



The 75<sup>th</sup> EAAAP Annual Meeting  
1-5 September 2024, Florence, Italy

# Energy Use in the EU Livestock Sector: A Review Recommending Energy Efficiency Measures and Renewable Energy Sources Adoption

B. Paris, F. Vandorou, D. Tyriss, A. Balafoutis, K. Vaiopoulos, G. Kyriakarakos, D. Manolakos, G. Papadakis



**CERTH**  
CENTRE FOR  
RESEARCH & TECHNOLOGY  
HELLAS



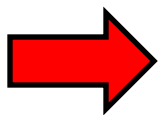
**ΓΕΩΠΟΝΙΚΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΘΗΝΩΝ**  
AGRICULTURAL UNIVERSITY OF ATHENS

# Introduction

---

- Significant data is available on a European level on the **production levels, production patterns, and financial accounts** of livestock held in the EU
- However, relatively little information is available on the **energy use associated with livestock production** as a whole and for specific livestock categories
- In recent years, national and EU policy is increasingly focused on improving **environmental sustainability** and **animal welfare** of livestock production
- Livestock rearing and production will need to transform in the coming decades to achieve the goals set out in the **Green Deal** and the **Farm to Fork strategy**

For the development and implementation of these goals, a clear understanding of **energy use concentrations** in the livestock sector in production systems and across production stages is a prerequisite



The goal of this paper is to provide a review of energy use in the EU livestock sector by bringing together data from a range of studies

# Introduction

---

- Many existing studies provide figures on the energy use associated with the production of animal feed; these, however, show **significant variation** depending on **origin, raw material use, and livestock system**
- The production, processing, and transportation of the feed require a significant amount of energy inputs, which are mostly dependent on fossil resources, and represent a large proportion of the total energy consumed in livestock production

**From the data covered in this article, the proportion of feed makes up more than 50%, and in many cases 75% or more, of the total energy consumption within livestock sectors**

- In most systems, livestock is kept in animal housing, but **significant variation** is reported in terms of energy use depending on the structures used, the agroclimatic conditions, and the types of livestock used
  - heating, cooling, ventilation, lighting, and a range of other devices
- In **dairy systems**, specifically, significant energy consumption is allocated to **milking processes**

# Results – Overview

- In all main production systems in the EU-27, except for beef, **animal feed was the main energy input** in livestock systems accounting for around  $\frac{3}{4}$  of all energy requirements
- In meat production systems, the main direct energy requirements were for **housing, feeding** (electricity) and **manure management** (diesel fuel)
- In milking systems, the main direct energy-consuming activities were related to **milking, milk cooling, and water heating** (electricity or direct fossil fuels)
- The studies covered suggested that **beef** was the most energy-intensive production system per kilogram of meat, followed by **pork and poultry**



