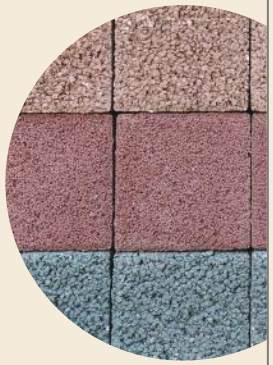
Circular economy in Serbia

Innovative projects and bussiness models



Republic of Serbia
Ministry of
Environmental Protection

gef

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

UNDP

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Innovative solutions for the circular economy

INTRODUCTION

The United Nations Development Programme (UNDP) in Serbia, in close cooperation with the Ministry of Environmental Protection of the Republic of Serbia and partners, has extended its efforts throughout 2023 and 2024 to support innovative circular economy solutions. These efforts have further accelerated the development of businessmodels aimed at reducing greenhouse gas (GHG) emissions through circular economy practices.

Through the mechanism of Challenge Call, local self-governments, public and private companies and civil society organizations were invited to submit innovative and cost-effective ideas for businesses and technical solutions that reduce GHG emissions in localcommunities through the application of circular economy principles. The most promising ideas were then developed into projects with the support of mentors and experts in the so-called “acceleration process” which resulted in completed project proposals. The most mature projects received financial support for their implementation in practice.

This mechanism was applied within the two initiatives: “**Reducing the carbon footprint of local communities by applying the principles of the circular economy in the Republic of Serbia – Circular Communities**”, project implemented by the Ministry of Environmental Protection and UNDP, with financial support from the GEF, and "EU for Green Agenda in Serbia”, implemented by the UNDP with the technical and financial support by the European Union, in partnership with the Ministry of Environmental Protection, and in cooperation with the Embassy of Sweden and the European Investment Bank (EIB), where additional funding has been provided by the governments of Sweden, Switzerland and Serbia.

CIRCULAR COMMUNITIES IN SERBIA

Within the “Circular Communities” project, financial support in the amount of USD 223,900 was given to the authors of the 4 best innovative solutions for a faster transition to a circular economy. One solution involves using hydrophilic plants as a source of energy – to produce a biomass. Another solution aims to transform organic waste into compost at hospitality facilities, thus contribute to reducing bio-waste from landfills and GHG emissions. The next solution aims to reuse wood scraps from discarded park furniture by applying a Japanese wood-burning technique and create the new outdoor furniture. Finally, there is a solution that seeks to establish a production line for extracting bio-waste from various sources to produce natural extracts for supplements, medicines, and preparations.

EU FOR GREEN AGENDA IN SERBIA

Within the “EU for Green Agenda in Serbia” project, financial support in the amount of USD 1,181,765 has been allocated for the 13 innovative solutions that effectively reduce GHG emissions through circular economy practices. These solutions include using biowaste for composting, recycling ash into construction materials, research the use of waste sludge in composting for agriculture, and production of construction blocks from hard-to-recycle materials. Additionally, there are projects involving biowaste treatment for animal feed production and extraction of bioactive essences from herbs waste for cosmetic products.

All of these solutions showcase a commitment to reducing resource consumption and waste generation, promoting sustainable practices, and enhancing resource efficiency across various industries in Serbia, improving the quality of the environment for the benefit of all citizens.

Production of biomass for heating (pellets or briquettes) from hydrophilic vegetation.

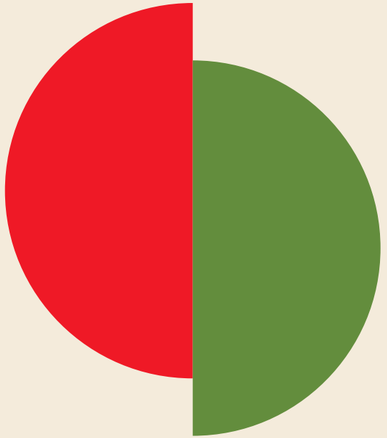
Biomass for energy and biodiversity (B4EB)

Implementing partner:
Institute for Biological Research "Siniša Stanković", University of Belgrade

This solution foresees the use of hydrophilic plants (plants that thrive in or have a natural affinity for water) as a source of energy. The heat potential of the vegetation has already been analyzed and has shown high values. Based on it, a business model was developed for production of biomass for heating (pellets or briquettes) from hydrophilic vegetation, with support of innovative mobile dryers, followed by the placement of the biomass on the market. This system includes the dainage channels, that are continuously cleaned. The solution also includes conducting an analysis of the vegetation's potential for energy storage (batteries) and a purchase of a special machine to be used for mowing vegetation in the drainage channels (the so-called "extended arm") and cleaning them. Partners in implementation, along the Institute “Siniša Stanković” which conducts the research, are the Water Management Company Sibnica, responsible for cleaning the drainage systems, as well as private company Dea Loyalty, that aims to expand its business in the field of green economy through the production and market placement of biomass. This solution is a successful example of collaboration between the academic, public, and private sectors. It significantly contributes to the improvement of flood prevention in suburban areas of Belgrade.

