

THE VER'S CERTIFICATION: SUSTAINABILITY ACTION FOR ANAEROBIC DIGESTION FROM ANIMAL MANURE

CRISTINA CORDONI (*) - IMMACOLATA MANCO (*) -
VITTORIA PERCIVALLE (*)

Abstract

“*Verified Emission Reductions*” (VERs), are voluntary negotiations of certificates acknowledging reduction of greenhouse gas (GHG) emissions. They form part of the International framework aimed towards controlling, monitoring and containing GHGs according to the directives of the Kyoto Protocol.

The objective of the project consists in evaluating recognition of the feasibility of VER certificates for facilities of energy recovery from livestock manure.

By means of a real case study, the project outcome has been the specification of a “*Project Design Document*” (PDD) to be prepared and submitted to an accredited Verifier that can release VER certificates.

The Project Document calculates the balance between emissions existing before building the facility (*baseline*) and the minor emissions generated by the construction of the anaerobic digestion plant.

The document has been edited coherently with the international standards and guidelines using the calculation methodology recognised by the United Nations (UNFCCC).

The application of the PDD to a real case study (Lombardy pig farm) embodies a Pilot Project in the Lombardy socio-economic context and could represent a starting point for an involvement of Local Regional Authorities, in their future policy programmes for sustaining the agro–livestock sector.

Keywords: VER certification, biogas, livestock manure.

(*) Università degli Studi di Pavia, Dipartimento di Ecologia del Territorio, via S. Epifanio , 14 – 27100 Pavia, Italy – tel +39 0382984851, fax +39 0382234240, e-mail cristina.cordoni@unipv.it

Introduction: reference elements of the international regulatory framework

The evolution of the international attention regarding polluting emissions was originated by the initial attention for the ozone layer. In fact, in 1975 the World Meteorological Organization (WMO) published a report entitled “*The modifications of the ozone layer as a consequence of human activities*” where CFC¹ and Halon were identified as the main responsible of the ozone layer reduction. This was followed by an international regulation for the protection of ozone layer that delivered as a result the Vienna Convention of 1985 and the Montreal Protocol of 1987.

In 1992, during the “United Nations Framework Convention on Climate Change”² held in New York, the interested Parts also realised the progressive increase of climate changes potentially linked to human activities.

The main sources of carbon dioxide release into the atmosphere, recognised by the Convention, are: deforestation, industrialisation and transports. Moreover, for the agricultural sector, a relevant role was attributed to emissions derived from intensive breeding and paddy fields.

The Parts agreed about the need for a Global commitment in order to counteract the phenomenon. Amongst the measures adopted, it is considered necessary to introduce: new and more efficient and sustainable technologies, and progressively substitute energy sources, from fossil fuels (the main source of GHG) with renewable sources.

The United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro in June 1992, also known as “Earth Summit” was attended by 154 countries. An outcome of the Summit was the “United Nations Framework Convention on Climate” enforced the 21st of March 1994.

The parties to the Convention have met annually from 1995 in “Conferences of the Parties (COP)” to assess progress in dealing with climate change, reducing emissions by the year 2000 to the 1990 registered levels. At the end of each Conference, the treaty provides for updates (called “protocols”) that would set mandatory emission limits for each country.

¹ Chlorofluorocarbon

² Convention ratified in Italy with “Legge 15 gennaio 1994, n. 65 (in Suppl. ordinario alla Gazz. Uff., 29 gennaio, n. 23) – Ratifica ed esecuzione della Convenzione Quadro delle Nazioni Unite sui cambiamenti climatici, con allegati, fatta a New York il 9 maggio 1992”

The Conference of the Parties held so far have been 15 which have resulted in agreements among them are mentioned, here, the most relevant for the purposes of this study.

The agreement known as “Kyoto Protocol” was adopted during the third COP³, held in Kyoto in 1997 and aimed at fighting global warming.