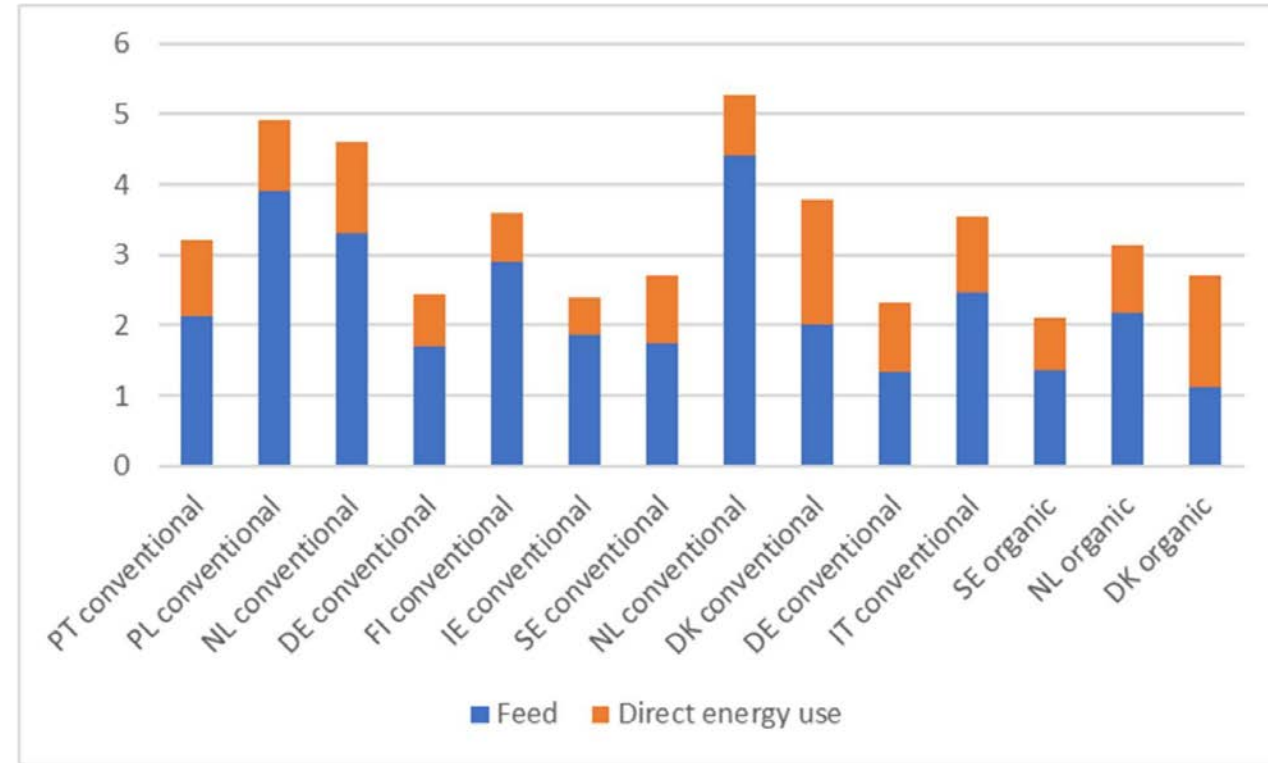
Range of energy inputs of studies covered in this review according to species in MJ/kg

# Results – Cow Dairy Production



The EU produces around 158 million tonnes of cow milk annually

- The main milk-producing countries are Germany (20.8%), France (15.8%), the Netherlands (8.9%), and Poland (7.7%)
- Milk production systems **vary significantly**, ranging between low and highland, and intensive to extensive
- The majority of milk production occurs in **intensive systems**
- In addition to the energy use associated with feed and housing, various **processes related to milking** consume a considerable amount of energy, including milk cooling, milk harvesting, water heating, and water pumping
- The energy embedded in the **feed** was the **highest energy input** in all but one of the studies
- Individual studies provided different sets of data depending on a range of factors, including the **production system** and the **type of milking system**



Energy inputs cow milk MJ/ECM (energy-corrected milk)

