



## Development of biogas and management of the nitrates in Veneto

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**Abstract.** *This study aims to analyze the development of biogas from an agricultural and animal husbandry matrix in the Veneto in order to evaluate its effects in terms of the involvement of animal biomass and production of nitrates. The analysis showed that the use of the digestate, from the process of biogas production, such as fertilizer, reduces the final quantity of nitrogen distributed directly on the ground in comparison with that derived from the traditional use of livestock and agricultural effluents, thereby reducing the possibility of groundwater pollution. The data on the location of the plants and the production of biogas, in connection with those related to the management of livestock manure and the production of nitrates, form a base of information that is useful for designing policies aimed at protecting the areas vulnerable to nitrates in the Veneto region.*

**Keywords.** *Biogas; Nitrates; Nitrate Vulnerable Zones; Groundwater.*

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### 1 The development of biogas in Veneto<sup>1</sup>

Energy policies implemented by European countries are aimed at diversifying energy supply sources, increasing energy efficiency and developing renewable energy. The Directive 2009/28/EC of the European Union set a target of 20% of energy production from renewable sources in total gross final consumption to be achieved by 2020 in the EU and a target of 17% for Italy. With various acts of programming, such as the National Action Plan for Renewable Energy in Italy (PAN) of 30 June 2010, the DM 15 March 2012 of the Minister of Economic Development, the so-called Decree Burden Sharing, for the splitting of the Italian target between different regions, and different regional energy plans, the possible development of each renewable source was defined in accordance with the overall targets set at the top level. In this sense, a significant role is played by bio-energy and particularly by biogas, which saw a rapid development in recent years throughout Italy and the Veneto thanks to the strong incentives that policy put in place. We have moved, at the national level, from a biogas production of 1,336.3 GWh in 2006 to a production of 4,619.9 GWh in 2012. Among the various matrices used, the products from agriculture and forestry carry a significant weight, contributing 54.8% (2012 data) of the total production compared with 8.3% in 2006. The same increasing change applies to the animal wastes related to animal husbandry with an 11.2% (2012 data) contribution; a significant increase when compared with 3.3% of 2006. In 2012 in Veneto, with 197 plants, 571.8 GWh or 12.4% of national production were produced from biogas, with a very diversified supply from various provinces.

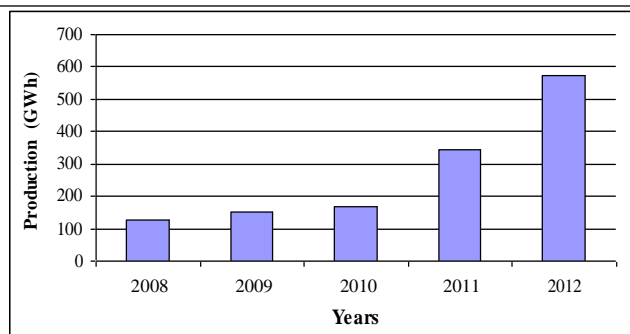


Figure 1: Production of energy from biogas in the Veneto (Source: GSE)

Provinces	Production from RES	Production from bio-energy	Production from biogas
Belluno	2,193.4	212.6	4.5
Padova	543.5	250.1	169.3
Rovigo	452.9	87.5	86.9
Treviso	1,002.9	37.5	32.0
Venezia	452.9	325.1	109.8
Verona	1,184.0	136.4	132.7
Vicenza	640.5	87.5	36.6
Total Veneto	6,470.2	1,136.7	571.8

Table 1: Production of energy from Renewable Energy Sources (RES), bio-energy and biogas in GWh in the Veneto provinces in 2012 (Source: GSE)

As with all energy sources, there is the problem with assessing the impact of biogas on the environment<sup>1</sup> and health. There were no major objections expressed so far compared to plants licensed or in operation, but proper verification and reporting on pollution associated with this type of energy production is useful in enabling the public administrators to take decisions advisedly and to prevent onset of so-called NIMBY syndrome.