The objective of the Protocol are the progressive reduction of emissions from Developed countries (Annex I) and the adoption of several “flexible mechanisms” that allow commercialisation of emissions, such as Emissions trading, *Clean development mechanism* (CDM) and *Joint implementation* (JI).

In order to allow the exchange of emissions between Developed countries, the Protocol establishes the need for the projects to possess the “additionality” requirement. This means that a project activity is *additional* if anthropogenic emissions of Greenhouse Gases are reduced below those that would have occurred in the absence of the CDM project.

The “*Executive board*” for the implementation of “*Clean development mechanism*” (CDM) projects was defined during the 6th Conference of the Parties held at The Hague in 2000.

From the documents of the 7th Conference of the Parties held at Marrakech in 2001, emerged with particular relevance Appendix B “*Criteria for baseline setting and monitoring*” in order to establish a regulatory and operational framework for the project document (PDD), which is also the object of the present work. In fact, the proposed guidelines provide the information required for editing the “*Project Design Document*” (PDD).

During 2005 the European Union introduced the mechanism known as “*Emission Trading*”, which is a system that provides for exchange of non-emitted carbon dioxide quotas and that rewards firms committed to reduce their emissions. This system involves more than 12000 industries and facilities, the emissions of which represent about half of the total EU emissions. Organisations that are unable to stay within the emission limits are required to buy allowances from more efficient companies.

Main Contents of the PDD

The first part in the appendix of the Document emerged from the Marrakech Conference covers the criteria to identify the reference scenario (*baseline*) i.e., the potential emissions of GHG in absence of the project

³ <http://unfccc.int/resource/docs/cop3/07a01.pdf>

(the facility that would allow emissions reduction). The reference scenario can involve single activities or multi-participant projects. Calculation of the “baseline” requires identification of methodologies, assumptions, parameters and data sources in terms of transparency and reproducibility.

The project design document (PDD) must include a “monitoring plan” for the emissions, which provides for data collection during the whole *crediting period*:

- relevant for estimating or measuring anthropogenic emissions occurring within the project boundary;
- necessary for determining the anthropogenic emissions of the reference scenario (baseline);
- relative to the identification of potential sources, that could increase or reduce the GHG emissions of the project
- concerning the possible environmental impacts;
- relative to quality assurance of control procedures for the monitoring process;

Besides, it would be appropriate to identify regular procedures for calculating reduction of emissions and for revisions of the monitoring plan.

The monitoring operations are required to ensure a steady reduction in emissions by the project. The guidelines provide for periodic monitoring of project activity by the accredited Body, to identify the constant maintenance of the conditions that allowed the release of “*Certified Emission Reductions*” (CER).

The project document, developed in this paper has been based on the scheme of “*Clean Development Mechanism*” (CDM) for projects in Developing countries.

However, the project activities considered are carried out in a Developed country (Annex I); therefore the Emission certificates released by the accredited Body will be not CER, but *Verified Emission Reductions* (VER).

Within the PDD, it is necessary to include detailed information as proposed by the guidelines:

- A description of the project including its technical description, the project boundary and a justification of the reasons that induced the project manager to choose such activity;
- Application of the *baseline* methodology to calculate potential emissions in absence of the project.
- The length of the crediting period;

- Description of how emissions of greenhouse gases are reduced by the project activity;
- Inclusion of potential environmental impacts identified in relation to the project;
- Information on funding sources, benefited by the operator, for the project activity;
- Eventual stakeholder comments;
- Expected Monitoring Plan during the “*crediting period*” years;
- Calculations, description of formulae used and sources of data used to estimate the reduction of emissions expressed as tonnes of *Carbon dioxide equivalent* attributable to the project activity;

The guidelines also establish the need to set up an appropriate special register in electronic format, kept by an approved institution, in which are recorded all transactions relating to certified units CERs.

As is the case for CERs in the international arena, also for the VERs there is a register in electronic form⁴.

The Negotiable Certificates

The Kyoto Protocol provides two types of instruments in order to achieve its goals.