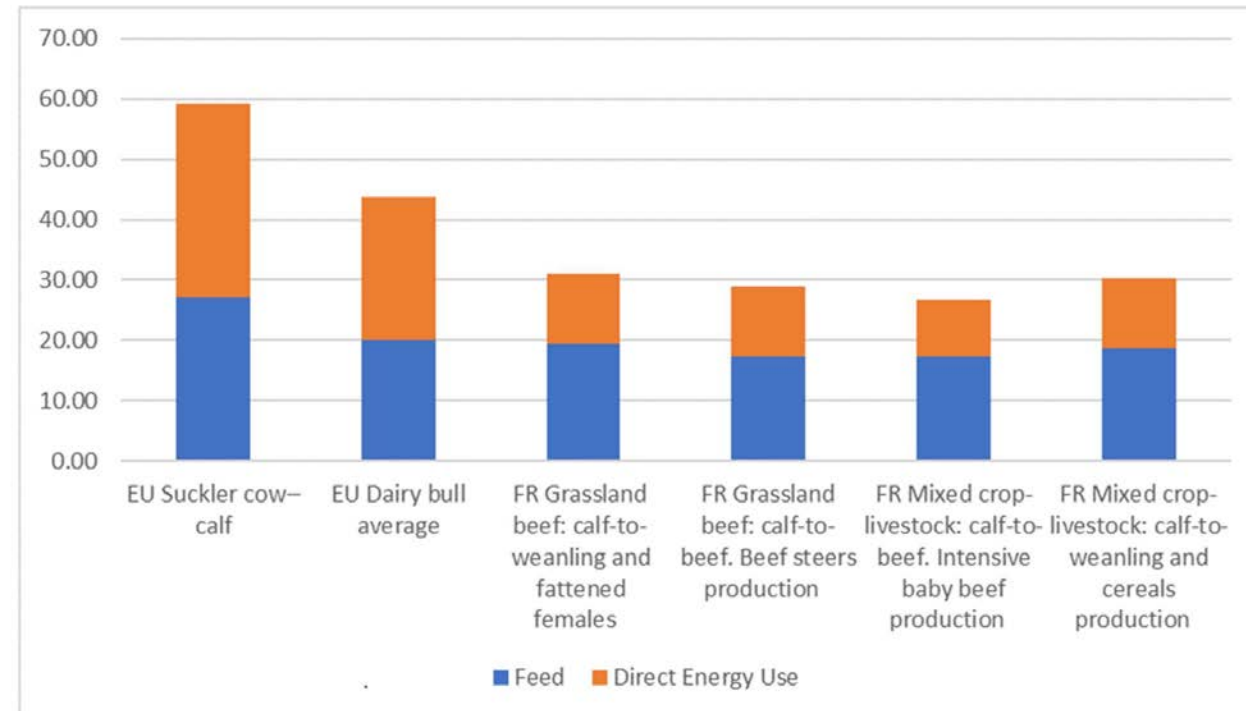
# Results – Beef Production

In 2018 the EU production of beef reached 7.9 million tonnes

- Mainly from France and Germany
- **Significant heterogeneity** between production systems across the EU was observed to a greater extent than in other livestock systems
- The production of beef carries the **highest environmental load** per kilogram of meat
- 60–70% of energy consumption in beef production systems is associated with **on-farm** activities

**Scarcity of data** across a variety of methodologies for calculating energy use in beef production systems

- According to the Agricultural and Food Research Council, **methods for predicting energy use in beef production systems are outdated**



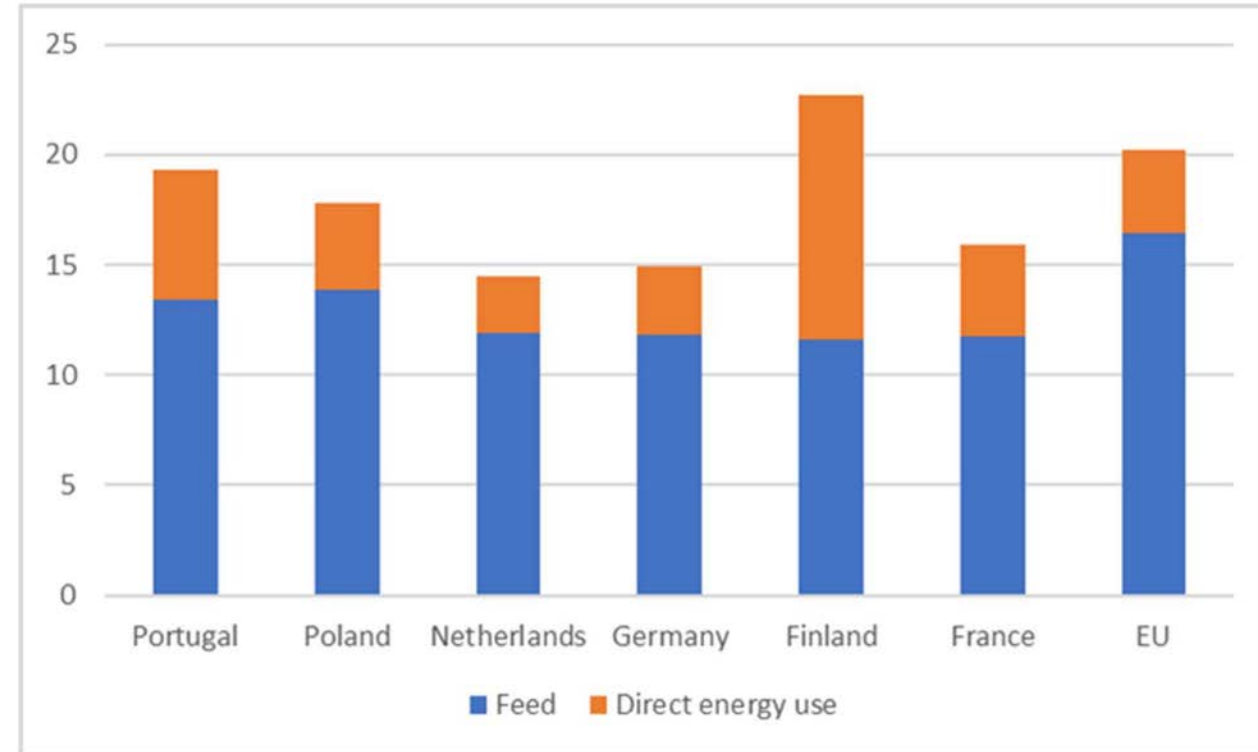
Energy inputs for beef production slaughter weight MJ/kg

