

COMUNE DI RAVANUSA (AG)

**PRESENTATION OF THE PROJECT FOR A PLANT
FOR THE PRODUCTION OF BIOMETHANE FUELED BY F.O.M.S.W.,
AGRI-FOOD WASTE AND GREEN
MAINTENANCE**

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**Il Progettista:
Ing. Francesco BARRESE**



Supply basin project for a biomethane production plant fueled by solid fuel (f.o.r.s.u.), agri-food waste, and green maintenance waste in Ravanusa (Ag).

Presentation

SUMMARY

1.	INTRODUCTION	3
2.	TYPES AND QUANTITIES OF WASTE MANAGED	3
2.1	Power plan.....	3
2.2	Suppliesystem.....	4
2.2.1	Thebioenergysupplychain	5
2.2.2	TYPES AND QUANTITIES OF WASTE MANAGED.....	5
2.2.3	Waste from agriculture and the agri-food industry.....	6
3.	ACTIVE SYSTEMS IN THE TERRITORY CONSIDERED BY THE PROJECT.....	7
4.	TECHNOLOGICAL SOLUTION	10
5.	CURRENT STATUS OF ACTIVITY.....	13

Supply basin project for a biomethane production plant fueled by solid fuel (f.o.r.s.u.), agri-food waste, and green maintenance waste in Ravanusa (Ag).

Presentation

1. INTRODUCTION

This technical report aims to illustrate and describe in detail the definition of the supply basin for the types of waste to be recovered within the biomethane plant powered by FORSU, waste from the agri-food industry and agricultural by-products to be located in the industrial area of the Municipality of Ravanusa (Ag).

2. TYPES AND QUANTITIES OF WASTE MANAGED

The plant in question will introduce a diet based on the use of the organic fraction of municipal solid waste collected separately, agro-industrial waste, and plant waste from the maintenance of green areas and/or forestry. This will be used to produce biogas, which, once properly purified, will be fed into the national distribution network.

2.1 Power Plan

The following table shows the power plan developed for the Ravanusa biomethane gas plant.

Supply basin project for a biomethane production plant fueled by solid fuel (f.o.r.s.u.), agri-food waste, and green maintenance waste in Ravanusa (Ag).

Presentation

Piano di alimentazione

Biomassa	CER	Quantitativi [t/anno]
Rif. Biodegradabili di cucine e mense (FORSU)	20 01 08	40.000
- Rif. Prodotti in agricoltura, orticoltura, acquacoltura, selvicoltura, caccia e pesca, trattamento e preparazione di alimenti (scarti agroindustria)	020101 020102 020103 020201 020202 020203 020301 020302 020304 020501 020601 020602 020701 020702 020704	10.000
- Rifiuti biodegradabili (scarti vegetali)	200201	5.000
	Totale	55.000

2.2 Supply System

To ensure the technical, economic, and environmental sustainability of the biomethane plant, it is necessary to design a dedicated supply system that is tailored to the specific characteristics of the area and maximizes the use of local resources (environmental proximity criterion). Indeed, the design approach was to prioritize the use of waste produced regionally, for example, to address the lack of facilities for the recovery of OFMSW and other waste requiring treatment. This choice was made considering the fact that this is a recovery plant whose scope (considering a 70 km buffer) includes municipalities in several Sicilian provinces, specifically the provinces of Palermo, Catania, Agrigento, Caltanissetta, Ragusa, and Enna.

For the purposes of this document, we limit ourselves to the analysis of the productions of the provinces of **Agrigento** (with the exception of the municipalities of Sciacca, Ribera, Menfi, Sambuca di Sicilia, Realmonte, Siculiana, Cattolica Eraclea, Bivona, Caltabellotta, Cianciana, S. Biagio Platani, Montevago, Alessandria della Rocca, Burgio,

Supply basin project for a biomethane production plant fueled by solid fuel (f.o.r.s.u.), agri-food waste, and green maintenance waste in Ravanusa (Ag).

Presentation

Montallegro and Calamonaci), **Ragusa** (excluding the municipalities of Pozzallo and Ispica), **Enna**, and **Caltanissetta**. The area of these five provinces, which falls within the 70 km buffer, includes approximately 940,000 inhabitants.

The biomass supply system for the Ravanusa (Ag) plant has been implemented through three different channels:

- OFMSW from municipal solid waste collection;
- Plant waste from garden maintenance;
- Residual waste from agricultural and food sources.

