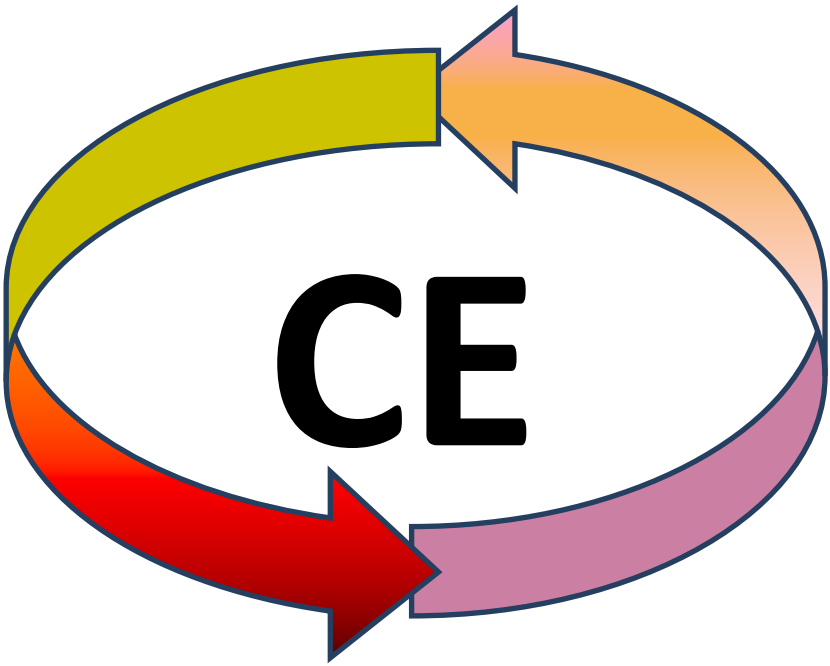
Guide to

Circular Economy (CE) in Opole



Opole 2022

Contents

Dear Opole residents!

We are providing you with this guide hoping for a better tomorrow

The wise man *(Homo sapiens*) or rather the man of convenience *(Homo commodus*[1])? Actually, he/she is also a wise human, but one who acts in an irrational way. Which is not wise...so what is the nature of this human?

A man of convenience usually is a self-centred person, who follows the belief that he/she is doing everything right, without being aware that his/her every action has an impact on the functioning of our planet.

This guide will teach us about the network of interconnections – for example, what our waste management has to do with our children, grandchildren, and future generations of all living plant and animal species.

Impatient people, who are always in a hurry, are invited immediately to the 3rd page of the cover. Note well! The information contained therein can change your life.

[1]*Homo commodus* – a human species invented by the Author. Although convenience is a trait of many people, such a species does not exist.

Waste management guide

1. Introduction

Municipal waste accounts for approximately 7 to 10% of all waste generated in the European Union. The amount of municipal waste generated depends on the wealth of the population – the higher the standard of living, the more waste is generated. In Poland, an average of 342 kg of municipal waste was collected per capita in 2020, 10 kg more than in the previous year. City dwellers produce one of the most complex waste streams and the way it is managed is generally indicative of the quality of a country's overall waste management system. According to the waste industry data, municipal waste is the most challenging waste to be properly managed, e.g. in terms of its recycling. Since none of us wants to live next to a landfill, we need to make efforts to enable waste reuse.

In the case of lacking waste segregation by residents (the so-called "sorting at source"), we are dealing with a mixed waste stream. Despite the mandatory waste segregation, this waste stream is still present (it is waste from black bins – which is sorting residue), but its structure is different. Composting of this waste was once attempted, but despite advanced facilities, the effect was meagre.

The main streams of municipal waste are: plastic and metal waste, paper, glass, biodegradable waste, hazardous waste, debris, sorting residue (mixed waste). It is particularly important to properly separate these streams, as this enables the effective recovery of the materials contained in the streams.

Otherwise, the waste will be landfilled or incinerated. Landfills have limited capacity. Once they are full, space will have to be found for new ones. The problem is that such places are almost nowhere to be found. In addition, landfills emit carbon dioxide and methane – greenhouse gases that change the climate.

So if we don't change our lives to a circular economy, we will deplete available fossil resources by producing more items, consume water and warm the climate so that future generations will not have a chance to survive. The bad news is that these generations are already alive – and they are our children and grandchildren.

2. Definition of CE

Circular Economy (CE) is a concept aimed at rational use of resources and reducing the environmental impact of manufactured products. This model aims to minimize the consumption of raw materials and the generation of waste, thereby reducing emissions and levels of energy use, i.e. changing production and consumption in such a way as to maximize product life. It involves limiting our needs, sharing and lending – that is, changing our daily habits. In the case of goods, this involves using them well, repairing, reusing, refurbishing and recycling. These processes should be maintained for the materials and products to be used for as long as possible. This will make it possible to generate almost no waste, and the residual materials will not be waste, but raw materials used in various industries, which will save fossil resources – such as metal ores.

Five priority sectors have been identified that will accelerate the transition to the CE throughout the value chain:

1. plastics,
2. food waste,
3. key raw materials (e.g., lithium, phosphorus, bauxite, antimony, bismuth and other),
4. construction and demolition waste,
5. biomass and bioproducts.

This is a departure from the so-called linear model, which is based on the following flow: take (raw materials) – make (goods) – use (product) – dispose (waste).

Plastics are the first area affecting the CE. They are a challenging waste in terms of variety, but also in terms of quantity. This is demonstrated by overflowing plastic waste bins in our bin shelters and those located by single-family homes. If we produce waste from fully biodegradable plastics (e.g. PLA – polylactic acid), we usually can't put it in the brown bin for bio-waste, because visually PLA is indistinguishable from other types of plastics. Selectively collected plastics are usually separated into fractions: PET or white, blue and green beverage bottles (Fig. 1.), HDPE (high-density polyethylene), LDPE (low-density polyethylene) film, PP (polypropylene) film.

