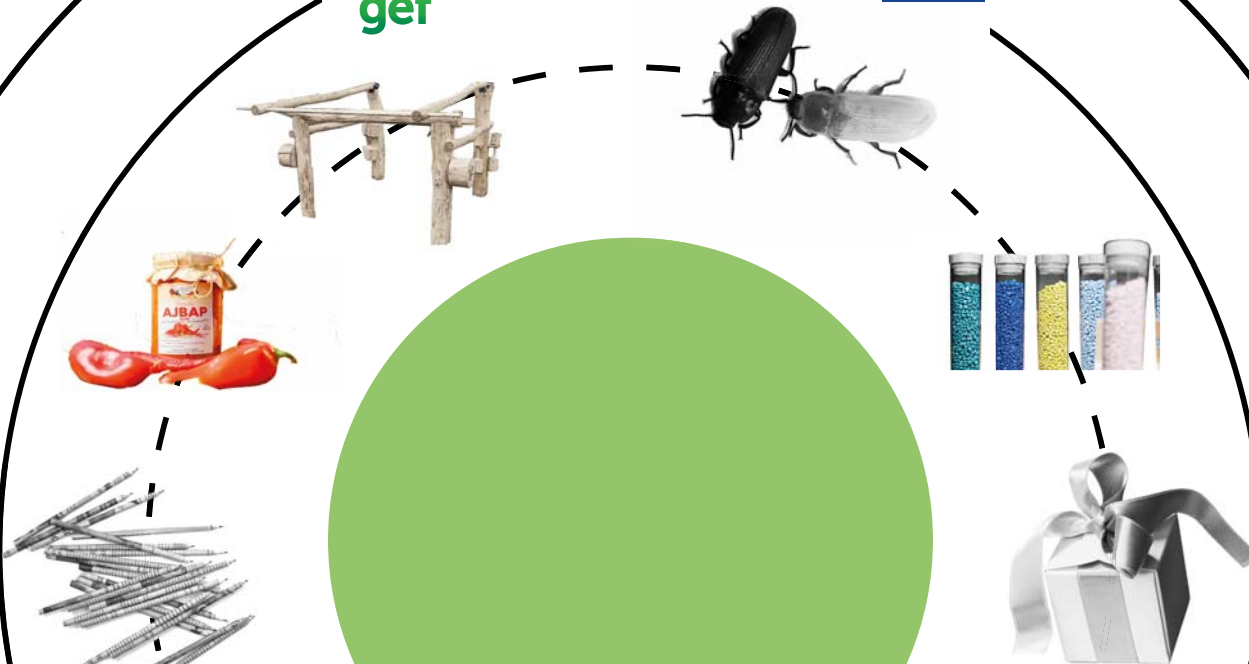




Republic of Serbia
Ministry of
Environmental Protection



CIRCULAR ECONOMY IN SERBIA

INNOVATIVE /
PROJECTS /
AND BUSINESS
MODELS
2022-2023



CIRCULAR ECONOMY IN SERBIA

INOVATIVE
PROJECTS
AND BUSINESS
MODELS
2022-2023

INNOVATIVE SOLUTIONS FOR THE CIRCULAR ECONOMY

To encourage and accelerate the development of solutions and business models that will reduce greenhouse gas (GHG) emissions via circular economy practice, the **United Nations Development Program (UNDP) in Serbia**, together with the **Ministry of Environmental Protection of the Republic of Serbia** and partners, launched two projects in 2022. These projects resulted in **16 award-winning innovative circular solutions** and **12 awarded circular vouchers for cooperation between academia and businesses** in less than a year.



The project “EU for Green Agenda in Serbia”, with the technical and financial support of the European Union and in partnership with the Ministry of Environmental Protection, is implemented by UNDP in cooperation with the Embassy of Sweden and the European Investment Bank (EIB), with additional funding from the Governments of Sweden, Switzerland, and Serbia.



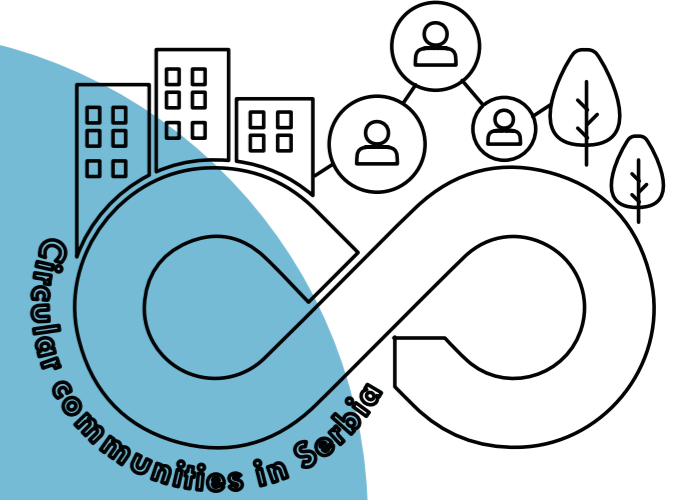
The Green Agenda for the Western Balkans is the growth strategy for the region, aiming to tackle the challenges of climate change and green transition and assist the Western Balkan countries to align environmental regulations with the European Acquis. The Green Agenda for the Western Balkans is based on the European Green Deal and the Economic and Investment Plan for the region. The objective of the project is to contribute to the efficient, inclusive, and sustainable implementation of the Green Agenda for the Western Balkans and its Action Plan, by building broad engagement and societal participation through policy support and capacity building, piloting actions to support the green transition and scaling up successful investments.



In 2022, a Challenge Call that sought innovative circular economy projects was launched, and it attracted 36 applicants. After acceleration and careful consideration by the UNDP team, Ministry of Environmental Protection, and external experts, **6 pilot projects were selected for co-financing of 265,000 USD**. These solutions reuse old newspapers as new material for graphite pencils and crayons instead of wood or plastic, bio-waste for natural cosmetic products, non-hazardous plastic and metal waste, wooden waste along the Sava River for the production of training equipment for eco-gym, using larvae of the insect Tenebrio Molitor to biodegrade plastic and biological waste while producing high protein food for pigs, and producing new biodegradable material BioSol from the remains of fruit and vegetables to be used as a substitute for plastic in the production of oils, bags, cups, etc.



The second project is implemented with financial support of the Global Environment Facility (GEF): “Reducing the carbon footprint of local communities by applying the principles of the circular economy in the Republic of Serbia – Circular Communities”, which enabled the development of circular, innovative, and cost-effective businesses and technical solutions that will reduce GHG emissions in local communities by applying the principles of circular economy. These solutions also bring other social, economic, and environmental benefits for the community and its citizens. The creators of innovative ideas are local self-governments and public utility companies, business entities and civil society organizations registered in the Republic of Serbia.



Upon the conducted Challenge Call, the expert jury selected the best 30 innovative ideas, which received mentoring and expert support through the Circular Economy Accelerator, so they could develop into mature projects and manage to obtain the financial resources necessary for their implementation in practice. **The best ten innovations received financial support of 783,000 USD for realization in 2023.** These solutions save energy by using innovative technologies, produce energy from bio-waste, use bio-waste for composting, use waste alcalis and acids for fertilizer production, reuse textiles, paper, cardboard, and cigarette packs, and substitute consumption of raw materials for new production.