# Results – Pork Production



The production of pork accounts for around half of the EU's meat total production, an estimated 23.8 million tonnes

- More than  $\frac{3}{4}$  of pork production occurs in just six Member States: Germany (22.4%), Spain (19%), France (9.1%), Poland (8.7%), Denmark (6.6%), the Netherlands (6.4%) and Italy (6.2%)
- Generally **intensive**, but large variations in the size and production focus among the different farms
- In most cases up to 75% of the energy usage is associated with **feed**
- Most direct energy use was associated with **manure management, housing, and feeding systems** in the form of electricity and fuels



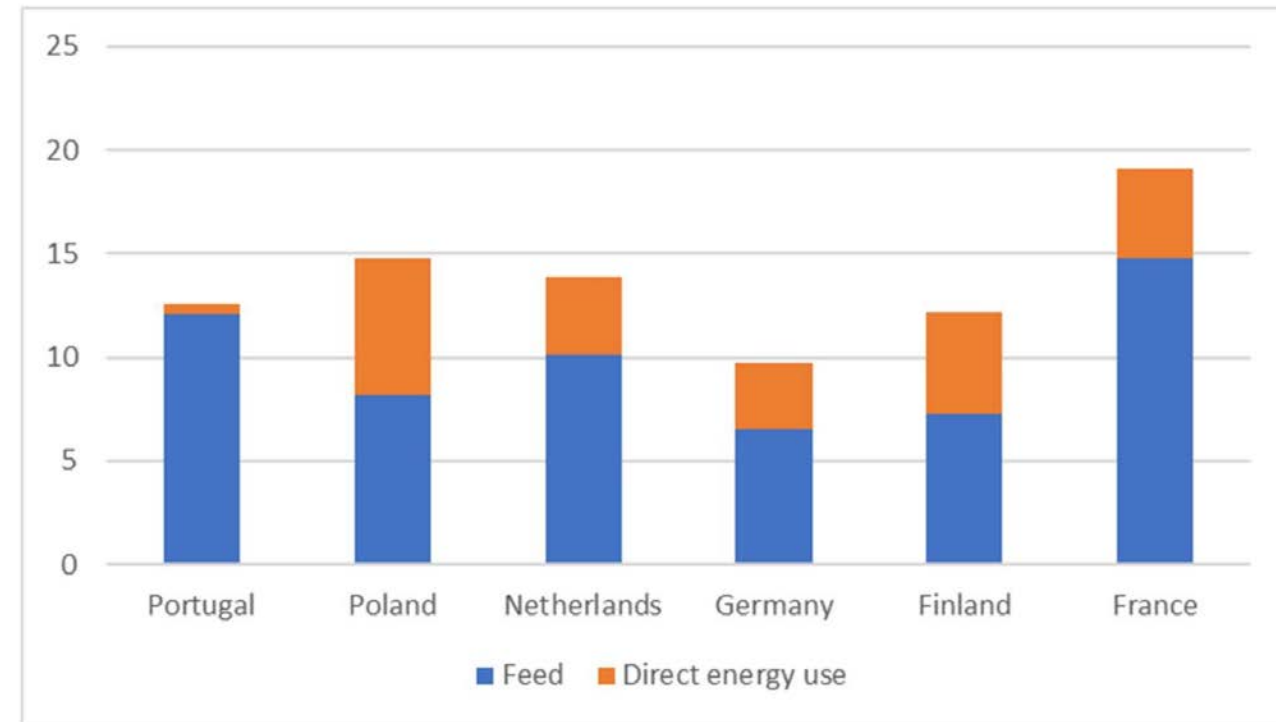
Energy inputs for pig production slaughter weight MJ/kg