Green solutions for bio-waste management

Implementing partner:
The Faculty of Hotel Management and Tourism in Vrnjačka Banja, University of Kragujevac



The main idea of this solution is to pilot a programme for transforming food waste from the hospitality facilities into compost at the facilities of the Faculty in Vrnjačka Banja and further use the compost in horticulture of public green areas. It includes application of innovative “EM active” microbiological technology, that in a rapid and efficient manner converts plant organic matter into the compost. The process is environmentally friendly and results in reduction of bio-waste from landfills, reduction of GHG emissions, sustainable fertilizing solutions and better management of green areas. In the long term, by increasing the number of included restaurants and hotels that provide organic waste for the composting process, economic benefits are expected for the compost producer. In this manner, the circular solutionfor bio-waste, from the realm of theory becomes a "living laboratory of sustainable development". It is expected that other tourist centers, especially spa centers in Serbia, will adopt this modeland increase the biological value of the soil. This solution is a joint initiative of the Faculty of Hotel Management and Tourism in Vrnjačka Banja, University of Kragujevac and the Faculty of Agriculture of the University of Belgrade (academic sector), hospitality facilities: three hotels and two restaurants (private sector), the Ministry of Environmental Protection, PUC “Banjsko zelenilo i čistoća” and the Municipality of Vrnjačka Banja (public sector).

Balkan beauty, natural aspirin and olibanum: the value of the waste

Lead implementing partner:
Beoflos Ltd.,
Belgrade

The goal of the project, for the first time in Serbia, is to establish a production line for innovative ultrasonic extraction of the bio-waste from bark of white willow-WVB (so-called "natural aspirin"), mature fruits of the shell of the horse chestnut, an endemic species of this region (so-called "Balkan beauty"), and solid residue of frankincense after distillation. Advanced green ultrasonic extraction enables the production of highly sought-after natural extracts rich in powerful bioactive components (polyphenols, esculin, melanin, tannins, polysaccharides, etc.). The obtained extracts have a wide range of application, primarily in supplements (dietary or cosmetic) and medicines. This extraction also reduces the carbon footprint compared to conventional methods, amounting to 750 tonns of CO2 equivalent annually and extends the life cycle of 500 tonns of the biomass. The solution first implemented in the undeveloped municipality of Paraćin, Gornja Mutnica, within the Sanicula company facility (project partner). Due to its scalability, replicability, and potential for upgrades, it can be implemented in multiple locations in Serbia.

Tree in circulation

Implementing partner:
Furniture design and production studio “Opip”, Belgrade

The goal of the pilot project "Tree in circulation" is to reuse zero-value wood scraps from discarded park furniture by applying the Japaneese Yakisugi burning technique. This creates new garden beds, planters, bins, outdoor furniture, bird feeders, park equipment and miscellaneous furnishings. The new wood elements once stripped down and recovered through the natural wood-burning technique are maintenance-free and eco-friendly, extending the life cycle of wood waste materials to create new products that are themselves safe for further recycling when end-of-life is reached. The solution foresees that the damaged wood waste elements will be collected from park areas managed by the Faculty of Forestry (Arboretum, Goc), sorted according to sustainability criteria and reprocessed using the Yakisugi surface burning technique to produce new furniture. It also encompasses the procurement of equipment and tools necessary for treatment, as well as organizing workshops in schools and universities on how to extend the lifespan of wooden materials.

EU for Green Agenda in Serbia

Green technology for obtaining antimicrobial composites for application in cosmetics

Lead implementing partner:
Vinča Institute of Nuclear Sciences, Belgrade

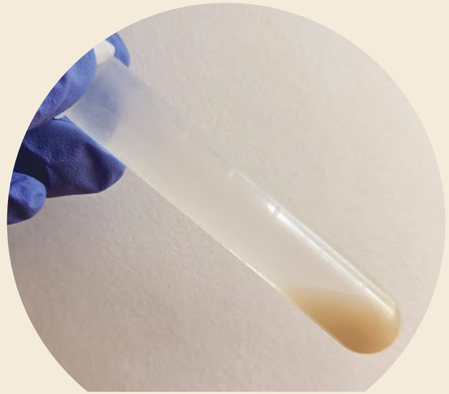
The Vinča Institute of Nuclear Sciences cooperates with “PR Amelles” on the development and application of green material synthesis technologies for the purpose of manufacturing new cosmetic products: natural sunscreen with mineral hydroxyapatite instead of harmful chemicals, and a face mask based on bio-cellulose with hydroxyapatite. Both products are biodegradable and environmentally friendly, and their natural and simple ingredients result in 30% reduction of production costs. The precise procedure of simple synthesis of all these ingredients into a final product is conceived through the project, which contributes to creating new and enhances existing cosmetic products. The testing of the final products, manufacturinge them and certifying them for potential the market placement.

