ROASTING THE PLANET

BIG MEAT AND DAIRY'S BIG EMISSIONS

GREENPEACE FOODRISE Friends of the Earth Institute for Agriculture & Trade Policy

KEY TERMS

CH_4	Methane, a greenhouse gas
CO_2	Carbon dioxide, a greenhouse gas
COP	Conference of the Parties—the annual United Nations climate change conference
GHG	Greenhouse gas
GWP	Global Warming Potential
IPCC	Intergovernmental Panel on Climate Change
$MtCO_2eq$	Million tonnes of carbon dioxide equivalent
N_2O	Nitrous Oxide, a greenhouse gas

Slurry tanker in Denmark, spreading liquid manure derived from pig excrement. This industrial method of fertilizing is responsible for the destruction of local groundwater and marine environments. Photo: © Greenpeace

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A mass-scale cattle farm at Estancia Bahia, Brazil. Photo: © Greenpeace / Daniel Beltrá

FOREWORD

By Paul Behrens, *British Academy Global Professor*

To date, the impacts of climate change have been systemically underestimated. The stakes could not be higher for the planet's future liveability or for the generations that might follow us. We have left it too late to avoid large amounts of suffering around the world, but rapid, unprecedented, systemic change could ease this suffering and stave off the climate tipping points that threaten to alter the planet for millennia.

Global agriculture is in a perilous state, reliant as it is on a stable climate. The agricultural system is imperiled by climate impacts at the same time as being the second biggest driver of those impacts, via emissions. It is one of the largest drivers of many other environmental crises, including biodiversity loss. Within the sector, animal agriculture clearly emerges as the dominant culprit.

This should not be surprising given its incredible inefficiency. When compared to plant proteins, intensively farmed animal systems are 2.4 to 33 times more expensive in terms of land and water use[1]. Emission statistics tell an equally sobering story[2]. Beef systems can be over 100 times more polluting in terms of greenhouse gas emissions than legumes, and chicken systems over seven times more polluting[3].

In a recent study, I and my fellow researchers, led by Dr. Helen Harwatt, asked over 200 climate scientists and food and agriculture experts—half of whom have authored IPCC reports—what efforts would be needed in animal agriculture to meet the Paris Agreement[4]. Averaging their responses, they suggested that global livestock emissions would need to peak this year (2025) and then to be reduced by 61% by 2036, with faster and deeper reductions in higher-income countries. What's more, 78% of the experts surveyed said that absolute global livestock numbers need to peak by 2025, and 85% agreed that dietary shifts to less livestock-derived foods are required, particularly in high- and middle-income countries.

Research repeatedly shows that dietary change is the single biggest option for cutting food system emissions that we have in high-income nations[5]. A recent study also identified the opportunity of a double dividend, whereby we save the massive amount of land spared via such a dietary shift and return it to nature[6]. If we can support farmers in a rural renaissance, it is projected that we would be able to roughly double the climate benefits of this food system transformation, according to the research[7]. For example, moving to a predominately plant-rich diet—the EAT-Lancet diet—in high-income nations would reduce food emissions by an estimated 61% and save an area roughly the size of the EU[8]. Were this area returned to nature,

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the land could draw down around 14 years of global agricultural emissions. Given the size of these opportunities, even small changes in dietary shifts can have meaningful consequences.

In a world of increasingly extreme weather, rising temperatures, and challenging agricultural conditions, food prices are set to rise over the long-term in high- and low-income countries alike[9]. By saving land and making a more efficient agricultural system, we could help bolster our ability to cope with these changes. Early research suggests that dietary shifts can be more resilient to shocks, such as the Russia-Ukraine crisis[10], while reverting land to nature would allow us to better absorb the injuries of climate change, such as those from floods and storms.

Even though there is a clear scientific consensus on the environmental need for dietary shifts, and a consensus they hold huge opportunities, meat and dairy company profits depend on their denial of their role as a driver of the crisis, as this report shows. Upton Sinclair noted: "It is difficult to get a man to understand something, when his salary depends on his not understanding it."[11]

Given this, what has been the industry's response to the environmental crisis—a crisis that will consign millions, if not billions, of people to suffering? It has been to repeat the fossil fuel industry's playbook in its decades-long campaign of climate denial and sowing seeds of doubt. As with the fossil fuel industry, the meat industry's efforts to limit action on livestock emissions is well documented in peer-reviewed academic literature[12].

This academic literature, along with investigative reporting and other research, show that multinational animal agriculture companies have been deeply unserious about the planet's future liveability. The industry has spent hundreds of millions in lobbying against climate action since 2000[13]. As this report demonstrates, JBS—the largest meat company in the world, slaughtering an estimated 3.6 billion chickens, 38.8 million pigs, and 20.8 million cattle per year[14]—announced a target to achieve net-zero emissions by 2040 only to go back on this a few years later, saying it was "never a promise" and was just an "aspiration"[15]. Aspirations don't help anyone in a 40°C heatwave. Aspirations are not going to keep this planet from being unlivable for billions of people.

Agriculture is uniquely vulnerable to climate change and requires urgent adaptation to new, ever-worsening climate conditions. The profound irony in the industry's resistance to change cannot be overstated. Agriculture, including animal agriculture, is one of the most exposed sectors to climate impacts, with agrifood systems facing escalating threats from climate change-induced loss and damage. Climate change is already significantly contributing to food price inflation. It is driving political instability in lower- and higher-income countries alike. Animal agriculture has been hit by increasing heat stress[16], drought[17], floods[18], feed shortages[19], water scarcity[20], and disease[21] in recent years. For example, 140,000 farm animals were lost in the 2025 Australian floods alone[22]. Meat and dairy companies are resisting the very changes needed to safeguard the planet upon which their own survival and profits depend.

Within this crisis lies unprecedented opportunity. All other things being equal, shifts to plant-rich food systems would result in lower temperatures, more nature, cleaner air, cleaner water, richer soil, higher biodiversity, lower antimicrobial resistance, reduced disease, better health in many high-income regions, and a reduction in the suffering of billions of animals each year. If countries around the world were able to save the land freed by this transition, we would also be better able to cope with climate impacts from flooding and drought.

The required transformation our food systems is profound but achievable. It calls for moving beyond the industrial agriculture paradigm toward predominately plant-rich systems. Those systems enable all people to benefit from nutritious food while reflecting sustainable production methods, mitigating climate change, and encouraging a rural renaissance.

We stand at a crossroads where the choices we make about our food systems will determine not just the trajectory of climate change, but the very viability of agriculture itself. The sector that feeds humanity has the power to become its savior rather than its destroyer. The science is clear. The solutions are available. The best time for action was yesterday, the second-best time for action is today.

