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# P O L I M E R Y

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## Equality in the creation of carbon dioxide equivalent

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**Abstract:** The article presents issues related to equality in the creation of carbon dioxide equivalent. The impact of the increase in the number of residents and roommates, waste generation systems, information and material waste, material waste generation, the age of plastics and digitization are discussed.

**Keywords:** carbon footprint, energy, ecology, waste.

### Równość w tworzeniu ekwiwalentu dwutlenku węgla

**Abstrakt:** W artykule przedstawiono zagadnienia związane z równością w tworzeniu ekwiwalentu dwutlenku węgla. Omówiono wpływ wzrostu liczby mieszkańców i współlokatorów, systemów wytwarzania odpadów, odpadów informacyjnych i materialnych, wytwarzania odpadów materialnych, wieku tworzyw sztucznych i cyfryzacji.

**Słowa kluczowe:** ślad węglowy, energia, ekologia, odpady.

Since the middle of the 20<sup>th</sup> century, the world's population has been growing exponentially. This has required finding of new procedures, methods, and materials to meet the necessary and desirable products of a growing population. The result is an increasing waste amount, because of material or informational human activities. Its management has become a global problem. The approach to the analysis of measuring the impact of waste on the environment is based on the experience in the field of plastic products waste management. Climate changes have occurred not only because of natural phenomena but also due to anthropogenic causes. This has imposed the need to introduce criteria for measuring anthropogenic impact. Carbon Dioxide Equivalent (CDE) has been

selected over the life – cycle of the product. Which connects information and material waste. An explanation of several components of the choice of this criterion is needed. Based primarily on the text on the trinity of information, energy, and a special form of energy, matter [1].

### INCREASE IN THE NUMBER OF RESIDENTS AND ROOMMATES

The continental world should be imagined as a table at which three people sat figuratively in 1950, the symbolic representatives of which were 2.68 billion inhabitants. Now, there are eight of them at the table, representing 8.0 billion inhabitants [2]. To paraphrase the American philosopher John Rawls [3], every human being should have the same rights to create carbon dioxide equivalent while maintaining their living needs. However, roommates must be added to the residents. In 2019, it was about 1.5 billion pets: dogs and cats, and the same number of vehicles and computers. There were about 3.3 billion smartphones and as many as 9.6 billion mobile connections [4].

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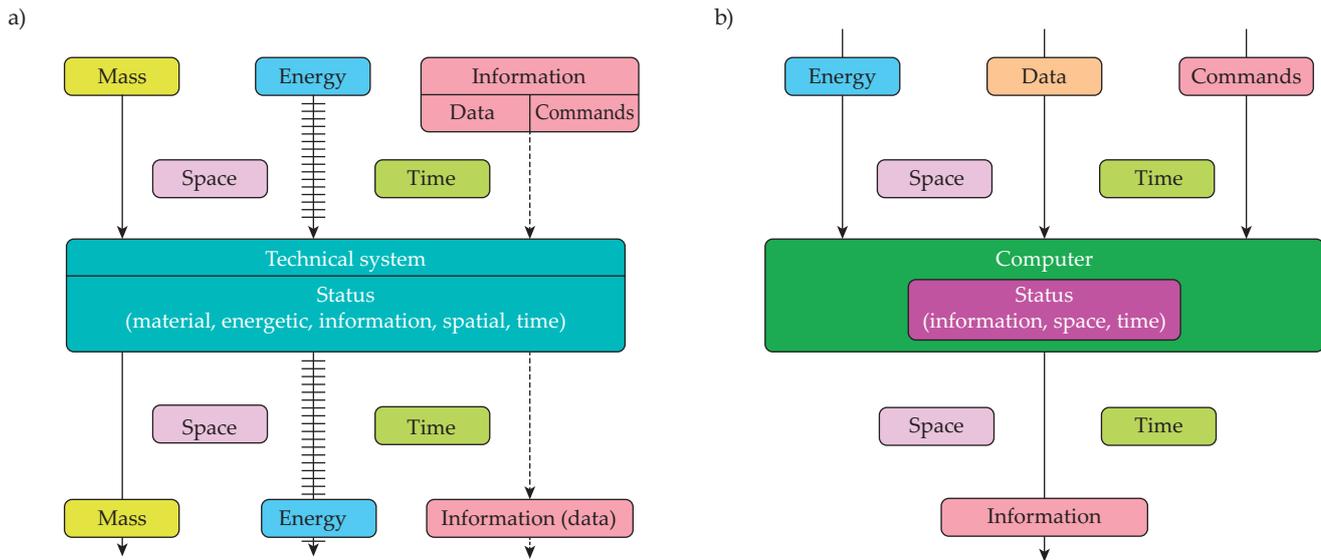


Fig. 1. Types of artificial systems: a) artificial technical action system (cyber-physical system), b) computer technical system (energy information system)

## WASTE GENERATION SYSTEMS

When considering the waste generation and its impact on the environment, two types of technical systems for the generation of EUD should be distinguished. Information, energy and mass (substances or materials) are the inputs and outputs of technical systems.