Fig. 1 colour-sorted PET plastic waste

The remaining plastic (many types of polymers) that is contained in the plastic waste stream is designed for energy recovery (electricity and heat). So if cups, or straws made of biodegradable plastic (such as PLA), end up in the yellow plastic bin they will be incinerated. Thus, in an LDPE or PET stream, biodegradable PLA material will be treated as a pollutant. The same will happen when it is dumped into the bio-waste stream, where it will be treated as plastic, even though it is not.

So it appears that the waste sector is not ready for compostable plastic waste.

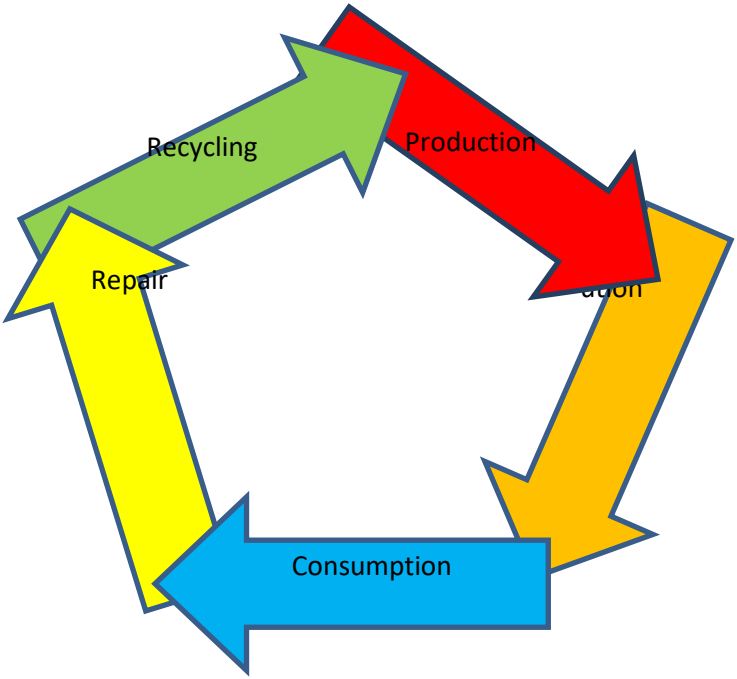
The second priority sector is food waste. It is difficult to manage because it rots quickly, attracting insects, fowl and rodents. How to reduce this waste? The answer is simple: buy less. In Poland, nearly 153 kg of food is thrown away every

second, of which households account for 92 kg. This brings the total to around 4.8 million tons. There are groups of people who "rescue" food dumped by markets into bio waste bins. They are freegans, a group of vegetarians seeking food at the back of super and hypermarkets. These bins may contain food that is safe to eat. Based on the available data, it appears that many of the fruits and vegetables found there had not exceeded their best-before date, and were discarded only because they were a bit bruised, or had ripened too quickly. This, of course, applies to all fruits and vegetables, but we should pay special attention to imported fruits (citrus) as their production consumes a lot of water, fuel for transport (these are sometimes distances exceeding 10,000 km) and a lot of packaging materials. And here the question arises – can't these greenhouse-grown cucumbers do without a plastic bag?

Controversial question: do we eat expired foodstuffs? Most of us will answer that no, because it's bad for our health. However, it all depends on the description on the package. The inscription: "Best-before date" means the farthest date we can consume a product, provided that we have not opened it before and it is stored in appropriate conditions (e.g., in the refrigerator). The second type of information: "Best consumed by" means that after the indicated time the product's properties will deteriorate – such as fat, protein, vitamin content, etc. If the product is stored in conditions other than those recommended – for example, at higher temperatures, its appearance may change, although this does not always indicate that the product "goes bad." Chocolate, even if it's not beyond the "best-before date" and has not been opened will be covered with a kind of white "tarnish." This does not mean that it is mouldy – it is just a change in the structure of fats. The same will happen if we put

the chocolate in the freezer. However, the only solution available to everyone is to be moderate. Let's buy less, but more often. If we forgot something – no problem – it's a training of our strong willpower. If we have already bought too much – let's give the excess to the food bank – they will know what to do next. A food bank is operating in Opole at 8 Berylowa street.

The operation of the CE is shown in the chart below:



The third priority sector for the circular economy includes key raw materials. For the most part, these are metals that must be imported and are essential to the economy. After their life cycle is over, they become waste.

The fourth sector includes construction and demolition waste – brick and concrete rubble. Associated wastes cover reinforcing steel, insulation materials and hazardous waste in the form of asbestos-containing products (eternit). The last priority sector is biomass and bioproducts. These are energy raw materials needed for power generation and bioproducts that enhance material recycling and safe waste disposal.

3. The mysterious 7R

7R comes from the initial letters of the following English words: Rethink (rethink your choices), Reduce (limit your consumption), Reuse (use again), Refurbish (renew old items), Repair (repair broken items), Recover, and Recycle. In the concept of recycling we have another hidden letter R which stands for Rot – compost, because composting is organic recycling. Of course, one can come up with other measures such as: Repurpose (suggest another use), or Refuse (refuse, e.g., to purchase one-off items, pseudo-promotions like 3 for the price of 2).

Failure to implement the following principles in everyone's daily life will contribute to the depletion of natural resources – including non-renewable ones like solid, liquid and gaseous fuels.

4. Sequence of operations

4.1. Rethink – rethink your choices

Rethink your choices (daily purchasing decisions or routine activities). Don't forget a canvas (or woven plastic) shopping bag. If you have the opportunity to buy something without packaging – do it! Vegetables bought at a supermarket, which we pack in plastic bags, cause a huge amount of packaging waste. Vegetables can be packed in a canvas bag you bring, or an openwork bag – even a knitted one. The amount of disposable plastic gloves used at a bread stand can be minimized by using metal tongs for rolls (choose a store where such tongs are available). Milk in glass returnable bottles is now sold in Opole – find out where it is available. Buying it will reduce the amount of plastic and multi-material packaging (the so-called boxes), which you don't really know what to do with, even if you selectively collect them. Toothbrush? There are already bamboo or polylactic acid (PLA) brushes available in stores, which won't languish in landfills for years. There are toothbrushes that have been produced from recycled plastics. A good choice is a brush that is packed in a cardboard box, or one that resembles an egg flat (Fig. 2 and 3). So when buying the next one – choose one that is more environmentally friendly.

