

BEST PRACTICES HANDBOOK



REPUBLIC OF SERBIA
Ministry of
Environmental
Protection



*Empowered lives.
Resilient nations.*



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Background Information

The United Nations Development Programme (UNDP), acting as an implementing agency of the Global Environment Facility (GEF), is supporting the Ministry of Environmental Protection (MoEP) to implement the “Climate Smart Urban Development Challenge” project, jointly financed by the GEF, MoEP and UNDP. The objective of the project is to promote climate-smart urban development.

Based on the results of the CSUD project a new Challenge Call is launched within a project “Climate Smart Bio-Waste Management Challenge”, financed by Swedish International Development Agency (SIDA). The objective of the project is to promote Climate Smart Bio-Waste Management.

The “Climate Smart Bio-Waste Management Challenge” project will focus on reduction of the quantity of bio-waste disposed on landfills that leads to the reduction of greenhouse gases emission and consequently reduction of environmental pollution (through the reduced contamination of soil, air and waters). In addition, this result is expected to contribute to the extension of the landfills lifetime. The project will initiate a Challenge based call for proposals of the business solutions and innovative projects that can contribute to creative ways of reduction, reuse and recycling of bio-waste in the Republic of Serbia, while at the same time preventing landfilling and reducing greenhouse gasses emissions. The Challenge call approach will be open for local self-governments, public utility companies, business sector, research, and scientific community and food and non-alcoholic beverage industry to come up with new and innovative project proposals on how to practically respond to the Challenge and to jointly develop, finance and implement these project proposals further.

Besides this, the Project will assist the Government of the Republic of Serbia to divert a bio-waste fraction of communal waste from landfilling and boost local economies and businesses that are based on sustainable and circular solutions. This can represent significant potential for the creation of new circular economy business markets. The solutions sourced through the Challenge call are expected to generate multi-benefits in terms of environment, social and local economic development. Besides investments into creative solutions for reduction, collection, and treatment of bio-waste, which is expected to be achieved through the Challenge call, this Project will support further implementation of policies on improved bio-waste management.

Significant efforts will be invested in transferring the lessons learned and knowledge generated throughout the project implementation to enable benefits for the wider group of stakeholders. Also, the Project is expected to raise the interest of the waste generators and operators in creating their own sustainable waste management models based on replication and amendments of the Bio-waste Challenge Call.

Introduction

Bio-waste is defined in the Law on Waste Management Law in the Republic of Serbia (Official Gazette of Republic of Serbia, no. 36/2009, 88/2010, 14/2016 and 95/2018 – other Law) as "biodegradable garden and park waste, food and kitchen waste from households, restaurants, caterers and retail premises, and comparable waste from food processing plants". The definition is the same as in the EU Waste Framework Directive (Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain directives). It does not include forestry or agricultural residues, manure, sewage sludge, or other biodegradable waste (natural textiles, paper or processed wood). According to Proposal for a Directive of the European Parliament and of the

Council amending Directive 2008/98/EC on waste, COM (2015) 595 final, 2.12.2015, bio-waste means biodegradable garden and park waste, food and kitchen waste from households, restaurants, caterers and retail premises, comparable waste from food processing plants and other waste with similar biodegradability properties that is comparable in nature, composition, and quantity.

Biodegradable waste is a broader concept than bio-waste, as it does not only focus on waste from households and other streams that are supposed to produce similar waste, but also on other industrial streams².

The figure below on classification of sources of biodegradable waste provides the better understanding of biodegradable waste and bio-waste.

