IEA Bioenergy
Technology Collaboration Programme

Sorting technologies

Case study about MSW sorting facility in Italy - Eco+Eco Srl

IEA Bioenergy: Task 36

February 2024

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Case study about MSW sorting facility in Italy - Eco+Eco Srl

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Preface

This report explores lessons on sorting technologies for waste in the field of material and energy valorisation of waste within the framework of IEA Bioenergy Task 36. The purpose of this report, as all the work carried out by Task 36, is to showcase examples from which countries can get inspiration and support in implementing solutions in the waste/resource management and Waste-to-Energy sector that would facilitate their transition towards circularity.

IEA Bioenergy Task 36, working on the topic 'Material and Energy Valorisation of Waste in a Circular Economy', seeks to raise public awareness of sustainable energy generation from biomass residues and waste fractions including MSW as well as to increase technical information dissemination. As outlined in the 3-year work programme, Task 36 seeks to understand what role energy from waste and material recycling can have in a circular economy and identify technical and non-technical barriers and opportunities needed to achieve this vision.

See http://task36.ieabioenergy.com/ for links to the work performed by IEA Bioenergy Task 36.

Summary

Eco+Eco plant treats residual municipal solid waste (MSW) generated by approximately 840,000 inhabitants of Venice Province and up to 37 million tourists per year and converts it into Solid Recovered Fuels (SRF) with high calorific value and high a biomass content (around 60% in terms of carbon) that is used to generate electrical power in situ or sold to other plants as fuel. The first step of the process is the sorting of recyclable material such as ferrous and non-ferrous metals (7,700 ton/year) or inert aggregates (i.e., gravel, sand, glass, and ceramics). Starting from 2026, a second co-incineration line will be operating and all the SRF will be used within the plant. The SRF plant is currently being revamped and it is expected that by the end of 2024 it will be able to sort out almost 6,000 t/year of plastics from the income MSW, reduce fossil fuel consumption due to automatization and material transport by trucks within and outside the plant. The upgrading will also decrease electrical auto-consumption and will increase the amount of sorted recyclable material from residual MSW, which usually is landfilled, decreasing CO_2 emission related to either combustion of fossil-plastics or internal and external transport of SRF. The total saved emission of CO_2 would be from 42,000 to 64,000 ton/year if all the sorted plastic will be recycled, or a more reliable amount ranging from 29,000 to 45,000 ton/year if only 70% of the sorted plastics is recycled. Energy recovery from SRF rather than the untreated unsorted MSW, results in a fuel which is 30% less in weight than the untreated residual MSW, with higher calorific value and more homogeneous characteristics thus providing fully oxidized ashes that can be used in construction industry and which make incineration management and flue gas treatment easier and healthier.

Background

There is a global urge for CO_2 emissions mitigation and Waste-to-energy (WtE) incineration plants are pointed out as one of the sources with potential for improvement/reduction. It is estimated that for each ton of waste burned, 0.7-1.7 tonnes of CO_2 are released depending on the type of waste feedstock[1]. Fossil-derived plastics account for a significant part of the waste incinerated and are responsible for fossil CO_2 emissions from the incineration plants.

The WtE sector is looking for solutions to become carbon neutral. An alternative is to act upstream and reduce the amount of fossil-based waste that ends up in the combustible mixed waste for incineration. This could be achieved by promoting, for example, plastic source sorting by means of new and stricter policies or price incentives, while material recovery is supported. Downstream, Carbon Capture Storage (CCS) and Carbon Capture Utilization (CCU) technologies represent a promising alternative that has recently gained lot of attention and, therefore, many incineration plants in Europe have on-going projects in this area. CCS/CCU retains both the bio- and fossil-CO_2 in the flue gas emitted by the plants. An intermediate solution to these two is the implementation of advanced waste sorting systems prior waste gets to the incineration plant. This alternative leads to a positive reduction on carbon emission while recovering material (i.e., plastics) for reuse or recycling for a more efficient use of it. It is noteworthy that all alternatives are compatible and could complement each other.

This report presents an example of a mixed waste sorting facilities in Italy, Eco+Eco Srl (Italy), that facilitates material recovery prior to incineration.

Eco+Eco converts Municipal Solid Waste (MSW) into Solid Recovered Fuel (SRF), known in Italy as *Combustibile Solido Secondario* (CSS), in part to be used in situ to feed a co-incineration plant producing electricity. Metals present in the MSW are sorted out and recovered; while the aggregates (i.e., gravel, sand, glass, and ceramics) are either reused or sent to landfill. Starting from 2026, a second co-incineration line (L2) will be operating and all the SRF will be used directly within the plant. By the end of 2024 Eco+Eco will be also able to sort out plastics from the waste prior to SRF production.

Plant description

Eco+Eco Srl is part of the Eco-district of Porto Marghera, near Venice (Italy), where companies in the waste value chain have created an integrated system. The cluster is processing materials derived from separated waste collection with the aim of reducing the landfills disposal. Eco+Eco Srl is focusing on the production of high quality SRF (Class 3.3.2. according to ISO 21640:2021 "Solid recovered fuels — Specifications and classes"), to feed a co-incineration plant producing electricity.