Fig. 2. Toothbrushes made of various materials. 1. Recycled plastic, 2. Polylactic acid (PLA), looks like plastic but is fully biodegradable, 3. Bamboo (handle) and biodegradable fibre (bristles).

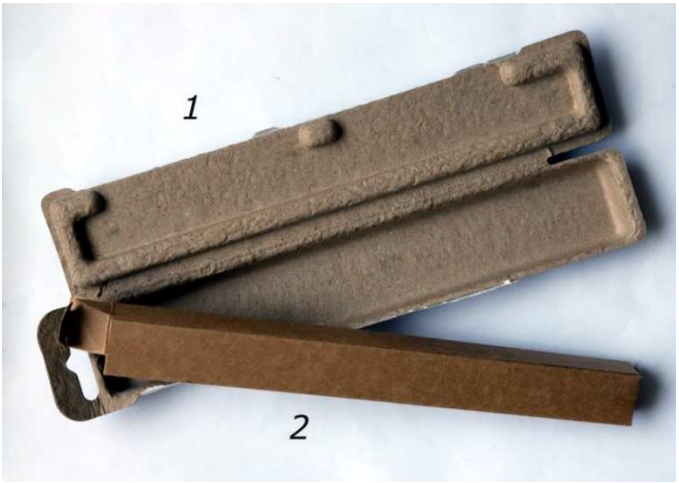


Fig. 3. Toothbrush packaging: 1. made of paper pulp – resembles egg flats, 2. made of cardboard.

Such packaging can be easily disposed of, even in-house by recycling or composting.

Drinking mineral water produces a significant amount of PET plastic bottles. Maybe a tap water filter would be a better option? How about a water filter pitcher? In fact, in Opole the tap water is potable without a need to be filtered. And this is the cheapest option – we will pay only PLN 1.06 for 100 litres of tap water. We will save a lot of money, plus reduce the number of bottles produced by more than 66 bottles over a period of about 3 months.

4.2. **Reduce** – reduce consumption

This applies to both consumption of goods and services. Do we really have to buy new furniture just because we're bored with our old ones? Are more T-shirts, pants, sweatshirts necessary for us? Has the shirt worn out? Put it on for cleaning around the house, for work in the garden, garage or basement. It's not a fashion show, and we won't have to buy a new one. Limiting purchases to essentials has a multifaceted impact on the climate as well, since many of the products we order are transported over vast distances, consuming fossil fuels and emitting carbon dioxide (CO_2).

Don't purchase goods of low quality. Their lifetime will probably be very short, thus when they become waste will require safe management. Unfortunately, in many cases it is landfilling – and none of us wants to live next to a landfill. An additional option is to grow vegetables in your own garden, or even in a balcony mini-plantation. There will be no need to go to the store, put vegetables into plastic bags, because we will have our own vegetables. Those with no mineral fertilizers or spraying with agrochemicals. One can start simple in growing your favourite herbs, but using the plastic braided bags you already have (Fig. 4), you can become the owner of a potato plantation.

Let's not throw away items just because we don't find a use for them at a given moment. Before the bags were put to use for growing potatoes they had been stored for over six months in the Author's garden shed.

Fig. 4 Growing potatoes in bags

4.3. **Reuse** – use again

Breathe new life into a used object – this is called upcycling. Buying liquids in glass returnable bottles is a good

choice. Such a bottle can be refilled up to 20 times before it goes into broken glass. If you are moving out and do not want to take the furniture, and it is in good condition (Fig. 5 was supposed to show also a wall unit, but someone has already taken it in the evening), announce it on the Internet, take it to the selective municipal waste collection point, where the second life of the

Fig. 5 Furniture (with floor panels free of charge) next to the bin shelter

items will begin, or finally leave it undamaged at the bin shelter. Go to a clothing swap point organized privately (it's called: swap party). Donate unwanted small-size items (i.e., ceramics, books, records, trinkets) to the ReUse shop (*Polish:* ReUżytkownia). Find

out (from a website also accessible from your phone: https://www.smieciopolis.opole.pl/reuzytkownia/ or "Opole segregates" application https://www.smieciopolis.opole.pl/aplikacja-mobilna-opole-segreguje-prezentacja/), what not to bring, and what hours the ReUse shop open.

4.4. **Refurbish** – renew old items

Thanks to a little reworking of old clothes found at the bottom of the closet you will avoid buying new ones, but also encourage others to do the same. The furniture polished with sandpaper and repainted (Fig. 6) looks like brand new, although we have had it for years! A refurbished door leaf made many years ago will regain its lustre, and its quality will remain unchanged.

Fig. 6. Repainted cabinet looks like brand new

4.5. **Repair –** repair broken items

Even if we don't have a knack for DIY, we can fix many things ourselves. On the Internet there are many detailed descriptions and even tutorials showing the repair of various pieces of equipment. If you are concerned about this – call a service technician. A bicycle bearing failure can be repaired even by a teenager. If we do not have time, or do not wish to do the repair, we can ask a neighbour, or give the broken thing to a service centre. Let's return a shoe with a broken strap or even a cracked sole to a cobbler. A TV set, washing machine can be repaired at home – you just need to call a professional. Someone threw out a leaking cooking pot. It was sealed (Fig. 7) and we have a 30-litre container.

Fig. 7. The galvanized pot, which was found, was sealed.
It is currently used to collect rainwater

4.6. Recover

Use the plastic bottles you have for watering plants.

Use the "bio" waste such as coffee grounds (Fig. 8) for a scrub (no need to buy in a tube/jar – you won't create packaging waste), or slug repellent. By being so creative, you won't have to order a new item (such as fertilizer) from the online store and that means no visit from the courier, which in turn translates into no more box at home and black stretch film that can only be thrown away. Innovative use of a variety of items is in vogue. Use something that most people would consider waste. Old bricks, boards, barrels, tires (Fig. 9), water.