From biowaste to biocosmetics

Lead implementing partner:
Faculty of Biology, University of Belgrade

The waste from three medicinal herbs, immortelle, lavender and heather, generated by “Sanicula” company in their essential oil manufacturing, is treated by the Faculty of Biology and the Institute of Chemistry in order to isolate bioactive essences and produce active coal. These components are being used in the manufacture of an innovative facial cleansing product. The manufacture and health certification of at least 50 bio-cosmetic products is expected with this method. The team has already investigated the market and signed Memorandums of Understanding with five companies interested for market placement of the examined product. The solution contributes to reducing waste, and consequently protecting the environment and human health.

Production of chitin and chitin nanopaper from secondary products from organic oyster mushroom farming



Lead implementing partner:
Ekofungi Ltd.,
Padinska Skela

The company has a wealth of experience in implementing innovative ideas in processing various secondary products for the purpose of growing mushrooms. The solution provides for separating chitin from various materials left over from the process of growing oyster mushrooms, by a special technological procedure. Chitin can be used in many ways, and one of them is to manufacture nanopaper - one form of biodegradable plastic, an environmentally friendly alternative to standard,non-degradable single-use plastic. Nanopaper is expected to be applied in the food packaging industry, electronic chips and medical device manufacturing. The idea is to protect the nanopaper manufacturing process by appropriate patents in both the EU and Serbia.

From biowaste to protein treasure

Lead implementing partner:
MDM Solutions Ltd.,
Sremska Mitrovica

This solution involves starting a pilot biowaste treatment facility to grow black soldier fly larvae. They can speed up composting and tackle the problem of organic waste. When harvested, these larvae provide a high-quality protein source for animal nutrition, while organic manure produced from their waste is also sold, contributing to closing the loop of the circular economy. Insects can also address food insecurity: considering the rising cost of animal protein and increasing food insecurity, the introduction and consumption of edible insects could present a sustainable alternative. The current Novel Food Regulation, applicable in EU since 2018, explicitly considers whole insects as novel foods, healthy and safe for humans. Not only can insects provide a key source of nutrients, but their production also has less environmental impact compared to conventional livestock farming. The facility in Čenej, on a site owned by the “Eko Sanit” company that has managed organic waste since 1992.

Biowaste management model as a basis for the development of the principles of circular economy and energy efficiency

Lead implementing partner:
Voćar Bogosavac Cooperative, Bogosavac

The “Voćar Bogosavac” agricultural cooperative collaborates with “Profi Agrar” cooperative and “Natura Balcanica” from Dobrić on collecting agricultural waste from farms. They use this bio-waste for microorganism-assisted composting, with the aim of generating high-value organic fertilizer. Box pallets were procured to facilitate the transportation of waste and compost, and the network of households involved in the process was expanded as well. The solution also includes installing solar panels that will cover at least 20% of the “Voćar” Cooperative’s electricity needs during the season.

Transition of sewage sludge into compost

Lead implementing partner:
Subotica Regional Landfill, Subotica

This solution deals with the issue of managing large quantities of waste sludge generated in Serbia through wastewater treatment. The opportunities of utilising waste sludge in composting and its applications in crop production are researched and tested in cooperation with the Novi Sad Institute of Field and Vegetable Crops. The investigation includes monitoring the composting process, setting up a year-long experiment with the application of the obtained compost product, as well as analysing the produced compost, treated soil, and the obtained yield of the crop variety grown for this purpose.The project also includes the development of a study with recommendations for using compost in agricultural production in line with the fundamental principles of protecting the environment and human health. This solution also serves as a test-bed for implementation of recently adopted regulation regarding end-of-waste status registration for compost.

At the source of the possible (city and village)

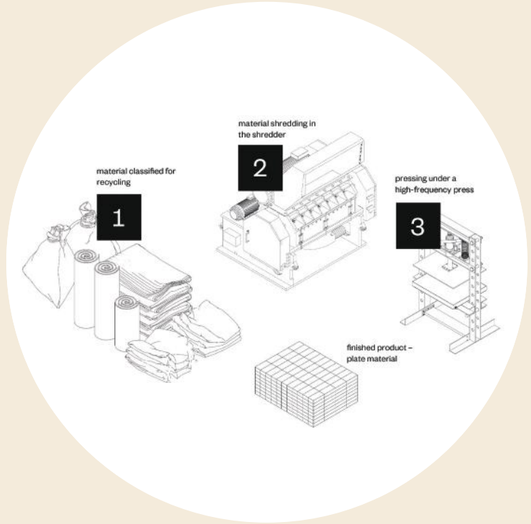
Implementing partner:
“Gralo” Ltd.,
Divci

