Research paper
6th PLATE 2025 Conference
Aalborg, Denmark, 2-4 July 2025

"Oh no, it's broken!" – How product functionality limits lifespan

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Keywords:
Product lifetime; Functionality; Energy-related Products; Purchase Decisions; Circular Economy.

Abstract: Today a large variety of products with various features and designs are available for consumers. In addition to the main functions of a product, there are more and more additional functions, especially for electrical and electronic appliances. This means that looking for the right product may require extensive research by consumers and does not always lead to a sense of making an informed purchase decision. The wide variety of designs and functions can overwhelm consumers. This creates uncertainty and might lead to overrate products functionality and thus significantly shorten the service lifetime of appliances. Furthermore, the environmental impact of such functions is usually unclear, and can vary depending on the actual usage scenario. In this study, a survey was carried out in order to better understand consumers perceptions and experiences related to additional functions of products, with specific focus on domestic hobs, household refrigerating appliances and televisions. The results confirm the large number of additional functions and their overwhelming effect for consumers. Consumers purchase devices with more features than desired, or replaced them prematurely because an extra feature fails while the main function is still available. The findings of the study can be used to better inform consumers and support them to make environmentally sustainable purchasing decisions.

Introduction

The aim of the European Green Deal is to achieve a climate neutral European Union by 2050 (COM/2019/640 final, 2019). As one related policy initiative, the Circular Economy Action Plan targets product design, circular economy, and sustainable consumption (CEAP, 2020). Scientific research is key in this regard, providing well-founded information for effective legislation and information for consumers to encourage well-considered purchase decisions. A successful implementation of the Green Deal and the CEAP requires measures in all branches of industry and areas of individual life. This also includes the use of electric and electronic devices in private households.

"Oh no, it's broken!" – sounds like a trivial thing to say but it often is not. While there were significantly less product types on the market a few decades ago, the circumstance to purchase a new device for the right application nowadays might require extensive research and frequently lead to an unsatisfactory result for the consumer. Inefficient information might also result in purchase decision in favor to appliances with shorter lifetime. A glance at the electronics stores reveals more devices with additional functions than without. For example, televisions are today no longer just a playback device, they became a multifunctional entertainment tool with pre-installed apps for gaming, streaming, video calls, etc. Many additional functions cannot be clearly assigned to a positive or negative environmental impact as the effects depend to a large extent on utilization. In addition, contradictory effects are possible. Finally, the question whether additional functions increase or decrease products' lifetimes remains.

Like the main function, additional functions have an influence on many product properties. This concerns reparability, which is to be improved with the right to repair and is communicated, for example, via a repair score (Schischke et al., 2022). It also concerns the bill of materials and the total material footprint of the product (Liedtke et al., 2014), as well as the standardization of durable products (Schlegel et al.). In the future, it should also be considered whether some information on additional functions should be included in the consumer-oriented version of the Digital Product Passport

(SVRV, 2024) in order to support the realization of the ESPR (ESPR, 2024/PE/106/2023/REV/1).

Against this background, the aim of the article is to describe the results of a representative survey aiming to better understand consumers perceptions and experiences concerning additional functions of products. A focus is set on the relevance of additional functions for purchasing decisions and product lifetimes, and related information requirements. The survey referred to these three product groups: domestic hobs, household refrigerating appliances and televisions.

What are Additional Functions?

The large variety of different designs and functions coupled with ranges in price can be overwhelming when it comes to purchase decisions. In addition to the primary functions of an appliance category, numerous additional functions are available. The additional functions can complement the primary function, enhance it, or also have no direct connection to it. The environmental impacts of such functions are usually unclear, and can vary depending on the actual usage scenario.

In order to define additional functions more specifically we refer to our earlier article on additional product functions (Tochtrop et al., 2024) and the definition given there: *"Additional functions are the functions of a product that are not related to the intended function or that supplement or reinforce the primary function. In other words, they are functions that are not required to ensure the primary function*".
Figure 1 illustrates this definition.