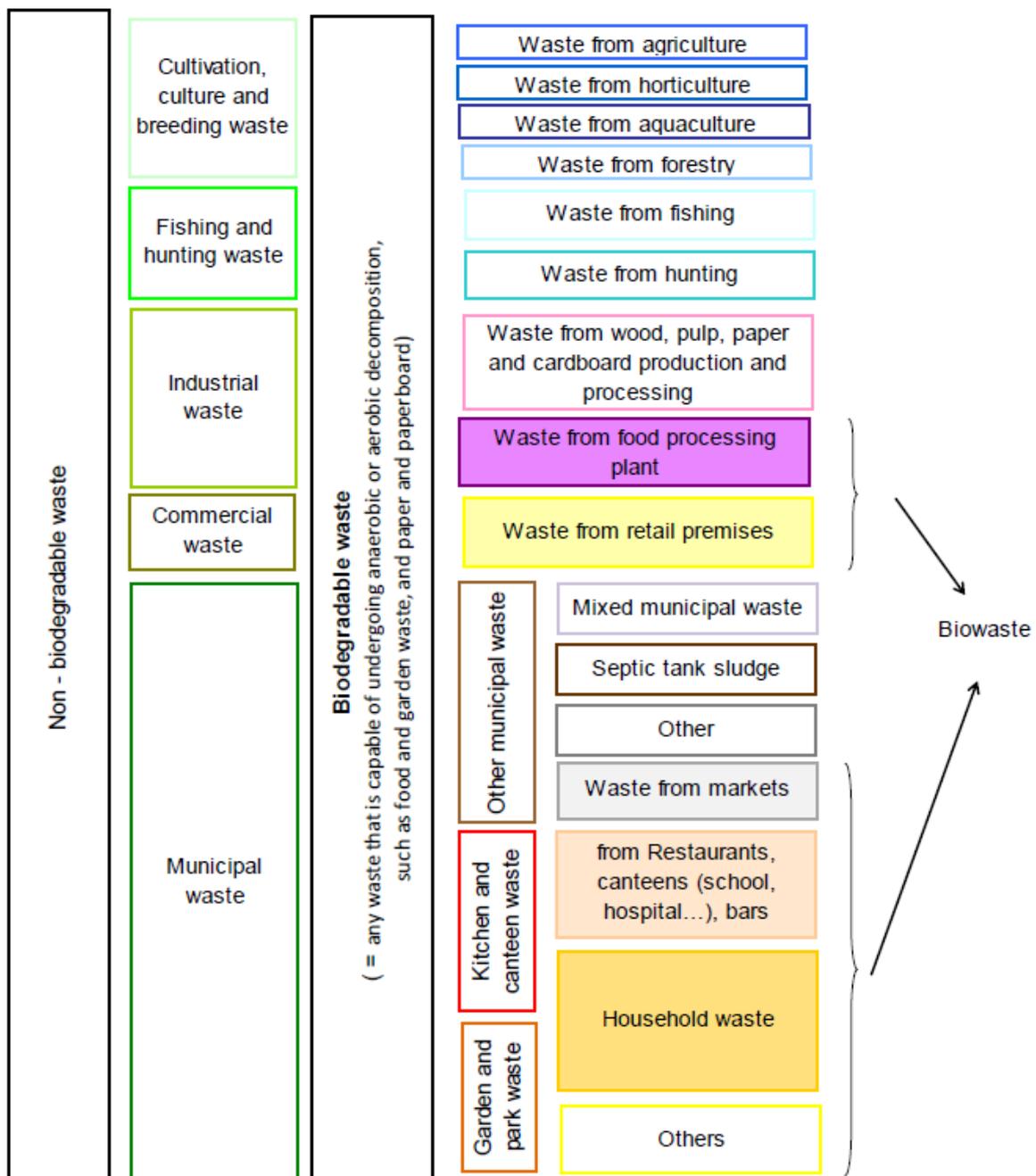


Figure 1. Potential sources of biodegradable waste and bio-waste²

Treatment of bio-waste

Unquestionably, landfilling is the worst waste management option for bio-waste¹. There are several ways to divert bio-waste landfilling following the waste hierarchy principle.

According to the waste hierarchy, as defined in article 4(1) of the Waste Framework Directive, waste prevention is the preferable option, followed by preparing for re-use, recycling and other recovery (e.g., energy recovery). Disposal (e.g., landfilling) is seen as the least desirable option².

If we talk about the treatment of bio-waste, then we should refer to biological treatments.

The main purpose of biological treatment is the circulation of nutrients in society as a means of closing the eco-cycle³.