The Eco+Eco's facility is based in Fusina with access either by land or sea (

Figure 1 and Figure 2). It was built in 2000 and since then it has undergone a continuous

[1] Pollution inventory reporting – incineration activities guidance note, available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/923125/Pollution-inventory-reporting-incineration-activities-guidance-note.pdf

improvement.

Eco+Eco Srl treats residual MSW generated in the entire Province of Venice, serving almost 840,000 inhabitants and a huge number of tourists (37 million single visits in 2022[2]). The MSW generated in Venice town and Lagoon islands is characterised by a high organic matter content due to the high tourists' fluxes, and the difficulty to implement a waste collection system that allows source sorting due to the critical logistics of this area.

Therefore, the lagoon area Authority decided to implement a door-to-door collection system where food waste and residual waste are in the same bag and not source sorted at the household level. This choice has brought logistical issues of collecting MSW in such a unique town, with narrow pedestrian alleys and canals that allow only hand collection, and the need to perform waste collection with high frequency, to maintain the streets cleaned and sanitised because of tourism.

In addition to the residual MSW, Eco+Eco site is also allowed to treat some types of industrial waste, mainly rejects from the recycling of plastics and paper/cardboard from separate collected MSW.

Figure 1. The industrial area of Eco+Eco Srl (in orange). The three operational MSW processing areas are: the transfer area (in blue), the SRF production and treatment area (in red) and the co-incinerator area (in yellow).

[2] Regione Veneto, sistema statistico regionale
https://statistica.regione.veneto.it/banche_dati_economia_turismo_turismo1.jsp

Eco+Eco plant is divided into 3 operational areas (

Figure 1 and Figure 2):

- Transfer station.
- SRF production and treatment area (two lines) with recovery of recyclable material from residual MSW.
- Co-incinerator area (at present a single line, referred as L1).

Figure 2. The industrial area of Eco+Eco Srl (in green). The three operational MSW processing areas: transfer area (in blue), SRF production and treatment (in red) and the co-incinerator area (in yellow).

Waste from Venice and the lagoon islands, as well as the rest of the Venice Province, is received at the transfer station, which includes three different areas: (i) the dock area for mooring barges; (ii) the area for processing pruning wooden residuals and wooden packaging, bulky waste, and (iii) the sorted waste area. Waste handling is solely done by wheel loaders and hydraulic loaders.

Figure *3* shows the different parts of the transfer area.

Figure 3. On the left: the barge docking area on the "Canale Industriale Sud". On the right: the area for processing wooden pruning waste, bulky and sorted waste.

In the production and treatment area, MSW is processed to obtain SRF in two separated lines (SRF Line 1, and SRF Line 2). In this area takes place the dry stabilization process, pre-sorting, production, and storage of SRF in form of fluff or briquettes. Eco+Eco is currently authorised to treat SRF in both line 1 and 2 with a maximum capacity of 258,500 t/year of waste and 1150 t/day. **Error! Reference source not found.** shows the bio-cell area where the dry stabilization takes place, and the SRF storage area. The SRF briquettes are piled up before being loaded into the furnace hopper.

Figure 1. On the left: the bio-cell area, where the dry stabilization process takes place; on the right: one of the two SRF storage areas (fluff and briquette shape).

In a third area (Figure 5), SRF is co-incinerated to produce steam for the turbine which generates electricity for the self-consumption of the entire plant as well as the neighbouring companies. At present only 30% of the produced SRF is used to generate electricity, while the remaining part is sent to other local energy recovery facilities or cement kilns and/or power plants mainly located in East Europe. A second co-incinerator line is planned to be operational in 2026 and then all the SRF will be used in situ for energy production (at present, the remaining 87% SRF is mainly exported). The L1 co-incinerator line produces up to 20 $MW_{t,}$ and with the start-up of L2 co-incinerator line, the combined combustion potential will increase up to 47.9 MW_t.

Figure 2 - On the left: the thermal area with the furnace for the combustion of SRF and the boiler for steam production; on the right: part of the flue gas treatment line.

The already operating line L1 and the new future line L2 are/will be configurated as follow:

1) *Receiving pit and loading crane.*

2) *Combustion furnace and recovery boiler for steam production.* Semi-integrated system, equipped with flow gas recirculation, with an overall efficiency of 0.2, as per BAT. The oven is equipped with 2 natural gas burners for start-up and stop phases and to avoid temperatures below 850°C. Bottom ash collection system under the grate with wastewater recirculation.

3) *Flow gas treatment*. Dry reactor with sodium bicarbonate, activated carbon and ammonia (SNCR), followed by bag filter and SCR (catalytic DeNOx).

4) *Thermal cycle and energy production*. 20 MWt for L1 and 27 MWt for L2.

5) *Continuous emissions monitoring system*. CO, HCl, HF, NO, NO_2, SO_2, NH_3, H_2O, O_2, TOC, Hg, dioxins are measured offline previous continuous sampling.

6) *Water treatment process, control, and recovery system.*

7) *Plant control and monitoring system.*

Line L1 and L2 are/will be fed with SRF (95%) and sewage sludge from the nearby Fusina wastewater treatment plant (5%). The co-incineration of the same SRF-Sludge mix with biomass and/or woody waste is authorised, but not yet implemented.