# Results – Poultry Meat



In 2018, poultry production reached approximately 15.2 million tonnes

- Broiler production was by far the largest producer of poultry meat in the EU accounting for over 80% of total poultry production
- Around 14% of poultry production was Turkey production
- Total energy use ranging from 9.6 MJ/kg to 19.1 MJ/kg, **around 75% of this total was associated with feed**
- **Heating** was by far the largest on-farm energy-consuming activity
- Significant **geographical variations**, especially in warmer climates



Energy inputs for broiler production MJ/kg

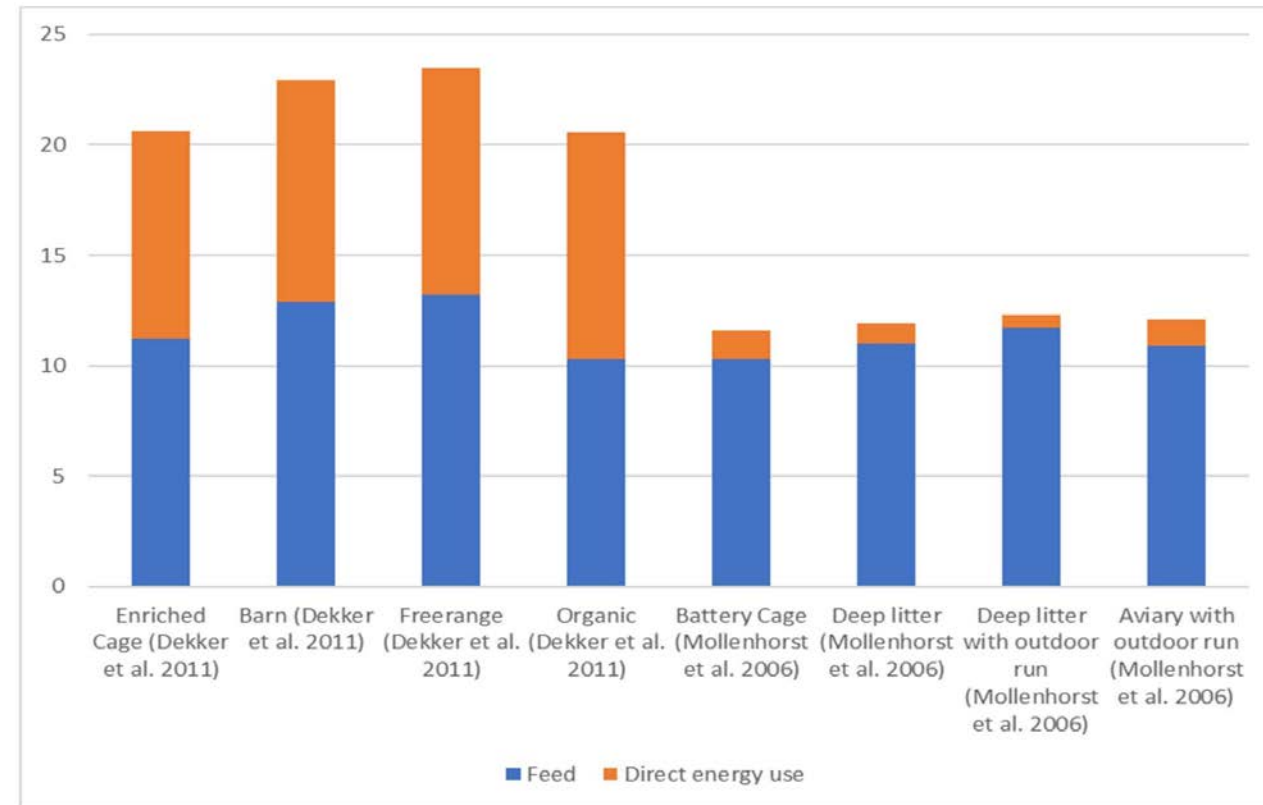


# Results – Poultry Egg Production



Around 400 million laying hens are kept in the EU

- 53% are housed in enriched cages, 27% in barns, 15% are free-range, and 5% organic
- Relatively little information available on chicken egg production in the EU
- To produce 1 kg of eggs, 20.5–23.5 MJ of energy inputs were needed
- At least 50% of all energy inputs were associated with feed



Energy inputs for egg-producing systems MJ/kg

# Conclusions 1/3

---

- **Animal feed** is the largest energy-consuming activity in livestock systems; **On-farm** energy use is concentrated in **housing** and **manure management**
- **Electricity** is generally used for lighting, feeding, and milking systems, while **fossil fuels** associated with direct energy inputs are often used for manure management and heating
- Switching to more **renewable** electricity and thermal sources could invariably help reduce the amount of fossil energy used for on-farm activities
- Energy use in livestock housing is likely to be considerably **higher in northern Europe** compared to southern due to additional **heating** required due to climatic conditions
- Livestock grown on **locally produced feed** requires considerably less energy
- There is no clear overview of the specific proportion of energy sources in livestock; it is generally accepted that **diesel use** is the largest energy source

**Further research is needed to gain a better overview of the total energy consumption/concentration in EU livestock farming**

## Conclusions 2/3

---

