

Safety considerations in waste treatment for the biogas production

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Romualdo Marrazzo (HSE Senior Expert. Seveso and IPPC-IED Inspector)

Service for Risks and Environmental Sustainability of Technologies, Chemical Substances, Production Processes and Water Services and for Inspections (VAL-RTEC)

ISPRA - Italian National Institute for Environmental Protection and Research

The role of ISPRA for industrial control

ISPRA has a national role as a **technical body supporting the Ministry of Environment** in the national implementing of the **Seveso Directives** for the prevention of major accidents

- Definition of **technical contents of laws and decrees** to control Major Accidents
- Set-up of the **National Inventory of major accident hazards establishments** and other related data-bases
- **Inspections of upper-tier establishments SMS-PMA** on regular basis or after an accident
- Support for **international activities** (EU, OECD, bilateral cooperation)
- Technical coordination and **addressing of Regional Agencies** for the Protection of Environment (ARPA)
- **Collaboration with other Authorities competent** for industrial risk (Ministry of home affairs – National Fire Brigades; Department of civil protection; Ministry of infrastructures)

Program and themes

1. Introduction and background
2. Biogas production and criteria of classification
3. Risk assessment for the biogas plants
4. Conclusions

1. Introduction and background

The Seveso III Directive

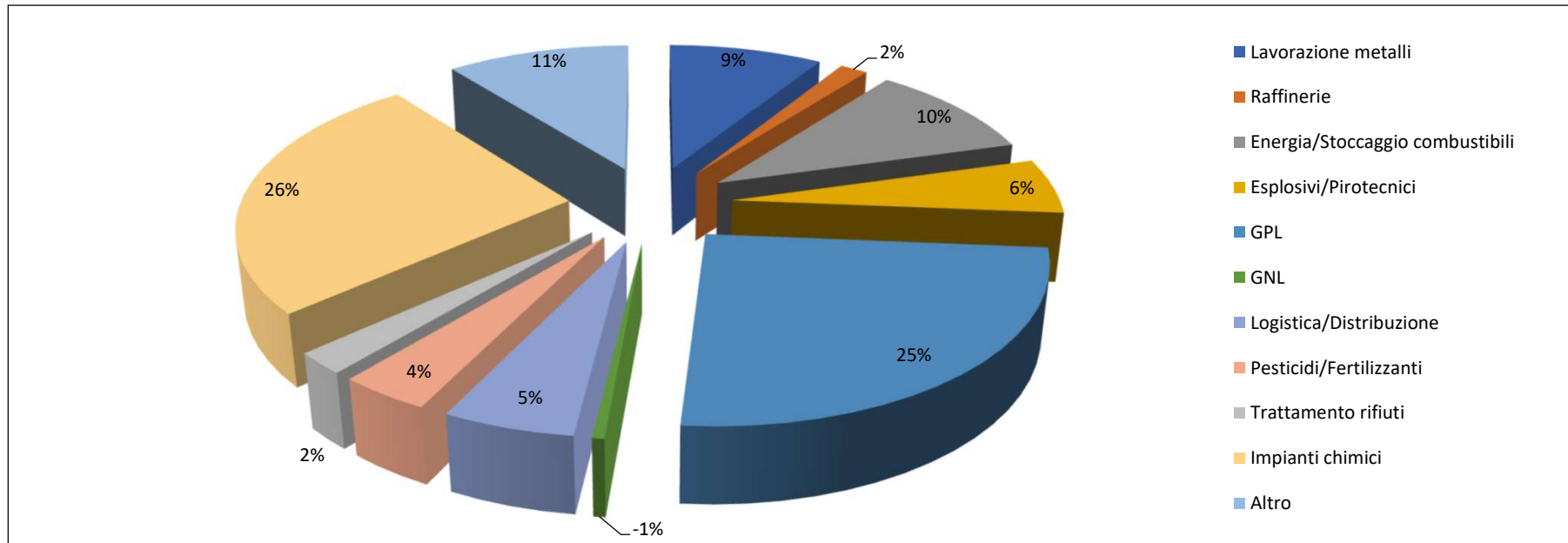
The **Italian** implementation of the **Seveso III directive** (2012/18/EU) is the **D.Lgs. 105/2015**, aiming at the **prevention of major accidents** involving **dangerous substances**

