UNIMOS
alliance

Casebook

CIRCULAR

EXAMPLES OF PRACTICAL SOLUTIONS AND PROJECTS
FROM THE CIRCULAR ECONOMY

25 lat SAMORZĄDU WOJEWÓDZTWA MAZOWIECKIEGO

Mazowsze dla organizacji pozarządowych

Zadanie publiczne pn. CASEBOOK CIRCULAR dofinansowane ze środków Samorządu Województwa Mazowieckiego.

Introduction

We are pleased to present a publication developed as part of the project 'Education and Information Activities in the Field of Waste Management, with a Special Emphasis on the Circular Economy (GOZ),' funded by the Mazowieckie Voivodeship Self-Government.

The aim of this study is to promote the concept of the circular economy and demonstrate how these principles can practically contribute to environmental protection and the creation of a more sustainable future.

We invite the residents of Mazovia to deepen their understanding of the economic and social benefits of effective waste management. Additionally, we aim to introduce the local community to the fundamentals of waste management and share innovative solutions and best practices from European Union countries.

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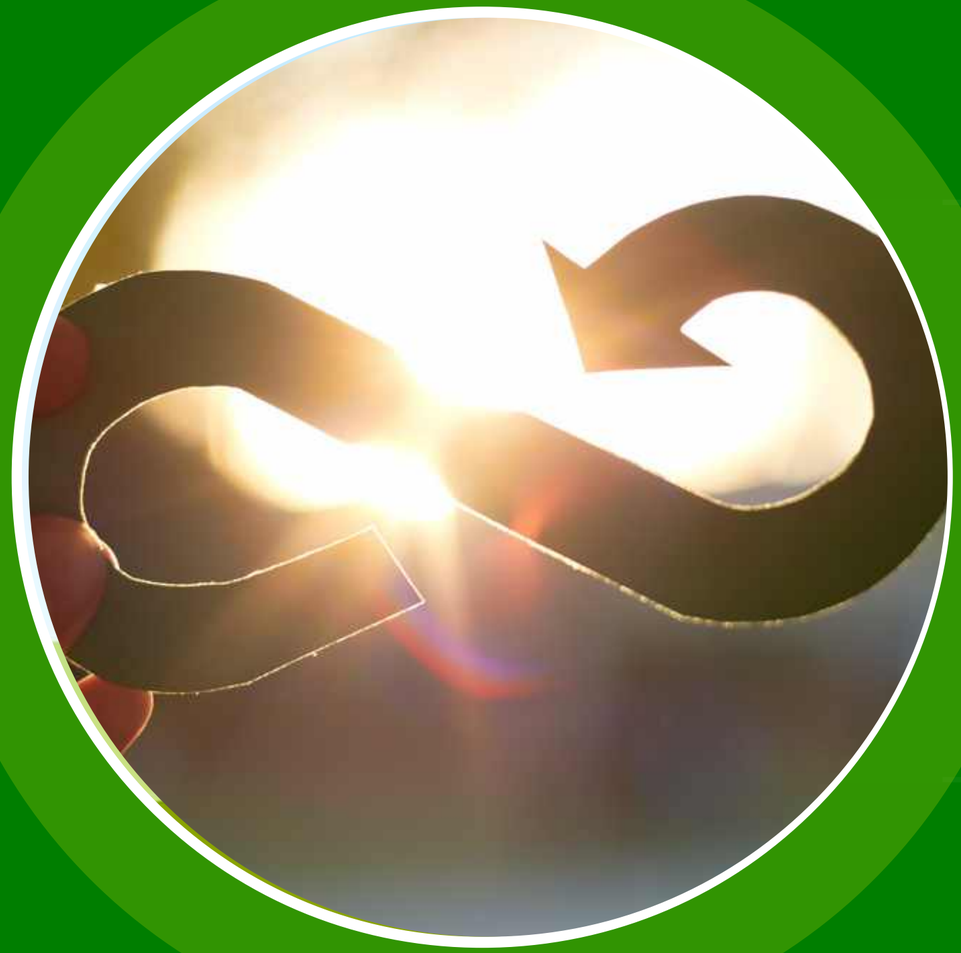
Did you know that a closed-loop economy can transform our perception of waste?

In this e-book, you'll find straightforward explanations and inspiring real-world examples that demonstrate how we can act more responsibly.

Begin now—
it's the first step toward a more sustainable future!

Table of Contents

To make the CASEBOOK easier to navigate, we have divided it into several practical sections:



1 WASTE CATEGORIZATION

Zadanie publiczne pn. CASEBOOK CIRCULAR dofinansowane ze środków Samorządu Województwa Mazowieckiego.

‘HOUSTON... WE HAVE A PROBLEM’.

According to the World Bank's report “What a Waste 2.0,” global waste production currently amounts to approximately 2.01 billion tonnes annually. By 2050, this figure is projected to increase by 70%.

Eurostat data from 2022 indicate that the average amount of municipal waste generated per person in the European Union member states is 513 kg per year.

In many developing countries, over 90% of solid waste is disposed of in unsafe ways, such as open dumps, which pollute soil, groundwater, and air.

EVERY MINUTE, AN AMOUNT OF PLASTIC EQUIVALENT TO WHAT A SINGLE GARBAGE TRUCK CAN HOLD ENTERS THE OCEAN.

Most solid waste is produced by municipal and industrial sources.

Solid waste, particularly plastics and other materials that are difficult to decompose, can have long-term environmental effects, contaminating soil and water.

Gaseous wastes, especially greenhouse gases, have the most significant impact on the environment as they contribute greatly to climate change.

Liquid waste can also affect the environment significantly. Its impact on aquatic ecosystems depends on its composition, and it often requires advanced treatment methods.

MOST SOLID WASTE IS GENERATED IN THE FORM OF MUNICIPAL AND INDUSTRIAL WASTE.

SOLID WASTE

This refers to solid waste from human activities, including households, industry, or agriculture.

Solid waste consists of materials such as paper, plastic, metal, glass, wood, textiles, and organic waste, which do not decompose quickly in the environment.

To minimise its environmental impact, solid waste is managed using various methods, including recycling, composting, incineration, and landfilling.

As urbanisation, consumption, and population growth continue to rise, the volume of solid waste is also consistently increasing.

LIQUID WASTE

The primary sources of liquid waste include:

- Food and petrochemical industries
- Agriculture
- Households

These sources disrupt aquatic ecosystems and contribute to water pollution by releasing chemicals, oils, detergents, organic substances, and even toxins that can enter the food chain of humans and animals.

GAS WASTE

The primary sources of gaseous waste are industry, transport, and inappropriate waste, i.e., off-site incineration.

Gaseous waste is a significant cause of climate change, water and soil acidification, air pollution, and health problems.

Gaseous waste also includes radioactive waste from processes related to the nuclear industry, mineral extraction and specific technological processes.
These are precisely monitored and stored to eliminate risks to the environment and public health.

IN POLAND, IT IS ESTIMATED THAT 109.4 MILLION TONNES OF INDUSTRIAL WASTE AND 13.4 MILLION TONNES OF MUNICIPAL WASTE HAVE BEEN GENERATED IN 2023.

SOURCE: https://www.rp.pl/biznes/art41253501-w-przetwarzaniu-odpadow-widac-potencjal-do-wzrostow z dnia 07.10.2024

ONLY 15.8% OF MUNICIPAL WASTE WAS RECYCLED.

Industrial waste

The primary sources of waste include mining (quarrying), energy processing, construction, chemical, and metallurgical industries. These wastes are mostly by-products of industrial processes, such as metal scrap, ash, chemicals, and other materials generated by factories and manufacturing plants. Some of these by-products are classified as hazardous waste.

Municipal waste

This is waste generated in households and public areas, such as parks and offices. It consists of various materials, including plastic, paper, glass, metals, and organic waste.