Fig. 8. Coffee grounds with ash, gelatine and herbs, when ground in a meat grinder make an excellent fertilizer.

Fig. 9. Tires converted into picture frames and poufs

Water? It's not a waste, but we're quickly turning it into wastewater. Water recovery in the face of a global drought is becoming a priority. Wastewater treatment produces sludge – a troublesome waste to manage. Everything that is reusable should be stored and then used.

4.7. Recycle

Recycling includes another letter R – Rot – compost (composting is called organic recycling). This applies primarily to biodegradable waste, but recycling itself is a somewhat broader concept. It also includes "material recycling" i.e. the selective collection of those materials that are recyclable, such as PET polymer. Of course, selective collection of bio-waste into brown bins is a good thing, but due to our laziness, all types of waste – even electronics, glass or film – end up in these bins (Fig. 10).

Fig. 10. Brown bin for bio-waste including waste that should never go there

A composting facility will do its best to turn our waste into compost, but it always requires a significant amount of energy, and the resulting product may not be of high quality –

there will always be shreds of film, broken glass or small objects made of metal. Don't have a garden? This is not a problem – composting is possible even at home or on the balcony (Fig. 11). Cover the daily portion of bio-waste with a thin layer of soil so that it does not attract flies and wasps.

Fig. 11. A bucket or mini balcony composter can attract insects – remember to cover it and place it in the shadow.

Even a small (10-12 litre) bucket and a handful of compost earthworms of the *Eisenia fetida* species (the so-called California earthworms) purchased online will solve the problem of slow composting (Fig. 12).

Fig. 12. Earthworm *Eisenia fetida*

These oligochaete are very voracious, eat all sorts of bio-waste and reproduce quickly. We can use the vermicompost produced as a substrate for our home flowers. In addition, we will not have to buy "garden soil" in the market. We will save money and will not put our hand to the devastation of peat resources, which is a component of most garden substrates. We will also not generate waste in the form of a garden substrate bag. The factory will not have to produce a new substrate bag. As a result – we will avoid the consumption of fossil resources. If you don't have home flowers, give vermicompost to friends or family. But beware – compost earthworms are like pets – when going on vacation, let's ask someone to take care of them.

Another solution could be a community composter. It's still a rare thing, but it's worth taking an interest to see if there is

something like this operating in our area. It's a composter where people who don't have a garden can donate their bio-waste free of charge. Of course, it is serviced only at designated times, such as early in the morning, because those who run to the catch the bus take "bio" waste from their waste bin. Along the way, they will leave it at a community composter. Similarly, in the afternoon/evening, the composter is open again for a few hours. The service can be staffed by retirees who are willing to take some time to ensure the quality of the waste brought in. The quality of the material produced in such a composter is much higher than the industrial composts produced from bio-waste collected in brown bins. An additional effect is the counteracting the social exclusion of elderly or lonely people.
If you have your own composter (e.g. in an allotment or in a home garden), compost according to the rules outlined in the composting guide available at: www.smieciopolis.opole.pl/poradniki/.

4.8. Repurpose – suggest another use

This is not a mistake, but another (already eighth) letter R, which can be associated with Recover.

Do you have ashes from your fireplace or grill? Don't throw it away. If you don't have time, spread a small amount evenly over the compost pile (along with the bits of charcoal that are always in that ash). If you don't have a composter, but have a little time (this can be done on long winter evenings or rainy days) – produce fertilizer. This is because it's a pity not to use the elements contained in biomass ash – phosphorus, potassium and calcium. By using ash, we will reduce the use of fertilizers, and therefore the exploitation and transportation of minerals.

Mining and processing waste will not be created because the factory will not need to produce the fertilizer.

The main ingredient in the fertilizer is sun-dried coffee grounds. Of course, they are also suitable for composting, but here we need them dried. Collect them in the warm season. If you don't drink coffee, you can ask at a nearby coffee shop – it produces about a bucket of grounds a day. Sift the ashes from the fireplace, grill or campfire through a sieve to separate the charcoal pieces. They are an ideal addition not only to the soil in the garden, but also to improve the soil structure of our potted flowers. If necessary, we can shred them a bit. You can also dump them on the compost, and store the ashes in a plastic bucket with a lid. Remember that ash is strongly alkaline – always wear rubber gloves. The last main ingredient is food-grade gelatine. If you intend to prepare a little more fertilizer it is worth buying it in a large package (e.g. 500 g). You can also prepare an old-style ice mould, which we will fill with our fertilizer (Fig. 13).

Note well! If we do not have a mould, we can spread the ready pulp on a flat surface, roll it out with a pastry roller and cut it into cubes. It will take even faster to dry than it does with cubes – about 2-3 days, depending on temperature and humidity. Fully dried fertilizer does not go mouldy and is always ready for use.

Fig. 13. Fertilizer ingredients and finished cubes

The most important advantage is that we can make various fertilizers from these ingredients. If, we mix them in different proportions – we will get an acidic, neutral or alkaline fertilizer – depending on our needs. The proportions have been provided in Table 1.

Table 1. Mass [g] and volume proportions of ingredients

Fertilizer type	Dry coffee grounds	Ash	Gelatine
Acidic	100	3	10
Neutral	90	10	10
Alkaline	80	20	10

Store the grounds mixed with ash in a glass jar with a cap. Use unsalted water after cooking food and at the same time

soak a weighed portion of gelatine in cold water and place a weighed portion of the grounds-ash mixture in a small plastic bucket (it can be a cheese, butter or even herring bucket). Use the (unsalted) boiling water after cooking to dissolve the gelatine. In this way, we reuse the energy used to boil water. Why pour boiling water down the drain? It takes about a glass (180-200 ml) of hot gelatine solution per 100-110 g of grounds-ash mixture. Before pouring the gelatine into our mixture of grounds and ash, it is essential to cool the solution.