Sorting Technology

Technology description

As mentioned above, the SRF production section can treat up to 258,500 t/year of MSW and it is equipped with 33 bio-cells where biological stabilization (bio-oxidation) of organic fraction in the residual MSW takes place. Bio-cells are divided into two lines, one of 15 bio-cells (SRF Line 1) and the other of18 bio-cells (SRF Line 2). Figure shows the flow chart of SRF production, while the different steps are briefly described below:

1) Reception: The first step of the SRF production processes is the control and authorization of the waste at the gate of Eco+Eco hub since it must comply strict rules. The delivery is checked by the gate control office in term of waste transport authorizations, including the truck licence plate number to verify if it is registered and authorized for the specific transported waste. Each truck is weighed both incoming and outgoing. The weighbridge is also equipped with a portal for radiometric control of the delivery. Then, the vehicles reach one of the two authorized areas for unloading the waste. Waste feeding the SRF Line 2 is unloaded on the ground and stored in a warehouse while the waste feeding the SRF Line 1 is unloaded into a storing pit located in another building. Safe access to these areas is regulated by traffic lights and rolling gates.

2) Primary shredding: The waste undergoes a size reduction aimed at facilitating the following treatments. From the pit of Line 1 and the unloading area of Line 2, waste is loaded into the feed hoppers of the primary shredders, bags are torn and the material size is reduced to less than 250—300 mm. Waste is then taken by a series of conveyor belts to an intermediate accumulation pit, in the case of Line 1, or to a building in front of the bio-cells, in the case of Line 2.

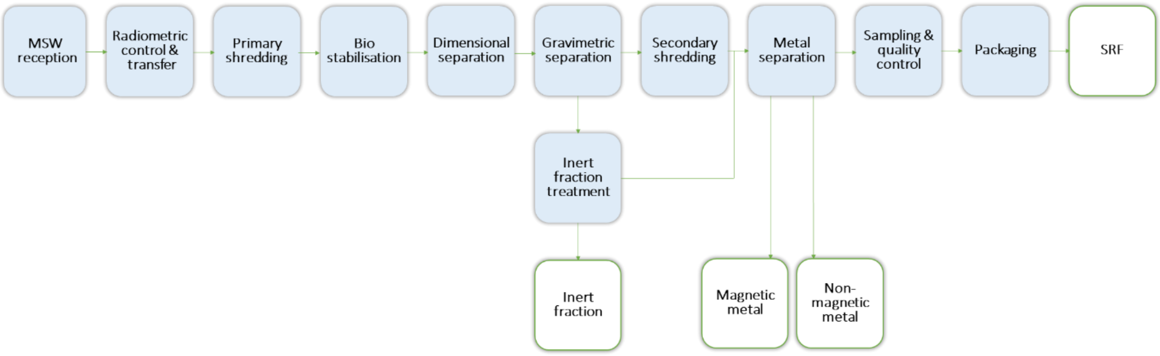


Figure 6. Flow chart of SRF production plant.

3) Bio stabilisation: Waste from Line 1 is loaded into the bio-cells using a mobile bucket on an overhead crane, while in Line 2 is directly loaded with a mechanical shovel. During the process, material undergoes a weight reduction of around 30% mainly due to the loss of moisture and the bio-stabilisation (oxidation) of the organic fraction present in the waste. The aerobic treatment lasts seven days, and the biological process starts few hours after closing the bio-cells roof.

To achieve optimal conditions, three different air flows are blown into the bio-cells (**Error! Reference source not found.**):

- fresh air kaken outside the bio-cells;
- uncooled recirculated air;
- cooled recirculated air.

The parameters measured during the bio-cell process are temperature, oxygen level, relative humidity, and air flow into and at the emission of the bio-cell. Figure 8 shows the parameters variation over the fermentation period that lasts 7 days.