Biological treatments use living microorganisms to decompose organic waste into either water, CO₂ and simple inorganics or into simpler organics such as aldehydes and acids. In the case of composting, organic substances are transformed into humidified mineral-organic complexes⁴.

Biological treatments are presented in the table below, but there are also other treatments of waste that are not included.

Table 1. Biological treatments of waste⁴

Biological treatment	Brief description
Aerobic treatment (including composting)	Biological decomposition of the organic content of wastes. Applied to solid waste, wastewaters, bioremediation and to sludge and soil contaminated with oil. Composting consists of building piles of waste (windrows) to encourage the aerobic biodegradation of organic solids, producing a humic substance valuable as a soil conditioner or a growing media constituent
Anaerobic treatment (or anaerobic digestion - AD)	Decomposition of the organic content of wastes in closed vessels in the absence of oxygen and production of digestate valuable as an organic fertilizer or soil improver. It is based on biocenosis using mainly two forms of bacteria: acid-forming and methane-forming. Applied to solid-liquid wastes, highly contaminated

¹ <https://ec.europa.eu/environment/waste/compost/index.htm>

² European Commission, Joint Research Centre, Institute for Environment and Sustainability, Supporting Environmentally Sound Decisions for Bio-Waste Management, EUR 24917 EN - 2011

³ Avfall Sverige, Swedish Waste Management 2018,

https://www.avfallsverige.se/fileadmin/user_upload/Publikationer/Avfallshantering_2018_EN.pdf

⁴ European IPPC Bureau, Best Available Techniques (BAT) Reference Document for Waste Treatment, EUR 29362 EN

	wastewaters bioremediation and in the production of biogas to be used as a fuel.
Mechanical biological treatment (MBT)	Treatment of mixed solid waste combining mechanical treatment (e.g. shredding) with biological treatment such as aerobic or anaerobic treatment.
Bio drying	A typical bio drying reactor includes a series of discrete, enclosed containers coupled with an aeration system or a large bio drying hall where batches of waste are progressively moved through the hall by a mechanical load crane (wandering heap)
Activated sludge	Decomposition of organic wastes in water by exposing them to biological growth. Water is recycled and aerated to facilitate biological action and sludge is generated. Two commonly applied systems: suspended growth systems and attached growth systems
Aerated lagoons	Large lagoons containing high concentrations of microorganisms. The lagoon is aerated to encourage bacterial growth and decomposition of waste.

Best practices for bio-waste

The basic idea of this handbook is to present several case studies of bio-waste management. The main criteria for presenting the specific case studies were innovative approaches, rounded waste management practices and consideration of practices that are high in terms of waste management hierarchy principle (prevention and reduction).

Case studies

Unverschwendet / Unwasted



Source: <https://www.unverschwendet.at/>

The young entrepreneur Cornelia Diesenreiter produces jam, chutney, and syrup out of non-used fruits, vegetables and herbs. She gets the ingredients (misfits) from farmers and private gardens in Vienna. Either she directly pick-ups the goods from the farms or she harvests them herself.

Cornelia sells her products on her website, in small markets and in small shops. Thanks to the network of more than 34 fruit donors, about 1.173 kg of fruits and 949 kg of vegetables could be processed in 2016. Within three weeks almost the entire inventory (2.500 jars) has been sold.

Another success story is the cooperation with the Viennese food bank. In December 2015. Cornelia Diesenreiter started to cook with people affected by poverty, such as young people and refugees, within the initiative "Smart jam". This concept will be implemented in another Austrian city in 2017, (<https://www.unverschwendet.at/>).5

Sozialmarkt /Social Market

Products from wholesale/retail, industry, catering, agriculture, etc. that are near or past their "expiration" date are sold at symbolic prices in social markets (e.g. SOMA-Market). The products might have lightweight packaging damage but are still suitable for consumption. Meanwhile, many "SOMA-markets" have been established, as well as other social markets with different names (e.g. Barbara Laden, Martinladen, Vinzmarkt, solali, Paulusladen, SOMI, Laube, Caritas leo, LEBILaden) and the mobile version in more remote regions (e.g. Tischlein deck Dich, Rollende-HerzenBus).