The first mechanism is represented by the *Policies and Measures* that countries are required to implement for the reduction of greenhouse gases in their respective countries.

The second types of instruments are the so-called *Flexible Mechanisms* that allow acquiring credits by promoting emissions reduction projects in different countries.

These mechanisms are the *International Emission Trading* (IET), the *Clean Development Mechanism* (CDM), and the *Joint Implementation* (JI).

These mechanisms are economic instruments the aim of which is to reduce the overall cost related to the management of GHG, making their abatement economically sustainable.

⁴ The internet address to access the Register that contains the registered VER projects is: <http://www.eCO2care.org>

The International Emission Trading

The International Emission Trading (IET) scheme also known as “*carbon market*” is regulated by the Directive 2003/87/CE that aims at efficiently reducing GHG emissions by creating a market of emission permits.

Since January 2005, the Directive 2003/87/CE has launched a trade system, within the EU, of GHG emission quotas based on a cost-effective and economically efficient approach.

Under this Directive *emission permits* are mandatory. Member States are currently required to draw up *national allocation plans* for the industrial activities considered responsible for most GHG emissions and how many allowances each installation will receive each year. One allowance gives the right to emit one tonne of carbon dioxide equivalent (CO₂e).

Companies that keep their emissions below the level of their allowances can sell their excess allowances at a price determined by supply and demand at that time. Once acquired, the quotas can be traded amongst operators, but also anyone else — individuals, institutions, non-governmental organisations, etc is free to buy and sell in the market in the same way as companies. These transactions are recorded in a specific National Registry.

Clean Development Mechanism (CDM)

The Clean Development Mechanism is a project-based financing mechanism in developing Countries that have ratified the Kyoto Protocol (Brazil, Honduras, India...) ⁵, whereby industrialised countries or countries with transition economy may implement clean technology projects in Developing Countries not having emission-limitation commitment under the Kyoto Protocol.

The mechanism provides environmental benefits and clean technologies, stimulating sustainable development in the host countries. The Annex 1 countries that promote and develop this type of projects can achieve reduction of their emissions according to the Protocol by earning *certified emission reduction* (CER) credits.

⁵ Felice Alfieri – Seminar “Meccanismi Flessibili del Protocollo di Kyoto. Opportunità e scenari per le attività agricole e forestali”. Pavia, 12th November 2009.

CDM projects can be described as follows (Fig. 1):

- Annex I governments or private entities subject to Kyoto compliance, can implement a project of emissions reduction in a developing country
- The amount of GHG that would not be emitted thanks to the project is calculated as: $(\text{Baseline emission} - \text{project emission}) = \text{avoided GHG emissions}$
- The “*baseline emission*” is equal to the emissions released in the atmosphere before the project, while the “*project emission*” is that successive to the captation of gases. The emissions difference generates CER certificates.
- The CER certificates can be cumulated or freely traded on the market.

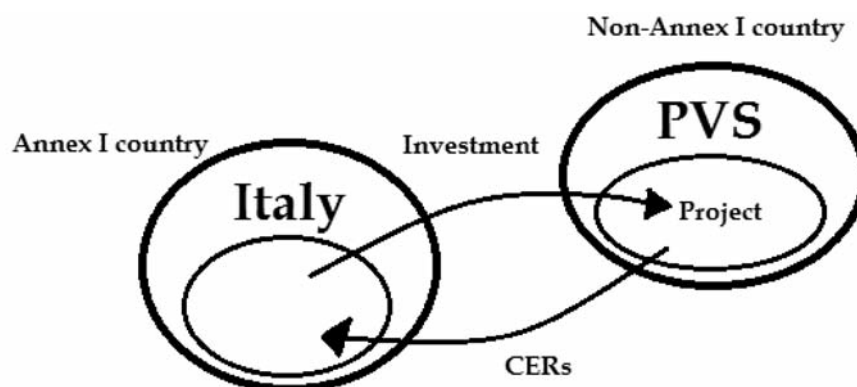


Fig. 1- Example of Clean Development Mechanism role.