Agricultural and bio-waste

Organic waste from agriculture, horticulture, and households (e.g., food scraps, grass cuttings, leaves, and manure) is a potentially valuable source for composting or biogas production; however, managing it appropriately remains a challenge.

INDUSTRIAL WASTE

Industrial waste is produced during the manufacturing processes in industrial plants and must be avoided.

This waste is generated by various sectors, including factories, mines, and industrial facilities. It encompasses a diverse range of materials, such as chemicals, metals, plastics, rubber, and oils. Some of these wastes are characterized by high levels of toxicity.

Industrial waste is treated by specialised operators. In accordance with the principles of a circular economy, an increasing number of companies seek to manage this waste within their production cycles or classify it as a by-product.

BY-PRODUCTS

A by-product is a material produced as a secondary effect of a production process. Although it is not the primary purpose of that process, it still has value or has a valuable application.

By-products primarily arise in industries such as manufacturing and agriculture, but they can also come from other sectors of the economy.

For example, fly ash is a by-product of coal combustion in power plants. Although it was initially considered waste, it is now utilised in cement and concrete production, which helps reduce its environmental impact. Similarly, wood chips and sawdust produced during wood processing can be repurposed to create particleboard, fuel pellets, or mulching material in agriculture.

In 2021, Poland unveiled its first footbridge from... a repurposed wind turbine propeller.

Wind turbines typically have a life cycle of about 25 years, and recycling them poses significant challenges for the industry.

After three years of testing, this innovative footbridge was developed in collaboration between a waste recycling company and the Rzeszów University of Technology.

Thanks to the materials used, the footbridge is durable and weatherproof. It is also an excellent example of upcycling, where waste is transformed into a higher-value product.

PHOTO FROM MUNICIPALITY OF SPROTAWA WEBSITE: https://szprotawa.pl/PL/strona_glowna/

MUNICIPAL WASTE - THE CHALLENGE FOR CITIES AND MUNICIPALITIES

Households, institutions, and various social and economic activities primarily generate municipal waste.

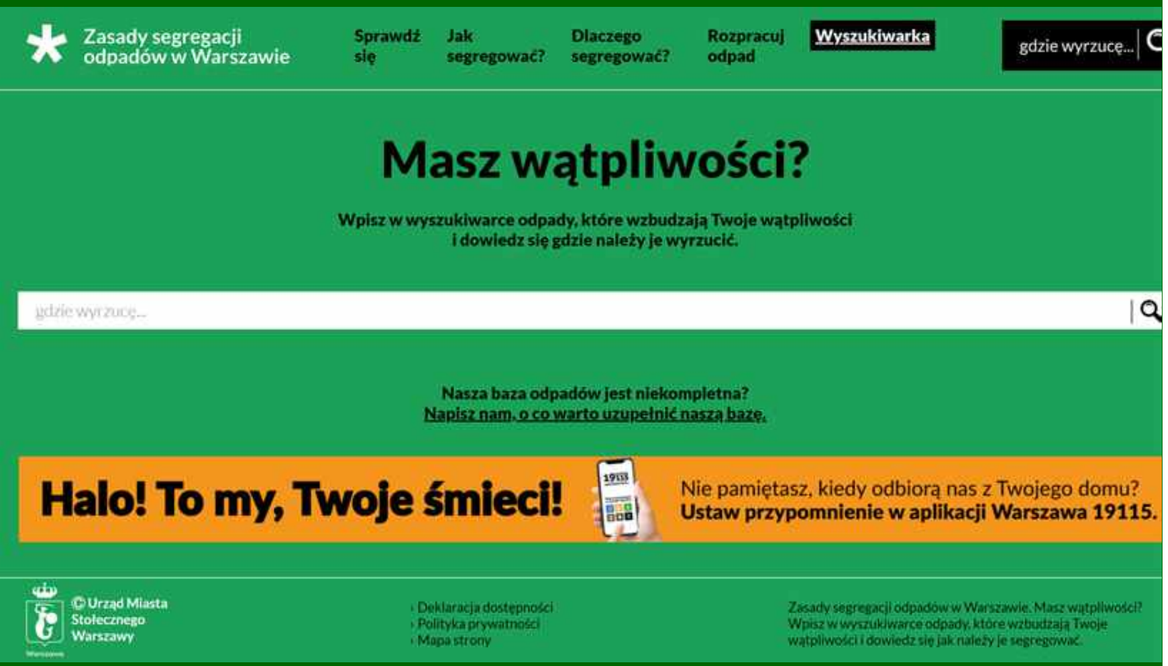
In Poland, waste separation is regulated by the Act of September 13, 1996, which requires municipalities to categorise waste into the following basic fractions:

- Paper (blue container)
- Metals and Plastics (yellow container)
- Glass (green container)
- Bio-waste (brown container)
- Multi-material Packaging Waste

There is also a specific category for hazardous waste, which includes items such as medications and electronic waste. This type of waste must be disposed of in designated containers. All other waste is mixed waste and should be placed in black containers.

Each municipality also has a separate municipal waste collection point where residents can drop off waste, such as bulky items and rubble, that cannot be disposed of in household containers.

WHAT IF WE DON'T KNOW WHERE TO DISPOSE OF THE WASTE?



www.segregujna5.um.warszawa.pl

Warsaw City Hall has created a unique website called Segregujna5 (in free translation - best school grade in segregation), which provides information on waste segregation and proper disposal methods.

This website explains the importance of waste segregation and describes how to implement these principles effectively in your home.

If you're unsure how to dispose of a specific product, simply enter it into the search engine. You will receive suggestions on where to dispose of the item, how to prepare it for disposal, and details on its recycling process.

In the ‘Test Yourself’ section, you can take a quiz to assess your knowledge of waste segregation rules and your ability to classify products correctly.

AGRICULTURAL WASTE AND BIOWASTE = FEEDSTOCK FOR COMPOST

Farms generate both organic and inorganic waste. By law, these types of waste are not classified as municipal waste, and farmers are responsible for their proper disposal.

Organic waste from agriculture and horticulture—such as food scraps, grass cuttings, leaves, and manure—can be valuable resources for composting or biogas production. However, effectively managing this waste remains a challenge.

The bioeconomy is working on developing solutions for better management of agricultural waste.

THE EUROPEAN POULTRY SECTOR PRODUCES **3.6 MILLION TONNES** OF FEATHER WASTE ANNUALLY, WITH ONLY ABOUT **25% BEING REUSED**.

The European poultry sector generates an estimated 3.6 million tonnes of feather waste annually, of which only about 25% is reused.

Feathers contain 90% keratin, making them a valuable raw material for producing biodegradable materials for agricultural and other uses.

The international UNLOCK project has developed prototypes of geotextiles, mulching films, and materials for hydroponic crops made from chicken feathers. These feather products aim to eliminate waste while enriching the soil with organic nitrogen. Researchers are also working on customising the biodegradation period to meet the specific needs of different crops.

PHOTO: TRAYS FOR HYDROPONIC CULTIVATION MADE OF FEATHERS

AGRICULTURAL PLASTIC WASTE POSES A MAJOR ENVIRONMENTAL ISSUE, CONTRIBUTING TO POLLUTION AND GREENHOUSE GAS EMISSIONS.

A company based in North Macedonia has launched a pilot program to engage local communities and minimise environmental impact.

During this initiative, over 800 kg of plastic was collected from local farms in five municipalities and converted into eco-friendly PET waste tiles.

The company intends to expand the campaign's reach and implement similar activities in additional municipalities.

PHOTO: ECO-TILES FOR OUTDOOR DECORATION MADE FROM PET PLASTIC WASTE

Source of information and photos:provided thanks to the cooperation of the SCALE-UP project (https://www.scaleup-bioeconomy.eu/en/home/)
The Marshal's Office of the Mazowieckie Voivodeship in Warsaw is a member of the SCALE-UP Mazovian Bioeconomy Platform.

2 CIRCULAR ECONOMY

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Source: European Parliament Research Service

A Circular Economy is an economic model that keeps products, materials, and raw materials in circulation for as long as possible.