THE BEST TIME FOR ACTION WAS YESTERDAY, THE SECOND-BEST TIME FOR ACTION IS TODAY.

A group of cattle in mass confinement, Sao Paulo, Brazil. Photo: © Alf Ribeiro / Shutterstock.com

EXECUTIVE SUMMARY

This report presents the latest global assessment of the meat and dairy industry's outsized climate impact[i], estimating the greenhouse gas (GHG) emissions generated by 45 of the world's major meat and dairy processing companies in 2023/22[ii]. It reveals that:

- These 45 meat and dairy companies together emitted an estimated 1.02 billion tonnes CO_2eq of GHG emissions in 2023/22[23]. If they were a country, they would be the world's ninth highest GHG-emitting nation[24]. In fact, the companies' combined emissions are estimated to be more than those reported for Saudi Arabia, reportedly the second largest oil producer in the world[25].[iii]

- The methane emissions from these 45 companies combined are estimated to be more than the reported methane of all the EU27 countries and UK combined[iii] in 2023[26].

- The top five emitters combined—JBS, Marfrig, Tyson, Minerva and Cargill—emitted an estimated 480 $MtCO_2$eq of GHG emissions in 2023, more than reported[iii] for Chevron, Shell or BP[27]. The estimated emissions of these five companies combined account for nearly half (47%) of the estimated GHG emissions from the total of 45 meat and dairy companies analyzed.

- JBS, here estimated to be the world's highest-emitting meat corporation, alone accounts for nearly one quarter (24%) of all estimated GHG emissions from these 45 meat and dairy companies. Greenpeace Nordic has estimated in an earlier publication that JBS emits more methane than reported for ExxonMobil and Shell combined[28].

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i Unless otherwise stated, the key emissions estimates provided in this report are based on a dataset and analysis commissioned from not-for-profit research firm Profundo. See "Annex 2: Methodology", p.28, for more information and access to the dataset.

ii The scope of research was 45 major processors of beef (12), pork (15), chicken (15) and milk (15)—see "Annex 2: Methodology", p.28, for more info on company selection. 2023 data was used for the number of animals processed for beef, pork and chicken. 2022 data on milk intake was used for dairy companies as 2023 data wasn't available at the time of analysis.

iii The comparisons with reported emissions for countries and fossil fuel companies in this report are indicative only, as these emissions are calculated using different methodologies. See "Annex 2: Methodology", p.28, for more details.

Thousands of chickens packed together at a factory farm in Switzerland. Photo: © Greenpeace

This analysis shows Big Meat and Dairy's colossal, yet often overlooked, climate footprint, which makes it one of the world's highest-emitting sectors. The global livestock sector is already estimated to be responsible for between 12% and 19% of total human-caused GHG emissions[29]. Two new studies this year warn that the Paris Agreement limit of 1.5°C might be breached earlier than previously thought[30]. Alongside action on fossil fuels, reduction in livestock emissions is essential to limit global heating, at a time when every fraction of a degree counts.

Rapid and ambitious methane cuts—including from livestock—offer a critical climate "emergency brake" that is urgently needed in the short-term. That's because methane is a powerful but short-lived gas compared to carbon dioxide. But there needs to be a rapid response: global methane emissions must drop by 40 – 45% by 2030 to affordably achieve the Paris Agreement's target of limiting global temperature rise to 1.5°C, according to the UN Environment Program[31].

The new data estimates show **a small number of meat and dairy giants are responsible for a disproportionately large share of the emissions**. But industrial meat and dairy companies are highly resistant to systemic change, reportedly spending hundreds of millions of dollars lobbying against meaningful action to prevent climate change around the world and promote false climate solutions. These false solutions include limited technology-based fixes like biogas and feed additives and pushing for the misuse of GWP* as a metric to distort and greenwash methane's heating impact. These false solutions are used by the meat and dairy giants as justification against reducing livestock numbers. In fact, companies like JBS have big plans to rapidly expand further, gunning for a 70% increase in global animal protein consumption by 2050[32].

An estimated 83% of global meat production and 77% of global meat consumption occurs in high and upper-middle income countries, while just 2% of meat production and consumption occurs in low-income countries, according to a recent research paper[33]. However, the impacts of the climate crisis are disproportionately experienced by the world's lowest-income people. Climate justice therefore demands that a just transition to lower livestock production be focused in high and upper-middle income countries, and new policies help reduce overconsumption in high and middle-income populations.

One of the biggest challenges in holding Big Meat and Dairy companies accountable for their impact on rising global temperatures—and the associated extreme weather and human suffering—is the significant lack of transparency and robustness when it comes to corporate GHG emissions reporting. While the damning emissions estimates in this report are based on the best publicly available data, they cannot be fully comprehensive due to the scarcity of publicly published, company specific production data.

Big Meat and Dairy companies—profiting from the status quo—are unlikely to reveal the scale of their environmental impact, or to become more transparent, until they are required to do so.

The research presented here demonstrates the need for Big Meat and Dairy companies to urgently reduce livestock numbers to limit global heating. This report outlines a comprehensive roadmap for change for policymakers, including mandatory emissions reporting; strategies to eliminate overproduction and overconsumption of animal products; binding reduction targets for agricultural emissions; and policies to support a just transition to nature restoration and agriculture systems rooted in agroecology, more plant-based food production, and food sovereignty principles.

Every fraction of a degree matters to limit the worst impacts of climate change and avoid disastrous tipping points. This is a global emergency and bold, decisive action is needed. Governments must apply the brakes on global warming by taking on the power of the global meat and dairy industry. Our future depends on it.

EVERY FRACTION OF A DEGREE MATTERS...

Aerial view of an industrial cattle feedlot, Alberta, Canada. Photo: © Russ Heinl / Shutterstock.com

INTRODUCTION: THE MEAT AND DAIRY INDUSTRY IS FUELING THE CLIMATE CRISIS

Animal agriculture is a widely overlooked cause of the climate crisis yet is estimated to account for 12% to 19% of total anthropogenic (human-caused) emissions globally[34]. "Business as usual" growth in production and consumption of livestock alone is projected to result in an additional 0.32°C of warming by 2050 relative to 2015, according to a recent analysis[35].

