

## DEMAND FOR ELECTRONIC DEVICES IN THE CONTEXT OF SUSTAINABLE DEVELOPMENT – EVIDENCE FROM POLAND

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**Purpose:** The purpose of the article is to identify how the goals of sustainable development in the area of responsible consumption are realized, using the example of demand for electronic devices in Poland, and to identify opportunities for its solution.

**Design/methodology/approach:** The article undertook to answer the question: how to reduce the negative impact of excessive consumption of electronic devices on the sustainable development goal of responsible production and consumption? The following methods were used: literature review, analysis of the results of research institutions and consulting agencies, deductive reasoning.

**Findings:** The causes of excessive consumption of electronic devices and the generation of harmful waste are not only the relatively low awareness of consumers, but also the strategies of producers inspired by technological progress and the intensity of global competition. Therefore, in order to reduce this problem and increase the possibility of implementing the principles of responsible production and consumption, systemic solutions involving three parties are proposed: consumers, producers and the state.

**Practical implications:** Opportunities and courses of action to reduce excessive demand for new electronic devices were suggested, which would better achieve the sustainable development goals in the area of responsible consumption.

**Originality/value:** The article is a contribution/voice to the discussion of the controversy surrounding the implementation of sustainable development principles in the context of technological progress and the desire of companies to maximize profits.

**Keywords:** sustainability, responsible consumption, consumer attitudes, electronic market.

**Category of the paper:** Conceptual paper.

### 1. Introduction

Socio-economic development inspired by technical and technological progress, has led in highly developed countries to an increase in wealth and the formation of a civilization of consumption. The dominant lifestyle based on consumerism leads to consumption of goods and

services that is excessive in relation to actual needs, which is carried out without regard to social, ecological and ethical costs (Frost, 2009). Excessive and irrational consumption results in adverse effects for society and the environment, such as environmental pollution, adverse climate change, waste of resources, generation of large amounts of waste, often difficult to dispose of waste. Especially dangerous is electronic waste (e-waste), which emits harmful substances into the soil, water and air. Dynamic technical progress in the field of electronics and information technology, especially intense at the turn of the 20th and 21st centuries, influences the shortening of the life cycles of electronic devices, the introduction of newer and newer models and the increase in demand, which generates large quantities of electro-waste that is difficult to dispose of.

The answer to these difficult challenges are the principles of sustainable development, which have been promoted and advocated for many years. The essence of sustainable development is the search for such ways and directions of satisfying needs that take into account aspects of environmental protection, economic growth, social development, spatial economic order and psychological well-being of both the current generation and future generations (Kielczewski, 2012, p. 204). The Sustainable Development Goals are defined in the 2015 UN Resolution - Transforming Our World: Agenda 2030 for Sustainable Development, adopted by member countries (*Resolucja ONZ - Agenda 2030*). One of the goals is responsible consumption and production, which deals with the development of sustainable consumption and production patterns, in line with the model of a circular economy.

The purpose of the article is to identify the problem of demand for electronic devices in the context of the implementation of the Sustainable Development Goals in Poland and to identify opportunities for its solution. In this connection, the following research questions were undertaken:

- 1) What are the main goals of sustainable development in Poland and how are they implemented?
- 2) What are the symptoms of sustainable consumption with regard to electronic equipment?
- 3) What is the demand for electronic equipment on the Polish market in the context of the electro-waste problem?
- 4) How to reduce the negative environmental effects of excessive consumption of electronic equipment?

The article uses the following research methods: literature review, analysis of the results of research institutions and consulting agencies, deductive reasoning.

The structure of the article consists of the following sections. Section 2 discusses the implementation of sustainable development goals in Poland. Section 3 describes actions taken for sustainable consumption by Polish consumers. Section 4 analyzes the demand for electronic devices in Poland in the context of the electro-waste problem. Section 5 formulates proposals for actions to solve the problem of excessive consumption of electronic devices.

## 2. How are the Sustainable Development Goals being implemented in Poland?

The 2015 UN Resolution formulated the following 17 Sustainable Development Goals (SDGs): No poverty (SDG 1), Zero hunger (SDG 2), Good health and well-being (SDG 3), Quality education (SDG 4), Gender equality (SDG 5), Clean water and sanitation (SDG 6), Affordable and clean energy (SDG 7), Decent work and economic growth (SDG 8), Industry, innovation and infrastructure (SDG 9), Reducing Inequalities (SDG 10), Sustainable Cities and Communities (SDG 11), Responsible Consumption and Production (SDG 12), Climate Action (SDG 13), Life Under Water (SDG 14), Life on Land (SDG 15), Peace, Justice and Strong Institutions (SDG 16) and Partnerships for the Goals (SDG 17) (*Sustainable Development Goals. Agenda 2023*). Poland has undertaken to meet these targets with a view to 2030. The level of progress was assessed and presented in a report adopted by the Council of Ministers on 2 June 2023. In the 2022 SDG Index, Poland ranked 12th out of 163 countries assessed (up from 15th place in 2021) with a score of 80.5%. This is a high position considering that in the first edition of the 2016 ranking Poland was ranked 38th. Poland performs best on goals such as poverty eradication (SDG 1), access to quality education (SDG 4), clean water and sanitation (SDG 6), industry, innovation and infrastructure (SDG 9), responsible consumption and production (SDG 12) and protection of sustainable land ecosystems (SDG 15). In contrast, the greatest difficulties relate to: climate action (SDG 13), ensuring the protection of marine resources (SDG 14), the Global Partnership for Sustainable Development (SDG 17), and affordable, clean and accessible energy (SDG 7) (*Realizacja Celów Zrównoważonego Rozwoju w Polsce. Raport 2023*).