This definition is based on the "International Electrotechnical Vocabulary" relating to different energy requirements of active-, stand-by- and off-mode. The vocabulary contains the following three definitions of functions that clearly relate to additional functions in our understanding:

- primary function = "function providing the intended purpose" (IEC, 2014a)
- secondary function = "function that enables, supplements or enhances a primary function" (IEC, 2014b)
- tertiary function = "function other than a primary or a secondary function" (IEC, 2014c)

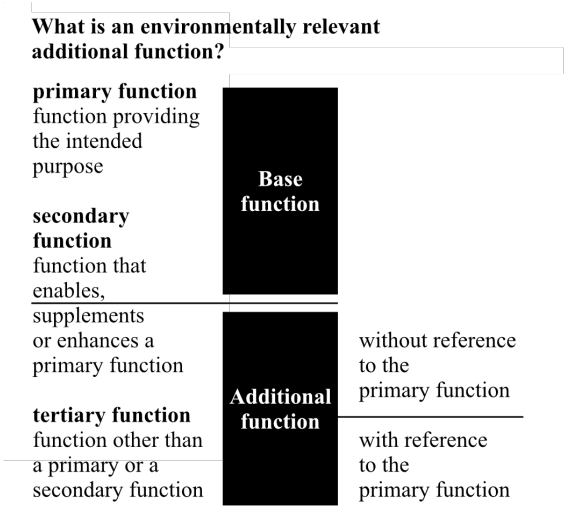

Figure 1: Additional functions in relation to primary, secondary and tertiary functions (Source: (Tochtrop et al. 2024).

Methodology

The overall methodology for this study has been initially described by Tochtrop et al. (2024) with further sources and background information. Here, we explain the key elements of the approach.

The methodology comprises the following five steps:

1. Identifying additional functions
2. Initial assessment by experts in an evaluation matrix
3. Focus group dialogue
4. Survey on user perspectives
5. Information concepts for consumers

The steps are described below, with specific focus on step 4 as the survey on user perspectives is the focus on this paper. Details on the steps 1 to 3 and 5 are described by Tochtrop et al. (2024). These steps are illustrated by reference to the three product groups analyzed: refrigerating appliances, TVs, and domestic hobs
In order to *identify additional functions*, preliminary market research was carried out in conjunction with the clear definition of the product group. The offers on the market were examined for each group of devices and analyzed with regard to these questions: which designs are primarily offered? Which functions can be clustered despite different brand names? The additional features we used to investigate further are listed below.

Refrigerating appliances

- Chill compartment
- Auto-defrost
- WLAN/ smart refrigerator/ control via app
- Camera inside (in combination with WLAN)
- Fast freeze
- Door alarm
- Automatic door opening function
- Door display with calendar and communication tools
- Ice cube maker and water dispenser

TVs

- Extra-large device
- Onboard Audio system
- Camera
- Smart TV onboard
- Smart TV via additional TV streaming stick
- Game hub
- Art mode
- Frame lighting
- ECO mode
- Eye comfort mode
- Special design

Domestic hobs

- Childproof lock
- Frameless design
- Removable control knob, magnetic
- Illuminated markings for cookware recognition
- Fast heating: Automatic boil or boost function
- Frying/cooking sensor for constant temperature
- Cookware recognition with resulting functionality
- Pause function
- Timer function (alarm clock)
- Keep warm function
- Automatic switch-off function
- Integrated fume extraction system

Survey on user perspectives

A total of 3055 participants took part in the survey. The group of participants, even after the following division into subgroups, corresponds to a representative composition of the German population. The questionnaire was structured as follows:

A) Standard demographic questions.
B) Questions on the basic perception of additional functions.
C) The participants are asked questions specifically about one of the three product groups refrigerating appliances, domestic hobs and TVs.
D) Preferences regarding the availability of information on additional functions.