Scientists have estimated that the global livestock sector accounts for 31% of anthropogenic methane emissions—driven mostly by enteric fermentation (cattle burps) and manure.[36] The Intergovernmental Panel on Climate Change (IPCC) estimates that methane has contributed 0.5°C of global heating since 1850 – 1900, second only to CO_2's contribution of 0.75°C warming.[37] Massive increases in livestock numbers have reportedly led to an estimated 332% increase in methane emissions from ruminant livestock between 1890 and 2014[38]. Yet, livestock methane emissions are projected to increase by an additional 30% by 2050 without policy interventions.[39]

Because methane is a shorter-lived but a more powerful greenhouse gas (GHG) than CO_2, methane emissions reductions would rapidly slow down the rate of global warming—and thus could provide a crucial "emergency brake" to help avoid breaching the 1.5°C warming limit (or bring it back to below 1.5°C)[40]. The UN's Global Methane Assessment finds that a 45% cut in global methane emissions by 2030 is feasible and would avoid more than 0.3°C of warming[41]. However, global climate action currently falls significantly short of meeting this target.

While the impacts of the climate crisis are disproportionately experienced by the world's lowest-income people, higher-income countries are the primary drivers of global emissions, including from livestock. Recent research has found that an estimated 83% of global meat production and 77% of global meat consumption occurs in high- and upper-middle income countries, whilst only 2% of meat production and consumption occurs in low-income countries[42]. Climate justice therefore demands that a just transition to lower livestock production be focused in high- and upper-middle income countries.

This report aims to shed light on the role of Big Meat and Dairy companies behind this unsustainable overproduction. We define "Big Meat and Dairy" as major companies that are mass-processors (and/or producers) of meat and dairy at an unsustainable industrial scale. Typically controlled by multinational corporations, production regularly involves rearing huge numbers of animals in concentrated feeding operations (mostly chickens, dairy cows, and pigs)—often with

large-scale manure storage systems—feedlots (beef cows), or extensive grazing systems (beef and dairy cows) that are vertically integrated into international value chains.

Big Meat and Dairy companies fuel this broken system through their core business: the mass-production and marketing of animal protein. They are one of the most powerful forces defending this unsustainable status quo and standing in the way of a just transition towards agroecological systems that empower rural communities and are good for the planet.

None of the 45 Big Meat and Dairy companies covered in this report appear to have explicit plans to substantially reduce their livestock numbers[i]—instead, many have doubled down on plans to *increase* livestock production. For instance, in 2023 JBS said that it anticipated a 70% increase in global animal protein consumption by 2050[43]. In 2021, Tyson Foods projected that global consumption of beef, pork and chicken would rise "by close to 95 billion pounds over the next 10 years," and said it was "targeting volume growth ahead of the market in every segment"[44]. Plans to increase livestock numbers are completely inconsistent with reducing global livestock emissions by 61% by 2036 or achieving a peak in global livestock numbers by 2025, which many scientists suggest is needed to limit global warming to 1.5°C[45].

In contrast, there are many examples of the meat and dairy industry actively pushing back against dietary change. An April 2025 investigation by DeSmog found that the livestock industry orchestrated a significant backlash against the reductions in meat and dairy consumption recommended by the EAT-Lancet Commission[46]. According to DeSmog, the Animal Agriculture Alliance hired a public relations firm which briefed journalists, think tanks, and social media influencers to frame the peer-reviewed research as "radical", "out of touch" and "hypocritical", and privately bragged that nearly half of the 1,315 articles about the Eat-Lancet report contained their messaging and quotes[47]. In 2023, Unearthed—Greenpeace UK's investigative publication—reported that the pro-meat manifesto *Dublin Declaration of Scientists on the Societal Role of Livestock*, launched in 2022 and used extensively to lobby top EU officials, had numerous links to the meat industry[48]. It has subsequently been critiqued by many scientists[49]. A 2021 investigation also found evidence of the meat and dairy industry spreading misinformation downplaying both the negative environmental impacts of meat and the benefits of a transition to lower meat diets[50].

Changing Markets Foundation's *The New Merchants of Doubt* report also compiled evidence to show how Big Meat and Dairy companies and their industry associations systematically worked to derail crucial EU policies to promote sustainable agriculture policies and cut methane emissions[51]. Six big agriculture industry groups, five of which solely represent the meat and dairy industry, have spent an estimated $200 million in lobbying in the U.S. since 2000, according to a 2021 research paper[52]. Meat and dairy lobbyists also turned out in record numbers at COP28, according to DeSmog[53].

Big Meat and Dairy companies instead appear to be pushing false solutions, techno-fixes and incremental reforms to business-as-usual livestock practices[ii]—often narrowly focused on reducing emissions intensity per kilogram of product, rather than reduction of overall emissions. These measures at best offer limited emissions reduction potential, and at worst greenwash this polluting industry, enabling it to continue the status quo and expand. These incremental changes include feed additives, improved animal genetics, changes to grazing management, and biogas (also known as "factory farm gas") which has faced serious criticism for helping entrench and expand factory farming[54].

To limit the climate crisis, we need to significantly reduce global livestock numbers and reduce the overconsumption of meat and dairy in high and upper-middle income countries. In fact, a recent Greenpeace Nordic report estimates that if just high and middle-income countries reduced production and consumption of meat and dairy in line with the Planetary Health Diet, it could reduce projected warming from livestock by 37% by 2050; with the potential to shave off as much as 0.12°C of temperature rise from the 0.3°C of warming expected from "business as usual" production and consumption projected by the FAO[55].

We need a just transition to more healthy plant-based food consumption, smaller-scale animal agriculture, and a huge restoration of natural habitats—as part of a broader shift to agroecology rooted in food sovereignty principles[56]. A just transition to this green alternative offers huge potential benefits for global food security, human rights, biodiversity, soil and water health, climate resilience, and animal welfare. In this report, we explore the outsized GHG emissions of key meat and dairy companies and offer a roadmap for change.

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i Except in cases where companies reduce livestock numbers processed in response to reduced market demand or their exit from certain markets, as e.g. communicated to the authors by the Vion Group.

ii Although big meat and dairy companies often push these techno-fixes as silver bullet solutions, Changing Markets' report *The New Merchants of Doubt* found they are very often not investing in them either, but instead asking for (more) public subsidies.

GREENHOUSE GAS EMISSIONS OF MAJOR MEAT AND DAIRY COMPANIES

Total GHG Emissions Estimates

In this report, we estimate the GHG emissions of 45 meat and dairy corporations as some of the key players in the global meat and dairy industry [i]. To do so, we have used the most up-to-date GLEAM 3.0 estimates for livestock emissions from the United Nations Food and Agriculture Organization (FAO), conversion factors based on industry standards, and publicly available data on meat and dairy company processing numbers, as well as processing numbers from the companies that supplied them to us. It should be noted that the emissions estimates in this report, including comparisons of these estimates to reported country-level emissions, should not be compared to previous emissions estimates using GLEAM 2.0 (see "Annex 2: Methodology", p.28, and "Annex 4: GLEAM 3.0 vs GLEAM 2.0", p.34, for more information).