According to Eurostat's report "Sustainable development in the European Union. Monitoring report on progress towards the SDGs in an EU context" of May 2022, Poland has made the most progress against the EU average in achieving 3 of the 17 SDGs, i.e. reducing inequalities (SDG 10), combating poverty (SDG 1) and partnerships for the goals (SDG 17) between 2015/2016 and 2020/2021. The biggest challenges are in achieving the goals related to sustainable food production (SDG 2) and responsible consumption and production (SDG 12) (*Sustainable development in the European Union. Monitoring report on progress towards the SDGs in an EU context – edition 2023*).

Responsible consumption is included in a group of 17 Sustainable Development Goals (SDG 12). The main measures to achieve this goal in Poland include (*Realizacja Celów Zrównoważonego Rozwoju w Polsce. Raport 2023*):

- the transformation towards a circular economy, which requires action at all stages of the life cycle: from product design, raw material acquisition, processing, production, consumption, waste collection and management,
- the development of organic farming,

- efficient waste management, with the possibility of secondary raw material or energy use,
- consumer education on the legitimacy of reducing over-consumption, rational use of resources, the need to recycle and selective collection of waste.

According to the government report, as well as the Eurostat report, this goal is being realised too slowly and only partially, and therefore it will not be possible to achieve it by the planned deadline, i.e. by 2030. One of the reasons for this may be the low awareness and knowledge of both the concept and the goals of sustainable development among Polish consumers. According to the results of a 2021 study by CSR Consulting and Bank BNP Paribas, just over half of Polish consumers surveyed (53%) know what the term 'sustainability goals' means, but nothing else; 22% have heard the term but do not know what it means; 19% know nothing about it at all. Only 6% of respondents admitted to knowing a lot about the issue and being interested in it. According to those surveyed, climate change and environmental protection are the two biggest challenges in the world today, and of the 17 Sustainable Development Goals, the most urgent is health and quality of life (SDG 3) (*Znajomość Celów Zrównoważonego Rozwoju przez polskich konsumentów. Wyniki badania. 2021*).

### 3. Actions for sustainable consumption

From a macroeconomic point of view, consumption has become one of the most important stimulators of economic development, a kind of locomotive driving the economies of individual countries and the world economy. A decline in consumption and market demand leads to a decline in production, which means the collapse of many enterprises, and subsequently results in increased unemployment, reduced taxes, an increase in the deficit of state finances and other problems causing economic downturns. Thus, modern economic development has become hostage to consumption (Bywalec, 2010, p. 8). However, the constant driving of demand has led to excessive, irrational consumption that ignores social, environmental, ethical costs. This lifestyle leads to the depletion of natural resources and the generation of excessive waste, poisoning the environment and consequently reducing the quality of life, as well as hindering human development. According to Thoreau, one of the critics of the consumerist lifestyle, "most of the luxuries and so-called comforts in life are not only not necessary, but are actually an obstacle to human development" (Thoreau, 1991).

Within the framework of the Sustainable Development Goals, sustainable consumption, also called socially responsible or ecological consumption, is postulated. It is consumption determined by pro-environmental values and consumer attitudes that build environmental awareness and lead to ecologically and socially responsible market decision-making (Zrałek, 2013). Sustainable consumption involves the economical and rational use of consumer goods

and natural resources, as well as the conscious and deliberate reduction of consumption of products that require high consumption of scarce, non-renewable resources and generate significant amounts of waste (Kryk, 2013).

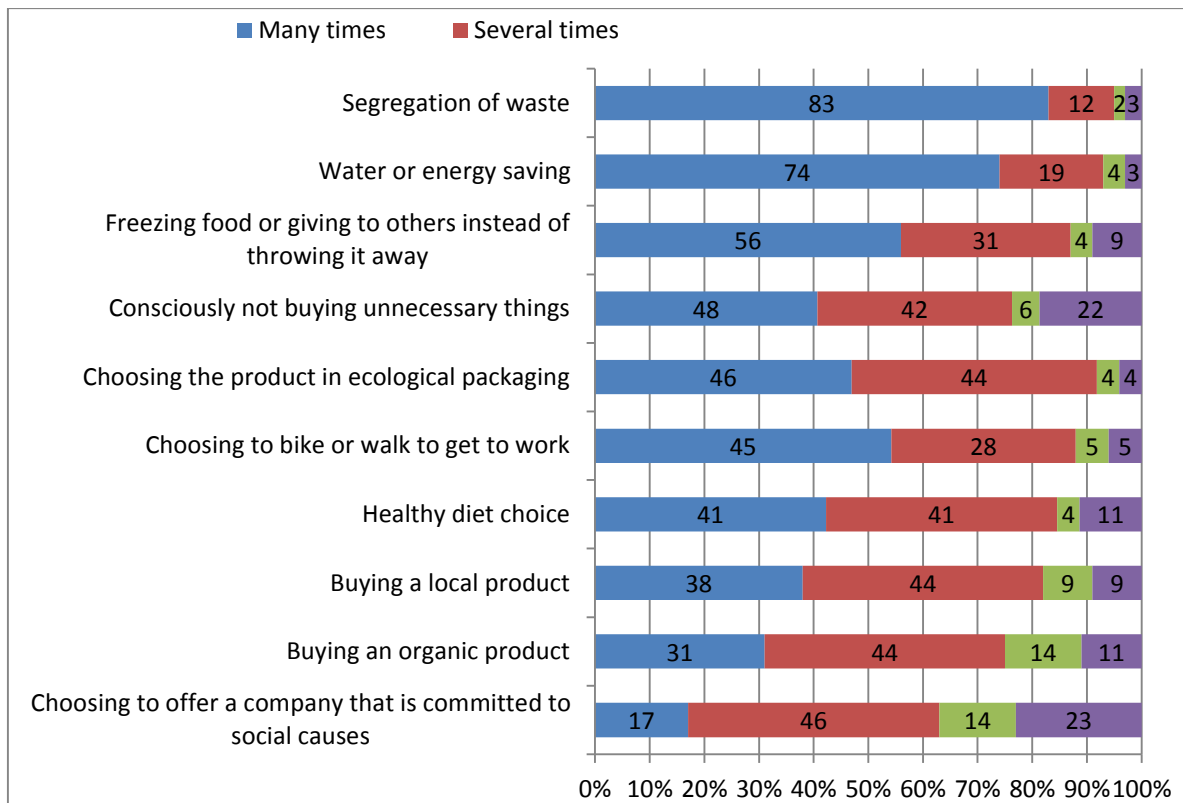
The manifestations of sustainable, socially responsible consumption include various trends and courses of action, such as, among others: needs-based shopping (deconsumption), green consumption, buying or selling second-hand items, collaborative consumption (or sharing economy) and smart shopping (Sobczyk, 2018).