By splitting the approximately 3,000 participants into three groups for the analysis of individual product groups, the questions are structured identically, allowing us to carry out comparative analyses. The questions related to these aspects:

- Which general quality aspects are important to consumers in a theoretical purchase decision?
- A list of additional functions of the appliance group was provided, for which the consumers were asked to decide how important these are for them.
- They should evaluate the same list regarding the suspected environmental impacts.

Due to the immense variety of household appliances and the associated potential additional functions, we decided to use free text fields in the survey. If the answer to the question “Have you ever bought an electrical appliance that had more functions than you actually wanted?” was yes, the next step was for the participants to indicate which appliances these were and which unplanned functions were associated with them. Finally, the participants were asked to rate the additional functions they had mentioned – whether they were a benefit, remained unused, had a negative effect, or had both negative and positive effects.

The following Tables A to D summarize the questions and possible answer fields.

Questions	Answer options
gender	female; male; diverse
year of birth	numerical
level of education	6 levels from 'no school-leaving qualification' to PhD / habilitation
Household income	4 levels from zero to above 4500€
Number of house-hold members	from 0 to 20, differentiation by total number and children under the age of 16

Table A: Standard demographic questions

Questions	Answer options
Please rate the following product groups according to their environmental impact:	
refrigerating appliances	selection boxes with scale 1-5; from positive over neutral to negative influence
domestic hobs	
TVs	
Give your opinion on the following statements: When buying an electrical appliance, it is important to me that...	
... I get a solid device with the basic functions.	selection boxes with scale 1-5; from 'fully agree' over 'yes and no' to 'completely disagree'
... I am technically up to date.	
... I buy a durable product.	
... it looks high quality.	
Have you ever bought an electrical appliance that had more functions than you actually wanted?	
Which device was that? Please give several examples.	5 text fields, only the first compulsory
Name or briefly describe the additional functions.	1 text field for each previously entered answer
Please tell us how you rate these additional functions in retrospect.	selection boxes: as a benefit, unclear, don't care / don't use, as a disadvantage, other (open text field)
Do you remember an electrical appliance that you replaced because an additional function broke down while the main function was still working?	
Which device was that? Please give several examples.	5 text fields, only the first compulsory

Table B: Questions on the basic perception of additional functions

Questions	Answer options
Assuming that your [refrigerator / hob / TV] is broken and you are going to buy a new one within the next few days. Give your assess-ment of the following statements: When buy-ing a [refrigerator / hob / TV], it is important to me that...	
... I get a solid device with the basic functions.	selection boxes with scale 1-5; from 'fully agree' over 'yes and no' to 'completely disagree'
... I am technically up to date.	
... I buy a durable product.	
... it looks high quality.	
Assume your [refrigerator / hob / TV] is broken and you are about to buy a new appli-ance. Which of the following additional functions are important for your purchase decision?	
List with 9-12 additional functions depending on the product group.	selection boxes with scale 1-5; from 'very important' over 'neutral' to 'not important at all'
Assume your [refrigerator / hob / TV] is broken and you are about to buy a new appli-ance. Give an estimation of how the following additional functions affect the sustainability of the appliance.	
Same list as above with 9-12 additional func-tions depending on the product group.	selection boxes with scale 1-5; from positive over neutral to negative influence

Table C: Questions specifically about one of the three product groups

Questions	Answer options
Give your opinion on the following state-ments:	
I would like to be better informed about the environmental impact of additional functions in devices.	selection boxes with scale 1-5; from 'fully agree' over 'yes and no' to 'completely disagree'
I would like to be warned about functions with a high negative environmental impact.	
The information provided by the manufacturer is enough for me to make a good purchase decision.	
How helpful would the following information on additional functions be for you when making a purchase decision?	
Information on additional functions on the EU product information	selection boxes with

sheet (which is linked next to the price at online retailers, for example).	scale 1-5; from 'very helpful' over 'yes and no' to 'not helpful at all' plus the option 'unknown'
An online self-test with environmental information on additional functions.	
An information campaign that draws attention to the topic of environmental relevance of additional functions.	
Mandatory information required from manufacturers on the monetary follow-up costs of additional functions that cannot be switched off and on the availability of devices with basic functionality.	