Pour the solution into the bucket with the mixture and with a spoon or small spatula mix everything thoroughly. Coffee is slow to absorb the gelatine solution, so add it carefully – not all at once, so that the final consistency is cake-like. Place the kneaded fertilizer in an ice mould – you will get fertilizer cubes, or mince it in a meat grinder through a large-mesh sieve (watch out – this requires considerable physical strength, and an electric machine may not be able to handle it). Place the mould in the refrigerator, and if you used a meat grinder – spread the obtained rolls very gently in a thin layer in the sun to dry. After a few hours, the mould is removed from the refrigerator, gently knocked out the fertilizer cubes and placed to dry in the sun.

Such a fertilizer will slowly decompose providing a balanced supply of nutrients contained in the ash (mainly calcium, phosphorus and potassium) and the resulting decomposition of grounds and gelatine. It is non-toxic and can be done even with a help of your child. We turn the waste into organic-mineral fertilizer ourselves. This is at the heart of the circular economy (CE).

An additional fertilizer ingredient can be paper from the shredder, but only with black printing. However, we recommend using such paper as an additive for composting.

Cardboard tubes left over from a used toilet paper roll or paper kitchen towel may also find new uses. Using these tubes as a place to grow seedlings of tomatoes (or other vegetable or ornamental plants that require thinning), not only do we have the opportunity to plant the finished seedlings in the beds without pulling the plants out of the tubes (the tubes will decompose in the soil), but most importantly, we will make use of the waste and not have to use plastic pots.

5. Examples of design in the spirit of CE

Packaging waste accounts for a significant share of the mass of waste generated in cities.

It is advantageous to sell goods only in a large bulk package (no individual packages). When bringing our own packaging, we can buy, for example, nuts, vegetables by weight. Designers and consumers should force packaging manufacturers to minimize packaging material and use easily recoverable materials. It is necessary to eliminate multi-material packaging – including beverage cartons, paper bags, envelopes with a plastic window and envelopes with bubble wrap inside. Virtually all of them will go to the incinerator. Waste bags that are made of cornstarch instead of polyethylene are now available. Packaging-free sales should be implemented, especially when it comes to single packaging – why would anyone need a cardboard packaging plus foil a toothpaste is packed in or a cardboard box which contains cream in a plastic or glass jar?

Toothbrushes or cotton buds are made of bamboo, lactic acid polymer or recycled plastic. Cutlery made of bamboo is much easier to manage than the plastic ones which come from the food service outlets-generated waste streams.

Sale of loose products (groats, flour, washing powders), from glass dispensers into our own containers. We will generate much less plastic waste.

Can you go and get a takeaway coffee with your own cup? At your fast food, are take-out dishes packed into

containers you bring? Do you use handy breakfast boxes instead of wrapping your sandwich in aluminium foil, which is incompatible with CE – the used foil usually ends up in mixed waste and ultimately in the landfill.

6. Designing the right collection systems

Implementation of the system: Pay-As-You-Throw (PAYT). The Individual Waste Segregation System is a revolution for Poland's waste management. It is the first solution that allows selective assignment of waste quantity and quality for each user of the system. It is designed for multi-family housing estates and single-family houses. Monitored and coded bins (each apartment is assigned an individual QR code, the scanning of which opens the bin) allow the registration of unauthorised waste dumping, and weigh dumped waste by stream: plastic, paper, etc. The rate of segregation in such a system exceeds 90%, which is not feasible in traditional systems (Fig. 14), where everything goes into the bin.

A heavily contaminated waste stream makes material recovery difficult or even impossible, so special emphasis should be placed on the quality of segregation at the source.

Fig. 14. Glass bin filled with various waste that should never go into it

A great idea is to introduce pictograms indicating what waste should be trashed in the given bin. Sometimes residents are unable to determine what an item is made of and it ends up in mixed waste. This is especially important for paper and plastic packaging, which we generate in significant quantities. The picture (Fig. 15.) shows a coloured pictogram which informs the user of the right bin. This significantly improves waste segregation.

More and more companies operating on the Polish market are opting for additional colour coding, making it easier for residents to make the right decision about which bin to deposit their waste in.

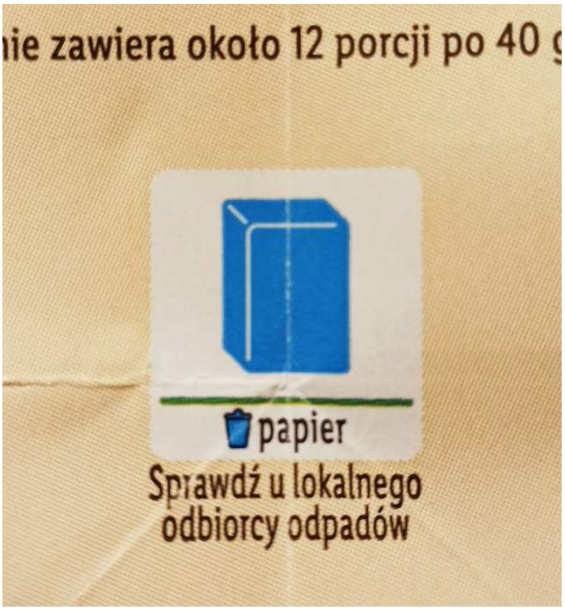


Fig. 15. Colour pictogram on packaging

In the "Opole segregates" application, there is a functionality related to the waste search engine, which indicates where the waste should go, i.e. into which bin to dispose of or where to deliver it (Fig. 16). While the app has other functions, its primary option is to present current schedules for the collection of individual waste streams from properties within the city of Opole. The database covers both individuals and companies.