The 45 Big Meat and Dairy companies analyzed caused an estimated 1.02 billion tonnes CO_2eq of GHG emissions in 2023/22[ii], more GHG emissions than reported for the world's second largest oil producing country[iii], Saudi Arabia[57]. The 15 highest emitters of these Big Meat and Dairy companies produced an estimated 774 million tonnes CO_2eq ($MtCO_2$eq) in 2023, more than the emissions reported for Germany[58]. See Figure 1, p.13.

According to our analysis, the top five emitters of these Big Meat and Dairy companies (meat giants JBS, Marfrig, Tyson, Minerva and Cargill) together were responsible for an estimated 480 $MtCO_2$eq of GHG emissions in 2023[59], more than the GHG emissions reported for Chevron, Shell or BP[60].[iv] See Figure 2, p.13.

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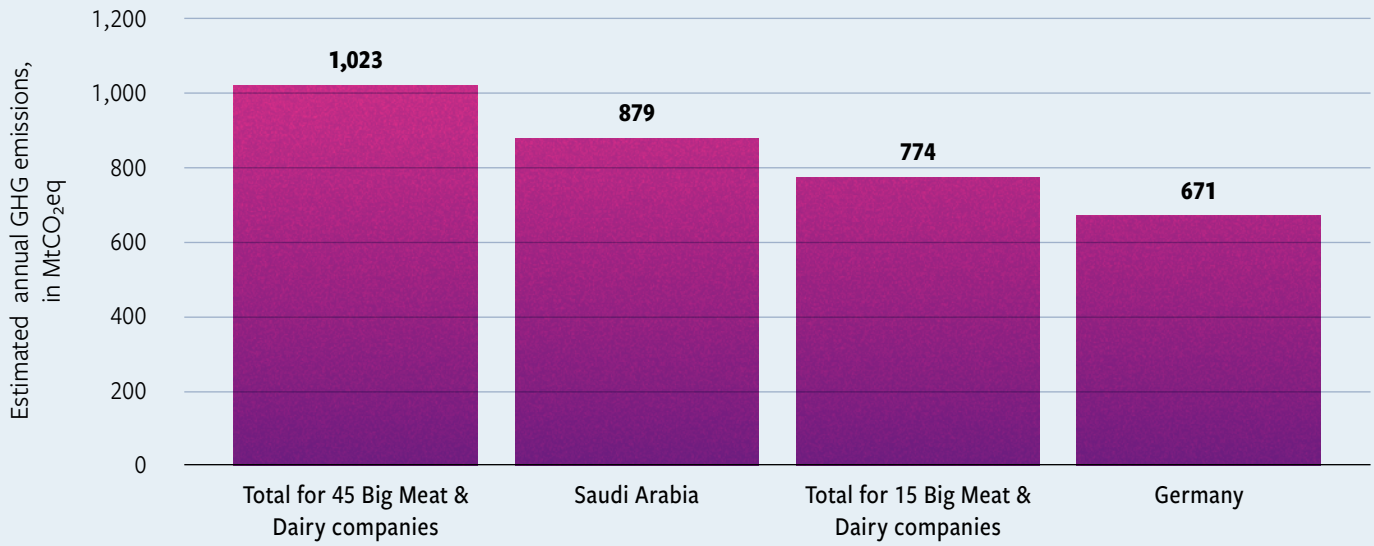
i Company emissions related to other food processing, or non-agricultural activities, are not covered by this report's emissions estimates.

ii The scope of research was 45 major corporations of the global meat and dairy industry that process beef, pork, chicken and milk—see "Annex 2: Methodology", p.28, for more info on company selection. 2023 data was used for the number of animals processed for the processors of beef, pork and chicken. 2022 data on milk intake was used for dairy companies as 2023 data wasn't available at the time of analysis.

iii The comparisons with reported emissions for countries and fossil fuel companies in this report are indicative only, as these emissions are calculated using different methodologies. See "Annex 2: Methodology" on page 28 for more details.

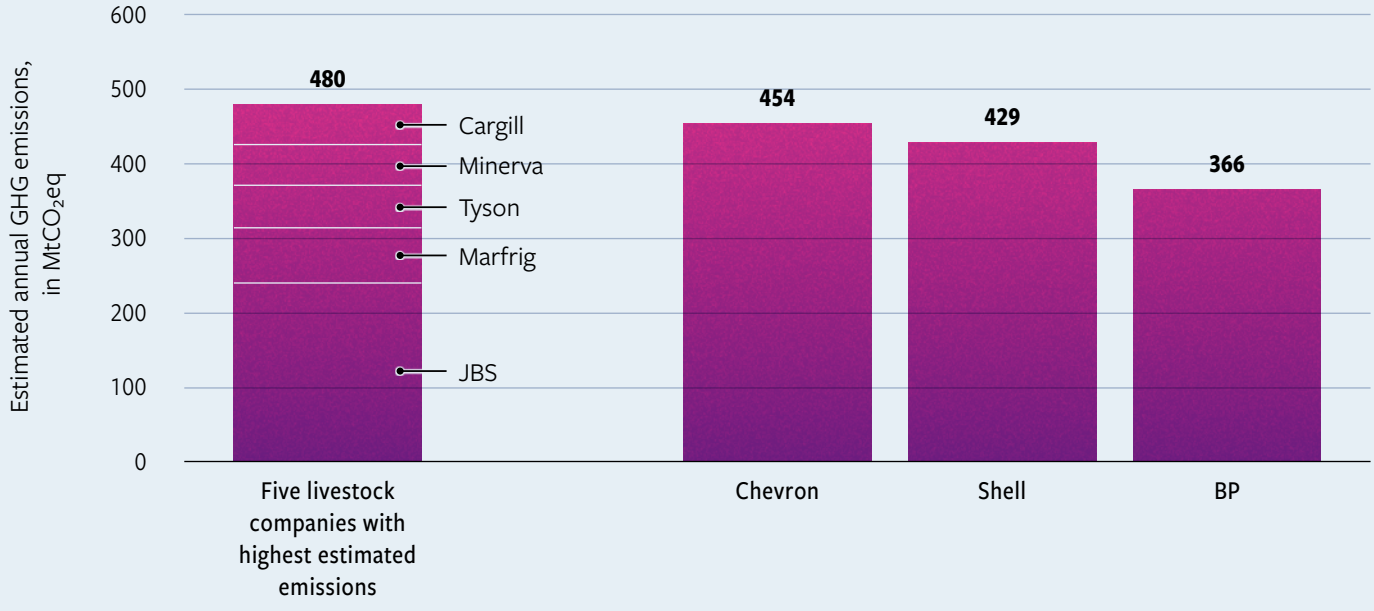
iv These comparisons are indicative only, as fossil fuel company emissions are calculated using a different methodology. See "Annex 2: Methodology", p.28 for more details.