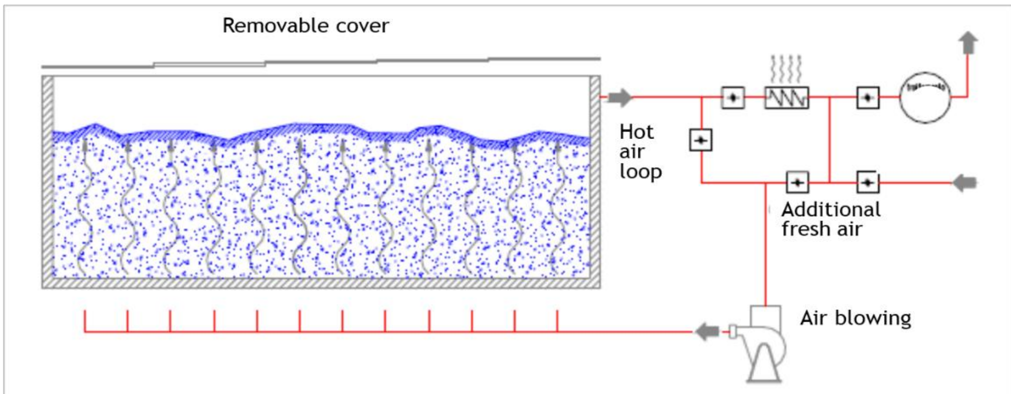


Figure 7. Bio-cell process: air flows

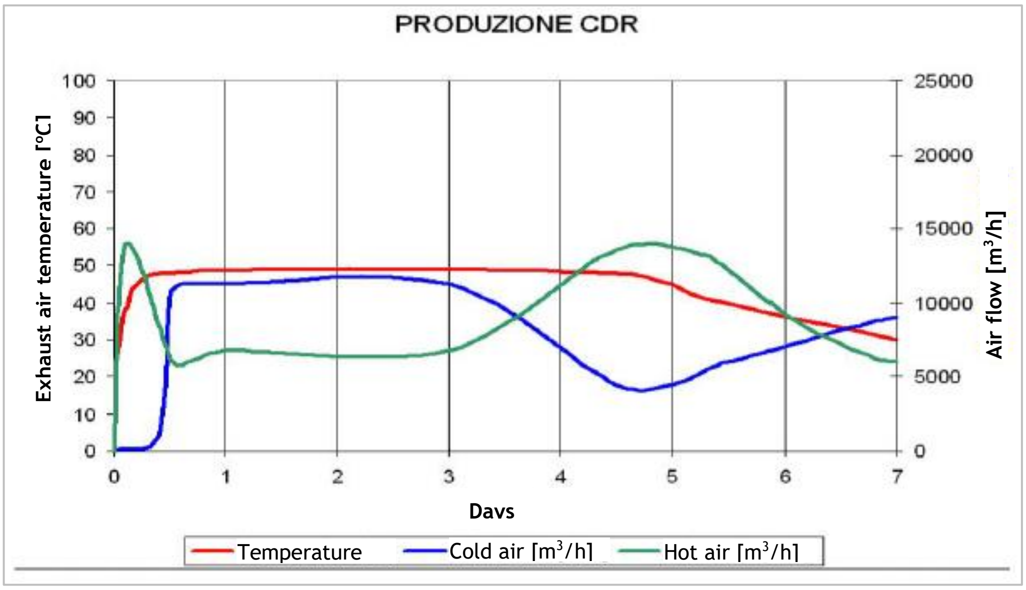


Figure 8. Bio-cell process: measured parameters variation during fermentation process

The fermentation process consists in 3 steps:

- starting of the process by increasing the temperature to the operational one (around 50°C);
- bio-oxidation at a temperature of around 50°C;
- cooling of waste, with further moisture removal.

Temperature increasing is due to heat generated by the microbial decomposition of organic matter, which results in the evaporation of water (moisture) present in waste.

Moisture content in the incoming waste is within the optimum range of 40—60%. Lower values inhibit the transport of enzymes and soluble substrates causing a slowdown and stagnation of bacterial activity, while higher values prevent correct oxygenation. The moisture content of the stabilized material is less than 15%, leading to a drop of about 30% in the weight of the mass of input waste and an increasing in calorific value of about 35%.

The oxygen level in the process air is kept in the range of 10–15%. As the blown air passes through the fermenting mass, it is enriched with CO_2 and smelly volatile organic compounds. This air flux is directly recirculated (hot air loop); cooled, dehumidified, recirculated again (cold air loop), and then added of additional fresh air. The surplus air is released into the atmosphere after high temperature thermal treatment to destroy the residuals organic volatile compounds.

4) Sorting of material: the waste coming out of the bio-cells is a dry material, which is easy to sort through a mechanical separation cycle. The stream is submitted to a number of sequentially mechanical screening and selection treatments, which progressively remove metals and all inert and low or no calorific materials, ending up with a material with higher calorific value, constituting the SRF. The process produces the following fractions of materials:

- SRF (stabilized organic matter, paper, cardboard, wood, plastics, textiles) suitable for energy recovery.
- Non-ferrous metals sent to recycling.
- Ferrous metals sent to recycling.
- Aggregates (gravel, sand, glass, ceramics, etc.) sent to reuse or landfilling.

The resulting SRF is high quality fuel with a calorific value of approximately 20 MJ/kg (as received).

Figure 9 reports the characteristics of the produced SRF according to ISO 21640:2020 – Specifications and Classes.

The plant has areas dedicated to the storage of the SRF as well as the various secondary row materials generated by the process, each identified by the proper EWC code.

Annex 1 shows two flow charts illustrating the present and the future asset of the plant, after SRF process revamping and doubling the co-incineration lines.

Efficiency and costs

An approximate amount of 0.4—0.5 tons of SRF is produced from a ton of MSW. As said, this significant mass reduction is mainly due to organic matter stabilisation and humidity loss during the bio-stabilization process within the bio-cells, which reduces the material mass of around the 30% and to the sorting of ferrous and non-ferrous metals, and inert materials.

Unfortunately, no data related cost of the process is available for publication.