Those innovative initiatives clearly demonstrate that a wide range of actors in Serbia recognize the importance of saving natural resources and energy, reusing and recycling products, and reducing the amount of waste. These circular solutions will speed up the green transformation of Serbian economy and society, improving the quality of the environment for the benefit of all citizens.



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ORGANIC
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AGAINST
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INDUSTRIAL
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- INNOVATIVE STRATEGY FOR
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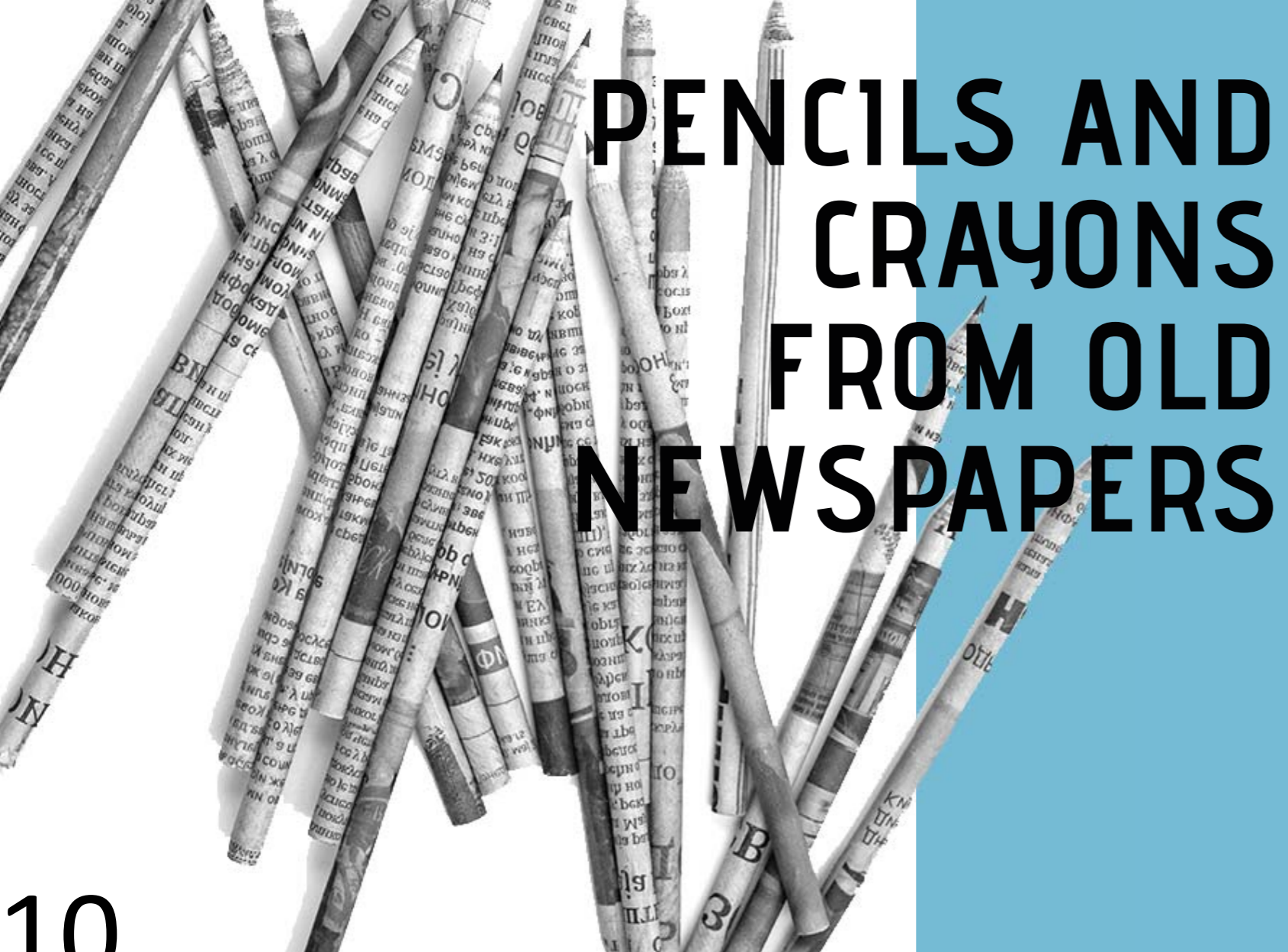
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PHASE II



PENCILS AND CRAYONS FROM OLD NEWSPAPERS

**IMPLEMENTING PARTNER:
NEWPEN D.O.O. SMEDEREVSKA PALANKA**

PROJECT DESCRIPTION

The company NewPen aims to help to protect the environment by manufacturing graphite pencils and crayons made from old, recycled or unread newspapers. This decreases the need for wood or plastic additives. The project will support the production by acquisition of two new, customized machines, which will allow NewPen company to triple its' production and export it to European market.

NewPen is the first company in Serbia, as well as in Europe, which produces graphite pencils and crayons made from old newspapers, instead of wood or plastic, thus they preserve trees and protect the environment. Moreover, educational component of the project is important, since NewPen organizes awareness-raising workshops for children.

INNOVATIVE ACTIVITY

**IMPLEMENTING PARTNER:
EKO BIO INVEST D.O.O. BELGRADE**

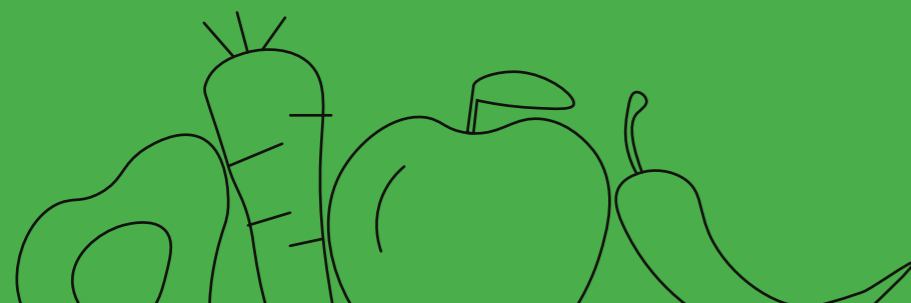
PROJECT DESCRIPTION

This solution will use EU patented process to test production of biodegradable and certified non-toxic granules from remains of fruit and vegetables from Čačak potato chips factory and centralized kitchens. Foils, bags, cups, etc. would be produced from new material - BioSol, with bio, organic origin and fully soluble (in hot water within less than a minute, and in cold or in/on the ground in the period from 25 days to 6 months), thus presenting a solution to flexible, single-use plastics. The project will support purchase of equipment, raw material testing, first batch of final products (50 kg of foils and 20 kg of cups) and signature of the first commercial contracts.

BioSol water-soluble articles are protected by the EU patent No 20306069.4, and obtained the „OK compost home“ certificate, which will be renewed through this initiative.

INNOVATIVE ACTIVITY

ORGANIC WASTE OF ČAČAK AGAINST TOXICITY



BIODEGRADATION OF PLASTIC - ESTABLISHING AN INCUBATOR CENTER - PHASE 1

IMPLEMENTING PARTNER:
BELINDA ANIMALS D.O.O. BELGRADE

PROJECT DESCRIPTION

Belinda Animals' goal is to construct the Incubation Center for cultivation of the brood mother of *Tenebrio molitor* (TeM) larvae. This specific type of larvae is able to biodegrade certain types of plastic, in particular polystyrene (Styrofoam).