Figure 1: **Estimated GHG emissions of Big Meat and Dairy companies compared to reported emissions of Saudi Arabia and Germany** ($MtCO_2eq$)



Source: Foodrise et al (2025); Our World in Data (2025)

Figure 2: **Estimated GHG emissions of five Big Meat and Dairy companies compared to those reported for Chevron, Shell and BP** ($MtCO_2eq$)



Source: Foodrise et al (2025); Carbon Majors Dataset (2025)

Over three-quarters (76%) of these emissions are estimated to be from the top 15 emitters out of the 45 companies analyzed, nearly half (4%) from the top five, and nearly one-quarter (24%) from JBS alone[61]. See Figure 3, p.15.

The estimated GHG emissions for the 15 highest emitters in this analysis are shown in Figure 4 below, broken down by type of greenhouse gas. The estimated GHG emissions for all 45 companies are shown in Table 1.1 on page 27 of this report. Overall, methane accounted for 51% of the estimated GHG emissions caused by the 45 Big Meat and Dairy companies, 34% was carbon dioxide, and 15% was nitrous oxide. See Figure 4, p.15.

In total, the 45 industrial livestock companies covered by this report slaughtered an estimated 17 billion chickens, 242 million pigs and 53 million cattle in 2023. This accounts for about 22% of chickens, 16% of pigs, and 17% of cattle slaughtered globally in 2023[62].

Breakdown of GHG emissions by animal type and production systems

An estimated 80% of the total emissions from the 45 meat and dairy companies was from cattle, 11% was from pigs, and 9% was from chicken. Cattle—regardless of production method—tend to cause significantly higher emissions and land use than almost any other food source[63]. However, pork and chicken still cause considerably higher emissions than most plant-based proteins[64]. Pork has on average over nine times higher emissions than pulses, and chicken has over seven times higher emissions than pulses, per 100g protein[65]. Pigs and poultry are also often reared in intensive systems[66], which drive other environmental, animal welfare, and social harms (see Box 1).

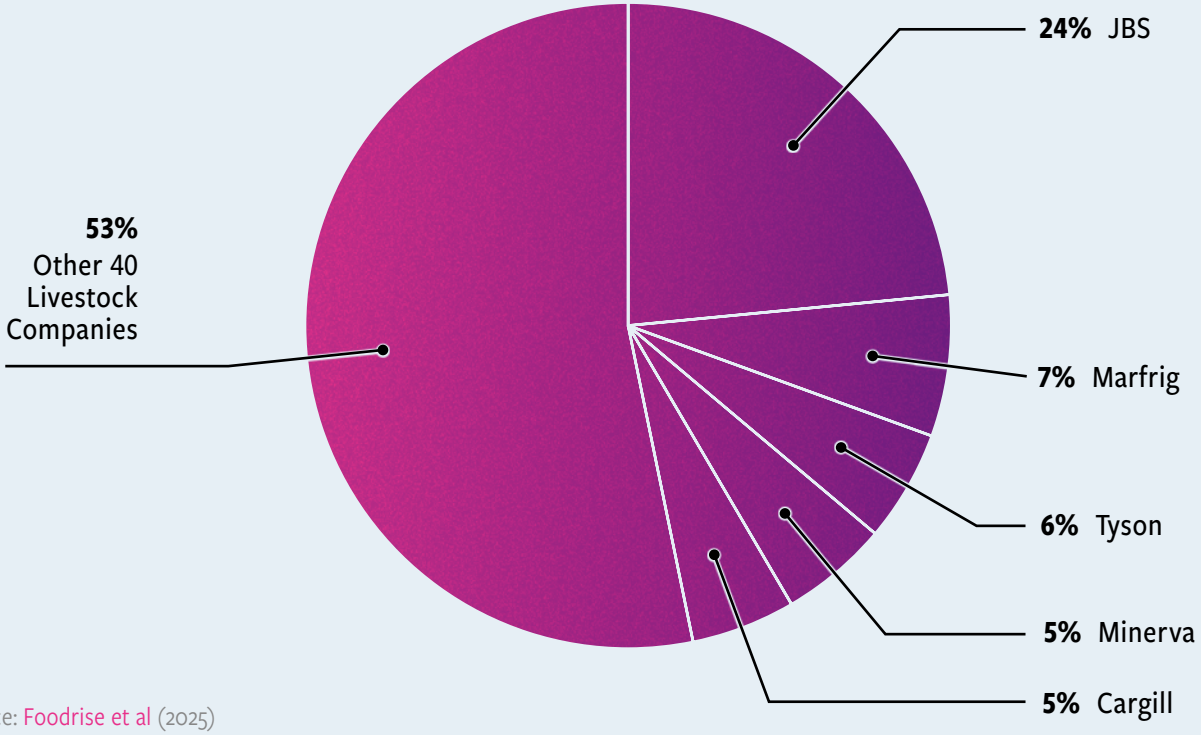
To reduce these numerous harms and to fit within planetary boundaries, it is therefore essential to reduce the overproduction and consumption of animal protein of all types. Ruminant livestock reductions bring the biggest emissions and land use savings, whilst pig and poultry reduction also lead to considerable emissions savings, as well as other environmental and social benefits.

For further detail on the breakdown of GHG emissions by animal species, GHG type and emissions source, see “Annex 3: GHG Emissions by Animal Type, GHG Type and Source” on page 31.