Advantages and Limitations

As mentioned above, due to the waste sorting systems prior to incineration, Eco+Eco increases the sorting of recyclable material such as ferrous and non-ferrous metals, and inert aggregates (i.e., gravel, sand, glass, and ceramics) from the original unsorted MSW, according to the waste hierarchy and enhancing material recycling from waste fractions that otherwise would be incinerated or landfilled. Approximately 7,700 t/year of ferrous and non-ferrous metals are sorted and sent to recycling.

The produced SRF has a higher calorific value and more homogeneous characteristics than the unsorted MSW and it is 30% lighter what simplifies co-incineration operations, flue gases treatment and reducing un-burnt material in bottom ashes.

The plant is currently being upgraded and it is expected that by 2024 it will be possible to sort out also plastics from waste prior the SRF production. These plastics will be sent to recycling, reaching a higher level in waste hierarchy, and reducing CO_2 footprint related to combustion of fossil-derived plastics.

The revamped and upgraded plant will also strongly reduce fossil fuel consumption by reducing material transport by trucks to within and outside (transport to other users) the area. The upgrading will also decrease electrical consumption and automatization will enhance environmental protection making easier the management and the maintenance of the plant.

ISO 21640:2020 (I)

eco+eco ricicla e valorizza

Template for SRF specification

Codice classe e origine	
Class code:	3;3;2
Origin: acording to 7.2 eand Table 1 of ISO 21640	3.4.5 - 5.1 - 5.2.3
Parametri fisici	
Shape:	briquettes
particcle dimension d95(mm)	25

Frazione principale (minimo 95% in massa), mm

P8 d95 ≤ 8 mm	P12	d95 ≤ 12 mm	P25 d95 ≤ 25 mm	**P50**	**d95 ≤ 50**
P90 d95 ≤ 90 mm	P140	d95 ≤ 140 mm	P200 d95 ≤ 200 mm	P300	d95 ≤ 300 mm
P500 d95 ≤ 500 mm	P1000	d95 ≤ 1000 mm	P1500+ d95 > 1500 mm		

			Limit value		
		Value (mean)	Min	Max	80° Percentile
Contenuto di cenere, A ISO 21656	% (dw)	13,9	9,9	18,2	15,8
Umidità, M CEN/TS 15414-1, CEN/TS 15414-2, ISO 21660-3	% (dw)	4,5	2,8	7,0	5,3
Potere calorifico inferiore, PCI UNI EN ISO 21654	MJ/kg (as)	19,2	16,9	22,7	20,1
	MJ/kg (dw)	20,3	18,0	23,8	21,2

Proprietà chimiche

	Method of Analysis		**Valore tipico (media)**	Limit value	
				Max	80° percentile
Cl	UNI EN 15408	% (dw)	0,79	1,24	0,88
			Value (median)	Limit value	
				Max	80° percentile
Sb	UNI EN 15411	mg/kg (dw)	62	171	90
As	UNI EN 15411	mg/kg (dw)	0,5	2,98	0,50
Cd	UNI EN 15411	mg/kg (dw)	1,09	6,2	1,65
Cr	UNI EN 15411	mg/kg (dw)	73	225	107,4
Co	UNI EN 15411	mg/kg (dw)	6,6	29	10,84
Cu	UNI EN 15411	mg/kg (dw)	105	1860	192
Pb	UNI EN 15411	mg/kg (dw)	54	580	76
Mn	UNI EN 15411	mg/kg (dw)	122	245	170
Hg	UNI EN 15411	mg/kg (dw)	0,0198	0,042	0,029
Ni	UNI EN 15411	mg/kg (dw)	15,9	44	22,9
Tl	UNI EN 15411	mg/kg (dw)	0,5	0,5	0,5
Sn	UNI EN 15411	mg/kg (dw)	12	36	18,6
V	UNI EN 15411	mg/kg (dw)	3,3	10,1	4

dw: dry weight
as: as received

Figure 9. Characteristics of the produced SRF according to ISO 21640:2020 - Specifications and Classes.

Environmental Aspects

As already mentioned, the Eco+Eco plant process residual MSW after separated collection, generated by approximately 840,000 inhabitants (and up to 37 million single tourist presence per year) to produce SRF that is now only partially used in situ to feed a co-incineration plant for energy recovery and the remaining part is sold on the market. At present L1 co-incineration line is currently not able to process all the produced SRS, but starting from 2026, with the addition of a second co-incineration line (L2) it will be possible to use all the produced SRF in situ, avoiding the transport to other sites and saving the related CO_2 emission. In addition, sorting, and recycling of plastics from the unsorted MSW feeding the SRF Line 1 will reduce CO_2 emission and will improve the waste hierarchy in the valorisation of waste in term of material recycling instead of energy recovery and energy recovery instead of landfilling.

At present SRF Line 1 produces only bio-stabilised waste (RDF) which is, only partially treated in SRF Line 2 for the upgrading to SRF of class 3.3.2. (according to ISO 21640:2021 "Solid recovered fuels — Specifications and classes"), while the remaining residual part is treated outside the plant. The biogenic carbon content of the produced SRF is now around 60% of total carbon content, but it is likely that it will increase after the preliminary sorting of plastic materials contributing to increase the renewable energy produced in the combustion process.

Revamping and doubling of the burners will also result in saving of manpower of the involved operators.