(Source: Environmental Ministry⁶)

To launch a CDM project, the country promoting the project must have ratified the Kyoto Protocol and possess a National emissions Registry.

Furthermore, the project should effectively contribute to the sustainable development of the host country (additionality) and reduce emissions of at least one of the GHG gases identified by the Protocol.

⁶ http://www2.minambiente.it/sito/settori_azione/pia/att/pna_c02/docs/direttiva_ce_87_2003_sintesi_direttiva.pdf

Joint Implementation (JI)

Joint implementation (JI) are projects that allow Industrialised countries and transition economy countries (so-called Annex I countries) can carry out emission reduction projects in countries of the same Annex. In this way countries can lower the costs of complying with their Kyoto targets.

As for CDMs, through the use of clean technologies, countries obtain emission credits called *Emission Reduction Units* (ERU). These credits can be used by both countries involved in the project. Industrialised countries can also host these projects but transition economies countries are preferable. In fact, in these countries the clean technologies required for the abatement of emissions have lower marginal costs.

To implement a Joint Implementation project the promoting country must have ratified the Kyoto Protocol, belong to the list of Annex I countries, and as for CDMs must possess a National emissions Registry

The project should reduce emissions of at least one of the GHG gases identified by the Protocol and the resulting emissions must be lower than the baseline.

The Directive 2004/101/EC, known as Linking Directive⁷ modifies the Directive 2003/87/EC (Emission Trading): the objective is to establish a link between the Kyoto Protocol mechanisms and the Community scheme of *Emission Trading*. The environmental benefits of this scheme are combined with the possibility of using emission credits produced by Kyoto mechanisms.

Since participation in JI and CDM project activities is voluntary, *corporate environmental and social responsibility* should be enhanced. In this framework, companies should be encouraged to improve their own social and environmental performance.

Voluntary or Verified Emission Reduction (VER)

During the last few years, in the environmental area there has been a noticeable diffusion of voluntary certifications regarding greenhouse gas emission (GHG) reduction.

⁷ Source: Directive of the European Parliament and of the Council that modifies the Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community

These certifications are voluntary because the Agricultural - Livestock sector, unlike the industrial sector, it is not bound to the Flexible mechanisms of the Kyoto Protocol or to the European Directive on Emission Trading for environmental protection.

By means of the voluntary certification the organisation guarantees that its emissions reduction is quantifiable, reliable and can be exchanged under the quotas exchange market.

It is important the existence of a strong organisation commitment and the use of new technologies and impact mitigation strategies. In this way, the agricultural facility can offer and trade products that are more sustainable and competitive, thanks to the additionality deriving from the emissions abatement.

The mechanism for the generation of credits "*Verified or Voluntary Emission Reductions*" (VERs) consists in a certification by a third party of the facility emissions.

The facility that has adopted innovative technologies in order to obtain the credits must produce a "*Project Design Document*" (PDD) (based on the scheme of the international CDM projects). In the document, it is necessary to specify the emissions balance by comparing the "*baseline*" with the final situation derived from the new technology ("*project emission*").

The reductions generated produce credits that following the certification body verification can become tradable and are called VER: 1 VER is equal to 1 tonne of carbon dioxide equivalent. The document is checked by the Control organism that can also contemplate an internal verification.

For the project to be recognised, it must satisfy a certain number of fundamental requirements:

- *Use of recognised standard and calculation methodologies*; in the present case study, the facility belongs to the "*III-D small scale*" type of CMD projects of UNFCCC⁸.
- *Additionality*, which means the real reduction of emissions with respect to the absence of the project.

VER credits recognised are registered in a "*VER Registry*"⁹. This is constantly updated with the new certified projects and their relative avoided (or fixed) quotas of carbon dioxide equivalent.