<sup>1</sup> This paragraph was edited by Federica Schenato

## 2 The management of nitrates connected at biogas plants<sup>2</sup>

Fertilization performed with the distribution of livestock effluents or with the use of digestate, i.e. the product resulting from the anaerobic digestion implemented in the process of biogas production, causes the release of nitrogen in the soil, which, if not absorbed by plants, can represent a potential source of pollution for groundwater and surface water. In order to protect water resources, the European Union enacted Directive 91/676/EEC, the so-called Nitrates Directive, which established the basic principles for the regulation of these activities in order to promote the proper use of agricultural practices. This Directive, which provides for the identification of Nitrate Vulnerable Zones (NVZ) and the implementation of Action Programs, is implemented in Italy by the Legislative Decree n. 152/1999, later replaced by Legislative Decree n. 152/2006 (Environmental Code). Subsequently, the Regional Government of Veneto with D.G.R. n. 2495/2006 approved the first Action Program for vulnerable zones by nitrates from agricultural sources, by regulating the activities of spreading of livestock manure for vulnerable zones and for the remaining agricultural areas; it was followed by the second Action Program covering the period 1st January 2012 - 31st December 2015, approved by D.G.R. n. 1150/2011. This Program is also effective in the territories classified as vulnerable zones in the drainage basin of the Venice lagoon, the Province of Rovigo, the municipality of Cavarzere, the hundred municipalities of the high plain, the municipalities of Lessinia and reliefs in the right Adige. These large areas of land correspond to about 60% of the surface of the entire region. It should be remembered that the current

<sup>1</sup> An interesting model for the analysis of the environmental impact of biogas plants, limited to atmospheric emissions, is contained in the analysis conducted by TIS - Techno Innovation Alto Adige S.C.p.A..

legislation provides different limits for the maximum amount of nitrogen by animals that can be used in spreading the field: 170 kg/ha per year in NVZ and 340 kg/ha per year in Ordinary Zone (OZ).

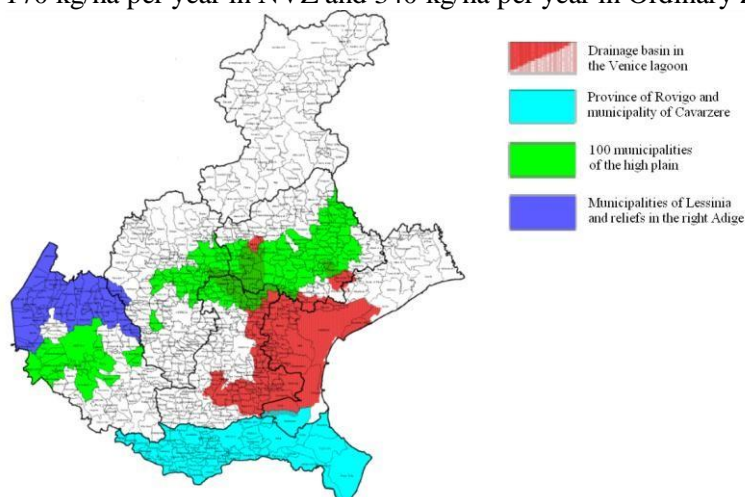


Figure 2: Map of NVZ (Source: Regione Veneto)

Let us now consider the data related to the nitrogen input and output from biogas production plants fed in whole or in part from animal manure, which results from the nitrates database built according to spreading plans and agronomic use manure communications. These communications are for installations with power up to 1 MW electric and 3 MW thermal.

	Zone type	NVZ	OZ	Total
	No. Plants	61	58	119
Nitrogen in the input in the plants	Nitrogen from zootechnic manure (kg/yr)	2,301,419	1,844,548	4,145,967
	Nitrogen from other biomasses (kg/yr)	1,708,597	2,510,105	4,218,702
	Total nitrore (kg/yr)	4,010,016	4,354,653	8,364,669
Nitrogen in the output in the plants	Nitrogen from zootechnic manure (kg/yr)	1,816,079	1,701,819	3,517,898
	Nitrogen from other biomasses (kg/yr)	1,419,464	2,312,929	3,732,393
	Total nitrogen (kg/yr)	3,235,543	4,014,748	7,250,291
	% abatement of nitrogen from zootechnic manure	-21.1%	-7.7%	-15.1%
	% abatement of nitrogen from other biomasses	-16.9%	-7.9%	-11.5%
	% abatement of total nitrogen	-19.3%	-7.8%	-13.3%