Has been estimated a saving of fossil fuels (shuttles and shovels used to unload the material from the two lines of SRF production) of around 500 L/month with consequent CO_2 emission saving. However, the CO_2 emission reduction is mainly due to the sorting of recyclable materials (mainly plastics) which results in a saving in production of virgin polymers from crude oil and a reduction of CO_2 emitted due to not burned plastics waste.

Eco+Eco estimates to sort around 6,000 ton of plastic saving it from the energy recovery. Considering the CO_2 emission factor for producing virgin plastics and for the combustion process, the estimated emission saving is in the range of 24,000 – 48,000 ton/year, due to virgin[3] material not produced and 18,000 ton/year because of plastics not sent to incineration. The total saved emission of CO_2 would be from 42,000 to 64,000 ton if all the sorted is recycled, or a more reliable amount ranging from 29,000 to 45,000 ton considering that only 70% of the sorted plastics is recycled.

Other aspects

Policy aspects

Eco+Eco plant belongs to the key facilities identified by the local government in its Regional Waste Management Plan aiming at implementing the European Waste Directives (2008/98/CE) in terms of waste hierarchy and principles of self-sufficiency and proximity.

[3] EPA 2015. Link here

Social and behavioural aspects

Most of the resident people accepts policies that improve the separated collection of MSW, but the so called “NIMBY” (Not In My Back Yard) syndrome is very rooted in the local public opinion with a low public acceptance towards any kind of waste treatment. Eco+Eco site, together with the entire Eco-district of Porto Marghera is placed in an industrial area with the aim of either keeping waste treatment plants as far as possible from towns or requalifying the industrial area, which caused important pollution in the past decades. Furthermore, co-incineration plants are not well-regarded by local inhabitants, fearing that the plume of the incinerator can cause high pollution and health diseases. To this extent, the owner of the plant has a plan for visits for schools and citizens (in 2022 more than 400 students visited the plant). According to the authorization for managing the plant, Eco+Eco publishes once a year the results of the monitoring activity carried out at the site, and it is developing a website where the results of air emission monitoring will be monthly published.

Future Plans

The present flow chart of the plan is reported in Annex 1 A. Revamping of the SRF Line 1 is in process and it is expected to be fully operational within the end of 2025. This line will be almost completely automatized. A detailed flow chart for the process once the upgrading of the plant will be finished can be found in Annex 1 B. After seven days of aerobic biological treatment, waste will be automatically picked up and transferred into the mechanical treatment and selection plant, where raw SRF will be refined. A disc sieve will divide the material into two fractions: material with size 0–35 mm and material larger than 35 mm. Afterwards, the fraction 0–35 mm undergoes ferrous and non-ferrous metals separation. The remaining inert material will be temporarily stored before disposal. The waste fraction larger than 35 mm coming out of the disc screen and will passe through two ballistic separators that sort the material into three streams:

- films and soft material, sent to a non-ferrous metal separator;
- rigid material sent the optical reader placed downstream the ballistic separators for the separation of plastics;
- fine materials (0–35 mm), sent to a subsequent wind screen for the separation of aggregates.

The plastic stream will be sent to a Near Infra-Red (NIR) optical reader, that can discern plastics between polypropylene/polyethylene (PP/PE) and polyethylene terephthalate/polyvinyl chloride (PET/PVC) on the base of their NIR spectra elaboration. The collected material is baled and sent to recycling in an external plant. Downstream of the latter treatment, the remaining material represents the produced SRF that will be transported by a conveyor belt to the feeding pit of the co-incineration lines, where a crane loads it into the feeding hoppers of both lines.

At present, the transport of waste within the plant is done by trucks, but in future it will be possible to reduce their use as well as of other devices, like shovels, strongly reducing the consumption of fossil fuels.

The expected advantages can be summarized in:

- reducing SRF production costs due to the use of energy-saving tools and devices;
- reducing fuel consumption, maintenance cost and related dedicated manpower;
- Increasing the profits from selling materials sorted during the process (mainly plastics and metals).

By making the process fully automated, the working environment and safety conditions for workers will be olso improved.

Lessons learned/recommendations

Advanced fully automatic waste sorting systems applied to residual MSW allows to:

- recover recyclable material from a waste stream prior the energy recovery, according to the waste hierarchy;
- reduce the amount of material sent to incineration/co-incineration, by coupling the bio-stabilization process and last generation sorting technology for the recovery of valuable material with a reduction in weight of around 30% with respect to the original MSW input;
- Increase the calorific value of the produced SRF up to 35% with respect to the original unsorted MSW;
- improve the incineration/co-incineration process, flue gases treatment and bottom ash quality, being the SRF more homogeneous than the original unsorted MSW;
- reduce the combustion of fossil-derived plastics, decreasing the related CO_2 emission into atmosphere.

General conclusions

Eco+Eco plant treats residual MSW produced by approximately 840,000 inhabitants of Venice Province and up to 37 million of single tourist presence per year, producing SRF that is used to in situ generate electrical power sold as fuel to other plants.

Starting from 2026, a second co-incineration line will be operational and all the SRF will be used inside the plant, avoiding transportation to other sites, reducing CO_2 emissions connected to its transport and becoming independent from external plants demand.