Now 34 social markets are existing throughout Austria that belong to the umbrella organization SOMA Austria and partners. All those social markets are charitable organizations or non-profit companies with clear regulations on prices, food hygiene and access authorizations.

All goods are donated for free from retail and industry. No additional purchase is allowed within the SOMA organizations. IN total about 60.000 needy customers can be reached by these initiatives. In 2014. food retailers have donated about 6.600 tons of food to social markets such as "SOMA

Österreich und Partner", "Le+O - Lebensmittel und Orientierung der Caritas Wien" or "die Wiener Tafel". The share of food retailers cooperating with social markets is as follows: Merkur 100 %, Spar 100 %, Unimarkt 100 %, Hofer 91 %, Billa 80 %, Penny 50 %. In 2013, a total of 11,123 t (+/- 238 t) of food were donated to social institutions in Austria. About 10.482 t (94.2 %) (+/- 227 t) were used as food. (ECR-AG, 2016)⁵

Iss mich! Bio-Catering / Eat me!



Source:

<https://www.facebook.com/issmichwien/photos/a.740289196002402/2705327799498522/?type=3&theater>

Since 2012, the waste-cooking-show waste cooking has been raising awareness for the topic of food waste. Now the waste cooking-chef Tobias Judmaier is taking initiative. Founding the food brand iss mich! is an important move in stepping up against food waste. The Viennese catering company uses fresh, non-compliant vegetables (misfits) from organic farmers, which cannot be sold on the market. The food is served in refillable jars at events or delivered by bike to the offices in Vienna. (Winner of the Viktualia Award 2014) "Eat it, don't waste it" is the slogan of iss mich! That's why iss mich! (eat me!) prepares vegetarian dishes from perfectly healthy veggies that did not meet retail standards - not due to quality but due to aesthetics. The dishes are served in jars in order to reduce packaging. With every iss mich! Glas 300 g of vegetables and 50 g of plastic waste are saved (www.issmich.at).⁵

Organic model farm at Nynäs gård

At Nynäs gård, there is a biogas installation, which is designed for the farm's phosphorus needs. The farm does not longer need to purchase any chemical fertilizers, nor does it need to buy fuel for its vehicles.

⁵<http://www.reducefoodwaste.eu/uploads/5/8/6/4/58648241/d.t12.1-best-practice-report-final-v3-3.pdf>

Since 2005, Nynäs Gård (Nynäs farm) produces its own biogas by digesting household waste from adjacent restaurants and grocery stores in the Trosa municipality. Thanks to the newly built biogas installation, the farm has been able to replace the use of fertilizer with nutrient-rich residue, which is obtained from the digestion process.

A gas treatment installation on the farm enables the upgrading of methane gas into biogas (vehicle fuel), which is directly used on the farm as fuel for vehicles. It is also used for heating the nearby-situated castle. Approximately 5 million kronor (500.00 Euros) have been invested in this project, resulting in the production of 10 cubic meters of gas per hour, which is equivalent to 6 litres of diesel. Thanks to this investment, the municipality also eliminates 900 t of waste, which would otherwise have gone to landfill.⁶

The Nynäs Estate is located on the Swedish Baltic coast, about 80 km south of the capital Stockholm.



Source: <https://www.ctc-n.org/products/organic-model-farm-nyn-s-g-rd>

Small Scale Anaerobic Digestion for Supermarkets

The practice is a pioneering pilot implemented by Continente (large retailer) for the on-site transformation of organic waste from one of its hypermarket stores into energy and fertilizer – it is the first retail company in the world to implement this solution in a hypermarket.

The Waste 2 Energy system uses a compact solution, a modular Anaerobic Digestion unit installed inside standard containers, that is placed at the Gaia Shopping Centre service parking.

The used technology will convert approximately 600 kg per day of inedible supermarket food waste into around 80 MWh of electricity each year, as well as 180 tons of fertilizer per.

The electricity will be used on-site whilst the fertilizer will be sold on, creating an additional revenue stream for the supermarket.

The total offset savings for the first year are projected to be around €27.000 which includes income from the generation of energy from waste and cost savings from the elimination of waste transport and landfill costs as well as other operational expenses.