2.2.1 The bioenergy supply chain

The bioenergy supply chain was designed following the criteria proposed by the International Energy Agency, taking particular account of potential biomass production at the local level.

The design and structuring of the bioenergy supply chain for the Ravanusa plant is based on the preliminary coordination of a complex series of relationships across the region, in order to achieve a balance, on a local scale, between supply and demand for biomass that can be used for energy production.

The bioenergy supply chain's contribution was maximized by keeping collection, processing, and use activities local and by favoring a plant size capable of absorbing the biomass supply on a local scale.

The bioenergy supply chain is eco-sustainable because it is "short" (in space) and "short" (in time), guaranteeing a positive energy balance (biomethane) and overall negative or zero CO₂ production.

2.2.2 Sustainable management of the supply basin:

The planned biomass plant will use as its production source FORSU from an area of southern Sicily, comprising 79 municipalities and a population of approximately 940,000, with an expected average annual production of

Supply basin project for a biomethane production plant fueled by solid fuel (f.o.r.s.u.), agri-food waste, and green maintenance waste in Ravanusa (Ag).

Presentation

Organic fraction from MSW alone (F.O.R.S.U.) equal to approximately 100,213 tons, calculated based on a regional average of 109.61 kg/inhabitant per year (source: ISPRA Report 2024).

The energy conversion plant will be operated using OFMSW or agro-industrial waste and/or by-products transported within a 70 km radius of the plant (definition of short supply chain expressed in Article 1, paragraph 382 of Law No. 296/2006, as amended by Article 26, paragraph 4bis of Law No. 222/2007).

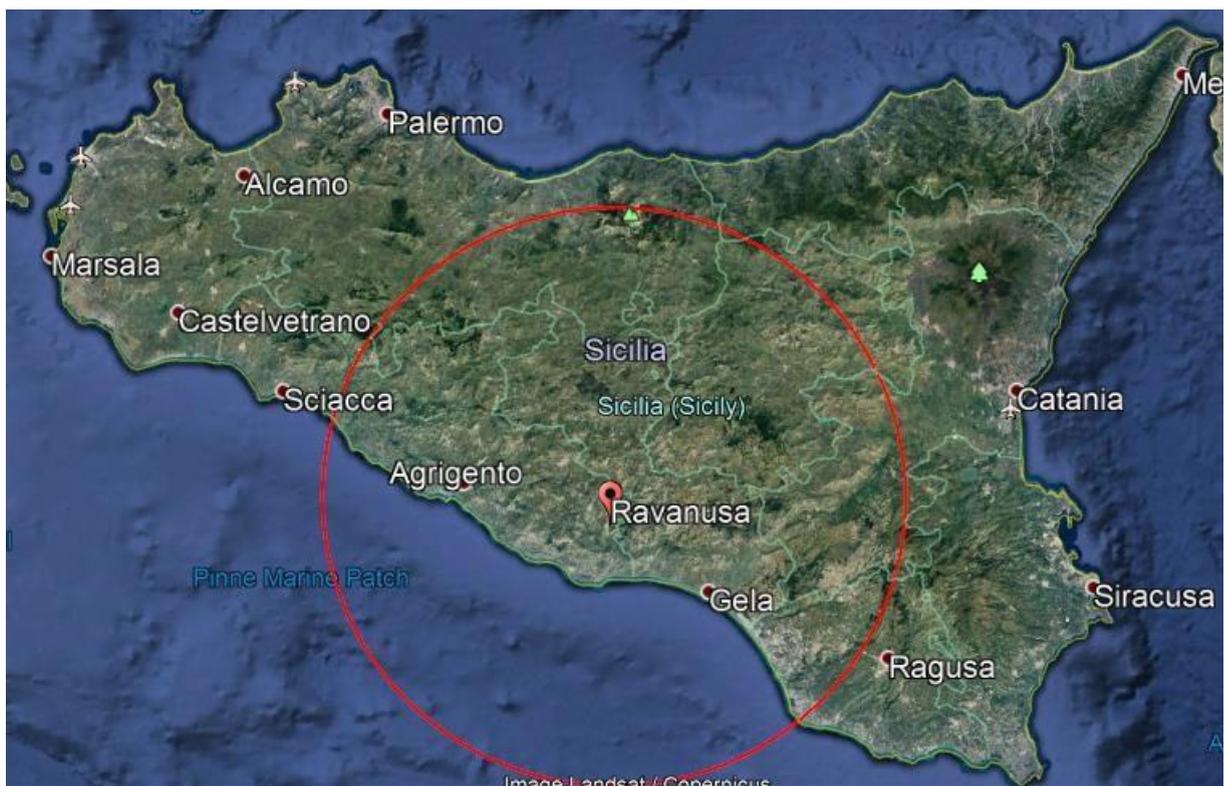


Figure 1: Territorial diagram of the supply basin of the OFMSW constituting the biomass to produce energy in the plant planned in Ravanusa (AG).