- Depending on the **amount of dangerous substances** present, establishments are categorized in **Lower Tier (LT)** and **Upper Tier (UT)** (*increasing safety measures according to the quantities*)
- **“Presence of dangerous substances”**: the **actual or anticipated presence** of dangerous substances in the establishment, or of **dangerous substances which it is reasonable to foresee may be generated** during loss of control of the processes, including storage activities

The compliances for the establishments

LOWER TIER	UPPER TIER
Notification of his own position and information to the competent Authorities	
Adoption of a Safety Management System for the Prevention of Major Accidents (SMS-PMA)	
Information to Authorities following a major accident	
	Producing a Safety Report (SR) containing the risk analysis
	Drawing up an Internal Emergency Plan (IEP)

The national situation



In Italy, about **1.000 sites** fall under Seveso directive (**50% of UT and LT**)

https://www.rischioindustriale.isprambiente.gov.it/seveso-query-105/inventario_listatolist.php

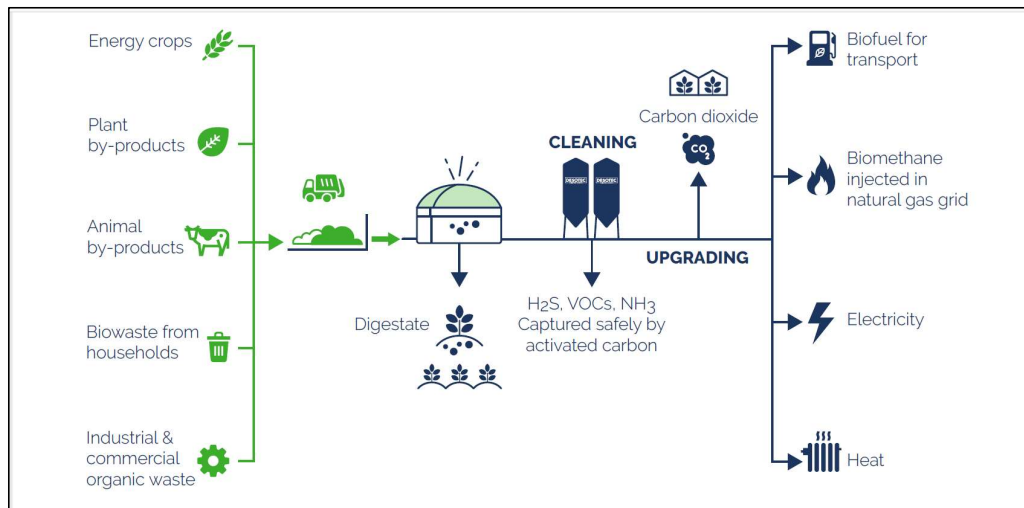
Biogas production Seveso sites

Establishments that produce biogas belong to the “Energy/Fuels Storage” and “Waste treatment” sectors (respectively 11% and 2%)

- 5 sites with the presence of biogas: Food and beverage industries (food distilleries); Production, supply and distribution of energy, water resources and wastewater (collection, supply and treatment)
- 1 site with the presence of biomethane, falling into the type of activities of Production, supply and distribution of energy

2. Biogas production and criteria of classification

The Biogas plants: a typical scheme



- Storage *tanks* (digesters)
- Supply and discharge *pipelines*
- *Compression stations and gas decompression cabins*
- *Control and safety equipment*
- *Ancillary systems*
- ❑ The **biogas** produced usually feeds directly into a gas engine to generate electricity (and heat)
- ❑ Through an **intermediate phase** with natural gas, biogas can be fed directly into the natural gas network

Bio-digesters for the biogas production

Typical bio-digesters consist of a tank covered by a special sheet to collect the biogas produced

- *Agricultural and zootechnical waste, animal manure, organic fraction of municipal waste*



The thresholds range applied to the gas mixture in the bio-digesters

Annex 1	Column 1	CAS	Column 2	Column 3
	<i>Dangerous substances</i>		<i>Qualifying quantity (t) for the application of</i>	
			<i>LT</i>	<i>UT</i>