Purchasing at the level of needs means to limit it rationally and consciously to the necessary size, conditioned by individual needs, abilities and preferences. The idea is not to buy excessive quantities of goods or unnecessary products, suggesting, for example, attractive promotions, bargains, advertisements or snobbery or show effect. A new phenomenon in consumer behaviour is emerging here, called deconsumption. Deconsumption, defined as the conscious restriction of consumption to a rational size (i.e. resulting from the natural, individual, physical and psychological characteristics of the consumer), boils down to a responsible lifestyle, which means in practice the need to think about one's own needs and to realise needs that are real and not created by various external factors (Mysona Byrska, 2021). Deconsumption manifests itself primarily through: the rationalisation of market behaviour, limiting the volume of purchased and consumed goods in favour of their quality, the servicisation of consumption, the preference for local, regional consumption over international, global consumption, the greening of market behaviour, the propensity to engage in systems and networks of shared consumption, which allows access to products and services, without having to bear the costs of ownership, the consideration of ethical aspects at each stage of the purchasing process, and finally a change in the consumer's lifestyle (Wilczak, 2016).

Green consumption refers to the purchase and use of products (and their packaging) with the least possible negative impact on the environment, the economical use of specific resources (primarily water and energy), the rational use of durable goods, the avoidance of activities leading to devastation and pollution of the environment through, inter alia, waste segregation, packaging disposal, the use of low-emission means of transport, etc. (Witek 2017).

An important manifestation of sustainable consumption is the circulation of second-hand items on the secondary market. It concerns durable items such as clothing, footwear, furniture, electronic equipment, etc., whose useful life is extended, thus reducing the purchase of further products and excessive waste generation. The development of this form of market is facilitated by modern communication tools such as the Internet, social media or mobile devices, which enable representatives of demand and supply to contact each other quickly and easily.

Polish consumers take various actions within the framework of sustainable consumption, or more broadly, sustainable development. The most common of these are segregating waste, saving water and energy, and buying ecological products, according to a number of studies conducted in this area. According to the results of the CSR Consulting and Bank BNP Paribas study from March 2021, cited earlier, the main sustainability actions consumers take systematically are: segregating rubbish, saving water or energy or freezing food (Figure 1).



**Figure 1.** Actions to achieve the Sustainable Development Goals.

Source: *Znajomość Celów Zrównoważonego Rozwoju przez polskich konsumentów. Wyniki badania. 2021.* <https://kampania17celow.pl/wp-content/uploads/2021/04/Badanie-Cele-konsumenci-K17C-rozszerzona.pdf>

When it comes to buying organic products, these are primarily food items. According to the results of the 2021 study on trends in Poles' eco-shopping<sup>1</sup>, the vast majority of consumers (86%) buy organic food products, of which 44% do so at least once a week (*Trendy w ekozakupach Polaków 2021. Raport Farmy Świętokrzyskiej*). The main reason for buying organic food is the belief that it is healthier and of better quality, which is why as many as 67% of respondents are able to pay a higher price for organic products than for conventional products.

#### 4. Demand for electronic equipment and the problem of electro-waste

The electronic equipment market in Poland has been growing dynamically in recent years. Demand is increasing year on year, as evidenced by the growing number of electrical and electronic devices in households. It is estimated that in 2022 there will be an average of around 30 units per household, ranging from washing machines, fridges, TVs, computers, small

<sup>1</sup> The survey was conducted in April 2021 by Nationwide Research Panel Ariadna on behalf of Swietokrzyska Farms on a representative sample of 1,077 Poles aged 18+.

household appliances, power tools to solar panels. This is half the number of more than 10 years earlier (*Czas na zmiany w systemie zagospodarowania elektroodpadów. Puls Biznesu, 2022*). The increase in demand is a result not only of rapid technical and technological advances in electronics and rising consumer incomes, but also of the coronavirus pandemic. Compared to other retail markets, the pandemic has had a positive impact on the electronics market. Restrictions on movement, the need to study and work remotely created a need to purchase and/or replace various types of electronic equipment. According to data from the PMR report, the electronics market reached a value of PLN 36.1 billion in 2020, an increase of more than 15% year-on-year (*Rynek produktów RTV, AGD i sprzętu elektronicznego w dobie COVID-19, 2022*).

According to the forecasts of AB, a Polish IT and consumer electronics distributor, the turnover dynamics of the electronics market will reach 4% (year-on-year) in 2023, and this will be the fourth consecutive year of growth in the Polish market. The reasons for the increase in market demand in 2023 include: digital transformation, government programmes supporting IT spending, such as a project to purchase notebooks for students and teachers, a loan programme for cloud transformation, a programme to develop high-speed internet access or favourable legislative changes in public administration services - mObywatel (*Rynek dystrybucyjny IT oraz elektroniki użytkowej w Polsce wciąż rośnie – AB*). In turn, according to forecasts from the PMR report "Retail market of household appliances, consumer electronics and audio/video devices in Poland 2022", the market will grow at an average annual rate of 3-5.5% in 2022-27 (*Wartość sprzedaży na rynku RTV/AGD przekroczy 40 mld zł w 2022*).