Box 1: Intensive production systems

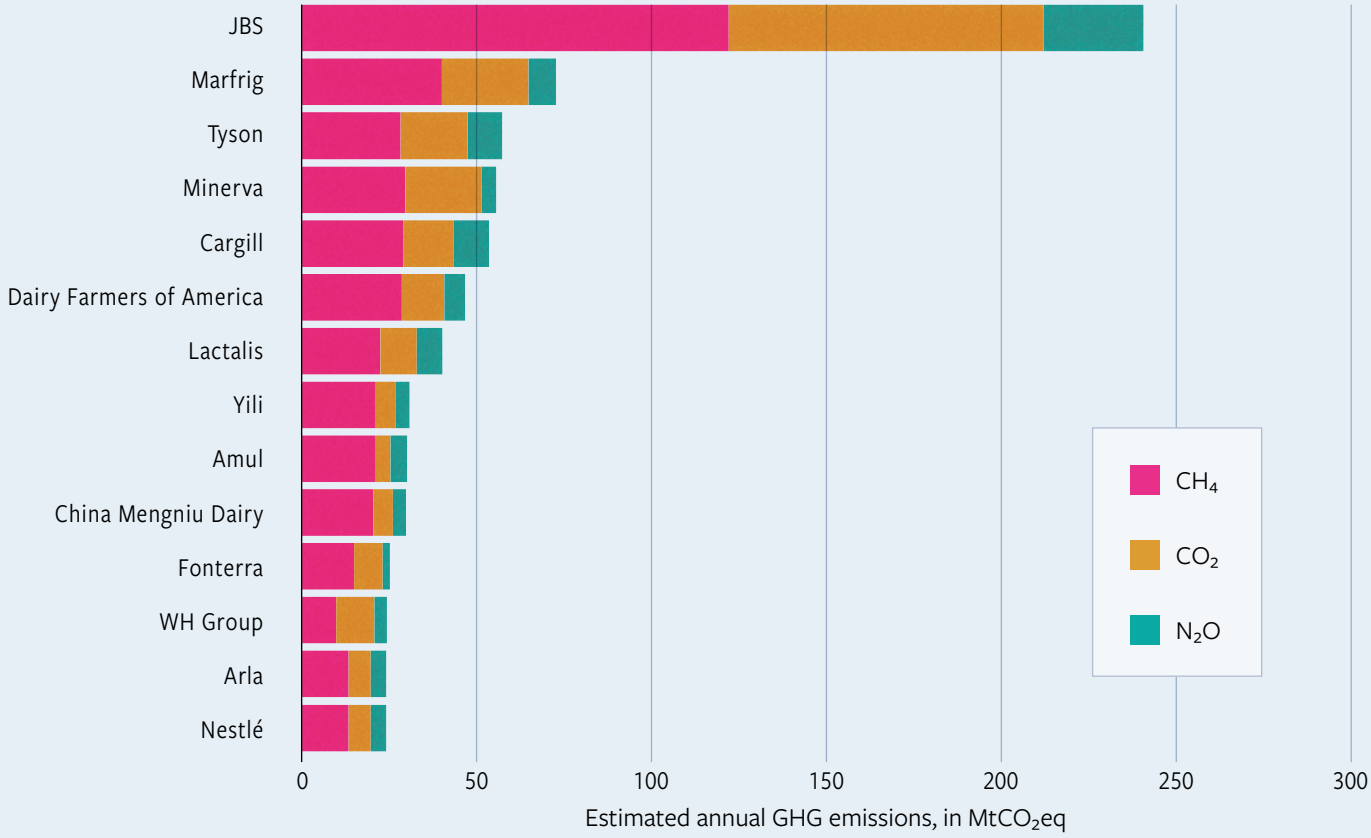
Intensive livestock production (also known as “factory farming”) is linked to significant environmental and social harms[67] which extend beyond its high emissions impacts: high concentrations of manure which drive pollution of soils, air, and water[68]; low animal welfare and pandemic risks driven by the rapid spread of animal disease[69]; the growth of antibiotic resistance driven by over-use of antibiotics[70]; food-feed competition where valuable cropland is used to feed animals rather than grow food for direct human consumption[71]; and deforestation-risks linked to soy production for feed[72]. Cropland currently used to grow animal feed could be used to grow agroecologically produced food directly for human consumption—for instance, an estimated 63% of Europe’s cropland is used to grow animal feed[73]. Reducing cattle, pigs, and chickens raised in intensive systems will thus have co-benefits for reducing these harms as well as emissions. In the U.S., according to the Sentience Institute, an estimated 99% of farmed animals are factory farmed—including 74.9% of cows (most of which are initially raised on pastures but then “grain-finished” in intensive feedlots), 98.6% of pigs, and 99.9% of chickens raised for meat[74].

Figure 3: **Estimated share of total emissions associated with the 45 Big Meat and Dairy companies—JBS accounts for 24% of the estimated total**



Source: Foodrise et al (2025)

Figure 4: **Estimated GHG emissions by gas for the top 15 emitters out of 45 Big Meat and Dairy companies analyzed** (2023/2022, $MtCO_2eq$, GWP100)



Source: Foodrise et al (2025)

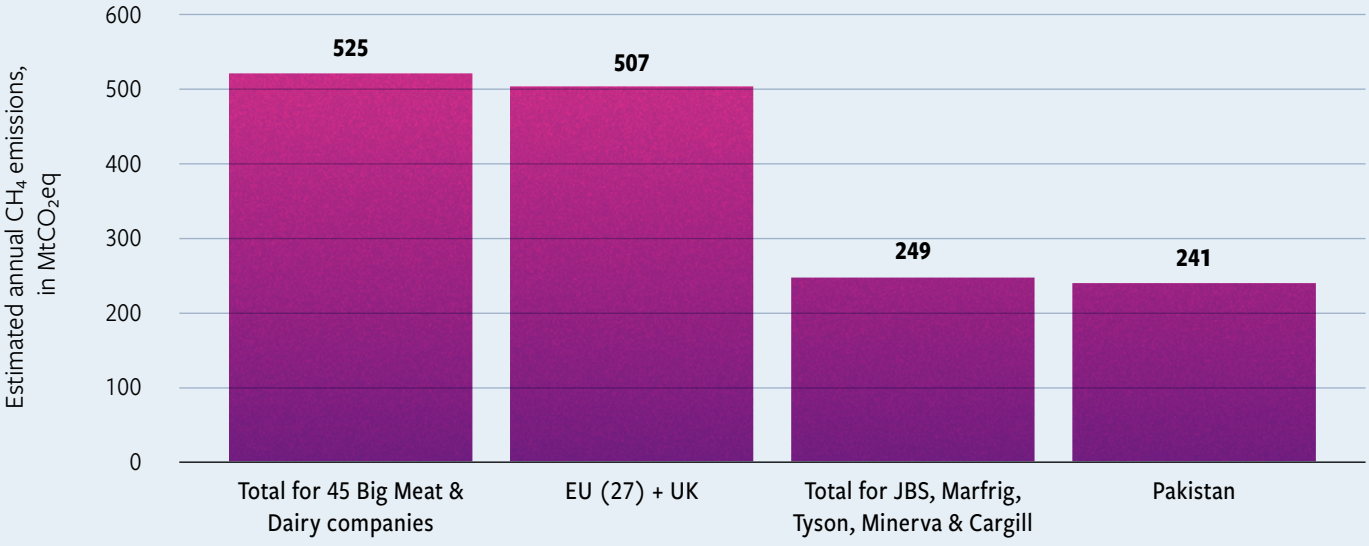
Aerial view of Marfrig slaughterhouse facilities in the Amazon, Brazil. Here, deforestation by fire to make space for mass-scale cattle ranches not only destroys biodiversity and displaces indigenous peoples, but is also responsible for 75% of Brazil's greenhouse gas emissions, making Brazil the world's fourth largest climate polluter.
Photo: © Greenpeace / Daniel Beltrá

Methane emissions

Narrowing the focus, the estimated methane emissions of the 45 meat and dairy companies were 525 $MtCO_2eq$ (GWP100) in 2023/2022—more than the total reported methane emissions of the EU27 countries and UK combined[75]. The estimated methane emissions of the top five emitters out of the 45 companies analyzed (JBS, Marfrig, Tyson, Minerva and Cargill) were higher than those reported for Pakistan[76]. See Figure 5 below for estimated figures[i].

i The comparisons with reported emissions for countries and fossil fuel companies in this report are indicative only, as these emissions are calculated using different methodologies. See "Annex 2: Methodology", p.28, for more details.