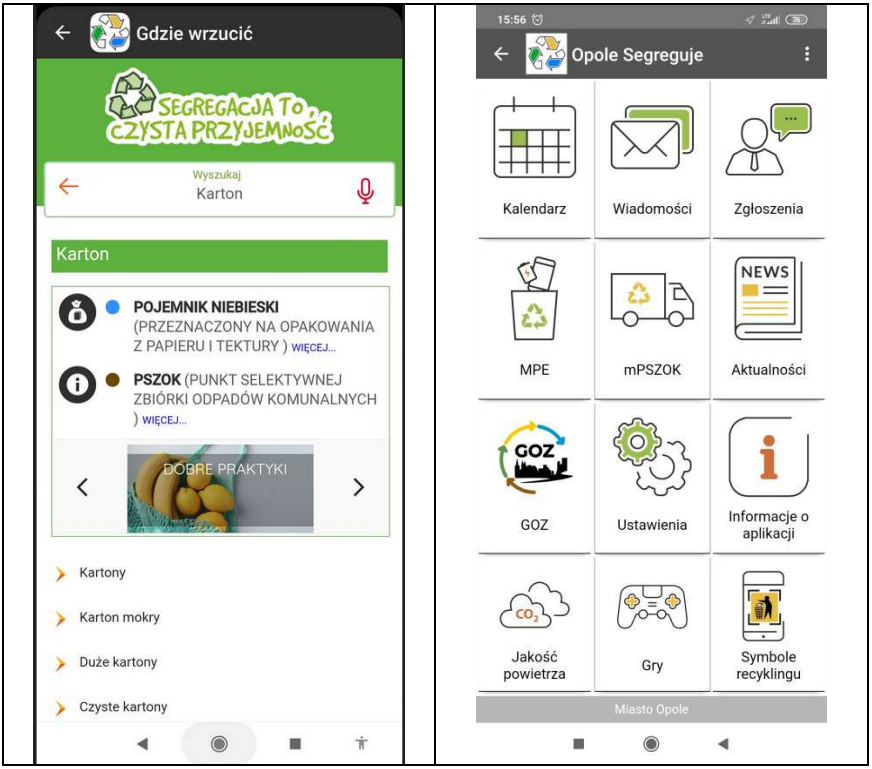


Fig. 16. "Opole segregates" application

Another app allows finding a restaurant or cafe (or other business) that cuts prices on products at the end of the day. Their distribution will prevent the generation of further waste (Fig. 17). You can also use the app to find a community refrigerator where you can leave food.

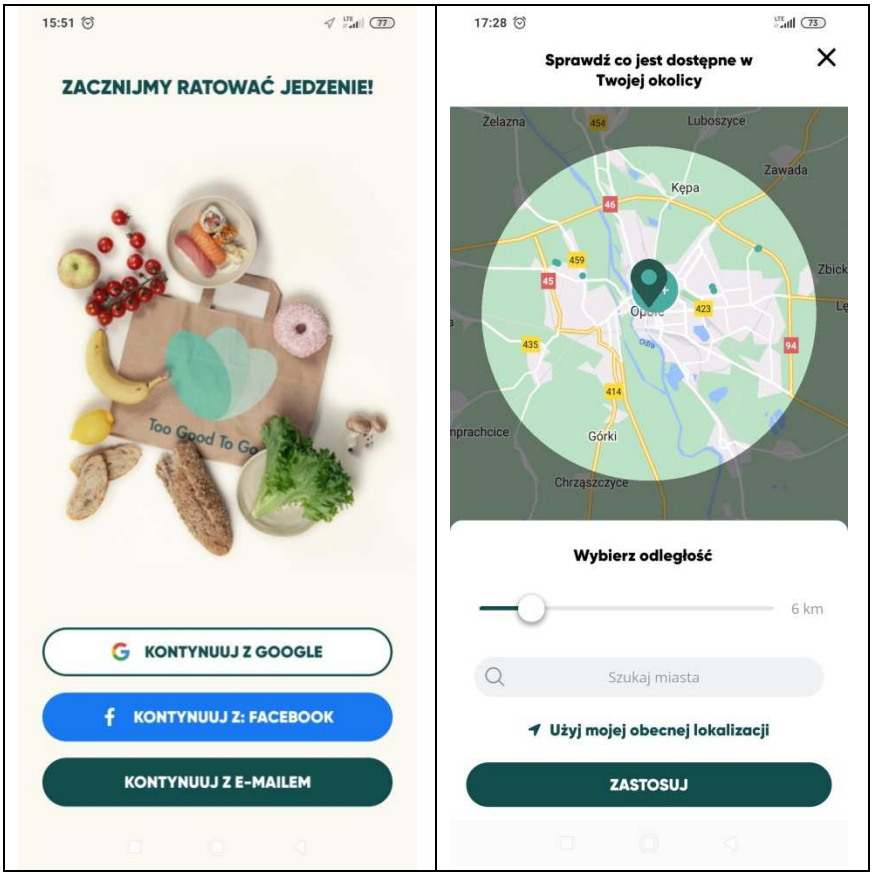


Fig. 17. A free app that allows users to find places that offer discounted food.

7. Acting in the spirit of CE – what can I do myself?

1. Limit the consumption of goods. Especially avoid those that are packaged and the packaging is difficult to recover. If you can buy more product by sharing with your neighbour, you will generate less waste and emissions. Quitting the purchase will result in no waste being generated.

2. Be especially careful when purchasing perishable goods (food). You can manage, even if you don't eat your favourite foods for a day or two. It's better to do without bread than to throw away half a loaf because it got mouldy. Sometimes mouldy bread is dumped under the bin shelter "for the birds." Birds should not eat bread at all. Even fresh one.

3. Use your possessions with care. Do not expose everyday items to premature wear and tear. This will extend their lifespan, which will delay the moment to buy a new item to replace the broken one.

4. Use the services of repair facilities. Many appliances can be repaired instead of buying new ones right away. If the broken item is large – call a technician to come to your home.

5. Don't succumb to bad fads. You really don't have to have everything that is fashionable. This applies not only to clothes (as the negative trend of "fast fashion" – a trend where collections appear almost every week – is widespread).

6. Compost biodegradable waste. The obtained compost will fertilize the soil, making it possible to grow vegetables or flowers. If you dispose of them in the brown bin – dispose of them in bulk, not wrapped in a bag.

7. Don't buy water in plastic bottles. Water in Opole is drinkable straight from the tap. In addition, it is the cheapest drinking water. If you are nevertheless concerned, use a pitcher or bottle equipped with a filter.

8. Before you throw anything away – think if you can't use it somehow. If you temporarily don't have time or an idea – store this item, give it to another person or deliver it to the ReUse shop.