However, the growth of the electronics market together with dynamic technical and technological advances is shortening the life cycles of these products. This applies not only to the life cycles of the final products, but also to spare parts and components, making it impossible or uneconomic to repair an old device. In this situation, the consumer buys a new model and the manufacturer works on further improved versions. It has been estimated that the restitution demand for electrical and electronic equipment, associated with the replacement of old equipment, is about 80%, and the primary demand, resulting from the need to purchase the first appliances in a household in a given category, is 20% (*Czas na zmiany w systemie zagospodarowania elektroodpadów. Puls Biznesu, 2022*). As a result, large quantities of obsolete equipment are generated which must be managed, disposed of or recycled in some way. In this way, a gigantic e-waste problem arises and grows rapidly.

Electro-waste is waste electrical and electronic equipment, covering a wide range of products, from used batteries and energy-saving light bulbs to smartphones, tablets and laptops to washing machines, cookers and fridges. These products contain many harmful substances, such as mercury, lead, cadmium, Freon, asbestos or bromine compounds, which can seep from a broken appliance into the air, soil and groundwater, and from there into the human body. Produced in 2022 alone, small devices such as mobile phones, electric toothbrushes, toasters and cameras will weigh approximately 24.5 million tonnes. The very rapid growth of electro-

waste in recent years is a global problem. According to estimates, 5.3 billion smartphones will be taken out of use globally in 2022 alone. WEEE Forum research<sup>2</sup> has shown that in an average European home there are 74 products classified as electrical and electronic equipment; as many as 13 of these are broadly defined as electro-waste, four of which are no longer working, nine of which are not in use. The most commonly kept categories of electro-waste are: (Stradowski, 2022)

- small consumer electronics and accessories (e.g. headphones, remote controls),
- small household appliances (e.g. clocks, irons),
- small computer hardware (e.g. external hard drives, routers, keyboards, mice),
- mobile phones and smartphones,
- small food preparation appliances (e.g. toasters, grills).

Statistics on the global e-waste problem have been presented since 2014 in the Global E-Waste Monitor report overseen by the United Nations. The growth rate of e-waste is very high - it is one of the fastest growing waste streams. In 2019, the world generated 53.6 million tonnes of e-waste - an average of 7.3 kg per capita. This is an increase of almost 20% in five years. At the same time, the percentage of e-waste that we collect and recycle has increased globally from 17 to 17.4%. E-waste generation is expected to increase to 74.7 Mt in 2030 and reach as much as 110 Mt in 2050 unless we change our practices (*The Global Transboundary E-waste Flows Monitor 2022*).

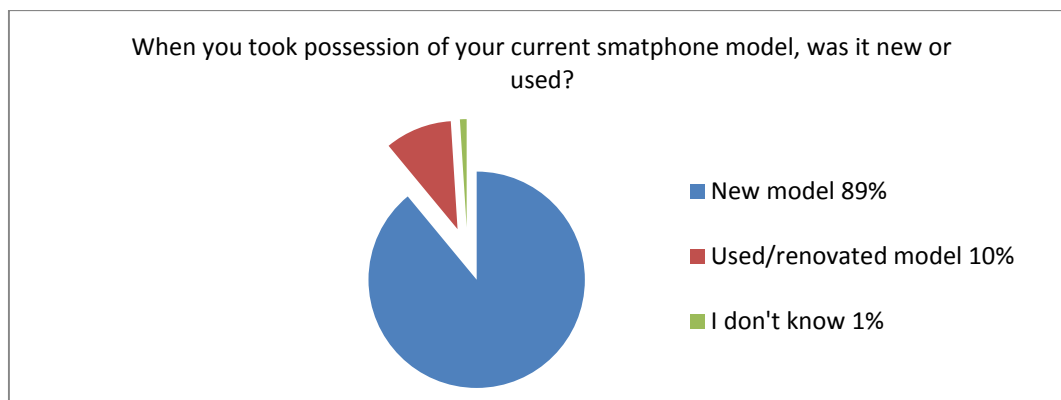
One of the important issues concerning the generation of electro-waste is consumers' purchasing habits and behaviour. This problem will be discussed using the example of smartphones, which are among the most popular and most frequently purchased electronic products. According to IDC (International Data Corporation), 11.3 million mobile phones were sold in Poland in 2021, of which 10.9 million were smartphones. Compared to 2020, this was an increase of 27.6% for smartphones. In value terms, sales increased by 48.5%, as customers were more likely to choose devices at the higher end of the price spectrum (*Polski rynek smartfonów trzyma się mocno na tle osłabionego regionu*. 2022.07.14.).

In 2022, Deloitte surveyed Polish consumers on purchasing trends for the most popular electronic devices, including smartphones. It turns out that the vast majority of respondents (89%) choose a new rather than a used or refurbished device when buying a smartphone (Figure 2).

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<sup>2</sup> The survey covered 8775 households from Portugal, the Netherlands, Italy, Romania and Slovenia, as well as the UK.