This approach helps reduce the amount of waste in landfills and the environment. Reusing raw materials lessens the need for new extraction.

Less waste and the conservation of raw materials contribute to a decrease in greenhouse gas emissions and energy consumption.

Additionally, the Circular Economy fosters the creation of innovative solutions and the development of new industries, such as advanced materials recycling and repair services.

Example of circular economy

- Designing products with longevity in mind, focusing on their ease of disassembly and recyclability.
- Utilising production waste as raw materials to create new products.
- Establishing systems for replacing, renting, or refurbishing items to extend their life cycle, such as repairing electronics instead of discarding them.

The application of circular economy principles in practice has a measurable positive impact on the environment:

- Savings in the consumption of raw materials and energy
- Reduced reliance on non-renewable resources
- The creation of a more sustainable economy that benefits society, the environment, and the economy
- Decreased environmental pollution

The ‘6Rs’ principle—rethink, Refuse, Reduce, Reuse, Recycle, and Recover—is an environmental and sustainability framework that aims to minimise waste and improve resource management.

This approach helps protect the environment by decreasing waste, reducing CO_2 emissions, and lowering the consumption of natural resources and energy.

Adopting sustainable practices also offers economic advantages. Using fewer resources can save money, and repairing items instead of replacing them can extend their lifecycle.

Additionally, a mindful approach to consumption decreases pressure on the environment and supports the growth of a circular economy.

RETHINK

REFUSE

REDUCE

REUSE

RECYCLE

RECOVER

WHAT CAN EACH OF US DO TO HELP?

RETHINK
Do I really need it?

This principle encourages individuals to reflect on whether purchasing a specific product truly makes sense and fosters the exploration of alternatives that have a lower environmental impact.

For example, when considering this principle, ask yourself if you genuinely need a new phone just because a new model has been released.

In recent years, an increasing number of companies have provided solutions to combat excessive consumerism. Instead of buying a bicycle or scooter, you can rent a vehicle by the hour when you need it. Some DIY stores offer rental options for construction equipment as an alternative to buying. Additionally, there are companies that allow you to rent electronic equipment, which can be useful for one-time use or for trying out a product before committing to a purchase that may ultimately prove unnecessary.

REFUSE
Say NO to things that damage the environment

Some products have a more significant negative impact on the environment than others, so it is essential to choose the products we use carefully.

We should consider a few key factors when following this principle: Can the product be reused multiple times? Is it easy to repair if it breaks? Is it made from sustainable or easily recyclable materials?

We can make more eco-friendly choices by shopping with our bags daily. For example, when we buy takeaway coffee each morning, we can bring our reusable mug. Examining product packaging is essential to ensure it is made from environmentally friendly materials.

REDUCE
Keep the CONSUMPTION to a minimum

Manufacturing significantly impacts the environment by consuming energy, water, and raw materials while contributing to climate change. However, production is primarily driven by consumer expectations.

It's essential to save raw materials in our daily lives. Simple actions like turning off the lights when you leave a room, unplugging chargers once your phone is fully charged, and turning off the water while brushing your teeth can make a difference.

Additionally, we should examine our shopping habits. According to the Food Bank's ‘Don't Waste Food 2024’ report, 45% of households throw away food. Before grocery shopping, check your fridge and plan what you need to buy and how you will use it.

REUSE
Give products new life

Upcycling, recycling, and downcycling are different methods of waste processing that lead to the creation of new products.

In upcycling, higher-quality products are made from lower-quality materials. For example, Euro pallets can be transformed into comfortable and functional garden furniture.

In downcycling, a high-quality product is recycled into a lower-quality one, extending its life cycle. One example is using an old T-shirt as a kitchen cloth.

Some products can be reused multiple times. For instance, jars from purchased items are excellent for storing homemade preserves. Additionally, unused toys a child has outgrown can bring joy to other children when passed on.

RECYCLE
segregate waste

Recycling is one of the most common and popular waste management methods that people use every day. It involves recovering and reprocessing waste and the raw materials used to create products.

The key to adequate recycling is properly segregating waste to process it quickly. Lack of care can complicate recycling efforts and may even make them impossible. For example, placing paper packaging with food leftovers in the recycling bin can contaminate the paper, which should be dry and uncontaminated.

It is also crucial to dispose of hazardous waste correctly. Items like batteries and accumulators can pose severe risks to the soil or even spontaneously catch fire, so they should always be placed in designated containers for hazardous materials.

Therefore, please dispose of such items in the appropriate containers.

RECOVER

Before you decide to throw it away, check if it can be REPAIRED

A few years ago, repairing shoes and white goods was common practice. However, today, the number of service points for repairs is declining, and associated professions are gradually disappearing.

Some manufacturers intentionally design their products to require replacement after a certain period, with electronics manufacturers leading the way.

Before discarding a jacket with a broken zipper, consider whether your local sewer can replace it. Repairing items not only has obvious environmental benefits but also supports small service outlets, such as shoemakers and watchmakers, helping them stay in business.

Do you know of any repair shops in your area? They might be worth a visit!

3 CASE STUDIES

PRACTICAL EXAMPLES OF A CIRCULAR ECONOMY

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CASE STUDIES

EVERY DAY 9,000 TONNES OF USED COFFEE GROUNDS ARE WASTED IN EUROPE

Statistically, about 80% of Poles consume coffee daily. The coffee grounds are increasingly used in various industries as a source of valuable ingredients.

One noteworthy project in the 15th edition of the ‘Innovator of Mazovia competition (2023) was a zero-emission and zero-waste biorefinery that processes coffee waste into coffee oil, antioxidants, feed additives, and lignin.

At home, coffee grounds can effectively be used as a plant fertiliser, an additive in cosmetics, a body scrub, or a dishwashing detergent. They also help eliminate unpleasant odours and deter insects like ants and fruit flies.

NATURAL PLATES AND CUTLERY MADE FROM WHEAT BRAN

Bran is a by-product of flour and groats production. For many years, this material has been utilised to create innovative cookware.

The cookware is natural, made from bran and water without any chemicals. As a result, it is fully biodegradable and decomposes in just 30 days.

This cookware is heat-resistant, making it suitable for use in ovens and microwaves.

WORLD'S FIRST SHOES MADE FROM CACTUS

Some clothing companies are increasingly using raw materials derived from plants.

They use maise, cactus, and apple or grape pomace materials to produce shoes and leather accessories such as belts and bags. The organic leather produced through this process is fully biodegradable, cruelty-free, and free of harmful substances. Most importantly, waste processed in this manner does not end up in landfills; instead, it gains a second life as a unique product.

A NEW SUSTAINABLE RAW MATERIAL - STRAIGHT FROM THE FOREST!

More than half of Sweden is covered by forests.

A Swedish biotechnology company has discovered a way to utilise birch bark, a byproduct of the global pulp, paper, and plywood industries. They have developed and patented a unique material that replaces traditional rubber polymers, significantly reducing the carbon footprint.