9. Borrow the equipment you need instead of buying it. If you use something once a year, renting will be cheaper than buying. Good relations with neighbours will make this task easier. Don't isolate yourself in your world. Acting in a group is easier and more enjoyable.

10. Quit unnecessary activities. Every action you take can generate carbon emissions and consume the Earth's non-renewable resources. Some of the worse decisions are unnecessary travel – such as driving all over the city in search of a product from a certain company, even though there are substitutes of the same quality from other companies. To do this, we go from store to store, in search of a "favourite" product. We consume liquid fuels and emit CO_2 just to satisfy our own whim.

8. Environmental effects of actions in the spirit of CE

Are you really going to tell your child, granddaughter or grandchild that they have to do without oil, coal, clean water, fertilizers, plus they have to live in a climate 2 or 3 degrees warmer than you, because the current generations have already used up everything and, through their actions, have poisoned the planet and warmed the climate?

It is our duty to constantly think about the future of the planet. We cannot expose future generations, to a life without goods, just because we used them too extravagantly.

The linear model (buy-use-throw away) results not only in the consumption of non-renewable resources (metal ores, fossil energy sources), but also in the generation of a huge mass of waste. In Poland, in 2021 it was 358 kg/person, by 16 kg/person more than in 2020. The waste goes to a landfill or incinerator. Of course, before the waste is deposited in a landfill, it will be necessary to extract what is usable – such as metal waste or plastics. The waste deposited in the landfill undergoes methane fermentation – so our waste causes emissions of biogas composed of methane and carbon dioxide, which are greenhouse gases. So by landfilling waste we are contributing to climate destruction.

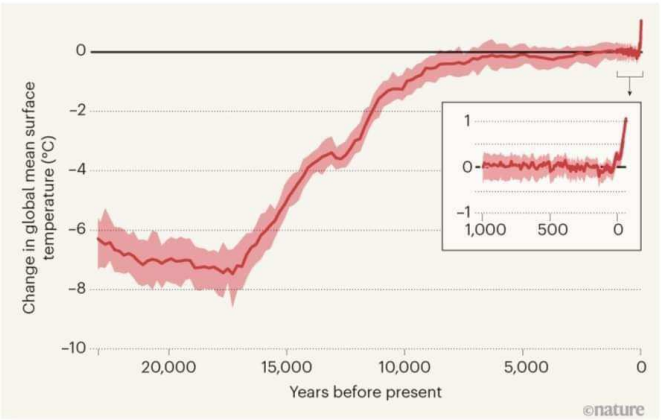
The incinerator is a qualified solution. Of course, we generate electricity and dispose of waste there, but at the same time we emit huge amounts of carbon dioxide. How much? Too much. A waste incinerator generating electricity emits CO_2 at a rate of 1360 kg CO_2/MWh. This does not seem very efficient, even compared to such an environmentally negative solution as a coal-fired power plant which emits "only" 1020 kg CO_2/MWh.

The circular economy (buy-use-recycle-use model), also known as the cradle-to-cradle – or waste-free model), is intended to be an antidote to the linear model.

What will be the environmental effects?

By reducing the demand for new items, we will preserve natural resources – such as metal ores. By reducing the extraction of ores, we will lower carbon dioxide emissions due to their extraction, refinement (such as flotation or even grinding or separation from waste rock) and handling. Thus, we will reduce the generated mass of wastewater and hazardous waste (oils and electronics for industrial machinery). Since there will be less sewage and waste – we won't have to treat sewage and dispose of waste (again, we will avoid emissions and slow down global warming).

Now comes the answer to the question of how fast we are changing the climate by aiming at economic growth, that is, consumption which, in turn, stimulates the economy. In the graph below (quoted based on the prestigious scientific journal Nature), we see a sharp jump in temperature in the last few decades (in the enlarged rectangle the last thousand years), compared to the rate of change in the distant past (Fig. 18).



Shakun and Marcott 2021 - Figure 1 - Changes in the global mean surface temperature over the past 24,000 years
https://www.nature.com/articles/d41586-021-03011-6

Based on:

Osman et al 2021 - Globally resolved surface temperatures since the Last Glacial Maximum
https://www.nature.com/articles/s41586-021-03984-4
https://www.nature.com/articles/s41586-021-03984-4/figures/2

Fig. 18. Global air temperature trends In the last 24 thousand years.

The baseline temperature (0°C), is the level that existed on Earth before the industrial era, that is, before 1850. Why is it important? Those measly few degrees? Because, as there were minus 6-7°C (20,000 years ago) from the baseline temperature (marked as zero on the graph), Europe was covered with a thick layer of ice. If global warming exceeds 2.5 degrees (we've already gone above 1 degree – see chart), further warming will not be stopped by any technology and for any money.

What will happen then? Hundreds of millions or even a billion residents of the intertropical zone will move north and south in search of cooler places to live. The problem is that these areas are already inhabited, and significant acreage is devoted to food production.

Sun-scorched areas from the Tropic of Cancer to the Tropic of Capricorn will not be suitable for survival. For the global, ever-growing population (currently 8 billion people), the space to live – that is, to live, produce food, get drinking water, fuel, etc. – will shrink significantly. The end result will be famine and war for resources.

As a result of melting glaciers, the level of the global ocean is rising. Many hundreds of square kilometres of land will be flooded in a short period of time. The first to be forced to migrate will be residents of the country of Kiribati and the city of Jakarta in Indonesia (more than 10 million people).

Let's have a look at Europe. Higher temperatures mean higher evaporation from the soil surface and from plant leaves. So the fields will have to be irrigated (there are annual droughts). Irrigation of fields will threaten drinking water supplies.

This answers the question – what does waste management have to do with the lives of our children, grandchildren and great-grandchildren.

9. Good practices based on the activities of the town of Opole

The first element is to enable separate collection of waste (the so-called segregation at source), regardless of location. There will always be someone who will say "There was no waste bin". So we have the aesthetically pleasing bins (Fig. 19) located throughout the city.