Table D: Questions on preferences regarding the availability of information on additional functions

Survey Results

As first question on the individual user perspective the respondents were asked to rate the product groups according to their environmental impact. Figure 2 summarizes the results. All product groups were assessed without a clear rating; refrigerators and televisions tended to be more frequently associated with negative environmental impacts than hobs. In Figure 2 the first broader bars in each of the four sections show the mean values for every group. This is followed by a breakdown by demographic group referring to age, education and income. Similar trends are seen across all groups and products. Younger people associate more negative environmental impacts with products than older people. Awareness of environmental issues is positively linked to education and income. However, it is noted that those with the lowest incomes (up to €1500) are more likely to expect negative environmental impacts than those with lower middle incomes (€1501-2250).

A similar analysis is shown in Figure 3 for the question of which aspects are important for the purchase decision. The higher the income, age and level of education, the more attention is paid to quality. Figure 3 shows the combined responses for all three product groups. However, the percentage deviations in the responses between the product groups were rather small, and there were no significant outliers.

For all questions, correlations were examined between demographic groups and their survey responses. Men and women could be analyzed individually. However, there were too few records for the *diverse* entry.

More than half of respondents (56,7 %) were in the affirmative when asked if they had ever bought an electrical appliance that had more functions than they wanted. Conversely, these people have not found the optimal product for their needs. In the following text fields, the participants could indicate which devices these were. A total of 1732 people entered between

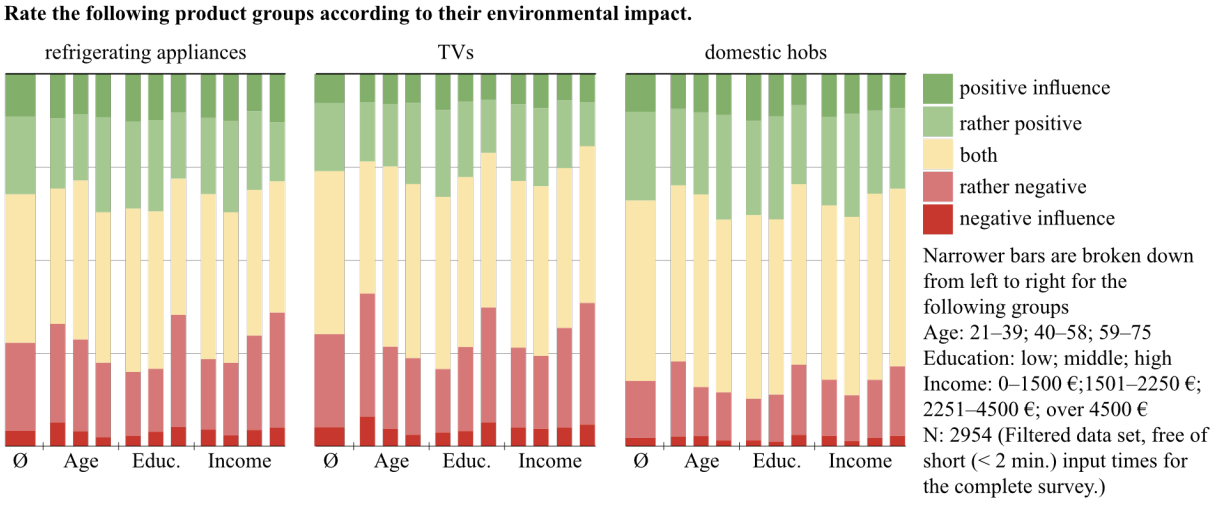

Figure 2: Rated environmental impact of refrigerating appliances, TVs and domestic hobs.