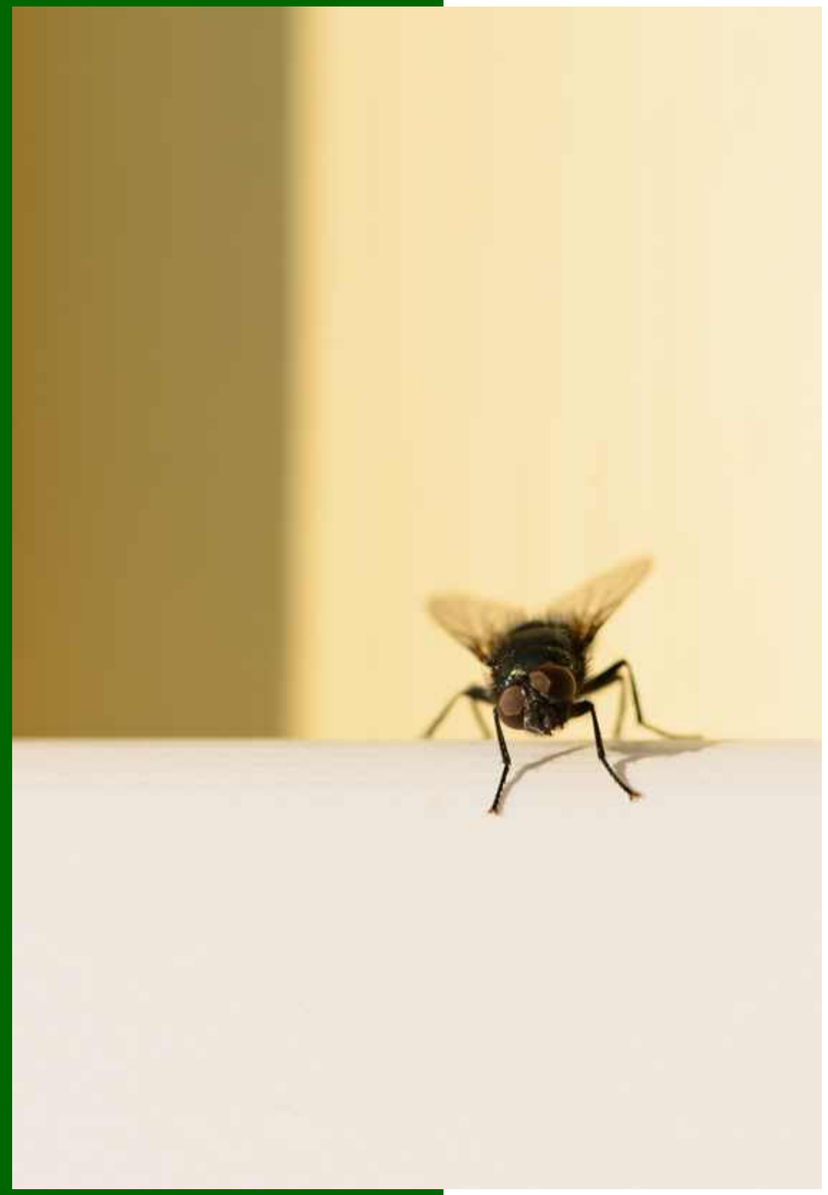
This new material is compatible with most conventional rubber polymers, fillers, and additives, allowing for various combinations. It can be used in multiple applications, including footwear, sports equipment, tyres, and other industries.

NATURAL PLANT-BASED COSMETICS IN SOLID FORM

The Austrian company produces various plant-based skincare products that come in solid form, all packaged in cardboard.

Handmade cosmetics are not only more effective but also certified and biodegradable. Additionally, because they are solid, they reduce the carbon footprint associated with transportation.

The company is currently testing the use of protein extracted from the pomace generated as a by-product of sunflower oil pressing, and the initial results are promising!

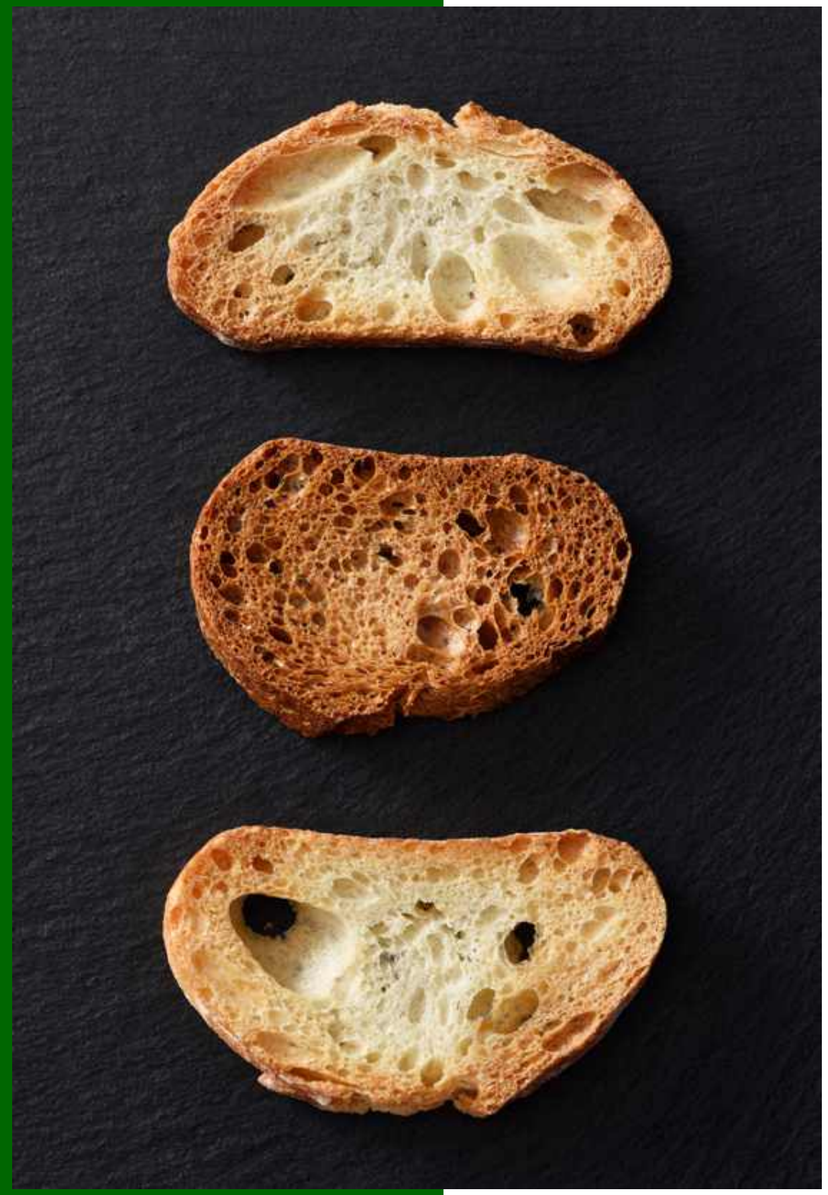


RECYCLED PACKAGING

The e-commerce market is increasingly utilising packaging made from recycled materials.

Cartons not containing added plastics—such as those used for packaging but not for beverages—are recyclable. These cartons can be transformed into new products, including cardboard, paper, and egg cartons.

Additionally, cartons can undergo upcycling processes, allowing them to be repurposed into decorative boxes or even dolls' houses.



IN 2021, A PROJECT WAS LAUNCHED IN KRAKOW TO REDUCE BREAD WASTE AND MANAGE SURPLUS BREAD THROUGH UPCYCLING.

A local technology company in Krakow is working to transform stale bread from a waste product into a reusable raw material, thereby saving resources and energy and benefiting the environment. The company has a laboratory and continuously expands its range of customer solutions. Additionally, it conducts consumer education activities.

Various products can be made from dry bread, including:

- new breads and tasty snacks
- probiotic drinks and breadbucha
- umami-flavored condiments and meat substitutes
- vegan cosmetics
- biodegradable packaging and biofilm for printing.