By dissolving it, TeM produces a protein-rich substance that could be used as animal feed, primarily for pigs, or as a land fertilizer. The project includes procurement of 10 air-conditioned chambers for rearing larvae, vibro sifter sieve, automated system for breeding process monitoring, *Tenebrio molitor* initial genetic material and substrate for larvae nutrition.



Use of *Tenebrio molitor* larvae for biodegradation of plastic is innovative on a global scale. Although experiments are conducted worldwide, this is the first time that this method for reprocessing plastic waste will be used in the region.

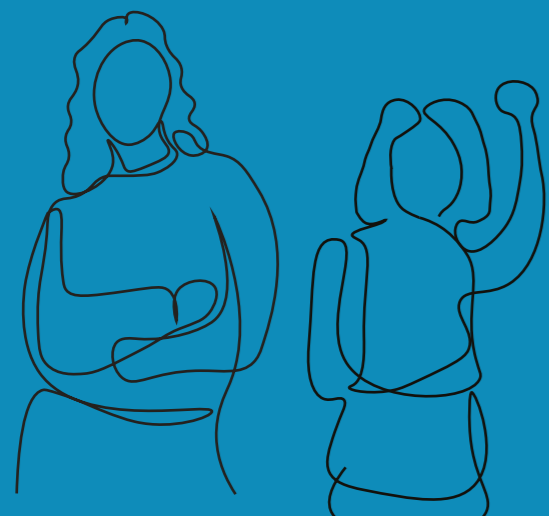
INNOVATIVE ACTIVITY

LEAD PARTNER:
JELENA MILETIĆ, ENTREPRENEUR PROCESSING,
CANNING AND TRADING FRUITS AND VEGETABLES

PROJECT DESCRIPTION

Overall goals of the project is **empowerment of women in the rural farms of southeastern Serbia**, processing paprika into the famous Serbian delicacy ajvar, through reuse of bio-waste for creation of natural cosmetic products. This will be achieved by forming a Network of Industrial Symbiosis of Social Entrepreneurs of Serbia (MISS), by paprika processors from Medveđa and Social Franchise Bio Idea.

This project will reuse parts of paprika such as stalk, leaves and heart with seeds, by drying them and making high quality powder to be used for bio-masks and soaps. The project envisages equipment purchase, training of 100 women, production of 1000 soaps and 500 face masks, and launch of an online platform.



The project applies industrial symbiosis through safe and innovative use of bio-waste by turning it into a high-value product.

INNOVATIVE ACTIVITY

INDUSTRIAL SYMBIOSIS - INNOVATIVE STRATEGY FOR SUSTAINABILITY OF WOMEN SOCIAL ENTREPRENEURSHIP



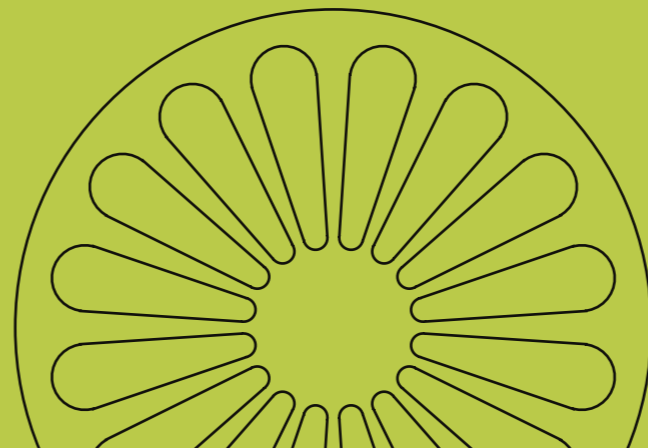


RECYCLING OF PLASTIC AND METAL WASTE – PHASE II

**IMPLEMENTING PARTNER:
CONNECT CLEAN ROMA GROUP**

PROJECT DESCRIPTION

The aim of this initiative is appropriate reuse of non-hazardous plastic and metal waste from old cables and small electronic household appliances, and consequently significant air-quality improvement, by reduction of dioxins and furans. Plastic, rubber, copper, brass and aluminum from waste will be reused for the purpose of producing high purity granules. The project will also focus on improving the socio-economic position of the Roma community.



The project establishes a form of social entrepreneurship through ecological cooperative, providing official employment for individual informal Roma waste collectors through cooperation agreements.

INNOVATIVE ACTIVITY

IMPLEMENTING PARTNER:
NGO CENTRE FOR DEVELOPMENT OF YOUTH ENTREPRENEURSHIP

PROJECT DESCRIPTION

The project envisages the **collection of wooden pieces from the Sava River drift and production of training equipment**, their assembly, standardization and installation of an eco-gym in the allocated park space in the municipality of Vršac. Project team has already realized the test production of a prototype (one piece of training equipment) and passed the standardization process. The project will support **complete production and certification of 12 pieces of training equipment**, production of boards with instructions and mulch for covering the field, transport, installation and promotion actions.

The project reduces accumulation of wooden waste along the Sava River bank and its' negative impact on water, air and soil. Life cycle of saved wood is extended with **reusing, natural resources are preserved because no trees are cut down and project carbon footprint is reduced, compared with alternative steel gym production.**

INNOVATIVE ACTIVITY

ECO-GYM



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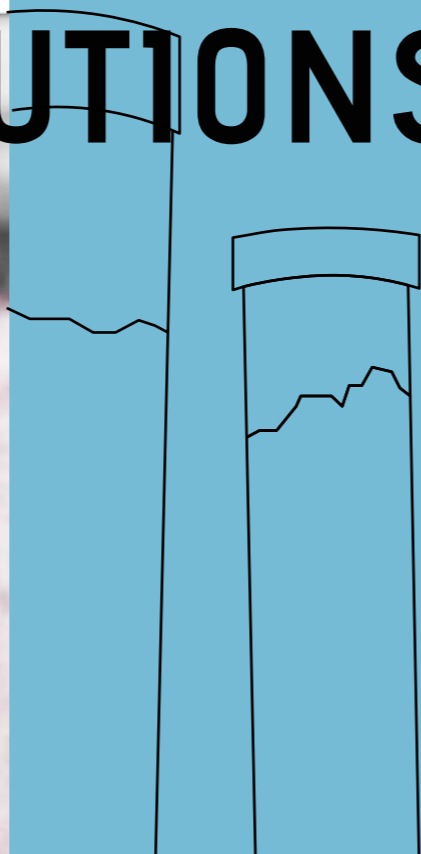
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FRUIT WASTE FOR
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DECREASE OF POLLUTANTS
AND GHG EMISSIONS
BY INSTALLATION OF
A NEW BOILER ROOM

REUSE OF WASTE ALKALI AND ACID SOLUTIONS



**IMPLEMENTING PARTNER:
ELIXIR ZORKA - MINERALNA ĐUBRIVA LTD. ŠABAC**

PROJECT DESCRIPTION

The project idea contributes to the management of hazardous waste, with the innovative use of waste alkali and acid solutions in the production process of fertilizers. The importance of this project is reflected in the fact that the Republic of Serbia does not have a facility for the treatment of hazardous waste, nor a facility for the storage of special streams of industrial waste, such as solvents, waste oils, alkali and acid solutions.

A certain amount of scrubbing liquid will be replaced by solutions of waste alkali and acids, in the amount of 40,000 tons per year. It is expected that this project will affect the reduction of demand and production of hydrochloric, phosphoric and sulfuric acid, as well as ammonia water, which is estimated to lead to annual saving of 148,679 tons of CO₂ equivalent.