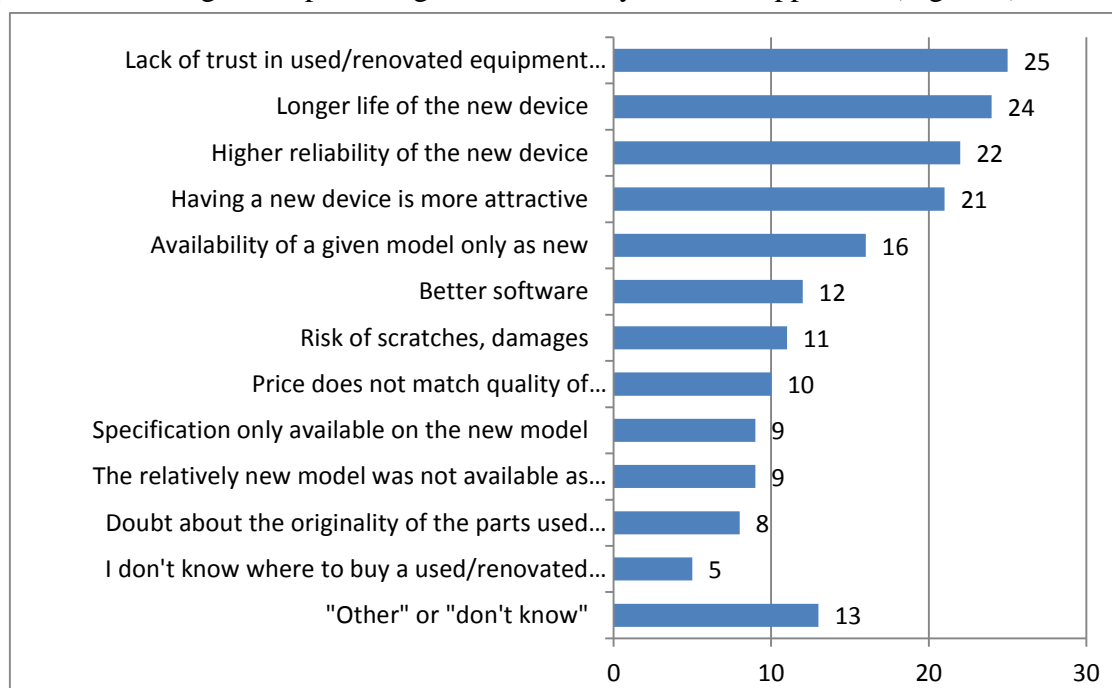


**Figure 2.** Acquisition of new and used smartphone models.

Source: *Digital Consumer Trends 2022, Deloitte, październik 2022*, p. 27.

Only in the youngest age group is the percentage of people owning second-hand or refurbished appliances higher, at 14% (compared to an average of 10%). This may be due to the lower financial capacity of this group and the passing on of older models within the family.

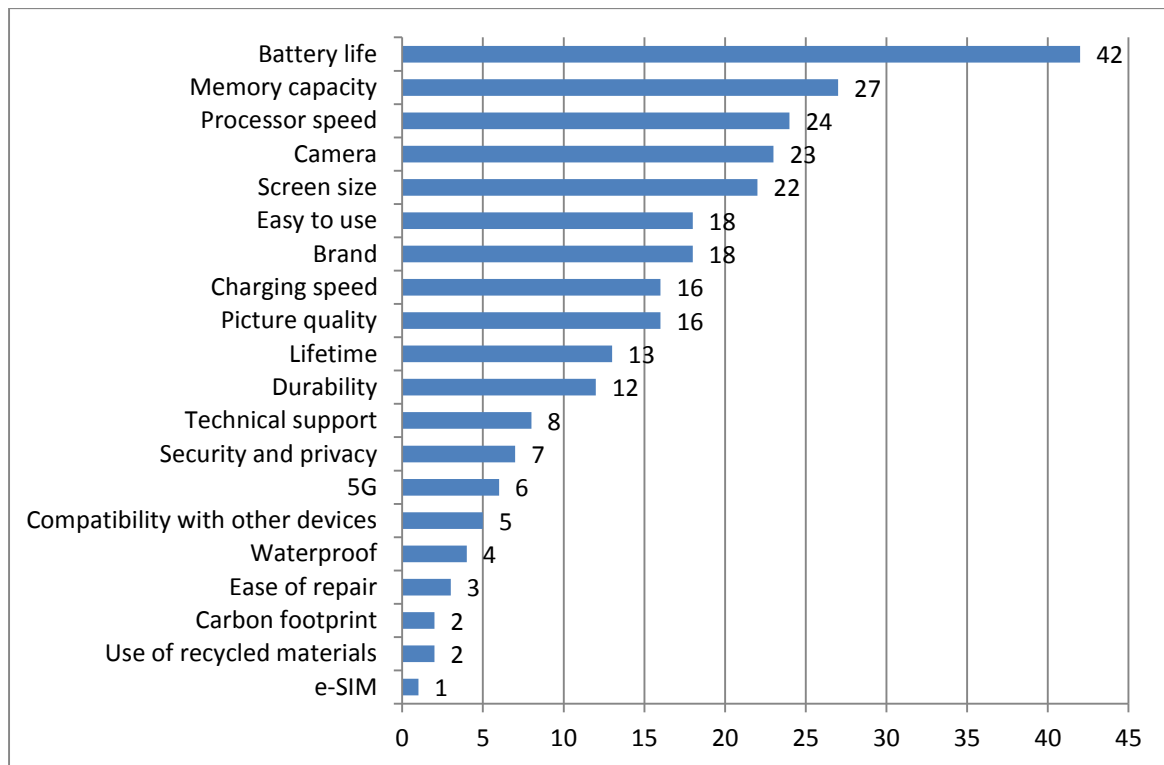
Respondents explain their decision by a lack of trust in sellers of used or refurbished appliances, the longer lifespan and greater reliability of a new appliance (Figure 3).



**Figure 3.** Factors for choosing a new phone model.

Source: *Digital Consumer Trends 2022, Deloitte, październik 2022*, p. 31.

