ENVIRONMENT

RUMINANT LIVESTOCK FARMING **AND ENERGY**

« How ruminant livestock plays a role in the energy transition? »

1

Ruminant livestock represents a minimal share of total energy consumption in France, compared to other sectors (transport, residential, industry, tertiary).

Like any production activity, farms consume energy to produce (mainly fuels). Nevertheless, solutions have been implemented for many years by livestock farmers to reduce their consumption and save energy.

2

The agricultural sector's unique ability lies in its capacity to produce renewable energies (solar photovoltaic and thermal, biogas, wood energy).

Promising prospects are in the hands of ruminant farmers, some of whom already produce energy for self-consumption on the farm and/or for the territory.
The objective of the sector is to continue to implement these practices.

3

Additional ways exist to save and recover energy in livestock farming.

INSTITUT DE L'ELEVAGE idele

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RUMINANT LIVESTOCK FARMING AND ENERGY

WHAT ARE WE TALKING ABOUT?

In terms of total energy consumption in France, the agricultural sector (3%) is far behind transport (31%), residential (31%), industry (19%) and the tertiary sector (16%) (Ministry of Ecological Transition and Territorial Cohesion, 2022). Ruminant farming accounts for 44% of consumption in the agricultural sector (Idele, 2023), or less than 1.5% of total energy consumption in France.

The scarcity of fossil fuels, their contribution to greenhouse gases emissions and the rising cost of energy (fossil or otherwise) require limiting the consumption of fossil fuels and developing renewable energy production.

To respond to the climate challenge, the reduction of greenhouse gases emissions is the guideline for national and European objectives. The 2019 Energy and Climate Law sets a target for France of 33% of energy produced from renewable sources in gross final energy consumption in 2030, imposing a reduction in fossil fuel consumption to achieve the objective of carbon neutrality in 2050.

For the agricultural sector, the national low-carbon strategy (SNBC) aims to reduce the sector's emissions by 18% in 2030 compared to 2015 and by 46% by 2050, excluding agricultural soils, whose emissions and removals are accounted for in the land use, land-use change and forestry sector. Fossil fuels used by agriculture (mainly oil and gas) account for 11% of greenhouse gases emitted by the sector. Farmers already play an important role in the energy transition by producing as much renewable energy as they consume (fossil and renewable energies) (Idele, 2020).

The main levers for action lie in energy efficiency of uses as well as the use of decarbonized energies to replace fossil fuels (Lejeune et Vallance, 2022).

ENERGY CONSUMPTION ITEMS IN RUMINANT LIVESTOCK FARMING

In livestock farming, a farm's energy consumption is related to fuels and electricity (direct consumption) as well as the energy needed to produce and transport inputs (feed and fertilizers), and to produce equipment and buildings (indirect consumption). In the rest of this document, direct consumptions will be the main consumptions addressed. Indeed, the improvement of indirect consumption is linked to:

- The improvement of food autonomy and the use of grazing, which help reduce energy consumption in the "feed" category. This topic is addressed in the sheet "Ruminant livestock farming and animal feed";
- The valorization of produced fertilizers and the reduction of fertilization inputs that limit energy consumption related to the "fertilization" category. This topic is addressed in the sheet "Ruminant livestock farming and soil quality";
- Also note that farmers have no leverage over the production of equipment and building.

1 Energy consumption

Direct energy consumption mainly related to fuels

Ruminant farming represents a minimal share in the final energy consumption in France, compared to other sectors (transport, residential, industry, tertiary). Nevertheless, like any production activity, ruminant livestock farms consume energy to produce milk and meat. These are mainly related to the purchases of non-road diesel (NRD), gasoline, and diesel fuel.

In ruminant farming, the ratios between fuel and electricity vary greatly between productions. For example, the dairy sectors consume more electricity than other sectors *via* the "milking" parlours, with an average share of milking in electrical consumption of 85% in dairy cattle. As for the suckling sector, fuel purchases represent the main energy consumption item (Idele, 2023).

In veal calves, direct energy consumption mainly concerns hot water production (71% of total consumption) and electricity for building ventilation (Idele, 2010a).

Solutions for reducing consumptions

Livestock farms have solutions available to reduce their energy consumptions.