PROJECT DESCRIPTION

**IMPLEMENTING PARTNER:
MIVAKA LTD. BELGRADE**

PROJECT DESCRIPTION

The initial component of this innovation improves primary livestock production and establishes the necessary circumstances for subsequent effective manure processing into high-quality solid organic fertilizer. The first segment's carrier is the "Terra bedding" mat used in livestock farming for animal growing, fattening, and exploitation. The second section describes how the manure is completely transformed into a solid organic fertilizer called "Toro chick" without the use of any additives and with the least amount of manipulation operations.



This two-segment innovative solution is based on the circularity of the sectors of agriculture and fertilizer production by converting non-hazardous organic waste from farms into a raw material suitable for further processing. The support provided will improve the transportation system of the chicken farm and composting site in Čenej, by installing the belt conveyer, which will increase the production of the final product by 12% and reduce the use of fossil fuels by 11%. The estimated carbon footprint reduction will be 6,500 tons of CO₂ equivalent per year. This innovation is co-financed by 79,000 US \$.

PROJECT DESCRIPTION

GREEN SUPPLY CHAIN MANAGEMENT



INCIRCULATE WITH COMPOST



**IMPLEMENTING PARTNER:
PUC "GRADSKO ZELENILO", NOVI SAD**

PROJECT DESCRIPTION

The innovative concept is centered on the facility for the treatment of green waste, the construction of the tank for the collection of leachate and pipelines for the recirculation of technical water, and increase of the compost field's capacity. These activities will help manage bio-waste, lower GHG emissions, and increase financial savings on waste disposal and water usage. As opposed to now being disposed of in an unsanitary landfill, Novi Sad's green waste from public areas will be used in a facility for the production of compost. This will help to maintain the city's greenery while saving financial resources that would otherwise be spent on fertilizer purchases. Separate collection of green and garden waste from households will be introduced gradually.



The existing compost field of 5,000 square meters will be expanded to 10,000 square meters. Wood chips, which PUC will use to heat its own building and a greenhouse with 3,000 square meters of flower-growing space, are another outcome of this solution. This approach will compost an estimated 5,000 tons of green waste annually. The solution is supported by 156,000 US \$.

PROJECT DESCRIPTION

**IMPLEMENTING PARTNER:
THE CITY MUNICIPALITY OF STARI GRAD, BELGRADE**

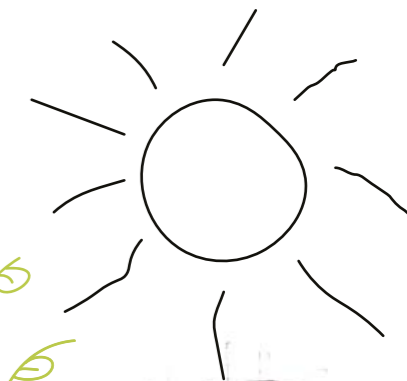
PROJECT DESCRIPTION

The project idea contributes to energy efficiency, pollution reduction, climate change adaptation, durability of materials, and an extended life cycle through the greening of school roofs in the City Municipality of Stari grad in Belgrade. The solution involves the construction and installation of the green roof on the terrace of the elementary school “Drinka Pavlović”, with high potential for replication on other school buildings across the city.

The construction of green roofs increases the percentage of greenery in the central urban municipality and reduces the runoff of storm water because greenery and soil absorb it. The roofs last longer because their exposure to high temperatures and water is reduced, and the insulation of the schools is also ensured. The return on investment is fast, and in addition to economic savings on energy consumption for cooling and heating, it includes the preservation of resources, protection of the environment, and reduction of the urban heat island effect. Finally, this green roof will have a **strong educational component and benefit**. This initiative is co-financed by 25,000 US \$.

PROJECT DESCRIPTION

GREEN ROOF OF MY SCHOOL



CIRCULAR 10T SYSTEMS AS TECHNOLOGICAL SOLUTIONS FOR FUTURE



IMPLEMENTING PARTNER:
BITGEAR WIRELESS DESIGN SERVICES LTD.

PROJECT DESCRIPTION

Internet-of-Things (IoT) modular, sensory devices for the digital transformation of business serve the users as tools for getting the necessary insight into the current situation in the field, which allows a decrease in operational costs with an increase in efficiency in areas such as waste management.

Through its own line of products, Bitgear places battery-powered telemetry and alarm IoT devices with low energy consumption that provide long-range wireless communication with quick and easy installation in the field. “IO-Guard” is a solution intended for surveillance of infrastructure in remote and temporary locations with no network coverage or internet connection (construction sites, industrial infrastructure, etc.). In order to overcome the problem of a potentially large number of false alarms, an “IO-Eye” device has been developed that provides verification through photography in the event of alarm detection. In its mode for periodic sending of photographs, the “IO-Eye” device can also be used for optimization of transportation of (recyclable) waste, which provides a significant decrease in expenses and diesel fuel combustion.

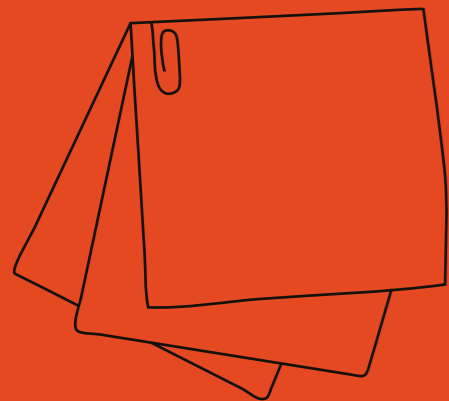
The devices in the IO-Elements series have a modular design, which allows repairs. The business model is based on selling an integral service: the lease of equipment and the use of software. The systems “IO-Guard” and “IO-Eye” will be piloted, tested and marketed. The support provided amounts to 37,000 US \$.

PROJECT DESCRIPTION

**IMPLEMENTING PARTNER:
DETO LTD. GRAPHICS COMPANY, PANČEVO**

PROJECT DESCRIPTION

This innovative idea contributes to solving the problem of the “**technical surplus of paper**” left **after printing**, due to the standardization of raw material formats and processing machines. This anomaly is responsible for losses in the approximate amount of 15-20% of raw materials (and often much more) through all stages of production, and in the last one, it is removed from the finished product and sent for recycling. This innovative solution, however, discovers a method to reuse that “**technical surplus of paper**” through the design, technical execution, and new paper products (mostly packaging) placed on the market by developing and launching a **web-shop platform**. The concept is that certain valuable items should be included and rescued from recycling on the margin of the paper or cardboard.



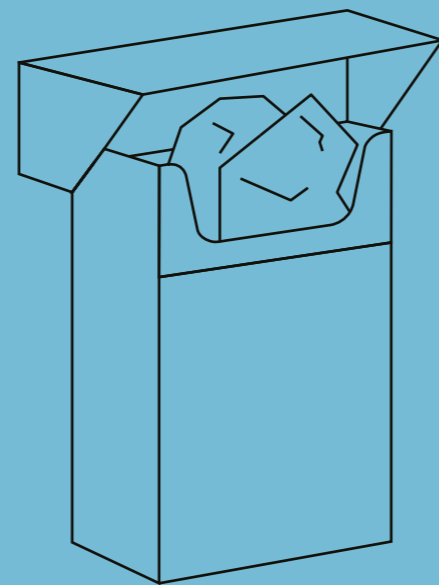
Because they were manufactured from waste at the expense of the items whose margin they were cut, **the pricing of these products would be much cheaper than in regular production** when they were finally launched. The provided support includes the **launch of the web-shop platform, the purchase of equipment, and the development of tools for new products**. The proposed solution is estimated to contribute to **reducing total CO₂ equivalent emissions of 4,140 tons per year**, but it also results in a **significant reduction in water consumption** (the critical resource in paper recycling), the need for logistics, transport, sorting, packaging, and processing, and forest conservation. This initiative is co-financed by 15,000 US \$.