⁶ <https://smartcitysweden.com/best-practice/92/organic-model-farm-at-nynas-gard/>

Model Contiente had a strong focus on resource recovery including the recycling of the product and transport packaging and the implementation of bins at its stores so that consumers can recycle items such as batteries, clothing, consumables and electrical⁷.



Source: <https://seabenergy.com/products/>

Bio-bean – powered by coffee

Founded in 2013. by Arthur Kay, bio-bean is the first company in the world to industrialize the process of recycling waste coffee grounds into advanced biofuels and biochemicals.

The start-up collects used coffee grounds from cafes, restaurants and factories, transports them to its recycling facility. There, the grounds are dried before coffee oil is extracted. The coffee oil is then blended with other fuels to create B20 biofuel, which can be used in diesel buses without modification.

„Spent coffee grounds are highly calorific and contain valuable compounds, making them an ideal feedstock from which to produce clean fuels”, the company says on its website.

Since starting up the company in 2013. the entrepreneur has already earned some esteemed awards and has quickly built up a team of 25 staff. They are dedicated to looking at new ways that WCG can be turned into a renewable product to reduce CO₂ emissions and our reliance on fossil fuels⁸.

One of the products are coffee pellets. Coffee pellets exploit the high calorific value of coffee, boasting a net calorific value ≥15% higher than standard timber pellets. They feature consistently low moisture content, high bulk density, a high ash melting point and good durability making them a high-performing alternative. Their efficient burn profile saves businesses money, requiring reduced volume

⁷ <https://www.urbanwins.eu/small-scale-anaerobic-digestion-for-supermarkets/>

⁸ <https://www.urbanwins.eu/bio-bean-powered-by-coffee/>

and therefore fewer deliveries to achieve the same energy output as wood pellets. They are Sustainable Fuel Register (SFR) accredited, and therefore meet the criteria for RHI approval⁹.



Source: <https://www.bio-bean.com/elements/pellets/>

Home and Community Composting (Terra à Terra)

Terra à Terra aimed at promoting home composting at collective buildings, houses and in public or private institutions, in Lipor's associated Municipalities (Espinho, Gondomar, Maia, Matosinhos, Porto, Póvoa de Varzim, Valongo and Vila do Conde). These municipalities contribute with approximately 500.000 tons/year of municipal waste that needs to be collected, transported, treated and disposed of, while 40% of the waste produced is bio-waste, which can be recovered through home or community composting. This project promotes a reduction in the centralized collection and treatment of organic waste within Lipor's area of intervention, thus reducing the environmental impact of the process and improving the quality of life of the population it serves.

Lipor helped to develop a composting site in a residential area, providing compost bins (to all houses that have a garden inside the 8 municipalities already mentioned) and the opportunity to learn about composting, participating in the composting workshops.

Collected waste/environmental improvement:

- 13.905 distributed composting bins (It is implemented at least 1 composting bin per household/institution)
- 75 community composting sites
- 4.020 monitoring and support visits to composting sites and households of the kitchen waste bucket. In 2014 Lipor started an online survey to have more information about the kitchen waste bucket. With this methodology, it is possible to estimate the bio-waste reduction per each compost bin: 423,3 kg/year/compost bin
- a bio-waste potential reduction of about 5.886 tons/year
- prevention of 1.237,07 tons CO₂/year.

The produced compost is used in gardens and urban farming¹⁰.

⁹ <https://www.bio-bean.com/elements/pellets/>

¹⁰ <https://www.urbanwins.eu/home-and-community-composting/>

Good Practice: Used Cooking Oil Reuse in Rethymno

A pilot system for used cooking oil (UCO) Recycling was set up in 2014. in the Municipality of Rethymno, Crete initiated by the Renewable and Sustainable Energy Systems Laboratory (ReSEL) of the Technical University of Crete, to locally collect and exploit UCO. This pilot applied recommendations and good practices identified in the frame of the EU initiative RecOil, which was co-funded by the European Commission through the Intelligent Energy for Europe Programme, aiming to increase sustainable biodiesel production and its local market intake by enhancing UCO collection and transformation in 6 European countries.