4 EUROPEAN PROJECTS IN THE FIELD OF BIO-BASED MANAGEMENT

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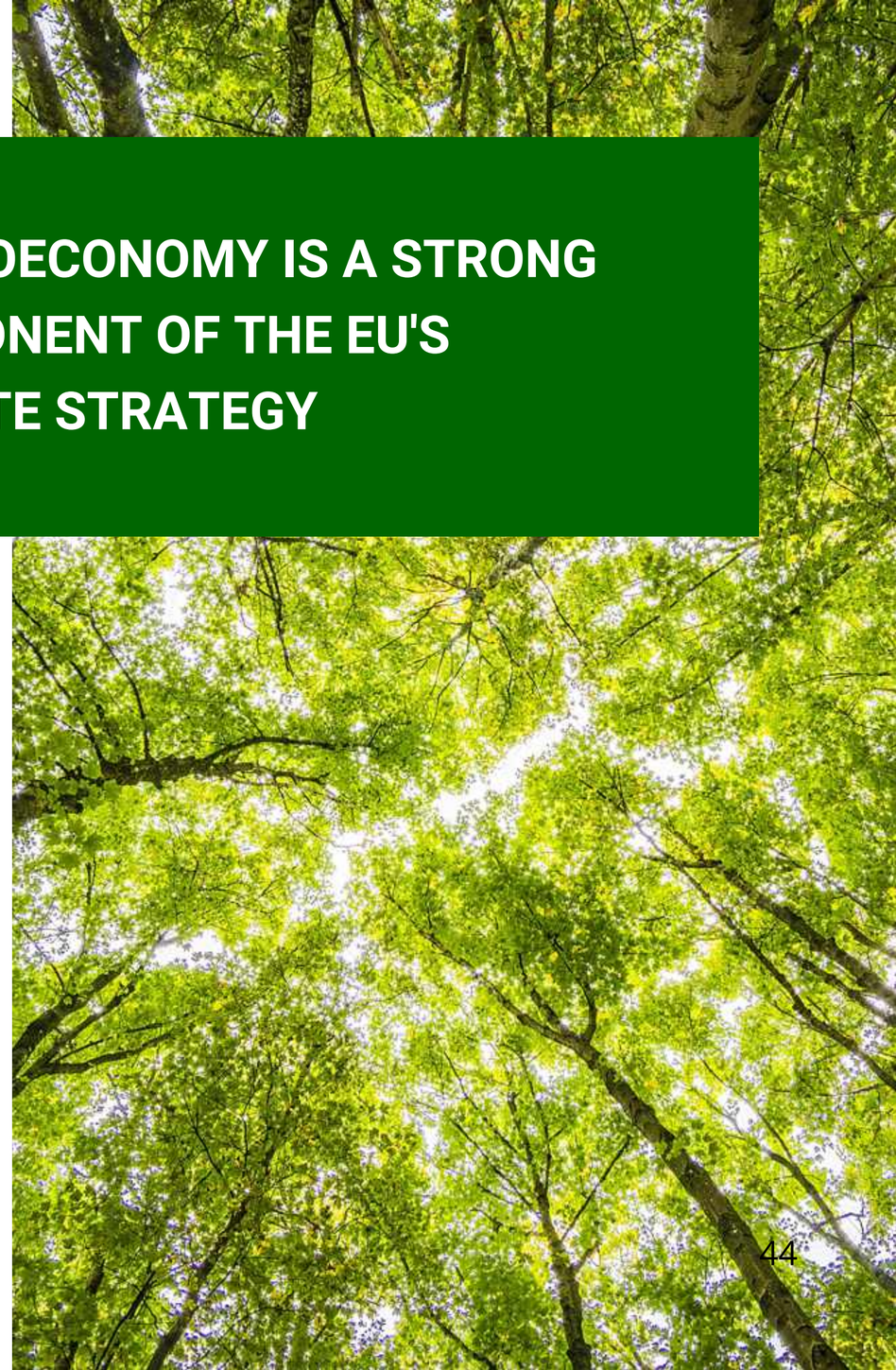
THE BIOECONOMY IS A STRONG COMPONENT OF THE EU'S CLIMATE STRATEGY

The European Union is actively promoting the development of the bioeconomy to encourage the sustainable use of natural resources and foster bio-based innovation.

Through funding and research programs, the EU empowers Member States to create advanced technologies and practices that facilitate the transition to a green economy.

Consequently, the bioeconomy is critical to the European climate strategy, contributing to job creation and strengthening local economies.



HORIZON EUROPE FOR RESEARCH AND INNOVATION

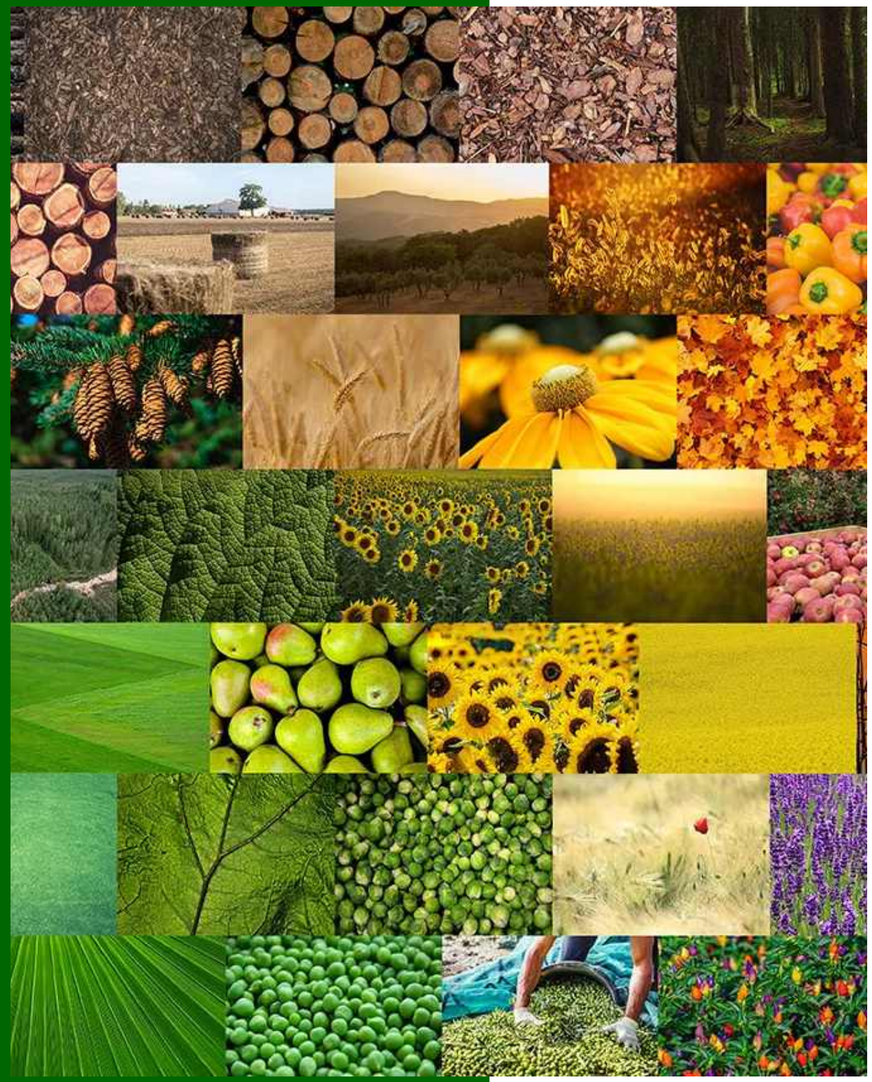
Horizon Europe is the European Union's program that supports research and innovation from 2021 to 2027.

With a budget of €95.5 billion, this program complements national and regional funding for research and innovation.

Horizon Europe is organized around three main pillars:

1. **Scientific Excellence:** This pillar focuses on supporting pioneering research projects and investing in research infrastructure.
2. **Global Challenges and Industrial Competitiveness:** This pillar funds projects that address key societal needs.
3. **Innovative Europe**: This pillar promotes the development of innovative technologies and provides support for start-ups.

Through Horizon Europe, it is possible to co-fund projects across various scientific fields while encouraging international cooperation.



SCALE-UP PROJECT

The Mazowieckie Voivodeship is one of six European regions selected as a case study for the SCALE-UP project. This initiative supports regional partnerships among businesses, governments, academia, and civil society organisations to identify and scale innovative, sustainable biobased solutions that leverage regional resources.

Significant waste is generated from apple production in Mazovia, which can be transformed into wood products, fertilisers, functional food ingredients, and other value-added products.

The European Union funds the SCALE-UP project under the Horizon Europe research and innovation program.