Unsorted MSW delivered to the plant undergoes a bio stabilisation process by means of bio-cells reducing water content and producing the oxidation of the organic fraction of waste, resulting in around 30% of weight loss of the original MSW. This allows to treat unsorted MSW from the lagoon of Venice, where for logistic problem, the food waste cannot be separated at the origin with consequent high organic matter content of the collected unsorted MSW.

The downstream of bio stabilisation process undergoes a mechanical treatment and selection that allows to:

- sort out recyclable material, such as ferrous and non-ferrous metals (around 7,700 ton/year), inert aggregates (i.e., gravel, sand, glass, and ceramics), applying the waste hierarchy and promoting material recovery in a waste stream fraction otherwise sent to incineration or landfilled;
- produce high quality SRF, with higher calorific value and more homogeneous properties than the original unsorted MSW.

The SRF plant is currently being revamped and it is expected that by the end of 2024 it will be able to sort out also almost 6,000 t/year of recyclable plastics from waste that could be sent to recycling, reducing the combustion of fossil-derived materials and the connected CO_2 emission. The biogenic carbon in the produced SRF is at present around 60% of total organic carbon content, but with this improvement it will be further increased.

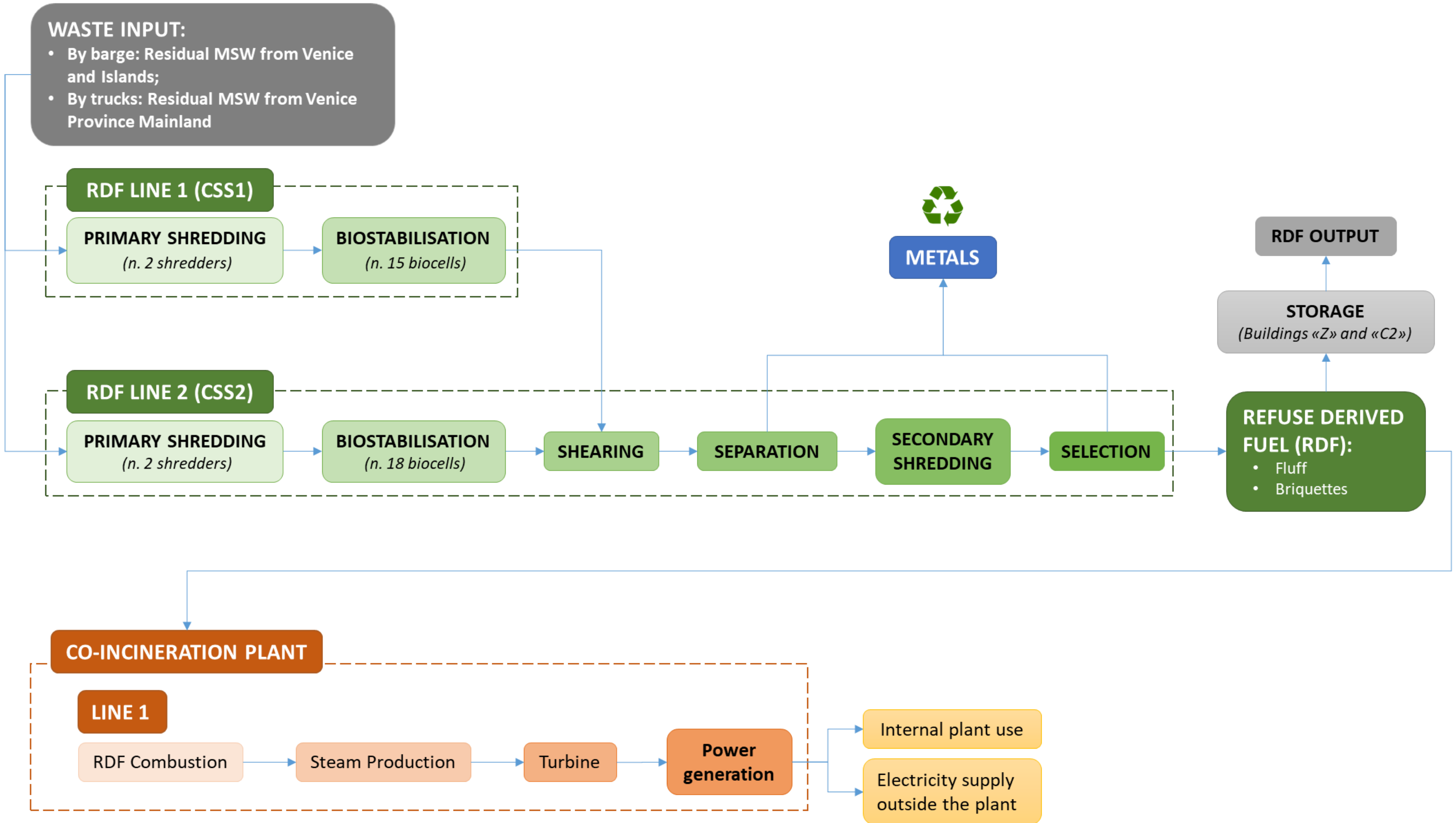
The revamped and upgraded plant will also drastically reduce fossil fuel consumption thanks to automatization, reducing material transport by trucks within and outside of the plant, decreasing self-consumption of power, making the working environment safer, and easier the management of control and maintenance of the plant, providing an example of integrated waste management that serves an extended and complex area, such the Venice Province, and “closing circle”.