- For all livestock farms, LEDs or energy-saving air circulators are solutions to reduce electricity consumption. As for reducing fuel consumption, economical driving, adapting equipment to tractors, exchanges/groupings of plots, or even a decrease in plowing are solutions that can be considered depending on the systems. Feeding, bedding, and cleaning robots, as well as electric tractors for livestock farming, also help reduce fuel consumption and decarbonize these uses.
- For dairy farms, solutions such as the tank pre-cooler, heat recovery unit, variable speed vacuum pump, or even the energy-saving tank can be considered to reduce consumption.
- For veal farms, energy-saving measures can include, for example, installing a heat pump to heat drinking water or optimizing the efficiency of hot water (Idele, 2010b).

Moreover, energy gains are often accompanied by economic gains for the farmer.

PROPORTIONS OF FUEL AND ELECTRICITY CONSUMPTION BY SECTOR
(CAP'2ER and Diapason data, Inosys-Réseaux d'élevage - treatment Institut de l'Élevage)

	Dairy cattle	Beef cattle	Dairy sheep	Sheep meat	Goats (dairy)	Goats (cheese)
Fuel	59%	90%	53%	82%	42%	27%
Electricity	41%	10%	47%	18%	58%	73%

KEY FIGURES

In 2020, french farms consumed **52,71 tWh** of direct energy, which represents **3%** of the final energy consumption by sector.
(SDES, final consumption of energy per sector, 2023)

Ruminant livestock farming accounts for **44%** of the energy consumption in the agricultural sector in France.
(Idele, 2023)

In France, between 1990 and 2010, direct and indirect energy consumption in the bovine sector has decreased by **22%** notably due to savings made on the purchase of feed and fertilizers (Idele, 2018).

For the "milking parlour": **-12%** energy consumption thanks to the pre-cooler and **-15%** consumption thanks to the heat recovery unit. Together, the pre-cooler and the heat recovery unit allow for a **20%** savings on the consumption of the milking block (data by Idele).

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2 Energy production

Ruminant livestock produces renewable energy

The production of renewable energy on farms mainly concerns photovoltaic installations on roofs or on the ground (electricity), thermal solar, methanization installations (electricity or biomethane), and wood production (logs or chips) for the needs of farmers' homes or for sale to third parties (electricity, gas, wood, or heat from methanization in cogeneration).

The methanization of livestock effluents, a societal and environmental service

Livestock farms produce waste that can be converted into biogas through methanization facilities. The biogas produced can be burned directly on farms to produce heat (minority cases) or used to produce electricity *via* cogeneration (majority cases in terms of the number of sites), or purified and then injected into gas networks (majority cases in terms of energy production). In the case of cogeneration, the heat produced by the engine can be used for nearby homes or communal or industrial facilities *via* a heating network. Finally, this biogas can also be used for CNG vehicles as a biofuel.

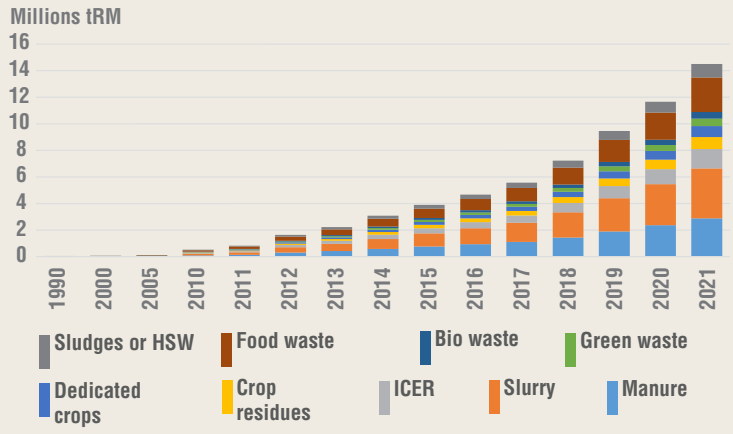
Altough the valorizations are diverse, the initial investment is significant, and the installation requires a regular supply of biomass in sufficient quantity and quality (Rieutort *et al.*, 2014).