Table 2: Nitrogen treated by the plants for biogas production in 2013. (Source: Based on data from the Regione Veneto - Sezione Agroambiente)

The data show a general decrease in the amount of nitrogen, which, although not caused from the anaerobic digestion process, but rather from the accessories treatments which underwent the digestate in output, goes in the direction of the reduction of the amount of nitrogen used directly in the fertilization of soils, compared to the amount that would have been available without the presence of digesters. This decrease was more pronounced in NVZ compared to OZ, and for nitrogen by animals, compared to that produced by other biomasses. In confirmation of these evaluations, it should be noted that in the 16 plants that use only zootechnic manure the decrease of the amount of nitrogen reaches 18.3%.

While it is not possible to establish a strict correlation between the development of biogas production from the treatment of livestock manure and the trend of the content of nitrates in water in Veneto, we can still make some indicative valuations.

In fact, in accordance with the Strategic Environmental Assessment and the requirements of the second Program of Action, to check the progress of nitrate concentrations and the environmental state of water bodies, the Sezione Agroambiente of the Region prepares special annual reports of environmental monitoring. The "Monitoring Report 2013 VAS nitrates" shows the data on average concentrations for the year 2012 and 2013 of nitrate in groundwater by sampling stations in the NVZ and OZ. These data reveal that the average concentration was kept constant at 16 mg/l in the NVZ and decreased from 8.9 mg/l in 2012 to 8.2 mg/l of 2013 in OZ. The Report shows that in the region, 83% of groundwater records in 2013 the chemical status of "good" and 17% "poor" rating due to the 3% for nitrates and to 14% for other pollutants. The same parameters referred to the NVZ make record 80% of "good" and 20% "poor", the latter due for 5% to nitrates and for 15% to other pollutants.

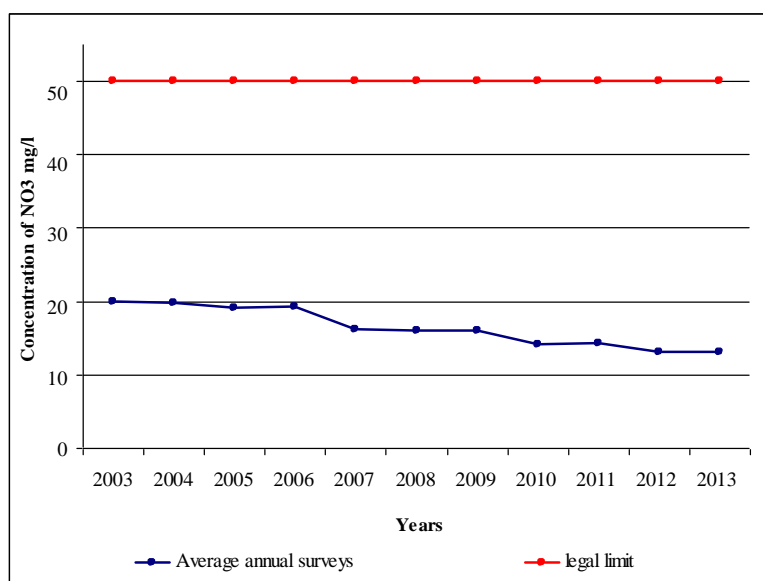


Figure 3: Average concentrations measured at the sampling points of groundwater (Source: Based on data Arpav)

The analysis presented in this work, albeit with the necessary caution due to the fact that the models have not yet completely defined the relationship between nitrogen and natural resources, it can be concluded that the presence of plants for biogas production leads to a reduction of over 10% of the amount of nitrogen released into the ground and that, in recent years, there has been a reduction in the average value of the concentration of  $\text{NO}_3$  in sampling points of groundwater.

<sup>2</sup> This paragraph was edited by Pierantonio Belcaro

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