PROJECT DESCRIPTION

KUTIJIJE.COM



FROM OLD TO NEW - PAPER RECYCLING



**IMPLEMENTING PARTNER:
ASSOCIATION FOR THE SUPPORT TO PEOPLE WITH
DEVELOPMENTAL DISABILITIES "NAŠA KUĆA"**

PROJECT DESCRIPTION

The project idea contributes to reducing the use of plastic and non-degradable packaging by making new products from empty cigarette packs and other waste paper and cardboard. It will contribute to the preservation of raw materials, save energy, and reduce the generation of waste through repeated use and recycling. Implementing the project idea, **employment conditions will be created for people with developmental disabilities.** Engaging them in the manual production of paper and cardboard products (using Japanese technology) can give them an opportunity to develop a higher degree of personal independence.

The solution introduces the **development of bio-additives** that will make the paper waterproof, recyclable, and biodegradable and the purchase of equipment for the manual and semi-automatic production of paper products from paper waste, including paper food delivery containers.

By organizing campaigns that would help raise the level of paper and cardboard collection, then developing a training program for working in the production of paper products with the establishment of cooperation with other organizations, it is expected that the **adopted approach will be upscaled to local communities across Serbia** and contribute to the inclusion of a larger number of people with developmental disabilities. The support provided amounts to 27,000 US \$.

PROJECT DESCRIPTION

IMPLEMENTING PARTNER: CITY OF NOVI PAZAR

PROJECT DESCRIPTION

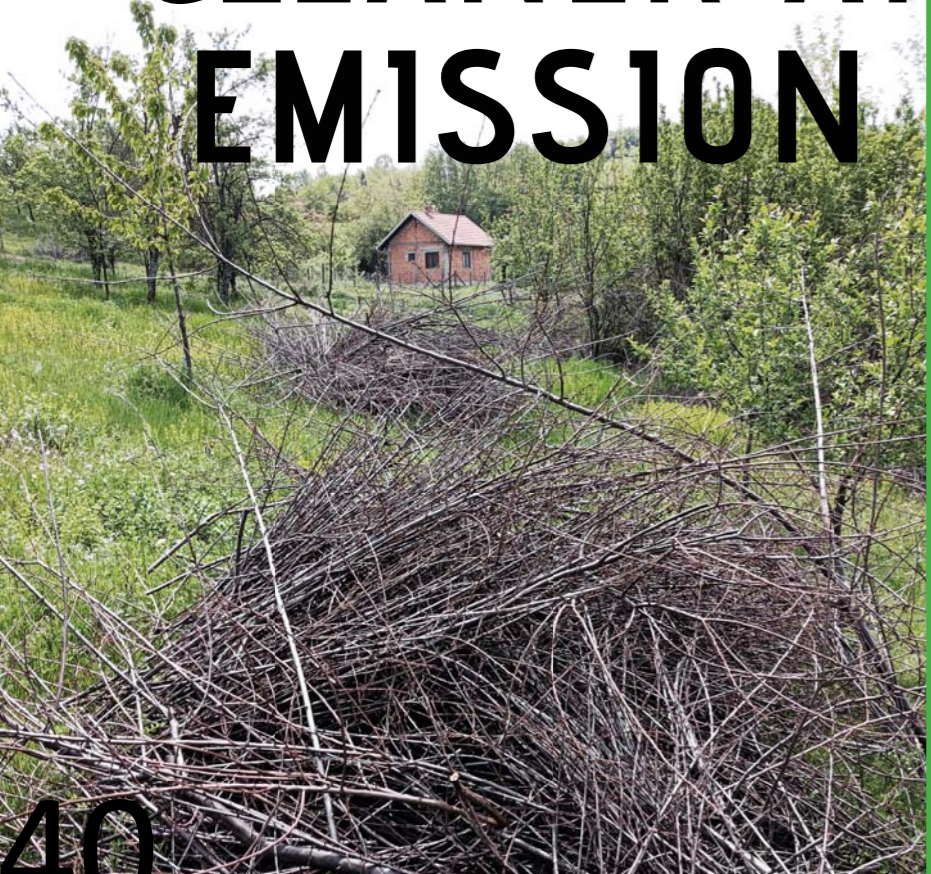
The city of Novi Pazar has been a textile center for several decades, with around 80 manufacturers of textile products operating on its territory, mainly producing denim. According to textile industry-related data, **1.5% of the total annual production is textile waste, which amounts to about 60 tons of this waste.** Currently, clothing manufacturers are obliged to hand over textile waste to authorized operators and pay a fee for the collection thereof. Because of this, **the real amounts of this waste are often not reported, and a considerable part ends up in a landfill or is burned.** The problem of burning textile waste and air pollution is a long-standing problem in the city, and due to the increase in energy prices, many smaller textile workshops and households are resorting to burning textile waste in their own furnaces.

Proper handling of textile waste - primary selection - would lead to **controlled waste management and separation at the source.** Collection, transport, and temporary storage of textile waste by the operator of PUC "Gradska čistoća" would reduce the creation of illegal dumpsites and prevent its inadequate disposal or combustion. In order to motivate companies to hand over all quantities of textile waste, **an agreement was made with the PUC on the free collection of textile waste from all companies in the city territory for a period of two years.** An agreement was also made with a waste operator that will take over all the collected textile waste as a solution in the first phase, while representatives of the city will continue to work on finding further new solutions for the use of this waste at the local level. The support provided amounts to 70,000 US \$.

PROJECT DESCRIPTION

REUSE OF TEXTILE WASTE

FRUIT WASTE FOR CLEANER AIR AND GHG EMISSION REDUCTION



IMPLEMENTING PARTNER: PUC "OSEČINA"

PROJECT DESCRIPTION

Previously, four fuel oil boiler rooms were utilized to run the Public Utility Company (PUC) "Osečina," which is in charge of district heating in the municipality, using coal and 2200 tons of fuel oil annually. Boilers powered by fossil fuels were switched out for hardwood biomass boilers at the PUC's initiative.

The innovative proposal suggests producing heating chips from trimmed orchards left over from growing raspberries. Since the area produces fruit, pruned waste is currently burned in the fields. The PUC intends to gather the trash from clipped fruit and make chips for heating.



This would be the first instance of trimmed orchards being utilized to make chips for heating in Serbia. Through a total installation of 2.85 MW of renewable energy, the project would save 4.653 tons of CO₂ equivalent annually. Wooden chips in excess would be sold. The project's financial outcomes are excellent, and the funded activities will improve PUC's routine operations. Ash produced from burning wood chips and trimmed waste will be used as fertilizer. This initiative is co-financed by 94,000 US \$.

PROJECT DESCRIPTION

**IMPLEMENTING PARTNER:
NEKTAR LTD.**

PROJECT DESCRIPTION

The company used a fuel oil boiler room with two boilers, using 2200 tons of fuel oil annually. For both financial and environmental considerations, a 9.2 MW gas and biomass boiler room was built, and the company itself will produce the biomass. It will make wooden chips from the purchased wood, and fruit residues from the production process will be dried to an adequate moisture content to be used as fuel in the boiler. The leftovers from the squeezed fruit (used for making juices) will be utilized 100% for powering the boiler room.