Rethymno, a Cretan small city of 55.000 inhabitants, was one of the pilots, where the lack of awareness among citizens and lack of collection systems led most consumers to pour UCO directly to the sink or soil. There was no previous experience or existing UCO collection system from households in the municipality, not even in the whole region.

The project in Rethymno applied different approaches: UCO collection in restricted locations (13 containers of 80 L in schools) and collection points in public spaces (20 bins of 365 L). The UCO collected was transferred to selected biodiesel producers for its transformation to biodiesel. The initiative was largely embraced by householders, as well as the whole school community and was actively supported by the local stakeholders including the Municipality of Rethymno, the Primary and Secondary Education Directorates, the Union of students' parents and the Municipal Enterprise of Water and Sewage.

ReSEL was responsible for the set-up, operation and management of the pilot UCO collection system and provided the Municipality technical advice and regular quality testing; also with educational activities, materials. Large-scale communication and training activities motivated the school's community and all citizens. ReSEL also assessed the sustainability of the collection system and built on experience gained so as to further evolve it¹¹.



Source: <https://blueislands.interreg-med.eu/news-events/news/detail/actualites/good-practice-used-cooking-oil-reuse-in-rethymno/>

¹¹<https://blueislands.interreg-med.eu/news-events/news/detail/actualites/good-practice-used-cooking-oil-reuse-in-rethymno/>

Compostela Inserta



Source: <http://www.biowaste-scow.eu/SCOW/userdata/SendFile.asp?DBID=1&LNGID=1&GID=786>

SCOW (Selective Collection of the Organic Waste in tourist areas and valorisation in farm composting plants), was a 3-year European project (2013-2015) funded by the ENPI CBCMED Programme, aiming to develop low cost, technically simple and high quality bio-waste collection and recycling models in territories with touristic areas and agricultural activity.

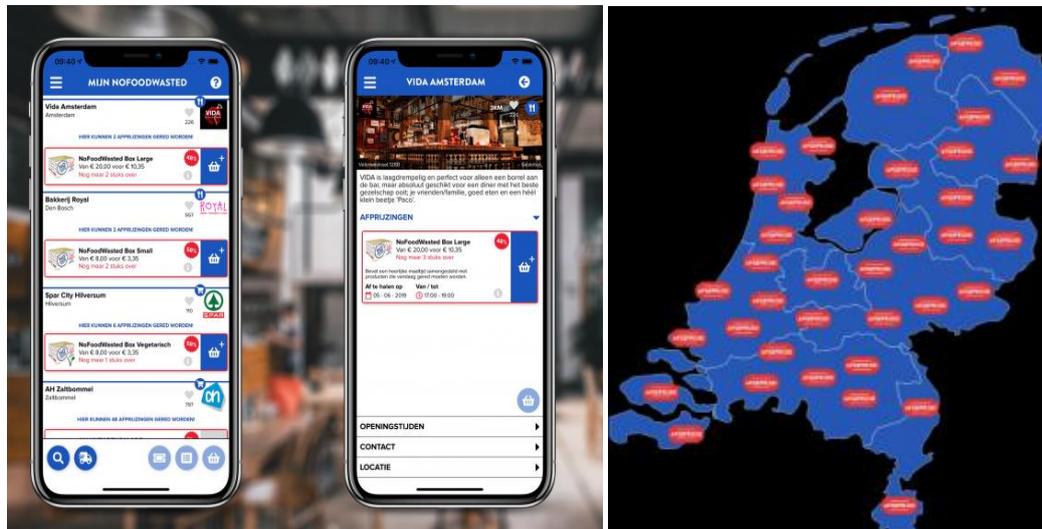
SCOW's goal was to define an innovative and sustainable bio-waste management system through effective collection and waste treatment into decentralised small-scale composting plants, located near bio-waste generation sites, and, at the same time, where the compost could be applied¹².

One of the best practices was a composting facility in A Coruña, Galicia, Spain. The composting facility was established as turned windrows for composting of the green waste from public parks and gardens. This facility also served as a school to train students about composting process and how to manage a composting facility (machinery, controls, maintenance...), so at the end of the course they could find a job in other composting facilities. Those students were people from groups in risk of social exclusion¹³.