⁸ <http://cdm.unfccc.int/UserManagement/FileStorage/MF0L1YGEXC4WO2PKQBDH9NVS53JZ8T>

⁹ The internet address is www.eCO2care.org

Methodology

The case study examined is a biogas plant, implemented in a pig breeding facility, which hosts over 10,000 fattening pigs. They are divided in three live weight categories: 31-50 kg (piglets), 51-85 kg (store pig) and 86-160 kg (fat swine). The animals are bred over leaked floor, with straw-free litter. The waste is picked up in dedicated storage basins and then pumped in bioreactors.

The work developed for the “Project Design Document” (PDD) final editing, represents a Pilot Project because, in Italy, there have not been certified projects for the assignment of VERs, by methane recovery from animal manure treatment. It was then necessary to make reference to the model “*Executive Board*” for CDM projects, provided by the UNFCCC. Such model is referred to the category of project known as “III.D-Methane recovery in animal manure management systems”¹⁰, related to animal waste management. The technical document reference is the 2006 IPCC Guidelines for National Greenhouse Gas Inventories volume 4, Chapter 10: “Emission from livestock and manure management”¹¹.

For the purpose of this paper, it was necessary to understand correctly the meaning of formulas contained in the IPCC document and in the guidelines of the executive board. Subsequently, the default data of the 2006 IPCC and those that must be collected in the facility have been identified.

The necessary elements to complete the PDD are schematized in Table 1. The collection of such data does not require additional knowledge for the breeder-producer of biogas, with respect to ordinary management of the plant. In fact, most part of the information already exists.

¹⁰ The methodology is downloadable from the following internet address: <http://cdm.unfccc.int/UserManagement/FileStorage/MF0L1YGEXC4WO2PKQBDH9NVSS3JZ8T>

¹¹ Downloadable form the following internet address: http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_10_Ch10_Livestock.pdf

TABLE 1

DATA FOR PDD EDITING

Project description	Quantitative Aspects	Technical- economical characteristics	Monitoring parameters
- Location; - Characteristic and extension of the facility involved; - Breeding typology; - Number and typology of animal heads raised in the facility and included in the project; - amounts of waste produced; - actual modality of waste management; - eventual certifications already present in the facility.	- Dimension of dedicate waste storage basins; - number and dimensions of digesters; - characteristic of storage basins/pits for digested storage; - possible quantity and typology of biomass to be directed for co-digestion with manure (logbook for biomasses); - sewage quantity directed to digester.	- Detection of biogas and percentage of methane output; - installed motors typology for production of Electrical and Thermal energy; - plant costs; - possible financings; - comparison of managerial costs with and without the plant, also considering possible spreading costs; - Electrical consumption; - technical details of the loading system and mixing digesters and of biogas pumping system into motors; - personal allocated.	- Number of animal heads; - Methane produced; - sewage treated; - collection procedure and data maintenance (employed personnel, automatic detectors and electronic data conservation, etc.); - ordinary maintenance plain.

The Pilot Document has been compiled so that the results can be extended to similar realities. The following paragraph analyses the essential elements of the Project Design Document (PDD) editing, in order to obtain certified VERs.

Baseline Scenario

The first essential element for the PDD editing is the baseline¹² configuration necessary to calculate the GHG emission reductions.

¹² As defined in guide lines proposed by 7th Conference of the Parties held in Marrakesh.

Therefore, it has been necessary to evaluate the relevant characteristics of the Lombardy zootechnical framework, to envisage the elements of the baseline configuration scenario in absence of project activity.

In this case study the wastewater management system is based on traditional storage in open basins for a period fixed by the Directive 676/91/EC, of at least 180 days. During this period the methane developed is released in the atmosphere. The calculation of annual baseline emissions (BE_y) is based upon the recognition of the potential “anaerobic decay” from sewage produced/year (data supplied by 2006 IPCC). The Volatile Solids (VS) content and the quantity of methane potentially produced (Bo), in relation to the qualitative and quantitative characteristics of waste annually produced in facility, and are necessary for the definition sewage characteristics.

