500kW
Elektra F Demanding Environments · Systemair	Fan heaters	2011	Fans driven by motors with an

Product name	Product category	Ecodesign compliance year	Compliance category
			electric input power between 125W and 500kW
Elektra V Demanding Environments · Systemair	Fan heaters	2011	Fans driven by motors with an electric input power between 125W and 500kW
SWX CE/CS Demanding Environments · Systemair	Fan heaters	2011	Fans driven by motors with an electric input power between 125W and 500kW
Ceiling convector TKW Fan Convectors · Systemair	Fan heaters	N/A	N/A
Bench Heater SH Radiators · Systemair	Radiators	2015	Local space heaters
Frostguard FML Radiators · Systemair	Radiators	2015	Local space heaters
TWS Radiators · Systemair	Radiators	2015	Local space heaters
TWT Radiators · Systemair	Radiators	2015	Local space heaters
FCPOB Controls Heaters · Systemair	Controls	N/A	N/A
FC for Radiant Heaters Controls Heaters · Systemair	Controls	2015	Local space heaters
FC Pro Fan Heaters Controls Heaters · Systemair	Controls	2015	Local space heaters
FC Building Fan Heaters Controls Heaters · Systemair	Controls	2015	Local space heaters
FC Smart Fan Heater Controls Heaters · Systemair	Controls	2015	Local space heaters
FC Direct Fan Heater Controls Heaters · Systemair	Controls	2015	Local space heaters
SIRe Advanced Fan Heaters SIRe Control system for Fan Heaters · Systemair	Controls	N/A	N/A
SIRe Competent Fan Heaters SIRe Control system for Fan Heaters · Systemair	Controls	N/A	N/A
IHBD Radiant Heater Controls · Systemair	Controls	N/A	N/A
PP Panther Fan Heater Controls · Systemair	Controls	N/A	N/A
TPT16 Electronic Thermostats · Systemair	Controls	2015	Unknown
TAP Electronic Thermostats · Systemair	Controls	N/A	N/A
PDK65 Sensors · Systemair	Controls	N/A	N/A

Product name	Product category	Ecodesign compliance year	Compliance category
SKG Sensors · Systemair	Controls	N/A	N/A
CBT Timers · Systemair	Controls	N/A	N/A
FCR230 Other Controls · Systemair	Controls	N/A	N/A
PSA/M01 Damper motors · Systemair	Controls	N/A	N/A
RB3 Radiant Heater Controls · Systemair	Controls	2013	Space heaters and combination heaters
PE Other Controls · Systemair	Controls	N/A	N/A
CFR1R Other Controls · Systemair	Controls	N/A	N/A
CAR15 Other Controls · Systemair	Controls	N/A	N/A
CIRT Radiant Heater Controls · Systemair	Controls	2013	Space heaters and combination heaters
IHMC Radiant Heater Controls · Systemair	Controls	N/A	N/A
ERP Radiant Heater Controls · Systemair	Controls	N/A	N/A
S123 Radiant Heater Controls · Systemair	Controls	N/A	N/A
RB123 Radiant Heater Controls · Systemair	Controls	2013	Space heaters and combination heaters
VPTK Valve Kits Heaters · Systemair	Controls	N/A	N/A
EV300 Fan Heater Controls · Systemair	Controls	N/A	N/A
SWYD Fan Heater Controls · Systemair	Controls	N/A	N/A
SWXRT Fan Heater Controls · Systemair	Controls	N/A	N/A
ELRT Fan Heater Controls · Systemair	Controls	2011	Fans driven by motors with an electric input power between 125W and 500kW
ELSRT Fan Heater Controls · Systemair	Controls	2011	Fans driven by motors with an electric input power between 125W and 500kW
SWR Fan Heater Controls · Systemair	Controls	N/A	N/A
ECG1 Sensors · Systemair	Controls	N/A	N/A
ERPGG Sensors · Systemair	Controls	N/A	N/A
RTI Electronic Thermostats · Systemair	Controls	2013	Space heaters and combination heaters
T10/TK10 Electronic Thermostats · Systemair	Controls	2013	Space heaters and combination heaters