The former is those who must give matter the form of mass in order to achieve the assumed goals (Fig. 1a) [1, 5]. It has not been sufficiently noted, or at least emphasized, that there are many artificial systems that do not need to have mass as input to the system in order to achieve their goals. These are information systems (Fig. 1b).

## INFORMATION AND MATERIAL WASTE

Figure 1b suggests that the "waste" or EUD of such a computer technical system is "invisible". They come from the necessary equipment (earlier stages) and energy for the needs of the system, including printouts. EUD in this case can be called information waste. The basic idea of wastefulness of such systems should be illustrated with the example of watching some streaming platforms for movies and similar works.

The blockbuster *Don't look up* [6] was shown on Netflix. It lasts 145 minutes. According to available data, Europeans consume on average between 55 and 56 grams of EUD per hour watching a video, or a total of 135 grams of EUD for that film.

One gram of plastic has 5 grams of carbon dioxide equivalent. So, for one viewing of the film *Don't look up*, 9 plastic bags weighing 3 grams could have been made. By the end of the second third of January 2022, that work alone had a registered consumption of 150 million hours of viewing, or the equivalent of 1.37 billion of very light bags. In between it has since racked up over

322,000,000 viewing hours. The equivalent of 2.94 billion of very light bags [7].

Similarly, the creation of information waste applies to digitization, social networks, the Internet, games, "mining" of cryptocurrencies, etc.

These data imposed a widening of the division of human history. Two new periods must be added to these periods up to 1950; the period of plastic, which began in the breakthrough year of 1950, and the period of collective digitization with the actual beginning of the 1990s.

## GENERATION OF MATERIAL WASTE

Everyone can have an idea for a necessary product. This is where the formation of the CDE begins. How to effectively place an idea and who to present it to?

In the 1990s, you had to bring the model to the table and then make it using known production methods. Since the 1990s, samples produced by additive manufacturing processes, popularly known as 3D printing, have become increasingly common. Modern products development requires market research and verification of activities. It consists of professional criteria and obligatory social and humanistic verification in the function of creating the basis for making the necessary political decisions. The examples of *Assessment of Technique* [8] and *Assessment of Medicine* [9] are known so far. It should be emphasized that there is no absolute certainty when a decision on a new product will be made. The criterion of product durability is being imposed more and more often. Once a product is made, it begins to be used and failures occur over time. The product should allow economically reasonable repair. Sufficient fixatives are assumed. Gradually, the product wears out and becomes waste. To make a real contribution to environmental protection, the time from the creation of a work to its transformation into waste should be extended.

In the concept of “from the cradle to the grave” it is necessary to distinguish what results from the cessation of function. From living, organic polymers, plants, you can turn them into products. Dead animals must be disposed of using special procedures. The dead will increasingly be cremated, which is a special form of incineration. Due to lack of space at the table.

### THE AGE OF PLASTICS AND DIGITALIZATION

In 1950, the production of fossil plastics amounted to 1.5, and in 2021 to 390 million tons [10]. This increase is 260-fold over a period of 70 years. Out of that, bioplastics account for about 2%. In the coming period, China aims to become a leading producer of bioplastics with about 35 million tons per year. At the same time, the International Energy Agency (IEA) predicts an increase in plastic production of 590 million tons per year by 2050. Compared to 1950, that is a 390-fold increase. In 2050, as much as 40% of oil will be spent on the plastic goods production. In conclusion, the plastic products will remain, despite everything. Without them, there is no modern civilization, especially no medicine. What would happen during the fight against covid if there were no disposable plastic syringes, plastic face masks or plastic clothes.

### NEW MATERIAL DIVISION

Among the controls, one of the selected materials is important. In addition, attention will be paid to inanimate substances and materials. Here is the choice between metals and polymers organic and inorganic [11].

Plastics can be organic: fossil and bioplastic, and inorganic, such as silicate products. For the sake of completeness, it is stated that concrete, rubber, and some types of polymers do not exist as independent materials. There are only products made of these materials.

When comparing material types, a life cycle balance should be made. For example, a publisher has for many years delivered a magazine in a 23.5-gram paper envelope. He accepted the specialist's offer. Now he ships the diary in a shrink-wrapped plastic envelope, making the 5 gram diary impossible to read. Instead of an EDU made up of five trucks, one is enough.

### CONCLUSIONS

The introduction of carbon dioxide equivalent (CDE) as a measure of the burden on the environment makes it clear that, in addition to material, there is also information waste, which is increasingly affecting climate change as an anthropogenic cause.

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