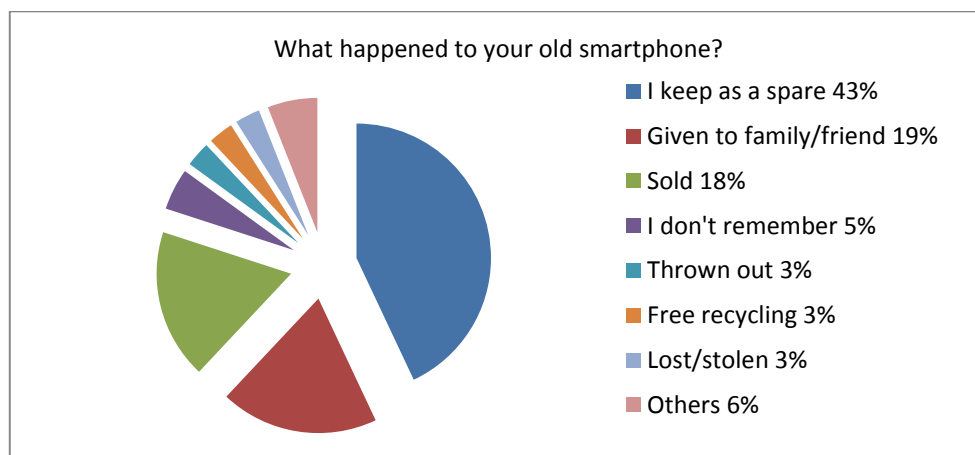
In contrast, when buying a new model of phone, they are primarily guided by: battery life, memory capacity and processor speed (Figure 4).



**Figure 4.** Priorities when choosing a new phone model.

Source: *Digital Consumer Trends 2022, Deloitte, październik 2022*, p. 31.

Respondents do not really know what to do with their old smartphone. The highest percentage of respondents (43%) keeps the old phone as a spare, 19% give it to family or friends, only 18% sell it. Only 3% recycle their old model for free (Figure 5).



**Figure 5.** Fate of the old telephone.

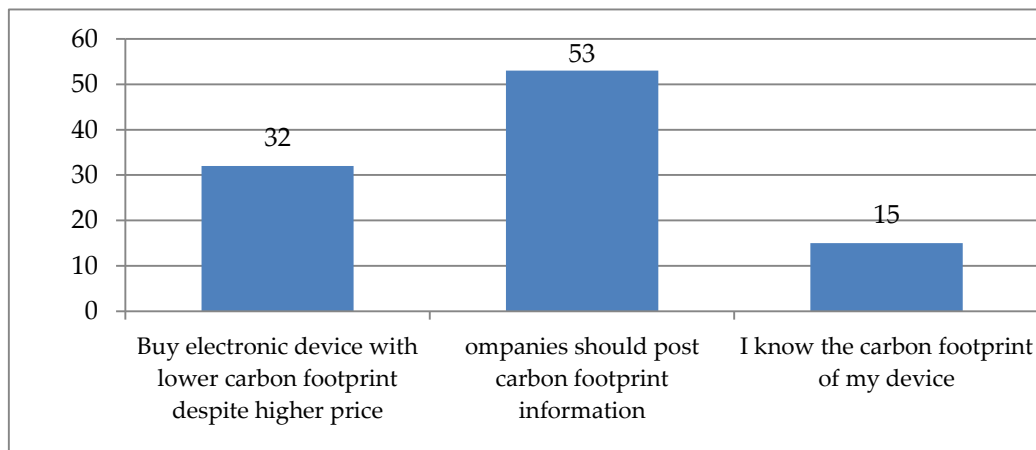
Source: *Digital Consumer Trends 2022, Deloitte, październik 2022*, p. 27.

WEEE Forum research shows that consumers do not recycle or reuse unnecessary electronic devices for the following reasons: (Stradowski, 2022)

- I might reuse it in the future (46%),
- I intend to sell or give it away (15%),
- it has sentimental value to me (13%),

- it may have value in the future (9%),
- I don't know how to get rid of it (7%).

The issues of the negative environmental impact of electronic devices are far less important to consumers at the time of purchase than for other products, such as organic food or clothing, for example. This is probably due to the nature of electronic equipment, the many technical parameters that need to be taken into account when making a purchase. Only slightly more than 1/3 of respondents declare their willingness to purchase an electronic device with a lower carbon footprint despite the higher price (Figure 6).



**Figure 6.** Respondents' attitudes towards their carbon footprint.

Source: *Digital Consumer Trends 2022, Deloitte, październik 2022*, p. 31.

A small percentage of respondents (15%) know the carbon footprint of their device, i.e. they are aware of the harmfulness of electronics and take an interest in this. More than half of respondents believe that companies should post information about the carbon footprint of their electronic products. The above opinions are independent of age, only when asked about knowing the carbon footprint of their phone is definitely higher among younger respondents aged 18 to 20

Although the majority of respondents believe that companies should include information about the carbon footprint of their products, but only 30% have confidence in the information provided. According to the Deloitte Sustainability Survey, almost 60% of technology companies surveyed in Poland said they count their carbon footprint and 37% plan to monitor this indicator (*Digital Consumer Trends 2022, Deloitte, październik 2022*, p. 32).

According to the research presented, the problem of electro-waste is exacerbated by the attitudes and behaviour of consumers, who purchase newer and newer models of equipment, are reluctant to use second-hand products, are unaware of their harmfulness and do not know what to do with used equipment.