Part 1	P2 FLAMMABLE GASES	—	10	50

Part 2	18. Liquefied flammable gases, Category 1 or 2 (including LPG) and natural gas	—	50	200

Biogas is Flammable Gas (Part 1), with **thresholds range of 10-50t**, more **restrictive** than thresholds range applied to **upgraded biogas (50-200t)**

- *Upgraded biogas* may be classified under entry 18 of Part 2 of Annex 1, where it has been **processed** in accordance with applicable standards for **purified and upgraded biogas** ensuring a **quality equivalent to that of natural gas**, including the content of **Methane**, and which has a maximum of **1 % Oxygen (biomethane)**

The classification of the biogas in the bio-digesters

- The biogas **upgrading and purification** process takes place **downstream of the digestion** tanks and therefore the **gas** retained by the **tank covers** is not to be considered purified or upgraded
 - ✓ The gases present in the bio-digesters are in fact characterized by a **methane content of 60%**, an **inert gas content (CO₂/N₂) of approximately 39%** and, for the remainder part - approximately **1%**, by **impurities** (dangerous)
 - ✓ The **conditions** required by the D.Lgs.105/2015 **are not met for the biogas before the upgrade**
- For the purposes of classifying and quantifying bio-digestion gas, it is necessary to consider **the quantity of gas in the state in which it is present in the bio-digesters** and not just the methane component
 - ✓ Considering the **total quantity of biogas** (free volume of biodigesters/post digesters - net of the volume used to contain the biomass), also considering all the **hold up of pipes/equipment for the transferring** of the biogas

3. Risk assessment for the biogas plants

An approach for the identification of dangers and the evaluation of risk

1. Information relating to the establishment

- *Typology of activities*
- *Organizational structure and management systems*
- *Establishment classification and verification subject to Seveso*

2. Identification of events and accident scenarios

- *Internal historical analysis*
- *External historical analysis of events, that occurred in similar establishments*

3. Evaluation of the frequency of events and scenarios

- *The identification of failure rates differs according to complex systems (“Fault tree analysis”) or “random” failure of a single component (equipment, systems, pipes)*



An approach for the identification of dangers and the evaluation of risk

4. Calculation of the frequency

- In the event tree, the *trigger probability values* (immediate or delayed triggering) must be *pertinent to the plant* reality or cautiously estimated

5. Calculation of consequences for possible accident scenarios

- *Flash Fire*. Fire of a flammable gas cloud that disperses into the atmosphere as a light-neutral gas
- *Vapour Cloud Explosion (VCE)*. It occurs when the confinement of the mass of flammable vapors is mixed with air at the moment of ignition.

6. Safety systems

- *Advanced Monitoring and Analyser Systems*
- *Locking systems* to make plants safe
- *Fire prevention measures and systems*

Risk assessment conclusions

- The **operator** produces a **risk assessment** with the description of risk analysis and **measures for the prevention of major accident hazards**
- The Italian competent **authorities carry out the technical evaluation** on the risk assessment **identifying accident scenarios, damage distances and frequencies** of occurrence, as well as the **safety measures** adopted, for the purposes of **External Emergency Planning (EEP) and Land Use Planning (LUP)**

4. Conclusions

Safety considerations in the biogas production

- The **gas mixture** contained within **biodigesters/post digesters** must be classified taking into account the **hazard characteristics** of the components of the **mixture, not of the methane** component only
 - ✓ Only **upgraded biogas** can be classified with a **less restrictive thresholds range**, as it is treated in compliance with the **standards** applicable to purified and upgraded biogas which ensure a quality **equivalent to that of the natural**
- It is possible to indicate an **approach regarding the identification of dangers and the evaluation of risks** in the bio-gas establishments
 - ✓ For the **implementation of the SMS** (risk analysis represents one of the fundamental elements) and for the **preparation of the safety report** (only upper-tier establishments)
- Input for specific **guidelines for the evaluation of the risk** analyses, given the **simplified and low plant complexity** of these establishments

If you think safety is expensive, try an accident



Questions...???

romualdo.marrazzo@isprambiente.it

Thanks for your attention!