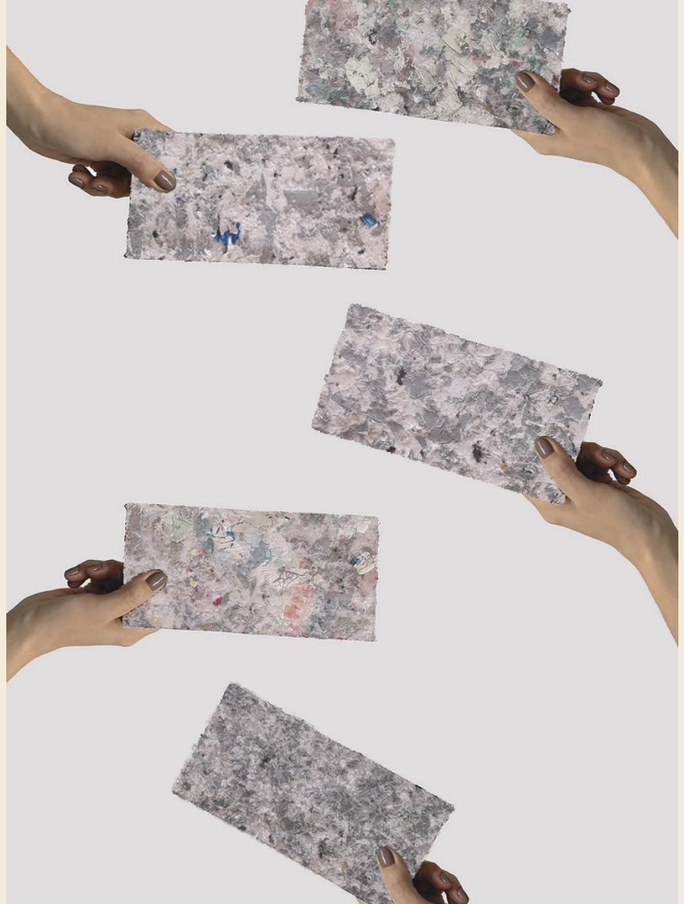
“Gralo" is an innovative agricultural holding model organised according to the principles of circular economy. It installed a wastewater treatment plant for treating wastewater discharged from its accommodation capacities, and the recycled water is used to water the green areas within the complex and the ‘energy willows’ - incredibly fast-growing shrubs and bushes, whose regular cutting can provide a sizable quantity of biomass. Biomass obtained from energy willows in the form of woodchips is used to produce pellets that in turn heat greenhouses and hotbeds, reducing this rural household’s dependence on external power sources. The estate’s hotbeds grow vegetables, with irrigation from a well and fertilisation with locally generated manure and compost made of the estate’s biowaste.

Water purification after recycling of waste lead batteries and lead from secondary sources

Lead implementing partner:
“EcoMet” Recycling Ltd., Kragujevac

This company deals with manufacturing refined and alloyed led from old automobile batteries and waste material. Their solution involves the construction of a wastewater treatment facility that employs an innovative technology to enable the reuse of water and use of sludge for further led extraction. This in turn has a positive impact on the environment, through eliminating the risk of water pollution. Concurrently, it improves the company’s production and increase its led recycling capacities.





Retex - reuse of construction textiles

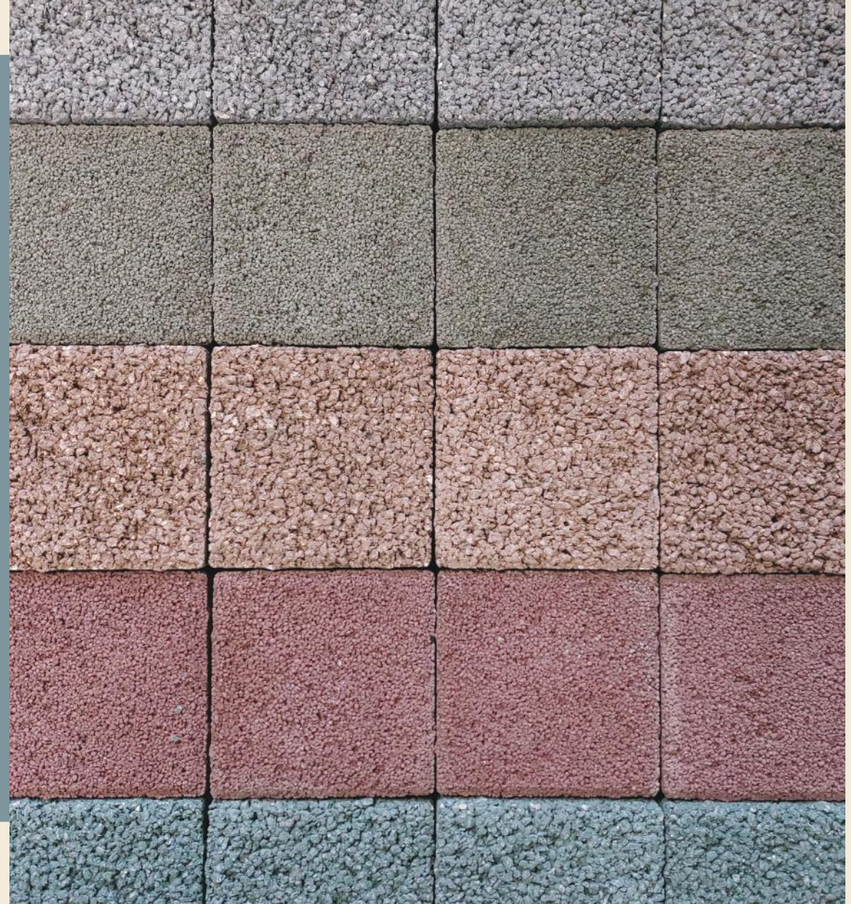
Lead implementing partner:
“ArTech inženjering” Ltd., Belgrade