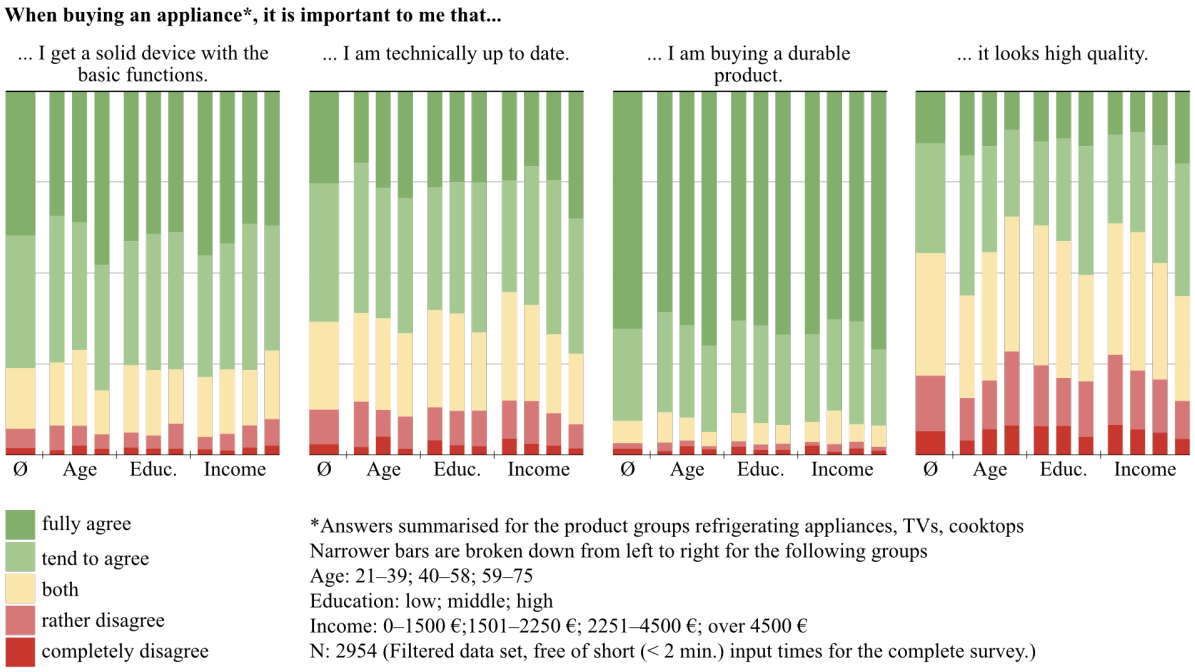

Figure 3: Analysis of quality criteria for new purchases

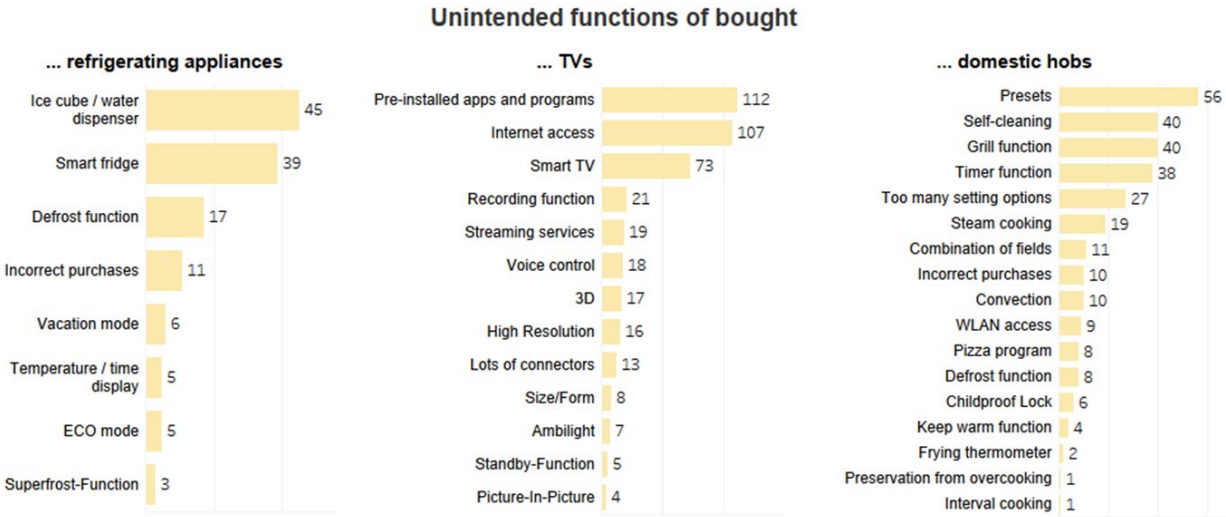

Figure 4: Listed unintended functions of bought products

one and five devices in the text boxes, which we then analyzed. Obviously incorrect and incomprehensible entries were not considered. The remaining data was sorted and counted according to recognizable product groups. Figure 6 shows the results in absolute numbers of mentions. Televisions are by far the most frequently mentioned product group with unintended extra functions. Behind the large number 151 under ‘Others’ is a total of 45 different products, reflecting the enormous variety available on the market today.

For the devices mentioned, the participants were then invited to list the functions that they did not specifically want when they made their purchase decision. In analyzing this data set, the entries were also harmonized into groups of equivalent features. It can be seen in Figure 4 that digitalization functions were mentioned frequently. In general, over-engineered equipment was often cited as a problem. The "Incorrect purchases" category includes entries where devices appear to have been purchased in the wrong product category. These included

for example buying induction when a ceramic hob was preferred, or buying a fridge-freezer instead of a refrigerator. Figure 5 lists the devices that people have already replaced because of a broken extra function. A total of 129 respondents identified 314 devices that they had replaced. This accounts for approximately 7.5% of the respondents who had purchased unwanted product features.