Figure 5: **Estimated methane emissions of the 45 meat and dairy companies exceed EU27 & UK's reported methane; emissions of the top 5 out of 45 exceed those reported for Pakistan**

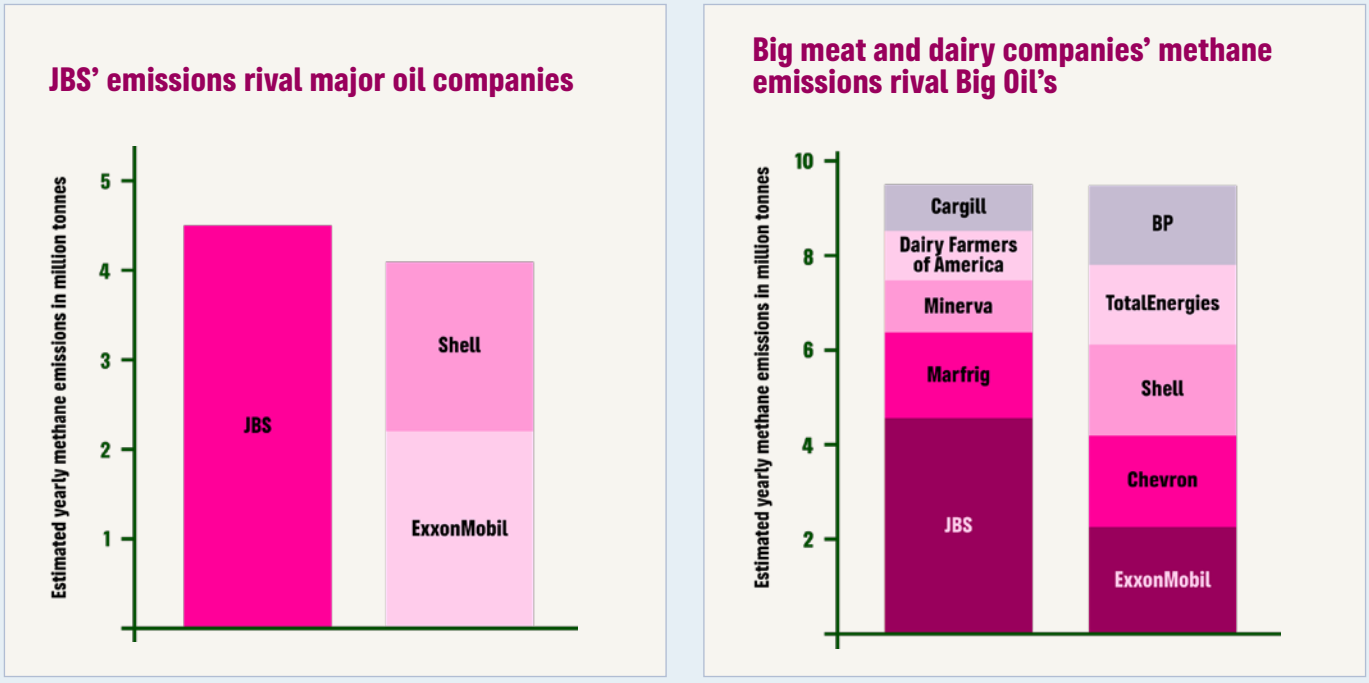


Source: Foodrise et al (2025)

Case Study: JBS—the meat industry's biggest polluter

JBS is the world's largest meat processing corporation by volume, slaughtering an estimated 3.6 billion chickens, 38.8 million pigs, and 20.8 million cattle in 2023[77]. Our estimates suggest that JBS is also the largest-emitting meat company in the world by a considerable margin: it is responsible for a colossal 24% of the estimated emissions from the 45 meat and dairy companies analyzed in this report[78]. We estimate JBS's total GHG emissions to be 241 million tonnes CO_2eq (GWP100) in 2023[79]—more GHG emissions than the individual emissions reported for 81% of the world's countries[80i]. Cattle (beef) accounted for 87% of JBS's estimated GHG emissions[81]. Greenpeace Nordic has estimated that JBS's methane emissions exceed the methane emissions reported for ExxonMobil and Shell combined, and that JBS would rank fifth in comparison to the biggest methane-emitting corporations in the fossil fuel sector[82].[ii]

The credibility of JBS's plans to reduce its emissions has been widely challenged[83]. In 2023, the U.S. National Advertising Review Board recommended that JBS USA discontinue its claims that "JBS is committing to be net zero by 2040," on the grounds that this is "misleading" and JBS does not have a "formulated and vetted plan" to achieve this goal[84]. Subsequently, JBS USA faced legal action from the state of New York[iii]—the lawsuit claimed that JBS has "no viable plan to meet its commitment to be net zero by 2040" and was thus misleading consumers[85]. Indeed, it is hard to see how JBS could possibly achieve such a target without substantial reductions in livestock numbers—yet in 2023, JBS said that it is planning for a 70% increase in global animal protein consumption by 2050[86]. JBS is pushing to further finance its expansion by dual-listing on the New York Stock Exchange[87], which was green-lit by the Trump administration in May 2025[88iv]. In 2025, JBS reportedly stated that its target to achieve net-zero emissions by 2040 was "never a promise" and was merely an "aspiration" —despite having previously used terms such as "commitment" and "pledge," and a slogan that stated, "anything less is not an option[89].



Reproduced with permission from Greenpeace Nordic from 'Turning down the Heat', Greenpeace Nordic (2024)

Sources: Greenpeace Nordic own estimates, Influence Map (2024)[91]

i More than 158 out of 196 of the world's countries. These comparisons are indicative only, as country emissions are calculated using a different methodology. See "Annex 2: Methodology", p.28, for more details.

ii These comparisons are indicative only, as fossil fuel company emissions are calculated using a different methodology. See "Annex 2: Methodology", p.28, for more details.

iii In January 2025, this case was dismissed by the Supreme Court of New York, although it allowed the New York attorney general the option of submitting an amended complaint.

iv JBS faced questions from U.S. Senator Elizabeth Warren over a "potential quid-pro-quo arrangement", after it was revealed that JBS subsidiary Pilgrim's Pride was the biggest donor to the Trump-Vance Inaugural Committee, donating $5 million. Source: Leah Douglas, "US Senator Questions Brazilian Meatpacker JBS over Trump Inaugural Fund Donations", United States, Reuters, 19 May 2025, https://www.reuters.com/world/us/us-senator-questions-brazilian-meatpacker-jbs-over-trump-inaugural-fund-2025-05-19/.