SCALE UP
community-driven
bioeconomy development

UNLOCK PROJECT

Feathers comprise 90% keratin and can be a valuable raw material for producing biodegradable materials. Only about 25% of feather waste in the European poultry sector is utilised.

A new project to develop and test innovative feather-based products for agricultural use has been initiated to manage this waste better and enhance its commercial potential. In Poland, efforts are focused on creating geotextiles and developing mechanical milling technology for feathers.

The European Union funds the activities of the UNLOCK project through the Horizon Europe research and innovation program.

UNLOCK

BIOBOOST PROJECT

The project aims to enhance the bioeconomy by integrating European innovation ecosystems and facilitating knowledge transfer between regions.

It brings together seven EU regions with common goals but diverse skills, allowing them to learn from one another and strengthen their potential for bioeconomy solutions. The project organises hackathons, study visits, and staff exchanges while building new networks. Additionally, small and medium-sized enterprises can receive support from experts across countries to help them develop their businesses based on best practices.

The European Union funds the activities of the BIO-BOOST project under the Horizon Europe research and innovation program.

BIO-Boost

SUAVE PROJECT

The SUAVE Eurocluster is an innovative project spanning six European regions. It focuses on developing urban agriculture to create sustainable and reliable food supply systems.

The SUAVE project supports small and medium-sized enterprises (SMEs) by providing access to innovative support mechanisms such as cascading funding, opportunities for missions abroad, and specialised training. The project aims to identify and implement solutions for urban agriculture that contribute to sustainable urban development, utilising local resources and the unique potential of the participating regions.

The European Union funds activities of the SUAVE project as part of the Horizon Europe research and innovation program.

suave
URBAN AGRICULTURE

ROSETTA PROJECT

The EU and internal marketing standards ensure consumers receive standardised and compliant products that meet their expectations. However, the "cosmetic specifications" and expiration dates established by these standards can significantly contribute to food waste, leading to the disposal of edible food.

ROSETTA aims to address this issue by reducing food waste caused by marketing standards. It proposes and verifies alternative methods for effectively using suboptimal food, focusing on promoting sustainability and resource efficiency.

The European Union funds the activities of the SUAVE project through the Horizon Europe research and innovation program.

ROSETTA

5 BY-PRODUCTS AND THEIR APPLICATIONS

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APPLE POMACE

Approximately 5 litres of apple juice can be extracted from about 8 kg of apples.

Fruit juice production generates by-products known as pomace, a valuable source of various nutrients. Pomace typically contains 20-30% dry matter, 1.5-2.5% pectin, and 10-20% carbohydrates.

Apple pomace is a rich source of important bioactive compounds, mainly concentrated in the fruit's skin.

The biomass of these residues has significant potential for innovation due to its rich nutritional profile and applications in energy production and fertilisation. For this reason, pomace is of considerable interest to companies in the food, biotechnology, pharmaceutical, and energy sectors.

In practical terms, pomace can be used to produce desserts and snacks, stabilise shampoos and lotions, or create delayed-action tablet coatings.

Apple pomace is also used to make eco-friendly watch straps and handbags.

WHEY

Approximately 100 grams of whey are extracted from 1 litre of milk containing proteins, lactose, vitamins (primarily from the B group), and minerals such as calcium and magnesium.

Whey is used in various industries, particularly the food sector, where it is the primary ingredient in protein drinks, sports nutrition, and dietary supplements.

Additionally, due to its valuable protein content, whey is used to produce cosmetics such as moisturising creams and to develop medicines in the pharmaceutical industry.

Whey's use in biotechnology, energy, and agriculture—including biogas production—highlights its potential as a versatile resource.

In a domestic setting, whey can be used as a souring agent for soups and silage or in bread baking.

Whey solution is also used in horticulture to combat aphids.

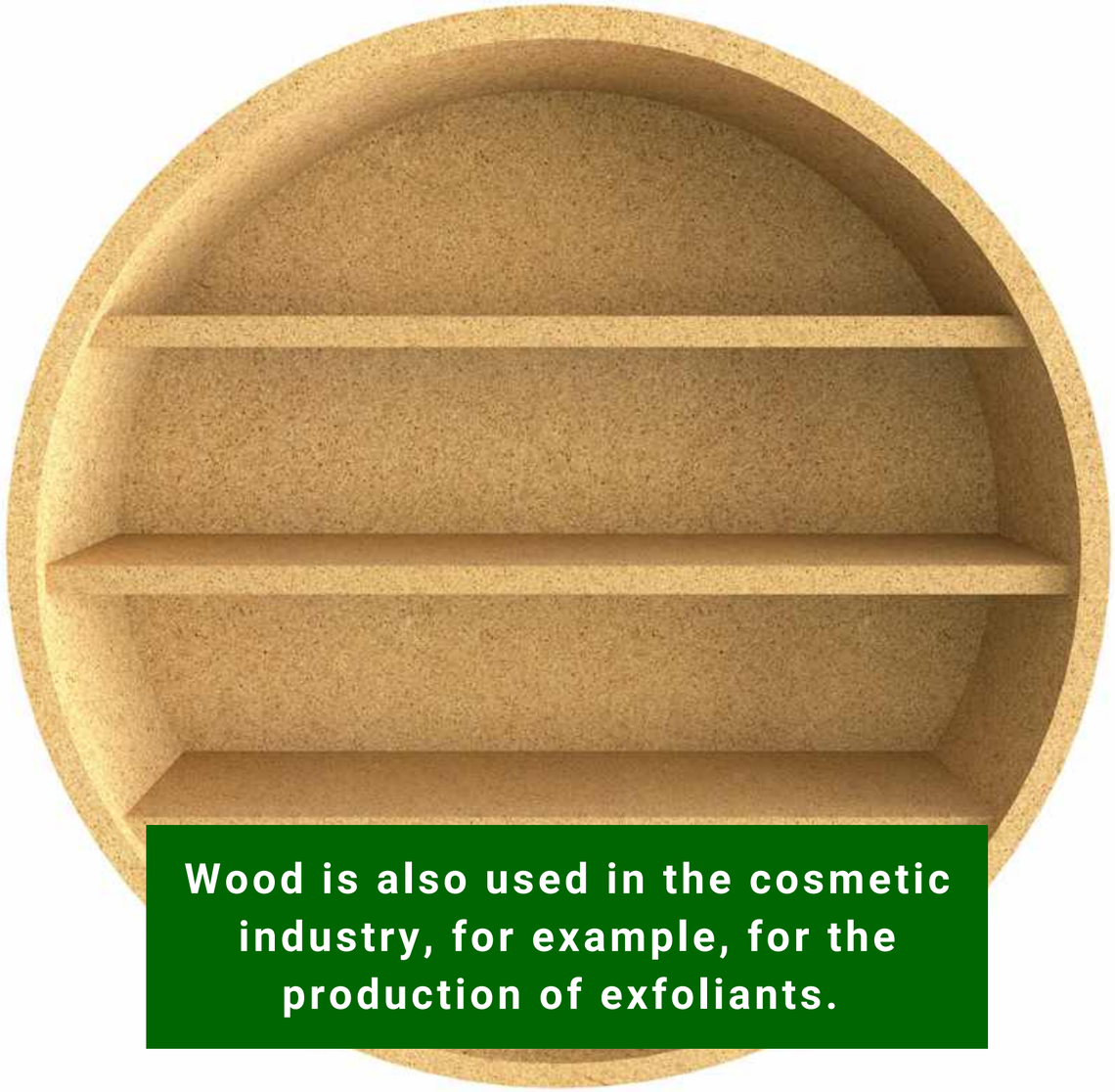
WOOD

Wood by-products, including wood chips, sawdust, bark, and other residual materials, are valuable raw materials utilised in various industries.

For instance, one tonne of wood chips can be processed to produce approximately 300 kg of pellets, which serve as biofuel in heating systems. Sawdust is commonly used in furniture manufacturing, such as chipboard, paper, and cardboard.

Wood bark, on the other hand, is utilised as mulch in horticulture and biogas production processes due to its high energy content.