The methanization of livestock effluents helps to reduce the overall carbon footprint of the farm, contributes to soil fertilization through the spreading of methanization digestates, and can reduce the farm's energy consumption. Nevertheless, recommendations exist for the sustainable development of methanization:

- Prioritize waste and crop residues in the digester to limit competition with animal and human feed;
- Optimize grazing in the farming system independently of methanization and simply use the animal dropping available in one's methanizer;
- Prioritize either small-scale installations at farm level or collective agricultural installations supplied by animal waste (Dumont *et al.*, 2019).

Farmers, however, remain in the best position to make the most suitable choices for their system.

ESTIMATION OF THE QUANTITIES OF INPUTS FEEDING AGRICULTURAL METHANIZERS IN FRANCE (CITEPA, 2023)



The production of renewable energy thru photovoltaics on the roofs of livestock buildings

In France, the photovoltaic sector has been gaining ground in herbivore farming since the mid-2000s. Indeed, livestock farming is a particularly favorable sector for the installation of solar panels on roofs thanks to farm buildings. Furthermore, the development of photovoltaic solar energy is very relevant for new constructions. The surface area installed with photovoltaic panels in livestock farming is estimated at 10 million m^2 (Idele, 2020). These installations notably represent a privileged axis for energy production for beef cattle farms.

KEY FIGURES

Thanks to its energy production, ruminant farming covers about **80%** of its consumptions in France.
(Idele, 2023 ; Idele, 2020)

In France, **1,624 Ktep** (Ktep = 1000 tons oil equivalent) of renewable energy are produced by livestock farms, across all sectors (Idele, 2020), accounting for **5,86%** of renewable production in France.

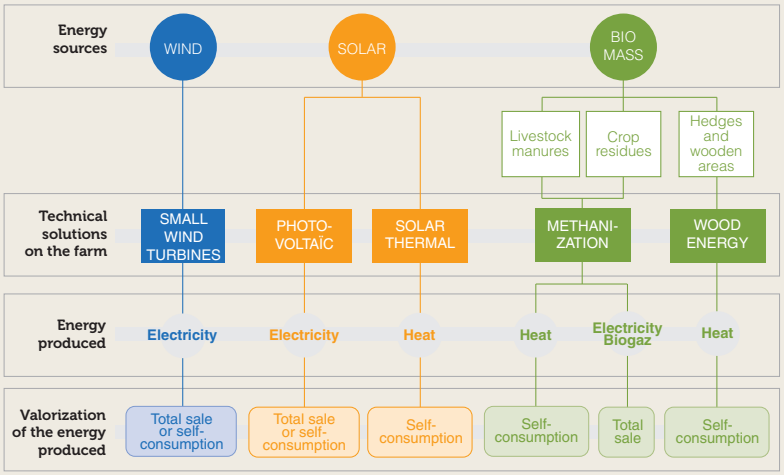
6,900 French farms produce renewable energy in 2020.
(Idele, 2020)

Cattle farms produce **24%** of the total renewable energy produced by agriculture.
(Idele, 2023)

Agrivoltaic, a coupling between agricultural production and renewable energy production

In France, agrivoltaic projects are booming, in line with the objectives of the Multiannual Energy Programming in terms of solar energy production by 2050. They allow for a coupling between agricultural production and energy production. A first framework was provided by the law of March 10, 2023, related to the acceleration of renewable energies. An agrivoltaic installation must be reversible and guaranty an active farmer significant agricultural production and a sustainable income. It must allow for the direct provision of services such as improving agronomic potential and impact, adapting to climate change, protection against hazards, and enhancing animal welfare.

PRODUCTION AND VALORIZATION OF RENEWABLE ENERGY AT THE FARM (Idele, 2020)



Energy production for the farm and for the farmers

Part of the energy produced by the farms is used directly for the farm's needs. Historically, this energy was mainly wood energy used for a few specific productions or for a small local heating network (house, guesthouse, etc.).

The development of methanization and especially photovoltaics has significantly increased the number of installations for total sale and self-consumption.

Photovoltaics can produce up to 25-30% of a farm's electrical consumption. Methanization, historically established on heat recovery, now allows for the valorization of electricity produced for self-consumption. Some farms thus produce more energy than they use, they are « positive energy farms ».

Solar thermal energy is also used for the farm's needs, particularly in veal-calve farming (e.g., solar water heater).