A) Baseline

$$\begin{aligned}
 &1] \quad BE_y = GWP_{CH_4} * D_{CH_4} * \sum_{j,LT} MCF_j * BO_{,LT} * N_{LT,y} * VS_{LT,y} * MS\%_{bl,j} \\
 &2] \quad N_{LT,y} = N_{da,y} * (N_{p,y}/365) \\
 &3] \quad VS_{LT,y} = (W_{site}/W_{default}) * VS_{default} * n_{dy}
 \end{aligned}$$

Fig. 2 – Formulae for Baseline calculations

The *Baseline Emission* formula is indicated by [1] in Figure 2, where, for year y:

BE_y = *Baseline emission*, expressed in carbon dioxide tonnes equivalent to the amount of methane (expressed as tCO₂e /year y).

GWP_{CH₄} = Global Warming Potential (GWP) of CH₄, corresponding to the default value (21).

D_{CH₄} = CH₄ density, equal to 0.00067 t/m³ (at room temperature 20 °C and 1 atm pressure).

UFb = Model correction factor to account for model uncertainties, equal to 0.94.

MCF_j = Annual methane conversion factor, for the baseline animal waste management system and related to local atmospheric temperature; value equal to 32%. As contained in IPCC 2006, Table 10.17.

$B_{0,LT}$ = Maximum methane producing potential of the volatile solids generated for animal type “LT”, value expressed as $m^3 CH_4 / kg$ d.m.¹³. The data correspond to $0.45 m^3$ of CH_4 / kg d.m.; data taken from IPCC 2006, relative to Western Europe.

$N_{LT,y}$ = Annual average number of animals of type “LT” presents in stable, (where LT is the type of breed considered); in the case examined, the value corresponds to 10,000 pig heads. For this value it is necessary to use the equation marked [2], in Fig. 2.

Where:

$N_{da,y}$ = Number of days whereby animal are alive in the farm in year y. This data is present in the “farm register” related to the breeding facility considered.

$N_{p,y}$ = Number of animals produced annually of type LT for the year y.

$VS_{LT,y}$ = Volatile solids for livestock type “LT” entering the animal manure management system (on a dry matter weight basis, kg dm/animal/year). Value equal to 212 kg/year, this is calculated with the equation marked [3], in Figure 2.

Where:

W_{site} = Average animal weight of defined livestock population at the project site, value expressed in kg and corresponding to 97 kg in the case under study.

$W_{default}$ = Default average animal weight of a defined population, this data is taken from IPCC 2006, Table 10A-7, referred to Western Europe (for market swines) and corresponding to 50 kg.

$VS_{default}$ = Default value for the volatile solids excretion rate per day on a dry-matter basis for a defined livestock population; this data is taken from IPCC 2006, table 10A-7 relative to Western Europe, expressed in kg dry matter / animal / day and equal to 0.3 kg d.m./animal/day.

n_{dy} = Number of days in year “y” where the treatment plant was operational, value equal to 365 days.

$MS\%_{obl,j}$ = Fraction of manure handled in baseline animal manure management system “j”. In the case considered the value is equal to 100% because all manure handled is directed to storage.

¹³ Dry matter

Project Emissions

The project emissions that can occur during the project activity are the following:

- Gas emissions derived from the manure management system, including production, storage and transport of biogas up to its combustion point ($PE_{PL,y}$);
- Emissions during the combustion of gas flux ($PE_{flare,y}$);
- Carbon dioxide emissions linked to fossil fuels use or to Electrical Energy consumption from the national network (derived from non renewable sources, $PE_{power,y}$).