Additionally, wood is employed in the chemical industry to create activated carbon and cosmetic products. Wood by-products are also widely used to manufacture building materials, such as medium-density fiberboard (MDF), and in the food industry as stabilisers in processed products.



Wood is also used in the cosmetic industry, for example, for the production of exfoliants.

RUBBER

Rubber rubber, a by-product of natural rubber processing, is utilised across various industries.

This material produces tyres, gaskets, and automotive components such as hoses, mats, and washers.

Additionally, rubber is used to manufacture footwear, sports equipment (e.g., balls), and everyday accessories.

Moreover, some rubber waste can be recycled into materials for the construction industry, such as soundproofing materials and floor coverings.

Rubber is used in many everyday articles, such as protective gloves.

HEMP

Hemp is a wide-ranging crop, and the by-products from its processing have numerous practical uses.

Hemp shavings, the residue left after the fibres have been separated, are used to produce ecological composite materials or as a substrate in animal husbandry. The leaves and stalks, on the other hand, can be used in agriculture as biomass to produce organic fertilisers.

Hemp seeds, which can also be a by-product of fiber-directed crops, are used in the food industry. They are processed into oils, flours, or dietary supplements rich in protein and omega-3 fatty acids. Additionally, hemp preparations have applications in the cosmetic and pharmaceutical industries due to their regenerative and soothing properties.

Hemp is used in the construction industry as an insulating material.

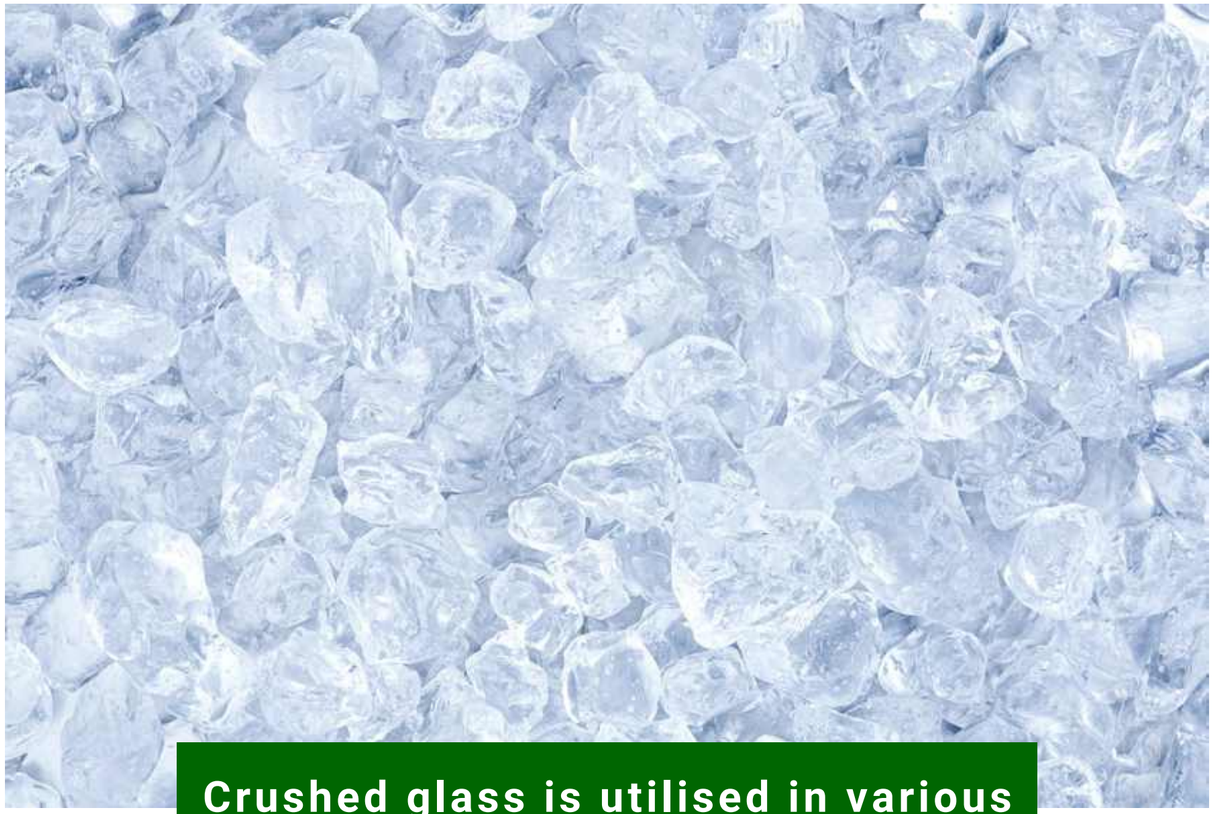
GLASS

Crushed glass, a by-product of the glass production process, has many applications across various industries.

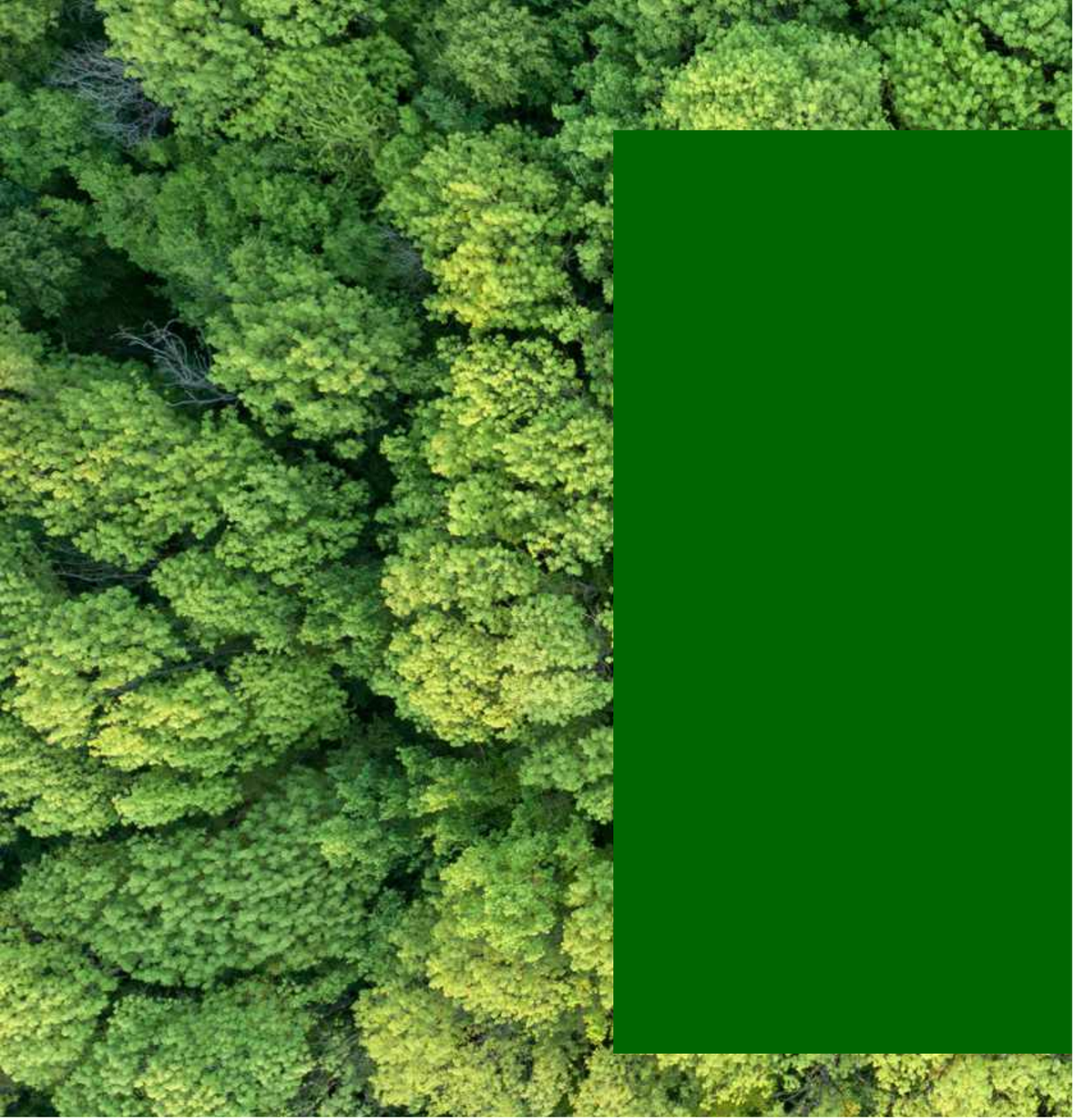
Due to its recyclability, glass can be recycled into new products, such as bottles and jars, effectively re-entering the production cycle.