2.2.3 Waste from agriculture and the agri-food industry

The area where the plant is planned to be built is characterized by the presence of several agri-food industries. The affected area also includes several other

Supply basin project for a biomethane production plant fueled by solid fuel (f.o.r.s.u.), agri-food waste, and green maintenance waste in Ravanusa (Ag).

Presentation

Agricultural processing companies. Based on information gathered from these facilities, annual waste production for energy recovery well exceeds 10,000 tons.

3. ACTIVE SYSTEMS IN THE TERRITORY CONSIDERED BY THE PROJECT

According to the ISPRA waste collection report for the year 2024, there are 23 active composting plants and 2 energy recovery plants in the regional territory;

Tabella 3.2.1 – Compostaggio dei rifiuti, per regione (tonnellate), anno 2023

Regione	N. impianti operativi (1)	Quantità autorizzata	Totale rifiuti trattati	Tipologie dei rifiuti trattati			
				Frazione umida	Verde	Fanghi	(2) Altro
Piemonte	16	391.130	217.822	24.895	115.264	46.941	30.722
Valle d'Aosta	0	-	-	-	-	-	-
Lombardia	58	1.196.735	757.437	43.099	463.865	60.455	190.018
Trentino-Alto Adige	11	84.280	43.224	12.975	25.030	-	5.219
Veneto	49	543.975	361.652	49.871	172.852	118.973	19.956
Friuli-Venezia Giulia	16	70.590	50.246	10.677	39.033	-	536
Liguria	5	49.900	20.455	1.023	16.817	-	2.615
Emilia-Romagna	11	269.470	294.796	69.028	167.815	46.872	11.081
Nord	166	2.606.080	1.745.632	211.568	1.000.676	273.241	260.147
Toscana	12	220.100	162.079	66.219	59.975	13.284	22.601
Umbria	2	47.000	27.655	-	9.073	14.422	4.160
Marche	4	130.400	89.124	61.121	15.135	9.453	3.415
Lazio	15	217.985	125.516	15.502	89.449	15.447	5.118
Centro	33	615.485	404.374	142.842	173.632	52.606	35.294
Abruzzo	5	157.650	84.329	54.963	7.298	17.950	4.118
Molise	2	32.400	12.308	9.909	464	1.844	91
Campania	5	186.820	61.860	7.968	6.205	38.386	9.301
Puglia	8	422.631	255.514	225.090	18.736	7.318	4.370
Basilicata	0	-	-	-	-	-	-
Calabria	11	224.600	104.496	69.076	17.497	14.161	3.762
Sicilia	23	821.575	490.980	295.568	65.607	124.754	5.051
Sardegna	22	378.160	248.475	199.701	38.752	13	10.009
Sud	76	2.223.836	1.257.962	862.275	154.559	204.426	36.702
ITALIA	275	5.445.401	3.407.968	1.216.685	1.328.867	530.273	332.143

(1) Nel numero di impianti indicato in tabella sono incluse le linee di impianti di trattamento meccanico biologico aerobico dedicate al trattamento delle frazioni organiche provenienti dalla raccolta differenziata, per la produzione di compost.

Supply basin project for a biomethane production plant fueled by solid fuel (f.o.r.s.u.), agri-food waste, and green maintenance waste in Ravanusa (Ag).