Product name	Product category	Ecodesign compliance year	Compliance category
RTS Electronic Thermostats · Systemair	Controls	2013	Space heaters and combination heaters
RTX Electronic Thermostats · Systemair	Controls	N/A	N/A
TD Electronic Thermostats · Systemair	Controls	2013	Space heaters and combination heaters
TKS Electronic Thermostats · Systemair	Controls	2013	Space heaters and combination heaters
TP Electronic Thermostats · Systemair	Controls	2013	Space heaters and combination heaters
TBK Mechanical Thermostats · Systemair	Controls	2013	Space heaters and combination heaters
KRT Mechanical Thermostats · Systemair	Controls	2011	Fans driven by motors with an electric input power between 125W and 500kW
KUR Timers · Systemair	Controls	N/A	N/A
PTA01 Fan Heater Controls · Systemair	Controls	N/A	N/A
VPTK NC On/off Valve Systems Heaters · Systemair	Controls	N/A	N/A
Aquaztrip Basic Heavy Duty Panel Heaters · Systemair	Radiant heaters	N/A	N/A
Aquaztrip Design Heavy Duty Panel Heaters · Systemair	Radiant heaters	N/A	N/A
IRCFC Heavy Duty Panel Heaters · Systemair	Radiant heaters	N/A	N/A

6.14 APPENDIX – RACER MATRIX

Criterion	Description	1 (Poor)	2 (Neutral)	3 (Good)
Relevance	Refers to whether the indicator is closely linked to the objectives to be reached.	Does not support a better understanding of true circularity.	Supports a better understanding of true circularity.	Highly supportive towards gaining a better understanding of true circularity.
		Supports no value-added circular opportunities.	Supports lower value-added opportunities (i.e. metrics related to waste generation, recycling, waste management, etc.)	Supports higher value-added opportunities (i.e. all R-strategies above remanufacturing) and wider systemic change (e.g. indicators that encourage PSS or circular design).
		Not linked to the project objectives and/or European policy objectives (existing or upcoming).	Linked to the project objectives, but not to European policy objectives (existing and/or upcoming).	Fully aligned with project objectives and European policy objectives (existing and/or upcoming).
Acceptance	Refers to whether the indicator is perceived and used by key stakeholders (such as policymakers, civil society, and industry).	Poorly accepted by key stakeholders, e.g. due to the use of confidential data.	Relatively accepted by key stakeholders as the benefits of measuring are clear.	Key stakeholders are motived to report this indicator, due to mandatory legislative requirements (current or upcoming), potential commercial benefit or being in the public interest.
Credibility	Refers to whether the indicator is transparent, trustworthy and easy to interpret.	No defined methodology associated with this indicator and/or interpretation of the indicator is ambiguous.	Methodologies have been proposed or currently existing, but not for this particular indicator (e.g. in a research article).	There is an EU defined methodology.
		Difficult to understand and communicate to stakeholders (e.g. units or measurement of something that stakeholders are not familiar with).	Moderately easy to understand and communicate to stakeholders (e.g. units or measurement of something that stakeholders are aware of but are not confident in practical use).	Easy to understand and communicate to stakeholders (e.g. units or measurement of something that stakeholders already use and are confident in applying).
Ease	Refers to the easiness of measuring and monitoring the indicator.	No defined methodology associated with this indicator and/or interpretation of the indicator is ambiguous.	Methodologies have been proposed or currently existing, but not for this particular indicator (e.g. in a research article).	There is an EU defined methodology.
		Difficult to understand and communicate to stakeholders (e.g. units or measurement of something that stakeholders are not familiar with).	Moderately easy to understand and communicate to stakeholders (e.g. units or measurement of something that stakeholders are aware of but are not confident in practical use).	Easy to understand and communicate to stakeholders (e.g. units or measurement of something that stakeholders already use and are confident in applying).
Robustness	Refers to whether data is biased and comprehensively assesses circularity.	No consistent methodology and dataset are available.	A consistent methodology and dataset available.	A consistent methodology and dataset available.
			A composite/aggregated indicator (based on multiples dimensions).	A one-dimensional indicator.
			A proxy indicator.	

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