The support enabled the purchase of the dryer. The purpose of the boiler room is to produce the saturated steam required for technical processes. The existing boilers operate at a production rate of about 12 t/h during the months of June through December, when fruit processing technology demands are at their peak. Recuperation of condensate is, during the summer months, approximately 75–80%. Ash, as a product of burning biomass, is intended for use as fertilizer. Recirculation is further achieved by recuperation. By replacing two old boilers, the estimated reduction in CO₂ equivalent is 4,200 tons per year. The solution is supported by 130,000 US \$.

PROJECT DESCRIPTION

DECREASE OF POLLUTANTS AND GHG EMISSIONS BY INSTALLATION OF A NEW BOILER ROOM



CIRCULAR VOUCHERS

In November 2022, the Public Call for the Improvement of Cooperation Between Academia and Businesses in the Field of Circular Innovations was announced by UNDP. Out of over 40 applications, the 12 best innovations received “circular vouchers” worth 10,000 US each as an incentive for further development, leading to practical implementation.

These innovations envisage the use of bio-waste in energy production, composting and manufacturing of new products (cosmetics, paint, varnish, ecological adhesives), as well as wastewater treatment in wood processing industry to make innovative bio-products. Some of the solutions propose using new technologies (artificial intelligence, software and applications) to decrease the emission of pollutants from thermal power plants, optimisation of electricity consumption, as well as transition from fossil fuels to renewable energy sources. The voucher winning ideas also include production of biodegradable bags from natural materials and breeding of insects whose larvae can decompose plastic. All these innovations were proposed by renowned scientific and research institutions in Serbia.

1. REVALORIZATION OF WASTE -USE OF WASTE EGGSHELL AND USED COOKING OIL FOR BIODIESEL AND PELLET

Scientific-research organisation: Faculty of Technology and Metallurgy, University of Belgrade
Company: Melange doo New Belgrade (eggs processing company)

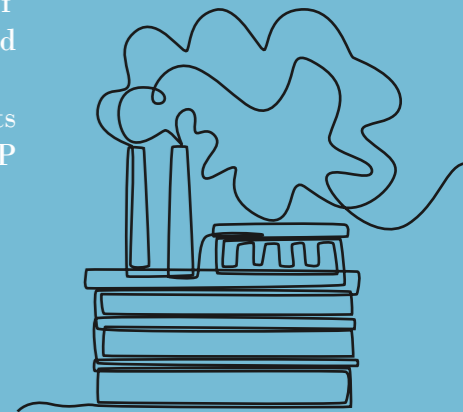
- **Goal:** reducing the use of fossil fuels by adding biodiesel in the transport sector and using enriched pellets for heating purpose, reducing pollution of aquatic ecosystem by waste oils.
- **Process:** waste eggshells will be used as a catalyst in the biodiesel production from used cooking oil and bioethanol. Further, the production of pellets from waste biomass with the addition of crude glycerol obtained in the biodiesel production will be optimized.
- **Result:** thermodynamic characterization of the obtained biodiesel necessary for its further use and comparison with binding European standards.



2. DEVELOPMENT OF AI MODEL FOR PREDICTING EMISSIONS OF POLLUTING MATERIALS FROM TPP "KOLUBARA"

Scientific-research organisation: Nuclear Institute „Vinča“
Company: PC "Electric Power Industry of Serbia" (JP EPS)

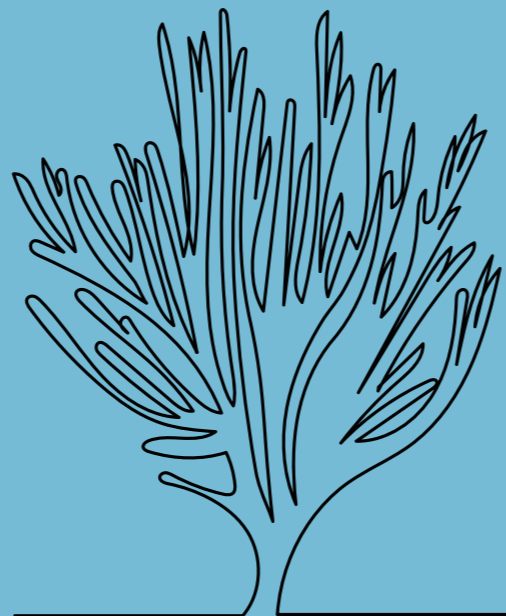
- **Goal:** development of reliable artificial intelligence (AI) models that enable monitoring of environmental impacts of TPP. By adjusting the input parameters of boiler operation, the possibility of reducing pollutant emissions from TPP "Kolubara" is estimated to be up to 20%.
- **Process:** Three advanced ML models will be developed by scikit-learn python library on the created database. Models will have values of technical/elementary analysis of lignite, TPP unit power output and steam production as input parameters.
- **Result:** develop machine learning (ML) models to predict pollutants emissions based on the experimental testing of the emissions from TPP "Kolubara".



3. ALGAE IN FUNCTION OF GHG REDUCTION

Scientific-research organisation:
Faculty of Biology, University of Belgrade
Company: Biotech Engineering doo

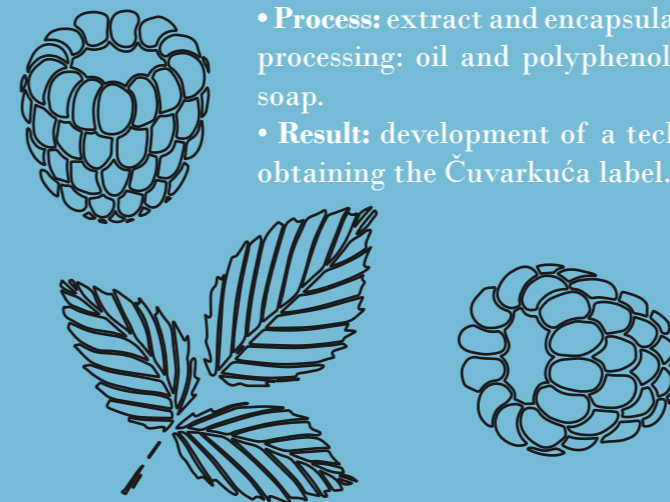
- **Goal:** Production of high-quality compost, with GHG and water vapor reduction.
- **Process:** a system consisting of two bioreactors, the first for aerobic degradation of organic matter (composter) and the second for growing algae (photobioreactor). CO₂ from composting is consumed in the photobioreactor, for accelerated growth and cultivation of algae, and the oxygen produced by the algae is consumed to speed up the composting process to 14 days.
- **Result:** improvement of the existing original solution of „green composter“ by testing large photobioreactor in open space, using the sunlight.



4. EXTRACTION AND ENCAPSULATION OF BIOACTIVE COMPONENTS FROM WASTE RESOURCES FROM RASPBERRY PROCESSING

Scientific-research organisation: Faculty of Chemistry, University of Belgrade
Company: Aleksandra Rašković PR Production of cosmetics AMELLES

- **Goal:** rational use of waste from fruit processing, containing valuable compounds: oils, polyphenols, enzymes, vitamins, and minerals, with antibacterial, antifungal, anti-inflammatory and antioxidant potential in cosmetics.
- **Process:** extract and encapsulate bioactive components from waste obtained in raspberry processing: oil and polyphenols, encapsulated to develop innovative serum, cream and soap.
- **Result:** development of a technical solution with application in the cosmetic industry, obtaining the Čuvarkuća label.