This company “ArTech inženjering” joined forces with “Zona eksperimenta” company to use textile waste to manufacture ReTex - a novel construction material, suitable for interior design, new construction, etc. The innovation includes purchase of the equipment, production testing and patenting of the new material. Apart from a sufficient quantity of textile waste for continuous manufacturing, the company has already secured technical support of an Austrian scientific institute for further research and development of ReTex, as well as support from prospective clients. With its efficient use of resources, this solution brings waste and pollution reduction.

Construction materials from reused textiles, plastic and rubber

Lead implementing partner:
“Euromiteks” Ltd.,
Niš

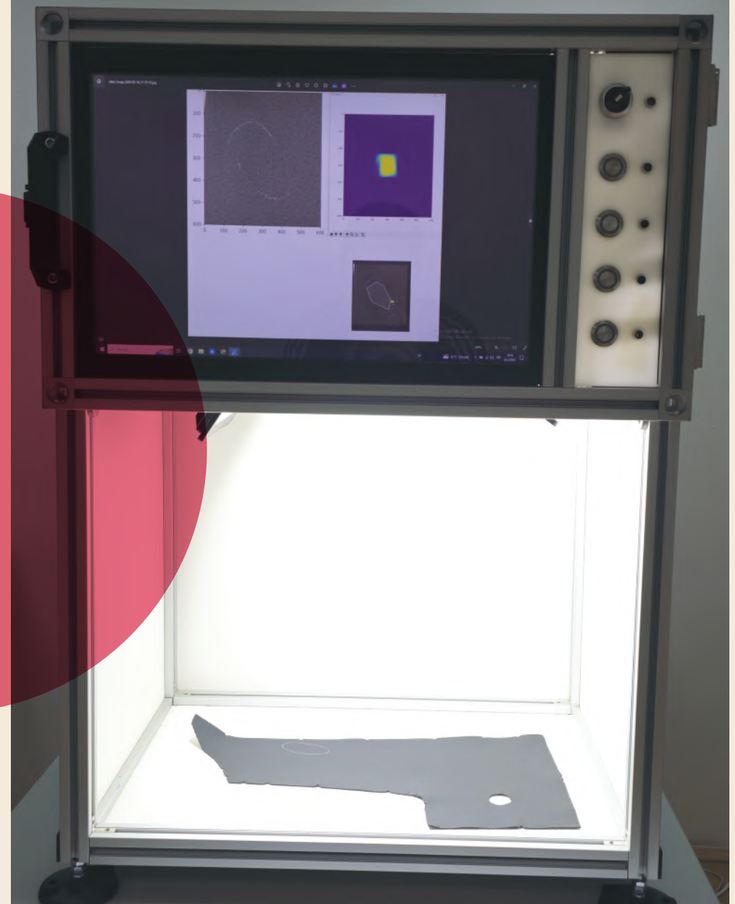
For its raw material, this innovation uses ingredients that are hard to recycle - textile, rubber and plastic - to manufacture construction blocks. Apart from these recycled materials, the blocks include water, sand and additives - with close professional scrutiny of the manufacturing process. As opposed to ordinary construction blocks, these blocks are manufactured in an environmentally friendly process, using a special machine that was purchased thanks to financial support. The new blocks are expected to have a longer lifespan, better insulation properties, higher durability and a lower price than the available construction blocks.



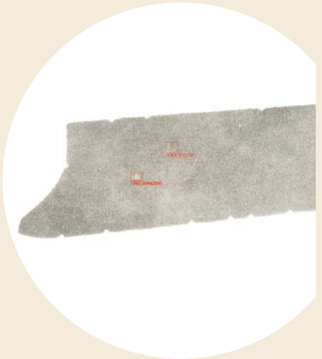
Zero-waste porous pavement alternatives for flood resilient cities

Lead implementing partner:
”Promobet” Ltd.,
Mladenovac

Large quantities of ashes made of burning coal are generated in thermal power plants. The waste ash pollutes the environment and presents a risk to public health. “Promobet” uses this ash as raw material for manufacturing porous concrete slabs the ash will replace some of the cement. The slabs will be used to pave parking lots and gravel paths, and to protect against flooding occurring in urban environments because of heavy rain. This innovation, based on circular economy principles, could have a broad application in the construction industry.