Additionally, crushed glass is utilised in the construction industry as a filler in concrete and in the production of building materials like slabs and blocks.

It also serves as a material for decorative items, jewellery, and filtration products.



Crushed glass is utilised in various applications, one of which is a component of road surfaces.



ABOUT THE AUTHORS

The author of the CASEBOOK CIRCULAR is the UNIMOS Foundation, which coordinates the AgroBioCluster and the Bioeconomy AgroBioCluster in the Mazovia region. The Foundation supports enterprises, local government administrations, research institutions, and business environment organisations in developing the agri-food bioeconomy. Additionally, it serves as the animator of the Mazovian Bioeconomy Platform, established as part of the European project SCALE-UP. This platform promotes the transition to a sustainable, regenerative, inclusive, and equitable closed-loop economy.

Over the past ten years, the UNIMOS Foundation has fostered clusters connecting businesses, scientific institutions, and regions to encourage strategic cooperation across various economic sectors. It is a partner and consortium member in numerous EU projects focused on bioeconomy, sustainable development, and circular economy initiatives.

25 lat SAMORZĄDU WOJEWÓDZTWA MAZOWIECKIEGO

Mazowsze dla organizacji pozarządowych

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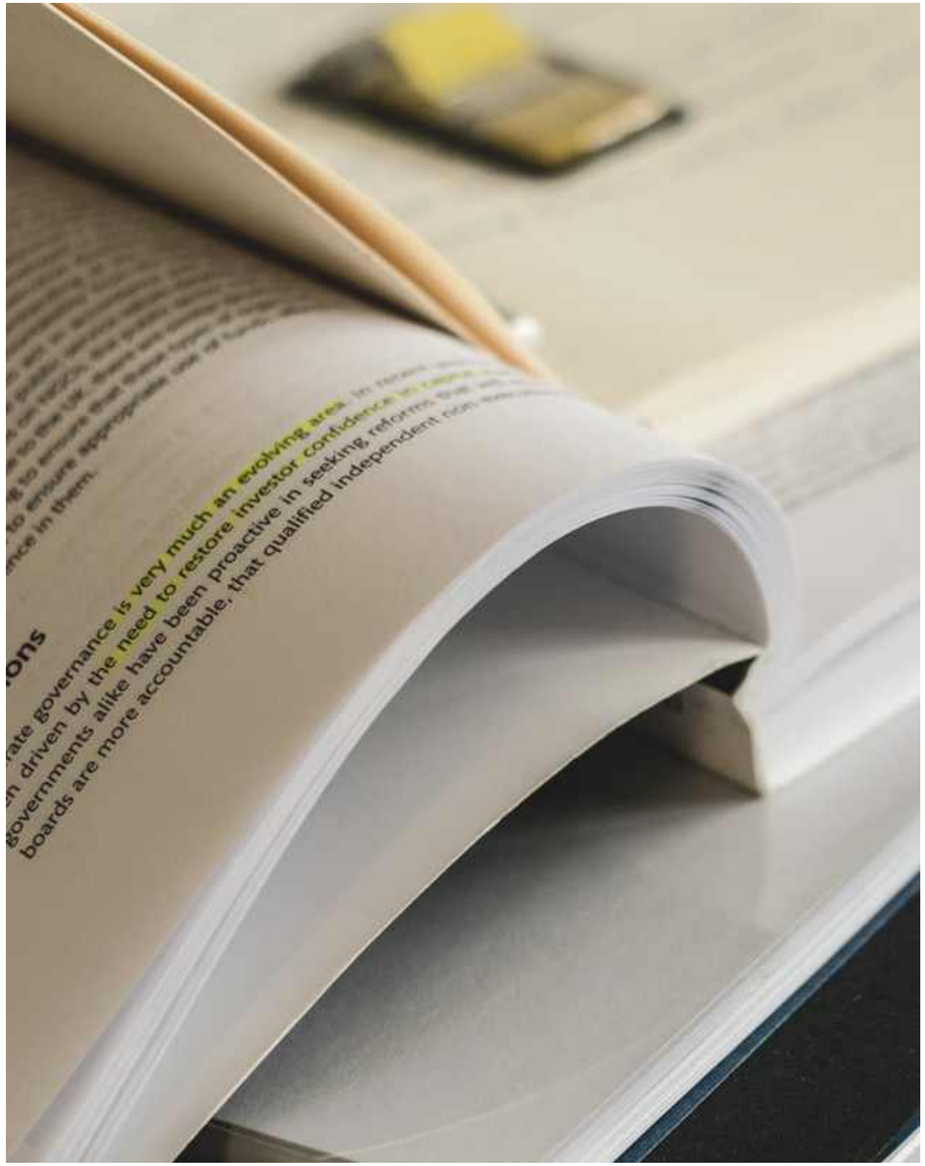

Unless otherwise specified in the photographic description, all photographs used in this study are taken from: www.canva.com.

SOURCES / BIBLIOGRAPHY AND NETOGRAPHY

Bibliography

1. Kaza, Silpa, Lisa Yao, Perinaz Bhada-Tata, and Frank Van Woerden. 2018. what a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050. urban development series. Washington, DC: World Bank. doi:10.1596/978-1-4648 -1329-0. License: Creative Commons Attribution CC BY 3.0 IGO.
2. Municipal waste down by 19 kg per person in 2022, https://ec.europa.eu/eurostat/web/products-eurostat-news/w/ddn-20240208-2
3. Don't Waste Food 2024’. , Report of the Federation of Polish Food Banks https://bankizywnosci.pl/swiatowy-dzien-zywnosci-2024/

Netography

1. Source City Hall website: https://segregujna5.um.warszawa.pl/ [accessed 29.10.2024].
2. Source web service/website of the City of Szprotawa: https://szprotawa.pl/PL/strona_glowna/ [accessed 29.10.2024].
3. Source the website of the Publications Office of the European Union CORDIS https://cordis.europa.eu/project/id/101060264.
4. Source Internet service of the Publications Office of the European Union CORDIS https://cordis.europa.eu/project/id/101136427
5. Source Publications Office of the European Union CORDIS website https://cordis.europa.eu/project/id/101096150
6. European Cluster Collaboration Platform: https://www.clustercollaboration.eu/content/suave-stimulating-smes-new-urban-agriculture-value-chain-sustainable-growth
7. Source Internet service of GREMI MEDIA SA https://www.rp.pl/biznes/art41253501-w-przetwarzaniu-odpadow-widac-potencjal-do-wzrostow (Article from 07.10.2024)
8. Source website of the SCALE-UP project https://www.scaleup-bioeconomy.eu/en/home/ [accessed 29.10.2024].
9. Source UNLOCK project website https://unlock-project.eu/ [accessed 29.10.2024].
10. Source VEGEPOLYS VALLEY website https://www.vegepolys-valley.eu/en/eu-projects/suave/ [accessed 29.10.2024].
11. Source BIO-BOOST project website https://bio-boost.eu/ [accessed 29.10.2024].
12. Source ROSETTA project website https://rosetta-project.eu/ [accessed 29.10.2024].

THANK YOU

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