Fig. 19. Durable, aesthetically pleasing integrated waste bins in Opole's recreational areas

A bin for electro-waste (this is known as hazardous waste) is a good idea. Unfortunately, in many cases electro-waste ends up in the mixed waste stream (residual after segregation) because

the resident will not reach the selective municipal waste collection point. The photo (Fig. 20) shows the Municipal Electro-Waste Point, which is a vertical, aesthetically pleasing bin for batteries, light bulbs, as well as other electrical and electronic waste.

Fig. 20. Municipal Electro-Waste Point at Copernicus square

They are placed in high traffic areas. The network of Municipal Electro-Waste Points is being expanded and there are currently 31 such facilities in the city. Stationary selective municipal waste collection points (Podmiejska 69 and Kępska 5 streets in Opole) accept electro-waste of large and small dimensions, while mobile selective municipal waste collection points accept electro-waste up to 75 cm in diameter.

9.1. Re-food programme

It aims to manage foodstuffs by transferring it to the Food Bank in Opole, from where it is further distributed, for example, needy institutions or NGOs.

9.2. Ecological town

An interesting educational activity that has been carried out for many years now is a family festival called Ecological town. This is an opportunity for entire families to participate in competitions with prizes and learn about the basic facts of waste management and deepen the knowledge. The event has been organized with great commitment and cooperation by local government units, city companies, NGOs and universities.

9.3. ReUse shop

This place has been created with the idea of exchanging things. At the corner of Krupnicza and Książąt Opolskich streets, we will find a place where one can bring unnecessary items or take the ones needed, according to the principle: "Bring – Swap – Benefit." The ReUse shop also hosts training courses and workshops. Read more here: https://www.smieciopolis.opole.pl/reuzytkownia/

9.4. Book Exchange Points

Opole, following the idea of bookcrossing, has introduced book exchange points throughout the city. They are used free of charge, following the principle: bring one – take one. The exact locations of the points have been given here: www.smieciopolis.opole.pl/punkt-wymiany-ksiazek/.

9.5. Education

A comprehensive educational campaign on how to handle municipal waste is carried out by the Department of Municipal Waste Management at the Opole City Hall, at the "Waste Fly" Studio and at the ReUse shop. As part of the educational activities undertaken, workshops, lectures are held, and leaflets, educational booklets or educational boards are issued. Competitions are held, and all up-to-date information is posted on the following website: www.smieciopolis.opole.pl.

9.6. "Opole segregates" app

Any cell phone user can download the "Opole segregates" application. It has a broad range of capabilities. The application has useful functionalities, including the following: it downloads waste pick-up schedules for the indicated property, both those belonging to private individuals and companies; it also features a waste finder so it suggests where to discard the given type of waste. In addition, it presents the elements of the municipal waste system, i.e. municipal waste collection points, mobile municipal waste collection points or Municipal Electro-Waste Point. The application also includes information about the circular economy and has a module that allows users to exchange things.

9.7. Re-Start Centre

This is a comprehensive socio-vocational reintegration project implemented in Opole. It covers a support program for people at risk of poverty or social exclusion. In particular, support will be given to the unemployed, who will be covered, among other things, by an internship program, psychosocial, vocational and legal counselling. The ReStart Centres also

organises activities that allow the beneficiaries to learn how to give objects a second life, for example, by teaching sewing or carpentry and upholstery classes.

9.8. Social refrigerators

It's a place where you can bring food that will serve those in need. Sharing food in this way is possible at the Polish Red Cross (PCK) welfare centre (Sienkiewicza 2 street – on the north side). The refrigerator is inspected daily – both for technical efficiency and for the food left there. It is secured against accidental opening.

10. Project activities under the URBACT program

In 2019 the Monitoring Committee of the URBACT Program has approved another 23 Action Planning Networks, including the town of Opole which has qualified to participate in the UrbReC network.

The point of interest are the city's resources. The goal of the UrbReC Action Planning Network is to support the development of urban resource centres that will fit into integrated waste management and promote the circular economy.

Project activities under the "URBACT" programme. The town of Opole, as part of the Resourceful Cities Network, is implementing the URBACT program. A Resourceful City is a city where residents treat waste as raw materials and the city government focuses on activities and supporting entrepreneurship. The resourceful city cares about lowering CO_2 emissions (which translates into climate protection) and a strong, vibrant local economy – that is, an economy based on short supply chains. So waste must be a raw material (that's what circular economy is about), which is an opportunity for future generations to survive, thus creating new jobs in the city.

One of the activities under the URBACT program is the ReUse shop, where unwanted items are brought. We can also take away, free of charge, the item we need. The main principle of the ReUse shop is Bring – Swap – Use.

Following the principle of "Think globally, act locally" we answer the question – will my action have any effect on a global scale. YES – IT WILL.

Do not give up pursuing the measures to rationalize waste management. The involvement of one person will not accomplish anything. Involvement of a thousand – that's something. The involvement of millions – is an opportunity for future generations.

11. Summary

A message to visitors from other planets:
We knew what we were facing.
We could have saved ourselves.
We were too lazy and too comfortable,
to get serious about it.

So our opportunism and laziness contributes to generating huge amounts of waste. How?
People's unbridled consumption forces the production of new goods. This requires: digging up the raw material, processing it, making the parts, assembling the product, and many kilometres of transportation at various stages of production. All of this results in the consumption of non-renewable resources – including fuels, which results in carbon dioxide emissions. Used goods turn into waste. The latter – again with considerable energy expenditure (which results in carbon dioxide and methane emissions), have to be processed.
Landfills are reaching the limit of their capacity. Once they are completely full, a place for new ones needs to be found. The problem is, however, that no one wants to live near a landfill. Thus, by reducing the mass of waste generated, we contribute to extending the life of existing landfills.
Carbon dioxide and methane emissions are causing climate warming. Effects of climate warming: extreme weather events, desertification of soils, global hunger, migration of hundreds of millions of people, including residents of Poland.
Production-oriented economic growth reduces the chances of survival for our children and grandchildren.

This guide has been developed on behalf of the Department of Municipal Waste Management at the Opole Town Hall and funded under URBACT III "Resourceful Cities"

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