Improving the utilization of industrially processed animal leather through the application of artificial intelligence



Lead implementing partner:
“DigitaLLeather” Ltd, Kragujevac

“DigitaLLeather” develops software and hardware to improve leather goods manufacturing; it automates discovering flaws in the leather with the aid of artificial intelligence, i.e. a machine learning system. This solution enables a more precise and efficient discovery of flaws, which will enhances the usability of the leather. This in turn leads to a reduction of industrial waste and improve working conditions in production lines. The solution was conceived for the automobile industry, but it has potential for application in other industries as well.

Recycling of fractions obtained from the treatment of automotive waste

Lead implementing partner:
”Steel Impex” LLC,
Novi Sad

This innovation sets up an air filtration system within an automobile waste recycling line, and therefore enhances this waste management system. Owing to the procurement of necessary equipment, the separation of various metal and non-ferrous metal fractions was enabled within the recycling plant in Krnješevci, which created conditions for recycling 80-90% of a signle vehicle in Serbia, rather than abroad, as was the case thus far. This will create 99.99% pure granulate that will be placed to local foundries. In addition, an analysis of the existing situation in automobile waste management is being developed with recommendations for further improvements in the field.

Circular vouchers

In 2023, supported by the GEF, the Ministry of Environmental Protection and the UNDP gave financial awards in the amount of USD 130,000 to the authors of 13 best innovative solutions for a faster transition to a circular economy.

The support went to research institutions which collaborate with private and public enterprises. Their innovations contribute to a more efficient use of resources and energy, better waste management, and hence a reduction in GHG emissions.

Each innovation, born in collaboration between science and economy, received the 'circular voucher', worth USD 10,000. Among these innovations are solutions to recycle waste glass, styrofoam and fly ash into materials suitable for the construction industry, as well as processes to convert vegetable and fruit waste into new raw materials, such as food coloring or innovative packaging.

A new clean green path from bio-waste to bioactive treasure

01

Scientific-research organisation:
The Faculty of Technology and Metallurgy of the University of Belgrade

Company:
BeoFlos Ltd.

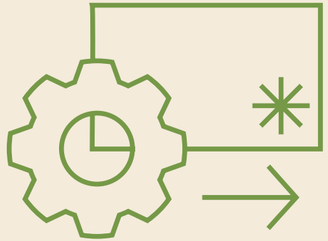
This team treats biowaste from Frankincense resin, tomato fruit from mashing, and a cold press by-product of rosehip seeds, by a new technology - advanced supercritical extraction (SCE) - to obtain new bioactive components used in natural medicine and as supplements in the diet. The initiative leads to bio-waste lifetime extension by cascading use, carbon fixation, resources and energy savings and reduction of waste and pollution. The initiative envisages lab-scaled proof of concept, obtaining SCE extracts and optimization of technological parameters, extraction, and isolation of components from these extracts, qualitative & quantitative determination of the obtained compounds and optimal production parameters.

Development of technology for the production of composite materials based on waste glass

02

Scientific-research organisation:
The Faculty of Technical Sciences Čačak, University of Kragujevac

Company:
Fragment Incorporated Ltd.



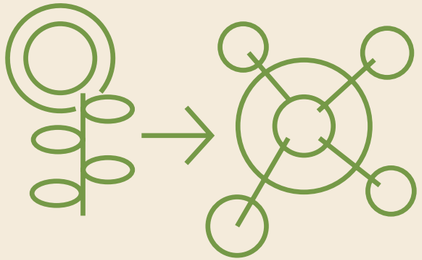
This team uses waste glass (up to 75% of the mass, in combination with cement) to produce the panel materials used in interior design (kitchen countertops, work surfaces, bars, bathroom elements, etc.). Fragment panels are already produced from "clean" waste glass (from windows, beer or juices industry), but there is a much larger amount of "dirty" waste glass, which is currently not used, since impurities significantly decreases the mechanical characteristics of the product. The aim of the project is to develop a technology that enables the use of "dirty" waste glass, in a combination with specific additives and a simple treatment process. This would recycle more than 450 t of waste glass in the next 3 years and drastically reduce the use of polymer composites obtained from oil or natural stone, while maintaining the cost-effectiveness and profitability of the process. At the end of their life cycle, the panel materials can be used as foundation for road construction.

Hydrochar production from fruit processing waste

03

Scientific-research organisation:
The Faculty of Technology of the University of Niš

Company:
Fruvita Ltd.