Presentation

Tabella 3.2.3 – Trattamento integrato anaerobico/aerobico dei rifiuti, per regione (tonnellate), anno 2023

Regione	N. impianti operativi (1)	Quantità autorizzata	Totale rifiuti trattati	Tipologie dei rifiuti trattati			
				Frazione umida	Verde	Fanghi	(2) Altro
Piemonte	8	631.700	449.421	286.212	72.458	57.311	33.440
Valle d'Aosta	0	-	-	-	-	-	-
Lombardia	10	1.251.440	990.814	885.993	75.564	11.492	17.765
Trentino-Alto Adige	1	60.000	58.238	40.041	18.197	-	-
Veneto	6	911.300	939.906	652.001	144.613	64.032	79.260
Friuli-Venezia Giulia	2	360.770	355.483	305.472	31.620	923	17.468
Liguria	1	80.000	61.926	60.136	1.790	-	-
Emilia-Romagna	10	754.350	586.938	457.727	104.581	695	23.935
Nord	38	4.049.560	3.442.726	2.687.582	448.823	134.453	171.868
Toscana	3	288.000	158.856	112.414	24.330	19.454	2.658
Umbria	4	208.500	124.791	89.194	35.247	-	350
Marche	0	-	-	-	-	-	-
Lazio	3	230.000	166.307	124.293	31.564	9.085	1.365
Centro	10	726.500	449.954	325.901	91.141	28.539	4.373
Abruzzo	2	106.500	66.336	57.005	6.240	1.659	1.432
Molise	0	-	-	-	-	-	-
Campania	3	125.648	72.427	45.132	5.705	1.135	20.455
Puglia	4	266.710	176.297	112.616	2.140	12.089	49.452
Basilicata	0	-	-	-	-	-	-
Calabria	2	132.000	103.627	101.517	1.268	-	842
Sicilia	2	87.375	37.438	27.265	10.173	-	-
Sardegna	0	-	-	-	-	-	-
Sud	13	718.233	456.125	343.535	25.526	14.883	72.181
ITALIA	61	5.494.293	4.348.805	3.357.018	565.490	177.875	248.422

(1) Nel numero di impianti indicato in tabella sono incluse le linee di impianti di trattamento meccanico biologico aerobico dedicate al trattamento integrato delle frazioni organiche provenienti dalla raccolta differenziata.

(2) Rifiuti di carta, cartone, legno, rifiuti provenienti da comparti industriali (agroalimentare, tessile, carta, legno), rifiuti da trattamento aerobico e anaerobico dei rifiuti.

Fonte: ISPRA

The total quantities treated in the region in 2023 were 528,000 tons, of which 322,000 tons were OFMSW and 75,000 tons were green waste.

Based on the above, it is deemed absolutely necessary to build biomethane production plants as, from an environmental, economic, and overall sustainability perspective, they offer far greater performance than traditional composting plants.

In the area covered by this project, there are currently two active plants with a total annual production of 24,131 tons. The aforementioned quantities include partly OFMSW, partly plant waste, and partly residual sludge.

Supply basin project for a biomethane production plant fueled by solid fuel (f.o.r.s.u.), agri-food waste, and green maintenance waste in Ravanusa (Ag).

Presentation

Figura 3.2.20 – Ubicazione degli impianti di trattamento integrato anaerobico/aerobico dei rifiuti, per comune, anno 2023



Fonte: ISPRA

Without further considerations on the different plant design (composting plants are now considered obsolete from a technical and environmental point of view and poorly performing from an energy and therefore economic point of view and almost all have been modernised by converting to anaerobic systems), from the data shown above there is absolute sustainability from the point of view of

Supply basin project for a biomethane production plant fueled by solid fuel (f.o.r.s.u.), agri-food waste, and green maintenance waste in Ravanusa (Ag).

Presentation

given the availability of organic matrices produced domestically in the area covered by the project.

4. TECHNOLOGICAL SOLUTION

Pretreatment

To create the conditions for optimal wet anaerobic digestion (WAD) operation, the waste fed to the plant must be appropriately treated to obtain a homogeneous, pumpable aqueous solution that is, as far as possible, free of non-biodegradable materials that could create problems with plant management and maintenance.

The pretreatment consists of:

- bag opening,
- iron removal
- pulping and homogenization,

Supply basin project for a biomethane production plant fueled by solid fuel (f.o.r.s.u.), agri-food waste, and green maintenance waste in Ravanusa (Ag).

Presentation

- size control,
- separation of lightweight aggregates and plastics, which includes the following functions:
 - washing of waste products
 - recovery of water for the process.

inert material separation system within which the functions of

- Aggregate separation
- Aggregate washing.

Pretreatment is capable of processing municipal waste feed with a dry matter content of up to 80% DM and a minimum of 80% putrescible organic matter.