Based on the results of the detailed methodology and this survey *information concepts for consumers* were developed for consumers, which lead to well-founded purchasing decisions through precise facts. For details see Tochtrop et al.

Discussion

Additional features and functions can be both useful and harmful – and this interpretation varies from user to user. Rebound effects may occur, when equipment that has been purchased for its environmental benefit is perceived too soon to be outdated. But some aspects are clear: Additional features and functions make the market complex, and the survey shows that respondents criticize the over-engineering of devices. The ubiquitous digitalization of everyday objects was identified as a problem for consumers and has also clearly led to more negative impacts on the environment as the United Nations summarize: “Digitalization’s promise of dematerialization has not yet materialized” (United Nations, 2024). All these aspects can lead to a significant reduction in service lifetime. It has become increasingly difficult in terms of transparency to buy a long-lasting device.

Finally, there is wasted potential in minimizing environmental impact in the case of environmentally sustainable (and also economic) purchases decision. The results have shown that people sometimes "accidentally" buy obvious extra features, such as an ice cube dispenser in the refrigerator or a permanently installed frame light on the TV. But even with less resource-intensive extras, there are many uncertainties left. In addition, the variety of brand names for similar functions in a product segment makes it difficult to choose the right product for certain households. Clearer language, maybe a standardized terminology, would help consumers to make informed decisions. One example is the multitude of terms in the refrigerator segment for the