This team develops an environmental and techno-economic simulation model of the fruit processing waste to obtain hydrochar and process water as a valuable by-product - by hydrothermal carbonization process. The model allows virtual testing without the need for physical prototyping. As a result, a feasibility study of the fruit processing waste hydrothermal carbonization at an industrial scale is being developed. The simulation model has experimental input values for the chemical composition, quantities, and availability of fruit processing waste, while the output parameters includes the quantity of hydrochar produced, process water, total capital investment, profit, and environmental footprint of the process. Hydrochar can be used as a bio-energy source, absorbent, or solid fertilize

Valorization of natural pigments from fruit and vegetable waste isolated using green extraction

04

Scientific-research organisation:
The Faculty of Chemistry of the University of Belgrade

Company:
Mandarina Cake Shop Ltd.

This team tests production of food colours for ice cream, through the green extraction of high-quality, stable, functional, 100% natural, and safe pigments from fruits and vegetable waste. The process uses environmentally friendly solvents such as natural eutectic mixtures which contain buffered vitamin C. The obtained extracts are being examined in detail to determine the chemical composition, antioxidant activity, and stability. The residue after extraction will be chemically characterized and composted to obtain an effective fertilizer for garden plants. Colours from fruits and vegetables waste can replace over 50% of synthetic colours currently used in the food industry, preventing approx. 70% of food waste from landfilling (and biowaste makes 40% of waste in Serbia), thus significantly reducing greenhouse gas emissions.

New sustainable materials based on natural raw materials

05

Scientific-research organisation:
The Innovation Center of the Faculty of Technology and Metallurgy in Belgrade

Company:
Jekom Ltd.

This team uses new, green methods for treatment of waste biomass and polymer waste, such as PET packaging, for the production of composites, as well as new biodegradable epoxy (EA) and polyurethane (PU) adhesives (glues) for use in industry and construction, e.g., for wood, aluminum and engineering wood product. Those products have improved mechanical and fire-resistant properties, and the initiative will reduce dependence on fossil resources, by developing new green methods for isolating and modifying raw materials from waste.

Application of waste from fruit processing to obtain high-value pectin-based products

06

Scientific-research organisation:
The Faculty of Technology of the University of Novi Sad

Company:
Essalk Ltd.

This team treats fruit waste in an innovative way – by extracting biopolymer pectin from the peel of the processed waste fruits, using a simple extraction procedure in an acidic environment. This biopolymer is being used to produce biosurfactants capable to replace conventional synthetic surfactants, but also edible active coatings, which should replace conventional plastic and extend the shelf life of new fruits and vegetables. In this way, the initiative solution will contribute to the reduction of food waste and its negative effects on the environment, as discarded fruit and vegetable parts contribute to the emission of GHG in the proportion of 8 to 10% every year.

Tradition and innovation towards circular agriculture

07

Scientific-research organisation:
Institute Mihajlo Pupin Belgrade

Company:
Biofrost Bioplastics Ltd.

This team have designed a new system for seedling production and planting, integrating an innovative planting system with precise soil dosing into biodegradable seedling pots. Seed preparation and planting to fully developed seedlings (ready for transplantation) is being automated using artificial intelligence and robotics. Eco-designed biodegradable pots from waste material are being directly planted into the soil, enriching it further and nourishing the plants during their natural decomposition. Such process reduces steps during planting, optimize and simplify the work, reduce cost and lower plants' stress while transplanting and retain moisture. The initiative results in accelerating the production process from several tens of minutes per product to producing 3 products in one minute, simultaneously eliminating a negative carbon footprint of 5.8 tons of CO2eq per year for every ton of production.

The potential of fungi produced in serbia for obtaining quality chitin and chitosan

08

Scientific-research organisation:
The Institute for Multidisciplinary Research (IMSI) of the University of Belgrade

Company:
Ekofungi Ltd.

This team examines the potential of using fungi cultivated in Serbia, to obtain chitin and chitosan. The technological process applies a combination of heating and alkali extraction, while further alkali deacetylation of chitin will produce chitosan. Application of chitin and chitosan as alternative materials in medicine, environmental protection, agriculture, and food industry (as packaging - as an alternative to plastics) is continuously increasing. This initiative aims to prove the concept that fungi are a good, viable, affordable, and natural source of chitin and chitosan, with properties compatible or improved in relation to the properties of currently available commercial products. Further education through workshops and lectures to motivate other fungi producers to such innovation is planned.

Use of waste expanded polystyrene and fly ash in the production of lightweight concrete blocks

09

Scientific-research organisation:
The Faculty of Engineering of the University of Kragujevac

Company:
Dorado Ltd.