Requirements and advantages of the pretreatment technology solution

The application of anaerobic digestion technology to municipal waste can be achieved effectively if the organic content of the waste is transformed into a homogeneous product suitable for the growth of anaerobic bacteria. Therefore, the results achievable with anaerobic digestion in terms of degradation efficiency, biogas production, operational stability, and the production of high-quality compost will depend on the pretreatment's ability to minimize waste and the organic matter it contains and its ability to create a homogeneous pulp that remains consistent over time, even as the conditions of the waste feed vary.

Anaerobic digestion

Anaerobic digestion refers to the biological process of an organic substrate conducted in controlled reactors in the absence of oxygen.

Wet anaerobic digestion is the most established and widespread technique and requires that the substrate fed to the reactor has a dry matter concentration of less than 15%.

In European Mediterranean countries such as Italy, the substrate has a high water content, ranging from 70% to 80% by weight, especially in summer due to changes in consumer food consumption and the increase in fruit and vegetable waste (watermelons, melons, tomatoes, vegetables, various fruits, etc.).

Furthermore, during the anaerobic decomposition process, the dry matter is transformed into soluble compounds in the hydrolysis phase and subsequently into

Supply basin project for a biomethane production plant fueled by solid fuel (f.o.r.s.u.), agri-food waste, and green maintenance waste in Ravanusa (Ag).

methane, reducing the dry matter concentration in the reactor to less than half its original concentration.

For this reason, the wet process allows for stable and homogeneous operating conditions, facilitating management and efficiency.

The wet anaerobic digestion process is carried out under mesophilic conditions at a temperature of 36-42°C.

Composting

In general, the digested sludge produced by the methanization phase may not be fully stabilized due to the short residence time in digestion reactors.

To this end, a subsequent aerobic stabilization phase must be included, aimed at completing the degradation of the organic matter and achieving sanitization of the material.

Biogas Valorization

Biogas production in an anaerobic digestion plant is generally constant, as the organic substrate is fed continuously.

Biogas production occurs within the digesters with a pressure range of a few mbar.

The biogas produced in the plant is sent to the purification system for the production of biomethane, with chemical and physical characteristics similar to those of natural gas.

Recovering the energy contained in waste as biomethane is the best option currently available:

Biomethane is a programmable source;

It is the most efficient waste-to-energy conversion system for automotive use; It does not concentrate combustion emissions (from engines) in a single point.

Biomethane grading

The purification plant will be powered by biogas produced by anaerobic digestion, producing biomethane for use in grid-fed transport. The plant has an estimated

Supply basin project for a biomethane production plant fueled by solid fuel (f.o.r.s.u.), agri-food waste, and green maintenance waste in Ravanusa (Ag).
capacity of approximately 4.5 million cubic meters of biomethane.

This plant consists of two main components:

- Unit of upgrading
- compression system for network emission by means of a bonbalaio wagon
- liquefaction system (as an alternative to feeding into the grid)

Wastewater Treatment

The digestate from the biodigestion process will be treated on site. The digested liquid will arrive with a dry matter content of 4.7%. Passing through a separator and then a centrifuge, the dry matter level will be lowered to 1.5-2%.

The treatment plant for the liquid fraction of the digestate was sized based on the overall mass balance, which estimates the anaerobic digestion plant will receive 80,000 tons of biological waste and by-products per year.

Discharge is planned in compliance with the requirements of Table 3 of Annex V of Legislative Decree 152/06 into the existing sewer system, which will transport the wastewater to the nearby consortium treatment plant.

The sludge from the various process stages will be partly returned to the top of the composting line and partly sent for disposal.

5. CURRENT STATUS OF ACTIVITY

As of the date of writing this report, the implementation status of the initiative is as follows:

1. The special purpose company RADICI ECOLOGIA SRL was established
2. Radici Ecologia srl is the assignee of the land in the Ravanusa industrial area (surface area 35,000 m²);
3. The authorization process is underway; on December 9, 2025, the second conference of services was held to enable the CTS to issue the EIA provision. The opinions received are favorable (Municipality, IRSAP, SRR Ag/4, and Fire Brigade), ARPA has requested additional information regarding water management (which must be submitted by the end of January 2026), and the Regional Superintendency has stated that it does not need to issue an opinion as the site falls within an industrial area. The other invited bodies have not issued opinions.
4. Authorization is expected to be obtained within the first half of 2026.

Supply basin project for a biomethane production plant fueled by solid fuel (f.o.r.s.u.), agri-food waste, and green maintenance waste in Ravanusa (Ag).

LAVELLO (Pz), 10/12/2025

IL PROGETTISTA

Ing. Francesco Barrese