B) Project Emissions

$$\begin{aligned}
 &1] \quad PE_y = PE_{PL,y} + PE_{flare,y} + PE_{power,y} \\
 &2] \quad PE_{PL,y} = 0.10 * GWP_{CH_4} * D_{CH_4} * \sum_{i,LT} B_{O,LT} * N_{LT,y} * VS_{LT,y} * MS\%_{0,i,y} \\
 &3] \quad N_{LT,y} = N_{da,y} * (N_{p,y}/365) \\
 &4] \quad VS_{LT,y} = (W_{site}/W_{default}) * VS_{default} * n_{dy}
 \end{aligned}$$

Fig. 3 – Formula for Project Emissions calculation.

The project emission formula (provided by the executive board) is marked as 1] in Fig. 3, where:

- PE_y = Project emissions in year “y”, value expressed by tCO₂e.
 $PE_{PL,y}$ = Emissions due to physical leakage of biogas in year “y”, value expressed by tCO₂e. To obtain this data it is necessary to use the formula marked [2] in Fig. 3.

Where:

$MS\%_{0,i,y}$ = Fraction of manure handled in system i in year “y”.

The remaining data are already defined for the baseline formula [1] in Fig. 2

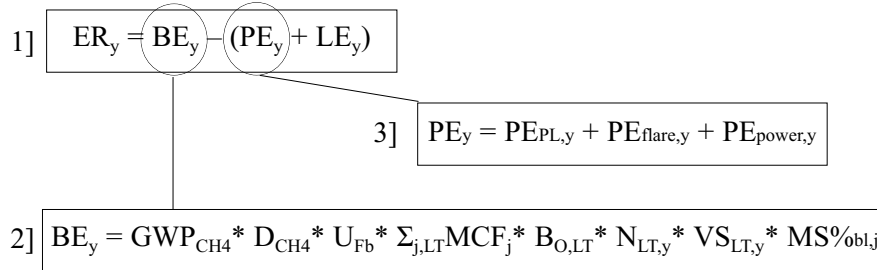
$PE_{\text{flare},y}$ = Emissions from flaring or combustion of the biogas stream in the year “y”, value expressed by tCO₂e. In the case examined, this value is set equal to zero since the leakage due to flare are considered negligible given the technical and managerial plant characteristics of the facility.

$PE_{\text{power},y}$ = Emissions from the use of fossil fuel or electricity for the operation of the installed facilities in the year “y”, value expressed by tCO₂e. In the calculation the value is equal to zero because the Electrical Energy used for anaerobic digestion plant working and animal breeding is completely self-produced by four co-generators.

Emission Reductions

To identify the effective project emission reductions, it is necessary to subtract Project Emissions from Baseline, by means of the formula marked 1] in Fig. 4.

C) Emission Reductions



$$1] \quad ER_y = BE_y - (PE_y + LE_y)$$

$$2] \quad BE_y = GWP_{CH_4} * D_{CH_4} * U_{Fb} * \sum_{j,LT} MCF_j * B_{O,LT} * N_{LT,y} * VS_{LT,y} * MS\%_{obl,j}$$

$$3] \quad PE_y = PE_{PL,y} + PE_{flare,y} + PE_{power,y}$$

Fig. 4 – Formula for emission reductions calculation.

Where:

ER_y = Emission reductions due to the project, based on monitoring values for year “y”, value expressed by tCO₂e.

LE_y = Leakage emissions. This value is equal to zero because the project leakages are negligible.

The BE_y value correspond to the data obtained in the baseline calculation (Fig. 2), while the PE_y data correspond to the value obtained in Project Emissions calculi (Fig. 3).

Monitoring

The model envisages a post-certification monitoring phase, to be performed during the *crediting period* that in the case study corresponds to ten years. The scope of this monitoring is to guarantee the continuity of the project performances.

The emissions reduction calculated until now (as proposed by the international model) is referred to estimated data. Therefore, the monitoring operations have the scope to confirm the real project emission reductions as GHG gas reductions.