KEY FIGURES

In the case of a farm that would produce 1000 T of bedded pack manure (équivalent to 150 wintered LSU), the **33,461 mpf** methan produced and injected into the network would allow:
- a production of **324,000 kWh** ;
- a compensation of **67 teqCO_2**, emissions linked to a decrease in fossil gas consumption.
(Life Beef Carbon, 2020)

500 m² of voltaic panels allow to product **100 000 kWh**, the equivalent of 10 000 liters of fuel (data by Idele).

The methanization of **1 m³** of manure allows to produce **18m³** of biomethan (variable depending on the type of manure) (data by Idele).

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Energy production for the territory

The electricity and and the biomethane produced from livestock farmings can be injected in the energy networks and used by everyone.

The wood present on the farm is also an asset for energy production for the local area. Biomass allows for the supply of firewood users, but also wood chip users. The valorization into wood chips allows for the supply of local heating plants, which are often set up to replace old oil or gas heating plants. The valorization of biomass also helps to encourage the presence and maintenance of woods and hedges on farms.

This energy substitution (electricity, biogas, heat), beneficial for mitigating greenhouse gases emissions, positions livestock farming as a contributor to achieving the decarbonization goals of buildings and territories.

Although the proportion of livestock farms that produce energy for needs other than those of the farm is still moderate, the prospects are encouraging and make livestock farming a provider of new societal services trough its important role in the production of local renewable energy and the achievement of national objectives.

KEY FIGURES

The production of **20 steres** of wood allows:
- a production of **38 000 kWh**;
- an offset of **10,7 teqCO_2** emissions compared to oil heating, trough a reduction in domestic consumption.

(Idele 2023, according to the Collection Guide CAP'2ER level 2 and Ademe imprint)

An installation of **100 kWc** (500 m panels, namely a building with a floor area of 700 to 800 m,) allows:
- a production of at least **100 000 kWh**;
- an offset of **0,2 teqCO_2** emissions (Life Beef Carbon, 2020).

A farm that would deliver **100 M^3** (Equivalent of woodchips for a local wood boiler room (in substitution of fuel oil) would allow:
- a production of **94 000 kWh**;
- an offset of **28 teqCO_2** emissions.

(Idele 2023, according to the Collection Guide CAP'2ER level 2 and Ademe imprint)

3 Additional indications

Farms dispose of additional indications to save and enhance energy

Today, the new energy context calls for new solutions and new perspectives to save and make the most of energy.

- Regarding self-consumption, consumption management systems will help increase the proportion of energy used directly on site. In parallel with these systems, controllable equipment will be developed or redeveloped (chilled water plants/ice accumulators for tanks and other cooling units).
- Finally, new avenues are opening up, such as the use of biomethane tractors, electric tractors for use on farms, electric equipment to replace fuel-powered equipment, electric utility vehicles, etc. The substitution of fuels with electricity will also allow for the production of some of the energy on-site.

ACTIONS AND TOOLS IMPLEMENTED BY THE SECTORS

SelfAgri Energie

As part of the CNE Energie Mieux program, this self-diagnosis tool allows farmers to position themselves in relation to the average consumption of farming systems by providing information on the characteristics of their farms in terms of consumption.

The objective is then to provide them with keys so they know on which equipment item(s) there are possibilities to reduce their consumption and ultimately, their expenses (selfagri-energie.cap2er.eu).

EnR2 tool

Aimed at farmers wishing to produce renewable energy on their farms, the EnR2 tool guides their project and raises their awareness about reducing their energy consumption.

The main solutions discussed are wood energy, methanization, photovoltaic solar in total sale or self-consumption with surplus sale, and thermal solar. The tool helps the farmer to identify particular points of attention to consider and the opportunities for the farm to produce energy, or even potential limitations.

Based on feedback from energy-producing farmers and industry experts, EnR2 provides an initial assessment of the feasibility and relevance of an energy production project on the farm and suggests further exploration of certain points using recent and high-quality technical-economic resources.

Finally, EnR2 allows for the identification of resource persons and structures for tailored and specialized advice. Indeed, reaching out to an energy or business advisor is essential for solid support that will determine the success of the project (www.idele.fr/enr2-1).

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