¹² <http://www.biowaste-scow.eu/SCOW//userdata/SendFile.asp?DBID=1&LNGID=1&GID=737>

¹³ <http://www.biowaste-scow.eu/SCOW/userdata/SendFile.asp?DBID=1&LNGID=1&GID=786>

No Food Wasted



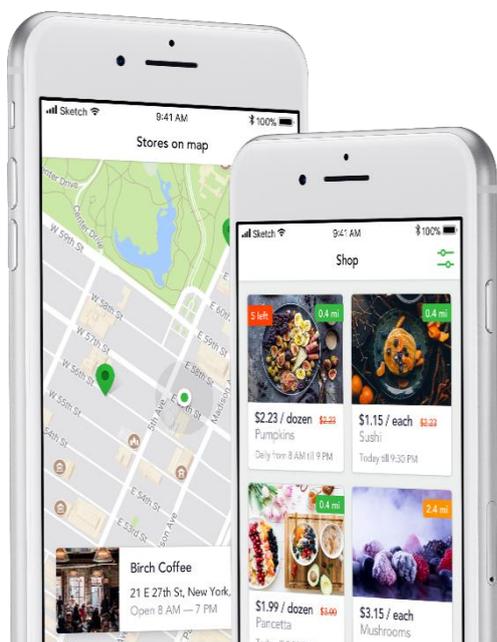
NoFoodWaste is an application for smart phones and tablets that shows to the user which products are on discount in the surrounding. The products are the one whose use is close to expire date. A consumer can order a product by the application and get 35% discount when buying the product in a supermarket.

Cooperation with 25 supermarkets resulted in reduction of food waste for 18% or 1.5 million of euros.

NoFoodWasted currently works with more than 200 restaurants, supermarkets, greengrocers and bakers.

Source: <http://www.nofoodwasted.com/>

goMkt



goMkt is an application where restaurants, cafes and coffee shops can upload the unsold meals with reduced price. Users receive push notifications for these products, or simply browse stores nearby. Using this app support small business and help in reducing food waste.

Source: <https://www.gomkt.com/>

Artificial Intelligence in kitchen

With its Food Is Precious initiative, IKEA aims to cut food waste by 50% by the end of August 2020. To reach the target, IKEA UK&IE brought Winnow Vision into its kitchens to fight food waste with AI.

Using a camera, a set of smart scales and the same type of machine learning technology found in autonomous vehicles, Winnow Vision ‘learns’ to recognise different foods being thrown in the bin and calculates the financial and environmental cost of this discarded food to commercial kitchens.

Winnow and IKEA UK&IE have been working on testing Winnow Vision since October 2017. To date, with Winnow Vision, IKEA UK&IE has achieved great results:¹⁴



Food waste cut across all stores
37%



Number of meals saved in 2018
800k



Cost savings in 2018
1.4 mil

Source: <https://www.winnowsolutions.com/>

¹⁴ https://cdn2.hubspot.net/hubfs/650776/Case%20Studies/IKEA%20UK&I_Vision_Case%20Study.pdf

OBRI

OBRI Tanzania is an Agri-Food company focusing on processing and supply chain management of healthier edible oils by working directly with local farmers in a fair-trade logic.

Sunflower oil cake is a residue from the edible oil production process. It is sometimes considered as waste but OBRI processes it in reusable form for animal feed meals. It is a good source of protein sources in livestock feed, especially dairy cattle, chickens, pigs and rabbits. It has a protein content of between 29-30%, crude fibre content of 27-31%, lignin 9-12% and lysine 3.5%. It is a good source of calcium, phosphorus and Vitamins B to animals.

Dairy cows produce more milk when fed on sunflower cake and OBRI highly recommend use of it to farmers.

Source: <https://obritanzania.com/>

Sintala Design

Sintala Design creates products made of solid wood without cutting down trees. The Company works with wood that has been collected from fallen trees, prunings and remains of other manufacturing processes.



Source: <http://sintaladesign.com/en/>

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