## 5. How to reduce excessive consumption of electronics?

The growing and ultimately excessive demand for electronic devices that generate a carbon footprint that is harmful to the environment is the result of several overlapping reasons. Firstly, it is a consequence of consumers' attitudes and behavior and the increase in their wealth. As the presented research shows, buyers prefer to buy new devices due to their longer life and better quality (reliability), but also because of the lack of trust in sellers of used or refurbished equipment. Since they buy new, more expensive models, it can be concluded that they have higher incomes. Although almost 1/3 of surveyed consumers declare their willingness to pay a higher price for a device with a lower carbon footprint, the vast majority of respondents do not know the carbon footprint of their device. Secondly, the objective reason is the very dynamic technical progress in recent years, the development of digital technologies and Industry 4.0, driven by growing competition on a global scale. Therefore, companies aiming to maximize their profits gradually improve their technologies and introduce new product models to the market. Thirdly, manufacturers of electronic devices rarely include information on their products about their harmfulness and carbon footprint, which does not help improve consumers' ecological awareness. In addition, greenwashing is a common practice, i.e. manipulating information and intentionally misleading recipients about the actual impact of the product on the natural environment, which additionally confuses and frustrates buyers (Szabo, Webster, 2020). In the context of these complex causes, the question arises whether and how the negative environmental effects of excessive demand for electronic devices can be reduced.

By analyzing the nature of the causes and conditions of excessive consumption of electronic devices, several basic directions of action can be indicated to reduce it, namely:

- 1) disposal and recycling, enabling the recovery of valuable raw materials by implementing a closed-loop economy (circular economy);
- 2) improving products to make them less harmful to the environment through eco-design and extending their life cycle;
- 3) educating consumers on the principles of sustainable consumption.

A circular economy is postulated as part of the Sustainable Development Goal - Sustainable Production and Consumption (SDG 12). The implementation of such an economy requires taking actions to increase the efficiency of the use of resources and raw materials by minimizing waste and the use of waste from one production process to another. Waste electrical and electronic equipment contains many valuable elements that can and should be recovered to a much greater extent than currently. According to data from the World Economic Forum (WEF) report "A New Circular Vision for Electronics: Time for a Global Reboot", in the case of iron, cobalt or nickel, recycling rates may exceed even 50%, and in the case of lithium (important for battery production) it does not exceed 1%, and in relation to mercury, which is harmful to the environment and human health, it is between 1% and 10% (*Od odpadu do*

zasobu. Zużyty sprzęt elektryczny i elektroniczny w ekonomii cyrkularnej. Międzynarodowy Dzień bez Elektrośmieci. 13 października 2022). The implementation of the principles of the circular economy requires a change in the business models of enterprises, which should be stimulated by administrative instruments (international standards, guidelines of international organizations and institutions, such as UN or EU agencies) and economic instruments (policies at the level of nation states).

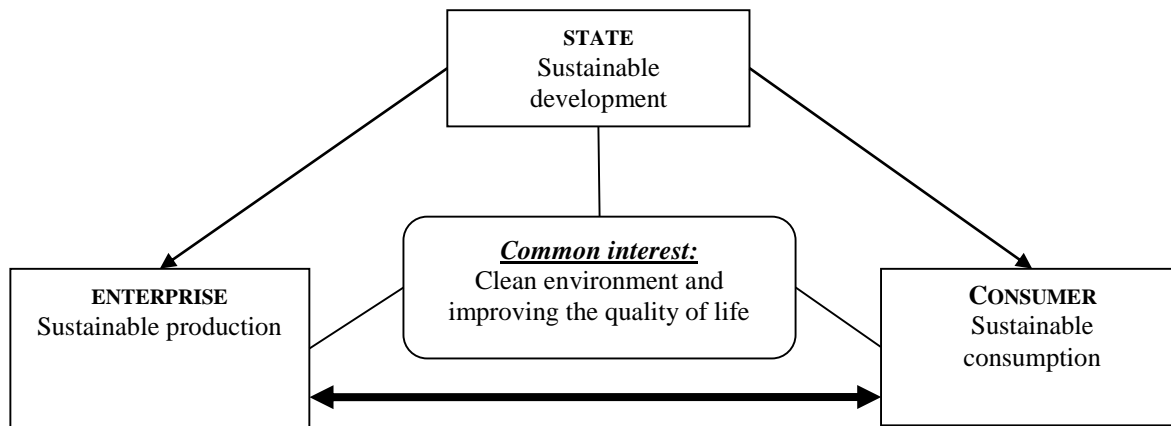
The second line of action is to improve electronic products to make them more environmentally friendly and extend their service life. The National Waste Management Plan 2028 indicates three actions that are of key importance for preventing the generation of waste electronic equipment: eco-design, extending the life of the product, the possibility of its repair and modernization (*Krajowy plan gospodarki odpadami 2028*). One of the most important activities is ecodesign, which involves taking into account ecological aspects at the stage of project development, selection of raw materials, materials, energy needs and determining the durability of the product (Burchart-Korol, 2010). Actions taken at this stage also determine the life cycle length and possibilities of repairs and modernization of devices. The postulated activities are also the responsibility of enterprises, although they can and should be supported by the state and social organizations, including consumer organizations.

The third direction of action is more effective and efficient education of consumers in making them aware of the harmfulness of electronic devices, the need to dispose of them, and encouraging them to share. The National Waste Management Plan 2028 formulates the following five information and educational activities aimed at shaping conscious consumer attitudes regarding: (*Krajowy plan gospodarki odpadami 2028*)

- 1) choosing more durable devices,
- 2) understanding the labeling used on products,
- 3) knowledge of the principles of proper use of equipment,
- 4) using repair services,
- 5) transfer waste electrical and electronic equipment to designated collection points.