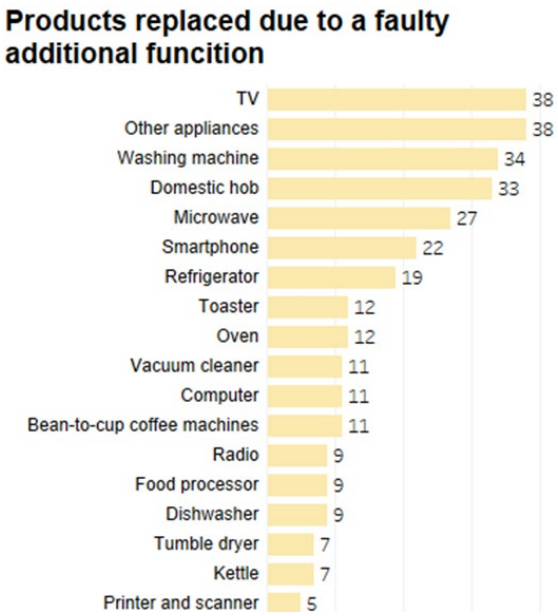

Figure 5: New purchases caused by broken extra functions

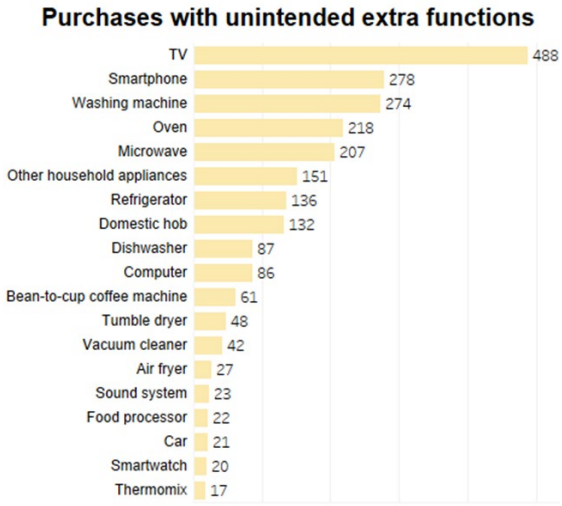

Figure 6: Purchases with unintended extra functions

vegetable drawer: hyperFresh (Plus), VitaFresh (Plus), DailyFresh, Cool Select+, Optimal Fresh+, (Ultra) Fresh Zone+, ExtraChill, UltraFresh, CrispZone, EverFresh+ and FRESHBalancer. The names become even more difficult to assign when trying to work out whether it is a ‘chill compartment’ or a ‘storage compartment for fresh food’ (Commission Delegated Regulation (EU) 2019/2016 of 11 March 2019).

Conclusions

The survey confirms that it is difficult to choose the most appropriate product for specific needs, given by the current diversity of products on the market. At the same time, product designers are challenged by the wide variety of consumer demands. Consumers value the same device very differently depending on their personal needs and life situations.

It remains a major challenge for manufacturers and products' designers to produce products that meet people's needs while minimizing their impact on the environment. The survey shows that it is difficult for consumers to distinguish between a function that adds real value to the user's daily life or one that adds technology to the device that is rarely used. From an environmental perspective, there were only a small number of functions that could be clearly recommend or rejected. In our view, comprehensible impact assessments such as product sustainability reports that are always structured in the same way would be helpful as a possibility to inform consumers. The results could be used to indicate additional functions that could limit the durability of the appliance. An example of this are integrated multimedia displays in refrigerators. Other additional functions, such as the timer function in cookers or the no-frost function in freezers, make longer and more energy-efficient use more likely.

Key stakeholders are called upon to make the overall economy more sustainable than the status quo through smart regulation, appropriate incentives, and thoughtful consumption. A more differentiated consumer communication and sometimes even less functions might contribute to it and the Digital Product Passport can be a building block towards this goal.

Acknowledgments

This presented study was conducted within the research project "Scientific Studies on Increasing Energy and Resource Efficiency of Products" financed and commissioned by Federal Institute for Materials research and Testing (BAM) and German Federal Ministry for Economic Affairs and Climate Action (BMWK).

We would like to thank the people who helped us with the statistical analysis of the results of the survey: Luca Fabian Tritto, Anna-Mariia Zaiets and Florian Feldmann.

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How to Cite

Rückschloss, J., Tochtrop, C., von Geibler, J., & Schlegel, M.-C. (2025). “Oh no, it’s broken!”: How product functionality limits lifespan. *Proceedings of the 6th Product Lifetimes and the Environment Conference (PLATE2025)*, (6). https://doi.org/10.54337/plate2025-10367

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