Monitored data during crediting period are:

- *Methane quantity* produced daily by the digester (CH_4) from waste. This data can be obtained from the daily biogas monitoring switchboard.
- *Number of animals* annually alive in the farm ($N_{\text{LT},y}$). Data obtainable from “farm register”, which contains the updated inputs and outputs of animals in the farm.
- *Average animal weight* (W_{site}), referred to animal population annually in the farm ($N_{\text{LT},y}$).
- *Fuel quantity* consumed for proper engine operation, value expressed in litres/hour.

Results and Conclusions

The calculations resulting from the PDD document, the facility considered reduces annually 2,751 tCO₂e corresponding to 2,751 VER/year, which during the full “crediting period” equals 27,510 VER.

These quotas, once certified, are inserted in the dedicated VER register and can be freely traded on the carbon dioxide market.

The actual market value¹⁴ of VER credits corresponds to 12.91 €. Therefore for the case under study, the facility should receive a sum equal to approximately 35,515 €/year¹⁵, for a total (over ten years of crediting period) equal to over 350,000 €.

A cautious estimate, on the basis of the reduction emissions calculation for the case study, assuming that all the Lombardy region pig dejections (5,092,848 heads) are conferred to anaerobic digestion; it would be

¹⁴ At 15th of March 2010. This value is regularly updated and visible at the internet VER register: <http://www.eco2care.org/>

¹⁵ Calculated value as 12.91 €/VER * 2,751 VER/year = 35,515.41 €/year

possible to avoid the release in atmosphere of over 14,000,000 tCO₂e¹⁶. This data shows the obvious potential of the Lombardy swine sector for the containment of GHG emissions

The livestock asset in the Lombardy-region is interesting for manure exploitation to produce Electrical Energy. This is possible thanks to high number of animals bred, (in fact, the 48.2% of national pigs are raised in Lombardy region). Moreover, the livestock sector is going through a period of economic crisis, and the VER market could be represent a new element to complement the usual farming income.

For a good scheduling of the sector it is necessary to encourage joint (consortium) sewage treatment, also in relation to plants dimensions with the objective to involve small – medium firms.

VER diffusion can improve the implementation of the technology for anaerobic digestion of livestock waste treatment, acting as a starter for the production of dedicated tools, which would have positive effects on jobs creation. For example, during the data collection phase, it has been ascertained the need to have more precise and efficient instruments (to be connected to the wastewater treatment facility) for data measuring.

The anaerobic digestion of livestock manure operates chemical transformations of sewage that in the form of digestate is environmentally friendly. In fact, the Nitrates Directive 676/91/EC allows spreading larger amounts of digestate/m², with respect to raw sewage.

It would be desirable for firms to obtain the support of local administrations (Regions). The public administrations could also predispose actions to facilitate and to streamline the administrative paperwork, thus allowing operators to focus operational aspects of greater interest.

Received 17 November, 2010

Accepted 1 February, 2011

¹⁶ The data is under esteemed, because it does not consider the possible use of straw for litters. The calculation is obtained with an easy proportion, where knowing that the total Lombardy Region pigs raised are over 5,092,849 heads, and the annual emissions reduction for the case study (10,000 heads) is equal to 27,510 tCO₂e; then the proportion will be 5,092,849 heads: x = 10,000 heads: 27,510 tCO₂e. It follows that $x = (5,092,849 \text{ heads} \times 27,510 \text{ tCO}_2\text{e}) / 10,000 \text{ heads} = 14,010,425 \text{ tCO}_2\text{e}$.

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- (3) IPCC 2006, volume 4, chapter 10:
 - http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_10_Ch10_Livestock.pdf
- (4) VER register:
 - [www.eCO₂care.org](http://www.eCO2care.org)
- (5) Other web site of reference
 - <http://unfccc.int/resource/docs/cop3/07a01.pdf>
 - <http://unfccc.int/resource/docs/cop6/05a02.pdf>
 - <http://unfccc.int/resource/docs/cop7/13a01.pdf>
 - <http://cdm.unfccc.int/UserManagement/FileStorage/MF0L1YGEXC4WO2PKQBDH9NVS53JZ8T>
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