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Estimating greenhouse gas emissions generated by the industrial production of compound feedstuffs in France

This estimate is based on the data provided by Tecaliman's Energy Consumption Observatory, following approval of the participating industrials **in 2011**. The resulting extrapolation should, however, be put into perspective, as it is based on the representativeness of the Observatory panel and on historical ADEME data for the period in question.

1. Background

The ADEME "Carbon Footprint" assessment used here takes a 3-step approach:

- Measurement of the company's physical flows, i.e. flows of persons, vehicles, objects, energy, raw materials, services, waste products, etc.
- Calculation of the emission factors for each flow
- Estimation of the quantities of emitted GHG

There are uncertainties associated with each step.

Furthermore, this approach is also influenced by its area of study, which may be:

- Solely **internal**: taking account exclusively of the productions, fuel usage or energy leakage internal to the company (offices and manufacturing processes)
- **Intermediate**: including, in addition to the above, electricity supply modes, staff mobility habits, deliveries, missions, etc.
- Or **global**: also including the carbon footprint for inputs, supplier transportation modes, construction of buildings, etc.

Out of the total specific emissions of greenhouse gases (GHG) attributed to animal feeds, taken as a whole, manufacturing alone (internal area) accounts for 5% of the total figure at the most. The bulk of the emissions can be traced to the production of raw materials (approx. 82%). Transport (raw materials, feedstuffs, staff and visitors) represents approx. 13%.

In all, **only about 10% of GHG emissions** (manufacture and delivery of feedstuffs) come **under the control of the production plant**.

2. Sources

2.1. "Energy" club

Tecaliman's "Energy Club" initiative forms the basis of the Energy Consumption Observatory in the industrial animal feed production sector. This approach is the only one of its kind in Europe.

It involves a voluntary undertaking open to competing industrials who are also members of the technical centre. A survey is carried out and the results published on a six-monthly basis. These results concern the Energy Performance indicators (EPI)

- Plant's specific energy consumption (kWh/$t_{produced}$)
- Purchase prices of the various energies (€/MWh)
- Plant's specific energy cost (€/$t_{produced}$)
- Specific greenhouse gas emissions (kg CO_2 equivalent /$t_{produced}$)

In 2011, data were obtained for the following sample:

- 43 medium-sized plants producing 142 000 t/year, with a mean output of 175 000 t/year. This mean output figure is far higher than that of the overall population of 294 plants (74 000 tons).
- 7.53 Mt of dosed compound feedstuffs produced, i.e. 35% of total production in France, 77% of which concerns pelleted feedstuffs in the following proportions: 42% Poultry feeds, 27% Pig feeds, 26% Ruminant feeds, 4% Rabbit feeds, 1% miscellaneous feeds and 2% heat-treated animal meals sold with no further processing.
- containing a greater number of generator sets than the plant population as a whole.

2.2. Emission factors

The emission factors used to calculate specific GHG emission ratios were taken from the Ademe database on the date of the estimation in late 2012 (http://www.basecarbone.fr):

- Electricity: 0.078 kg CO_2 eq. emitted per kWh consumed
- Natural gas: 0.234 kg CO_2 eq. emitted per kWh ncv consumed
- Propane: 0.269 kg CO_2 eq. emitted per kWh ncv consumed

- Heavy fuel: 0.327 kg CO_2 eq. emitted per kWh ncv consumed
- Domestic fuel: 0.329 kg CO_2 eq. emitted per kWh ncv consumed or 3.244 kg CO_2 eq. emitted per litre consumed.

3. GHG emissions associated with production

3.1. Description of the ratio

For GHG emissions generated by fuel and electricity consumption during the production of compound feedstuffs at plants participating in the Energy Observatory, the ratio:

- does not take account of GHG emissions relating to electricity consumption during the production of "MASH" feeds,
- does take account of GHG emissions relating to thermal energy consumption during the production of heat-treated animal meals,

3.2. Global footprints

For this sample, total specific GHG emissions amounted to:

- 8.9 kg CO_2 equivalent/$t_{produced}$
- Standard deviation = 2.4 kg CO_2 equivalent/$t_{produced}$

Total GHG emissions equalled 67,000 tons CO_2 eq. for 35% of national production, giving an estimated **national carbon footprint of approximately 190,000 tons CO_2 eq.** in 2011. Caution should, however, be used when interpreting this equalisation as the observatory sample included a greater proportion of "large-scale" production sites than is true for French plants as a whole.
These GHG emissions break down as follows:

- **34%** generated by electricity consumption,
- **66%** generated by fuel consumption during the production of steam.

In France, the GHG emission factor linked to the consumption of 1 kWh of electricity purchased on the supply grid is far lower than the GHG emission factor linked to the consumption of 1 kWh during the burning of fossil fuels (for steam production), due in part to the generation of nuclear power.
Therefore, the ratio of GHG emissions linked to the consumption of thermal energy is significantly higher. This trend is the reverse of the energy consumption breakdown (Figure 1).

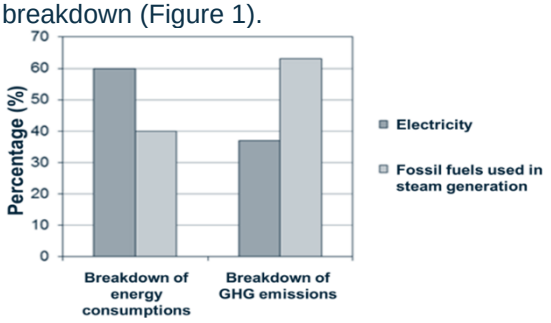

Figure 1 : Comparison of energy consumption and Carbon footprint according to energy sources

3.3. Carbon footprint per workstation

The mean estimated breakdown of GHG emissions for each production station (Table 1) demonstrates that the two main stations isolated in the form of unitary operations are **pelleting** and **grinding**. Pelleting and heat treatments (excluding the heating of liquids) account for 100% of the GHG generated by thermal energy, excluding temporary use of generator sets.

Stations	Estimated GHG (kg CO_2 eq./t)	%
Reception	0.07	**0.8**
Grinding	0.60	**6.7**
Dosage-Mixing-Molassing	0.18	**2.0**
Pelleting	6.59	**74.0**
Shipping and Associated	1.46	**16.4**

Table 1 : Estimation of carbon footprint per workstation in feed plant

3.4. Carbon footprint per production typology

Total specific GHG emissions according to production typology (Table 2) reveal that Poultry feed production units have a larger footprint due to their greater use of steam during the heat treatment decontamination process and the pelleting process.

Specialised plants	GHG footprint (kg CO_2 eq./t)	Standard deviation	No. of plants	% pelleted feedstuffs	% heat-treated animal meals
Poultry	**10.2**	2.0	15	82%	13%
Pigs	**6.7**	1.0	5	51%	-
Ruminants	**9.3**	2.5	13	93%	-

Table 2 : Estimation of carbon footprint per production typology

4. Conclusions

To sum up, the factors that draw the total specific GHG emissions trend upwards are listed below:

- high specific energy consumptions,
- high proportion of energy consumed in the form of fossil fuels (gas, fuel oil, etc.),
- plant specialisation in the production of Poultry feeds,
- use of generator sets, which burn domestic fuel to produce electricity,
- high proportion of pelleted feedstuffs in the total production tonnage

A given production unit can reduce its GHG footprint in several ways, i.e. by

- optimising the conditions of feed deliveries to farms,
- carrying out transport diagnostics (vehicles, driving habits, etc.),
- working on the characteristics of the manufactured feeds (physical forms, durability, etc.),
- performing energy diagnostics on the manufacturing process.