Sorting recyclable material from residual MSW -that otherwise would be landfilled- will lead to a decrease of CO_2 emission related to either combustion of fossil-plastics or internal and external transport of SRF. The related saved emission of CO_2 will be in the range of 42,000 - 64,000 ton/year if all the sorted plastics is recycled, or a more reliable amount ranging from 29,000 to 45,000 ton considering that only the 70% of the sorted plastics is recycled.

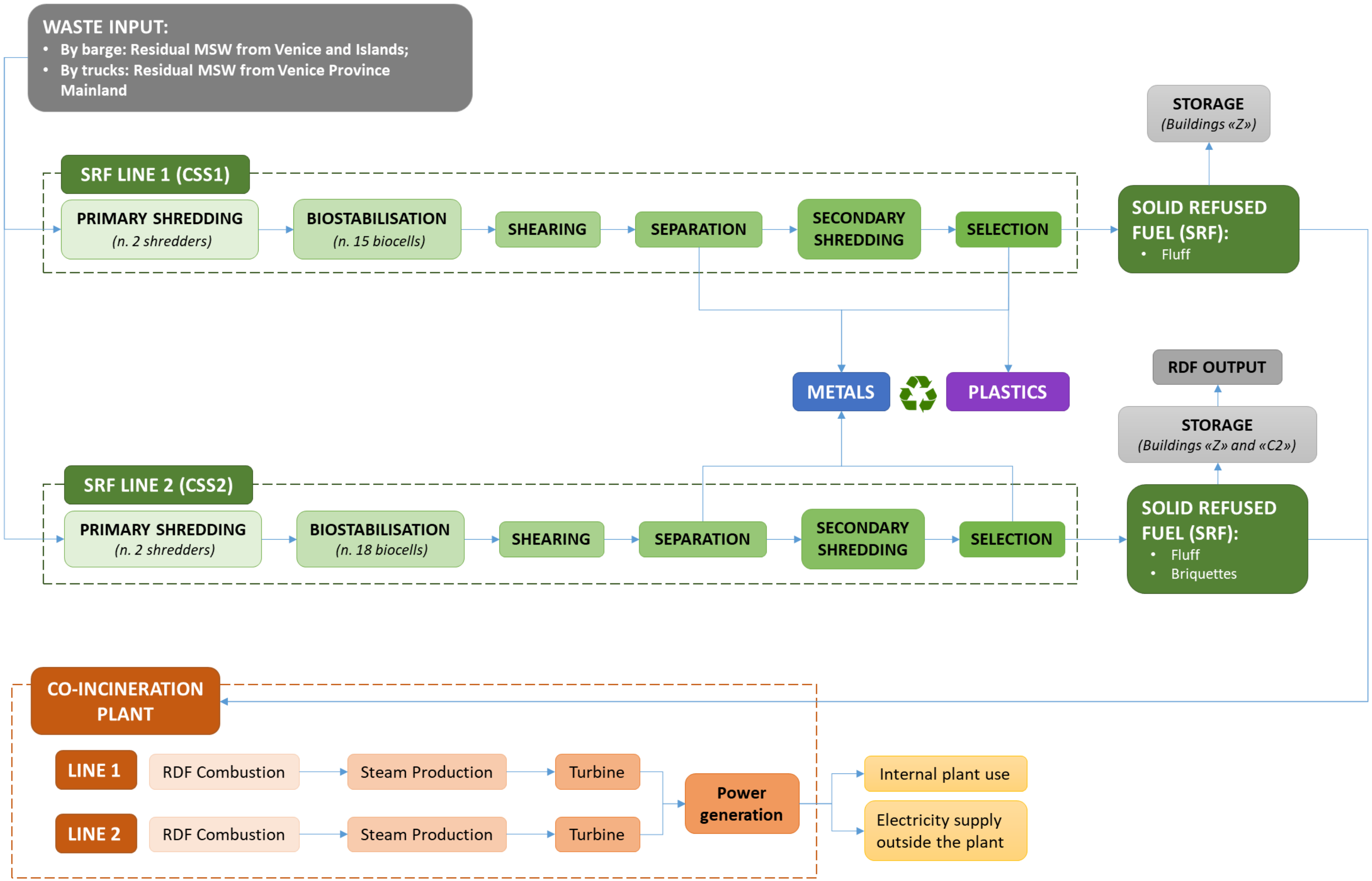
The in-situ energy recovery from a high quality SRF rather than from the original unsorted MSW will produce fully oxidized ashes that can be used in construction industry and makes easier the plant management, maintenance, and flue gas treatment.

Annexes

Annex1 - Current and future industrial centre of Eco+Eco



Flow chart of current industrial centre for the production of SRF.



Flow chart of future industrial centre of Eco+Eco for the production of SRF.

IEA Bioenergy

Technology Collaboration Programme