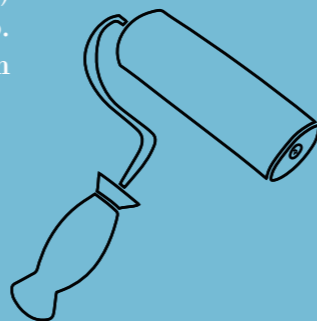
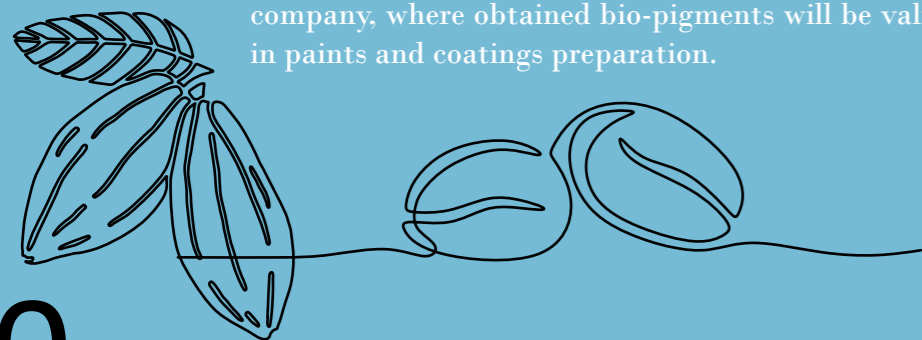


5. BIOTON - BIO-PIGMENTS FROM WASTE FOR INDUSTRY OF COATING AND PAINTING

Scientific-research organisation: **Institute for Chemistry, Technology and Metallurgy, University of Belgrade**

Company: **Fero Promet doo, Užice**

- **Goal:** high performance alternative for available antibacterial / antifungal painting program (95 to 100% biobased) allowing to reduce fossil consumption (80-90% decrease in carbon footprint) and harmful chemicals release in the environment.
- **Process:** a broad spectra of organic waste such as meat offcuts, spent coffee grounds, cocoa bean shells, and secondary bioplastics residues, will be used for a production of bio-pigments.
- **Result:** Bio-pigments of different colours (red, pink, purple and blue family) will find the industrial application with the collaboration of JUB d.o.o. company, where obtained bio-pigments will be validated through application in paints and coatings preparation.

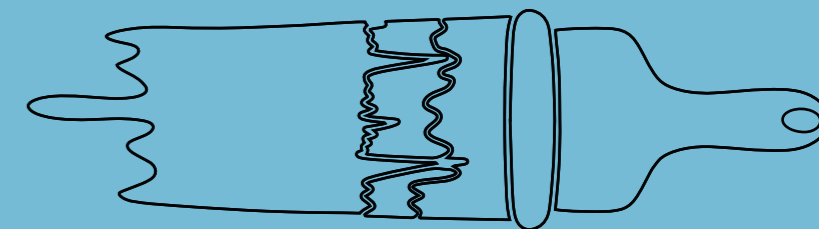


6. BIO-POLYOLS FROM AGRICULTURAL AND INDUSTRIAL WASTE (AIW) FOR NEW CIRCULAR PRODUCTION OF ECOLOGICAL ADHESIVES (GLUES)

Scientific-research organisation: **Faculty of Agronomy in Čačak, University of Kragujevac**

Company: **Tetragon, Čačak**

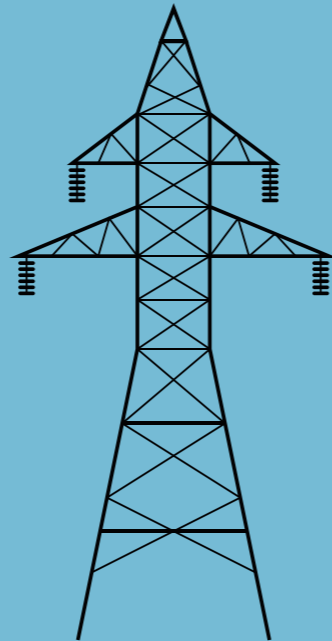
- **Goal:** innovative green technologies related to the AIW management for development of advanced eco-friendly adhesives.
- **Process:** new technological procedures for silica nanomaterials extraction from AIW and flying ash using green chemical route, which will allow to control the size and shape of nanoparticles which will be measured by scanning and transmission electron microscopy.
- **Result:** developing bio-based silica nanofillers and polyols for adhesive systems, as an alternative to fossil fuel-based polymers in adhesives.



7. SOLID STATE TRANSFORMER - DEVELOPMENT OF ISOLATED SYSTEM FOR MONITORING AND DIAGNOSTIC OF ELECTRO-ENERGY SYSTEM

Scientific-research organisation: Faculty of Agronomy in Čačak, University of Kragujevac
Company: Tetragon, Čačak

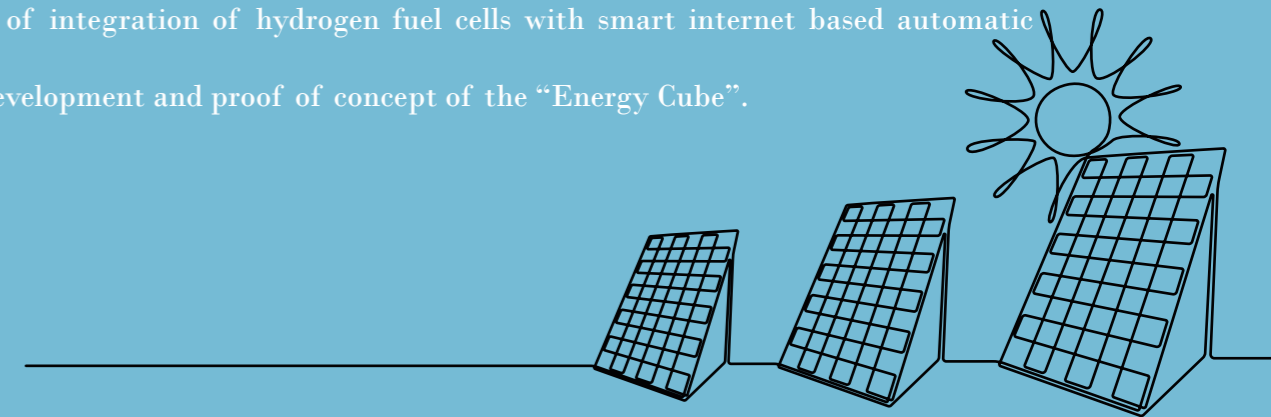
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8. MODULAR COMPACT TRIGENERATION SYSTEM OF NET ZERO ENERGY CONSUMPTION - "ENERGY CUBE"

Scientific-research organisation: Faculty of Mechanical Engineering, University of Niš
Company: ALFA KLIMA doo

- **Goal:** net zero energy housing, decentralized energy production, hospital operation rooms and clean rooms, greenhouses, plastic houses, container housing units and remote location facilities.
- **Process:** "Energy Cube" integrates energy processes providing electricity, heating and cooling using solar energy. It is a modular mobile solution, suitable for outdoor use, which integrates photovoltaics, air-water heat pump, energy storage (electric, heat), with possibility of integration of hydrogen fuel cells with smart internet based automatic control.
- **Result:** development and proof of concept of the "Energy Cube".