Many authors point to the important role of sustainable marketing in consumer education, which, as a pro-social discipline, should shape a new way of thinking resulting in pro-ecological market choices (Haider et al., 2022). Generally, consumer education should be aimed at changing the lifestyle and value system so that consumption and the possession of goods are not a goal or a measure of social status, but a means to achieve more non-consumptive goals. It is worth noting that in recent years there has been a change in consumer attitudes and behaviors, especially among younger groups of consumers who reject traditional patterns of excessive consumption and prefer minimalism, the principles of ecology and sustainable development. According to the principles of the sharing economy, they use and share goods together, using modern tools such as the Internet and social media (Szymańska, 2017).

The implementation of the proposed courses of action requires the involvement and cooperation of three parties: enterprises, consumers and the state, which create a specific "triad" of sustainable development (Figure 7).



**Figure 7.** The concept of the "triad" of sustainable development.

Source: Szwajca, 2018, p. 474.

By implementing the principles of sustainable production, enterprises can use resources more effectively, limit environmental degradation, produce ecological products, ensuring profit. Consumers, applying the assumptions and postulates of sustainable consumption, can better and more rationally satisfy their needs, maintaining a clean environment and securing resources for themselves and their successors. However, by pursuing a policy of sustainable development, the state can ensure environmental protection, economical management of resources, public education and the pace of economic development, ensuring an adequate standard of living for current and future generations. The common interest of these entities is to maintain a clean natural environment and improve the quality of life of citizens. A special role in this triad is played by the state, which has many instruments at its disposal to influence enterprises and consumers, ranging from information, educational and promotional activities, through active cooperation, fiscal policy instruments, to legal regulations in the form of orders and prohibitions. The state can therefore perform educational, motivating, integrating and coordinating functions, becoming a kind of "transmission belt" between production and consumption in the implementation of sustainable development goals (Szwajca, 2018). Enterprises and consumers can also stimulate each other: enterprises through the production and promotion of ecological products and the application of sustainable marketing principles, and consumers through their purchasing decisions and various types of actions (including boycotts) with the support of non-governmental and social organizations and international institutions (Karimova, LeMay, 2022).

Finally, it should be stated that the problem of limiting excessive demand for electronic equipment is only one element of the pursuit of sustainable consumption. This is a global challenge for modern societies, governments and policy-makers. Mont et al. (2022) suggest that sustainable consumption can be achieved through three strategies: (1) to reduce consumption,

(2) to change consumption, (3) to improve consumption, implemented with the involvement and cooperation of many social groups and environments at the international level. According to some, achieving the goals of sustainable consumption is only possible by limiting the rate of economic growth (Kallis et al., 2019). However, it seems that a complete solution to this problem is not possible in the context of the dynamic development of civilization, the current lifestyle and valued values - it is a deeper problem of a philosophical nature.

## 6. Discussion and conclusions

In recent years, there has been a growing demand for electronic devices on the Polish market. This is the result of very rapid technical progress, an increase in the income of real buyers and the desire of producers to increase sales profits. An additional factor was the pandemic, which forced consumers to purchase electronic equipment (mainly computers, laptops, smartphones) enabling learning, professional activity or dealing with various matters remotely. Growing demand and the increasingly shorter life cycle of electronic products generate large amounts of e-waste, which is very harmful to the environment and at the same time difficult to dispose of. The problem of e-waste is a very difficult challenge in the light of the implementation of the sustainable development goals adopted by Poland under the UN Resolution of 2015. This is especially true of goal no. 12: sustainable production and consumption, which is one of the most slowly and not very effectively implemented of the 17 adopted goals.

One of the reasons for this state of affairs is the low ecological awareness of Polish consumers regarding electronic products. According to research, they do not have sufficient knowledge about the harmfulness of e-waste. Consumers buy organic food more often and willingly because they notice its direct impact on their health and physical condition, while when buying durable goods, including electronic equipment, they are not fully aware of their negative impact on the climate and the natural environment. Only a small percentage of surveyed Poles (about 15%) know that products such as smartphones leave a carbon footprint. These are mainly young people, more ecologically aware and sensitive. Moreover, manufacturers do not fully inform consumers about the harmfulness of electronic devices in order to increase sales, and they also deliberately mislead by using greenwashing.

In order to reduce excessive consumption of electronics, the article proposes three courses of action:

- disposal and recycling within the circular economy,
- "greening" of products through eco-design and extending the life cycle,
- consumer education towards sustainable consumption.

The implementation of these activities requires coordination and cooperation of three entities: enterprises, consumers and the state, cooperating within the so-called “triads” for sustainable development. The leading role should be played by the state, which has the most effective instruments to influence other entities.

Finally, it should be stated that the problem of limiting excessive demand for electronic equipment is only one element of the pursuit of sustainable consumption. This is a global challenge for modern societies, governments and policy-makers. Mont et al. (2022) suggest that sustainable consumption can be achieved through three strategies: (1) to reduce consumption, (2) to change consumption, (3) to improve consumption, implemented with the involvement and cooperation of many social groups and environments at the international level. According to some, achieving the goals of sustainable consumption is only possible by limiting the rate of economic growth (Kallis et al., 2019). However, it seems that a complete solution to this problem is not possible in the context of the dynamic development of civilization, the current lifestyle and valued values - it is a deeper problem of a philosophical nature.

The considerations and proposals for reducing the problem of e-waste presented in the article contribute to the discussion on controversies related to the implementation of the principles of sustainable development in the context of technological progress and the pursuit of enterprises to maximize profits. They also have social management implications, as they indicate the directions of activities of government institutions, enterprise management boards and consumer organizations.

The limitation of the conducted research is the narrowing of the analysis to the Polish electronic market and the reliance on secondary data, without conducting our own empirical research. However, the article can be used for international comparisons and may also serve as an inspiration to conduct further research on the topic. Research on the effectiveness and efficiency of activities undertaken in Poland and other UN member countries to implement the sustainable development goals seems to be particularly important.

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