This team proposes a sustainable solution for recycling expanded polystyrene (EPS), namely Styrofoam, and fly ash, through production of new composite materials with those waste materials as aggregates in light concrete blocks. To initiate the serial production of the new material, it is necessary to test the optimal proportions of secondary raw materials in its' composition, as well as the appropriate physical, mechanical and thermal characteristics of the newly developed "green" material at the Center for Engineering Software and Dynamic Testing and the Laboratory for Energy and Process Engineering at the Faculty of Engineering, University of Kragujevac. In addition to experimental research, an economic analysis of the production of the new product is being conducted, for confirming the investment viability.

Application of geographic information systems to identify sites suitable for the use of biofertilizers

10

Scientific-research organisation:
The Faculty of Geography of the University of Belgrade

Company:
BioCombact Ltd.

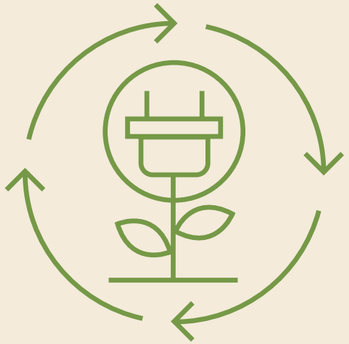
This team uses geographic information systems (GIS) to analyze three districts in Serbia (Kolubara, Šumadija and Podunavlje) in order to identify the areas that are most suitable for the application of innovative microbial-organic biofertilizers. The data in the form of a 50-page study with 6 maps ("overlapping" physical and social geographic features and open data), will show the most suitable areas for the application of biofertilizers, and the areas where it will be optimal to place composters, to test the commercial application of this fertilizer and to develop new variants of biofertilizers for other crops, with the aim of reducing or eliminating the use of agrochemicals.

Physico-chemical characterization of insulating plastic and possibilities of its use - circular approach to cable recycling

11

Scientific-research organisation:
Institute of General and Physical Chemistry

Company:
Connect Clean Roma Group



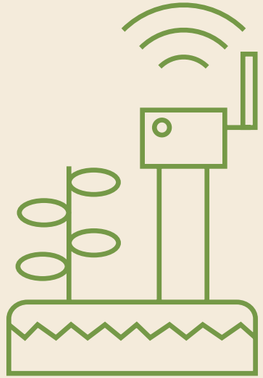
This team examines the characteristics of the insulating plastic obtained in the recycling of cables, to enable reuse of certain polymers. Research will include infrared (IR) spectroscopy, differential scanning calorimetry (DSC) and thermo-gravimetric analysis (TGA), to assess linear polymers in the total amount of insulating plastic generated during recycling and identify the individual types of polymers for reuse. Possibility for polymers further utilization will be suggested, with prediction of profitability of the investment in terms the equipment needed. Clear recommendations will be given regarding the reuse of linear and cross-linked polymers in the production of re-granulates or construction materials, respectively, which is expected to contribute to prevention of air pollution in Serbia caused by burning old cables.

Circular economy for smart manufacturing and use of wearable sensors

12

Scientific-research organisation:
The Institute of Chemistry, Technology and Metallurgy of the University of Belgrade

Company:
Flexisense Ltd.



This team creates a plan for the production and distribution of wearable devices, using the example of a wearable breathing sensor, which is in the prototype phase developed by Flexisense. The initiative creates guidelines for the application of circular economy principles when developing prototypes to final products of wearable devices, which can have a major impact on reducing e-waste on the wearables market. Considering that by 2030 it is expected that 65% of the world's population will use some kind of wearable device, the market for wearable devices will grow exponentially, and the amount of electronic waste is expected to exceed 50 million tons annually. The expected result of this initiative is an extension of the lifetime of the product by up to 70%, and the use of bioplastic and thermoplastic materials, which will result in a reduction of carbon dioxide emissions by up to 50%.

Climate changes mitigation by the moss carbon sequestration - greening and revitalization of degraded surface and communal waste landfill by mosses

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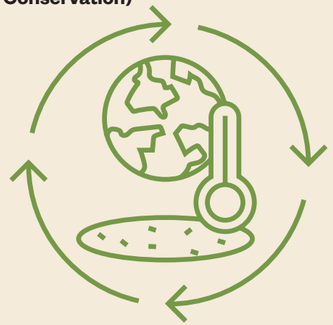
Scientific-research organisation:
The Faculty of Biology of the University of Belgrade (Center for Biotechnology and Plant Conservation)

Company:
PUC "Gradska čistoća"



This team uses waste elements which are side products in many industrial processes, as a wet anchoring grounds for moss settlements. The carpets of such material, overgrown with mosses, spread over devastated area, places where partial share of carbon dioxide is higher due to high decomposition rate. Mosses attach the carbon dioxide producing biomass, cleaning the air, and greening the areas in landfills, where partial share of carbon dioxide presence is rather high due to decomposition of waste. This slows down climate change trough processes of carbon sink/ carbon sequestration. Greening with mosses turns harsh environment to bio-bed, enabling other organisms' settlement. The primary focus of the project is on closed cassettes of communal waste.

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