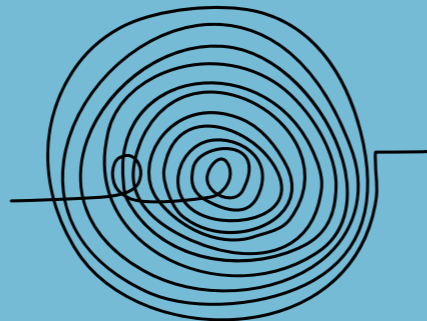
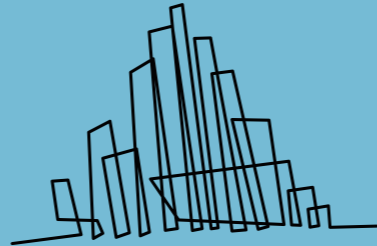
9. CONDENSATE FROM HYDROTHERMAL TREATMENTS OF WOOD - WASTE AS RESOURCE FOR INNOVATIVE BIOPRODUCTS

Scientific-research organisation:

Faculty of Agronomy in Čačak, University of Kragujevac

Company: Tetragon, Čačak

- **Goal:** innovative green technologies related to the AIW management for development of advanced eco-friendly adhesives.
- **Process:** new technological procedures for silica nanomaterials extraction from AIW and flying ash using green chemical route, which will allow to control the size and shape of nanoparticles which will be measured by scanning and transmission electron microscopy.
- **Result:** developing bio-based silica nanofilers and polyols for adhesive systems, as an alternative to fossil fuel-based polymers in adhesives.



10. OPTIMIZATION OF PARAMETERS FOR PRODUCTION OF BIODEGRADABLE AND COMPOSTABLE BAGS

Scientific-research organisation:

Faculty of Technology, University of Novi Sad

Company: Polyplast – packaging Novi Sad

- **Goal:** to reduce dependence on non-renewable fossil fuels, and the harmful consequences of non-biodegradable plastic disposal on the living world.
- **Process:** By using materials based on polylactide and starch, which are biodegradable biopolymers, and „green“ plasticizers based on glycerol and citrate esters, instead of proven toxic phthalates, the entire process is placed in an ecological framework.
- **Result:** optimize the parameters of the production of biodegradable and compostable bags.

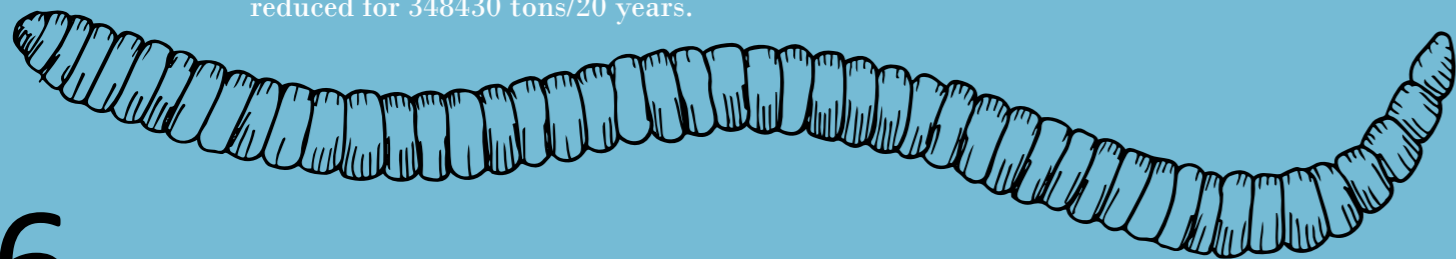


11. POTENTIAL OF INSECTS IN DEVELOPMENT OF SERBIAN AGRICULTURE

Scientific-research organisation: Institute for biological research „Siniša Stanković“, University of Belgrade

Company: Belinda animals doo

- **Goal:** alternative sources of protein-rich food to protect the environment and ensure sustainable development.
- **Process:** the cultivation of *Tenebrio molitor* (mealworm) larvae on agricultural farms and by food manufacturers. The nutritional composition of this insect's larvae is similar to fishmeal and can be an excellent alternative protein source for animals/aquaculture. The mealworm's advantage is its ability to break down organic waste and plastic. Larval frass (feces with unused food and exuviae) can be used as a high-quality organic fertilizer.
- **Result:** environmental awareness among farmers and plant/animal food manufacturers and to encourage them to establish *T. molitor* larvae "farms". By implementing this Initiative on only 1% of agricultural farms in Serbia, reduction of CO₂ emissions will be reduced for 348430 tons/20 years.

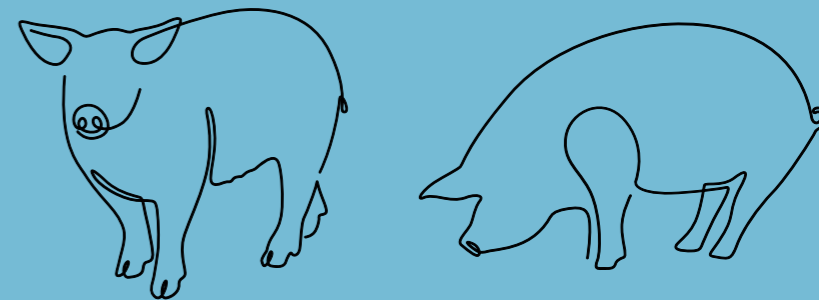


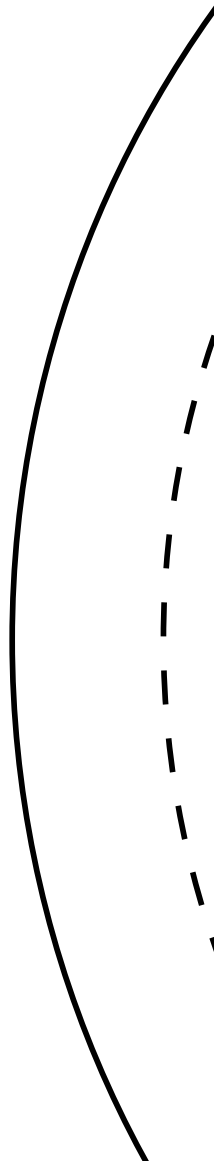
12. COMPROMISE BETWEEN THE PRODUCTION OF QUALITY PIG MEAT AND PROTECTION OF ENVIRONMENT THROUGH ECOLOGICALLY SUSTAINABLE AND ECONOMICALLY COMPETITIVE TECHNOLOGICAL PROCESSES

Scientific-research organisation: Faculty of Agriculture, University of Belgrade

Company: SUVOBOR KOOP NN D.O.O.

- **Goal:** to address environmental concerns, reduce emissions, and optimize economic efficiency.
- **Process:** The project foresees crossbreeding different groups of pig breeds, specifically Duroc meat breeds and indigenous Moravian breeds, to create hybrids that are genetically inclined to adapt to a free farming system.
- **Result:** food utilization directly from nature and secondary products of agriculture and the food industry, in accordance with the very principles of a circular economy. The resulting crossbred pigs would possess carcass qualities that meet market requirements while being ecologically competitive and economically profitable. Additionally, this process aims to reduce pollution, specifically the equivalent of carbon dioxide emissions (CO₂), by approximately 50.7%.





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