- The increasing usage of RES, Energy Efficiency Measures and technologies provide a unique opportunity to farmers to **reduce their farms' external inputs by producing their own energy**
- In recent years increasing research has been undertaken to improve the **energy efficiency** and **sustainability** of livestock housing
- The effectiveness of RES in each type of farm is associated with a combination of factors:
  - Position of the livestock building
  - Local environment
  - Characteristics of the buildings that constitute the farm unit
  - Domestic needs of the farm
  - Planning policies for RES technologies in rural areas

**Livestock, along with other sectors, will eventually move towards RES and high-efficiency technologies**

# Conclusions 3/3

---

- Significant barriers and limitations to this review
  - Large data gaps for certain livestock categories
  - Non-standardized methodologies for accounting for energy use in livestock and agricultural systems, including the selection of functional units and system boundaries
  - Compounded by the diversity and heterogeneity of livestock production systems

**Necessity to develop a standardized methodology and terminology for measuring, evaluating, and comparing with other studies on energy use on livestock farms**

## Conclusions – in one slide

---

- Energy use was concentrated in feed, housing, and manure management
  - In most systems, animal feed was the dominant energy use category
- Energy use in livestock systems is underreported as the majority of energy use associated with feed happens off the farm and is not attributed to the livestock sector in official agricultural statistics
- A reliance on fossil energy sources and discussed the transition toward more energy-efficient livestock systems and a higher dependence on renewable energy sources
- Need for a standardized methodology in measuring energy use in livestock systems
  - Necessary step to develop interventions that reduce fossil energy use and livestock contribution to climatic change



**Thank you!**

For more info please contact Mr. Bas Paris

[bparis@aua.gr](mailto:bparis@aua.gr)\*

\*Department of Natural Resources and Agricultural Engineering,  
Agricultural University of Athens, 75 Iera Odos str., 11855 Athens, Greece