Greenwashing at its most brazen: JBS advert which appeared in the New York Times 2021. Credit: Heated[90]

Box 2: Continued lack of consistency and transparency in Big Meat and Dairy's emissions reporting

The estimated GHG emissions for meat and dairy companies in this report are based on the best publicly available data (see "Annex 2: Methodology", p.28). However, these estimates are by no means comprehensive due to the inconsistency and lack of comprehensive, publicly reported production data from livestock companies. The use of regional average data for GHG emissions means that our analysis is necessarily limited, because the livestock practices associated with any individual company's supply chain may be more or less damaging to the climate than the average for each region. This report's GHG emissions estimates are also likely to be conservative, because they are based on the latest FAO GLEAM 3.0 data, and therefore should not be used for comparison with previous estimates of livestock companies' emissions based on GLEAM 2.0. GLEAM 3.0's estimates of global livestock emissions were developed with livestock industry involvement and are lower than those in the majority of the scientific literature. See "Annex 4: GLEAM 3.0 vs GLEAM 2.0", p.34, for more information.

Some Big Meat and Dairy companies have published their own estimated GHG emissions. However, such figures can be significantly lower than independent estimates.[i]

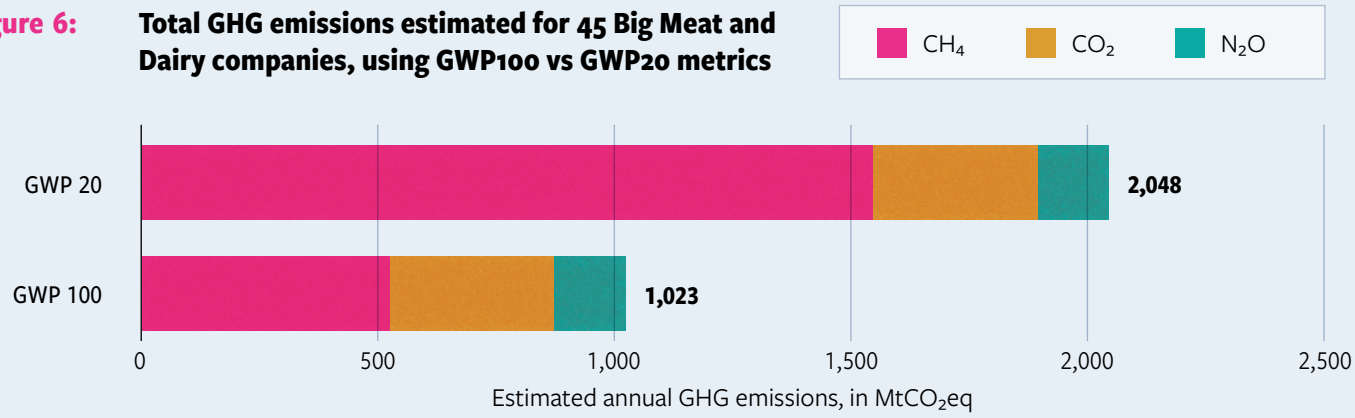
Scope 3 emissions (full supply chain) are the largest source of a meat and dairy company's emissions. Many companies do not include Scope 3 reporting, emphasizing emissions intensity rather than full emissions reporting, rely on offsets and/or appeal to unproven future technology to meet targets[ii]. For instance, Tyson was still not reporting Scope 1-3 emissions in 2023, and although JBS was reporting Scope 1-3 emissions, their company-reported figures were significantly lower than independent estimates[92].

This represents a recurring problem. Many meat and dairy companies do not report, or do not disaggregate their methane emissions from their overall GHG emissions. To more accurately assess Big Meat and Dairy companies' GHG emissions, it is imperative that governments require mandatory public reporting and independent verification of their Scope 1-3 emissions using a standardized methodology for consistency and comparison across companies and that carbon dioxide, methane and nitrous oxide are reported separately.

i See company estimates versus GLEAM 2.0 estimates in GRAIN and IATP's *Emissions Impossible* report.

ii Further information on company reporting, and assessment of their progress, can be found in Greenpeace's report *Turning Down the Heat* and Changing Markets' report *The New Merchants of Doubt*, as well as in IATP's Meat and Dairy Emissions Dashboard.

Figure 6: Total GHG emissions estimated for 45 Big Meat and Dairy companies, using GWP100 vs GWP20 metrics



Source: Foodrise et al (2025)

Methane emissions as measured over a 20-year and 100-year period (GWP20 vs GWP100)

Methane (CH_4) is an extremely powerful GHG, causing about 80 times more warming per kg than carbon dioxide (CO_2) over a 20-year period and on average 27 times more warming than CO_2 over a 100-year period.[93] Methane is also more short-lived in the atmosphere than CO_2. With an average lifetime of approximately 12 years, it gradually breaks down into CO_2 and H_2O—meaning its warming power declines, although not completely.

For this reason, Big Meat and Dairy companies producing large amounts of methane have a higher global warming effect measured over a 20-year period than when measured over a 100-year period. GWP100 (Global Warming Potential 100) is a measure of the heating effect of greenhouse gases over a 100-year period, whilst GWP20 is a measure of the heating effect of greenhouse gases over a 20-year period.

Unless specified, the global warming potential of meat and dairy company emissions provided in this report use GWP100, which means their contribution to climate change is underestimated over shorter timescales. We have used this metric as the default because this is widely respected in the scientific community—used as the primary metric by the IPCC and embedded in international climate agreements like the Paris Agreement. However, it is important to recognize that the global warming contribution of these 45 companies is even higher when looking at their effect over a 20-year period—which is a more relevant metric for looking at the shorter-term impacts of greenhouse gases for the purpose of avoiding climate overshoot and tipping points in the next two decades.

As shown in Figure 6 on page 20, when using GWP20 instead of GWP100, the global warming effect of the 45 companies' estimated GHG emissions doubles to an estimated 2.05 billion tonnes CO_2eq (GWP20).

Box 3: Non-fossil methane and GWP*

A myth pushed by the meat and dairy industry is that "biogenic" methane from animals, plants, and waste is part of a natural cycle, and therefore not important for global heating. However, the IPCC AR6 report categorically shows that biogenic (non-fossil) methane has only about 3% less warming impact over a 20-year period and 9% less warming impact over a 100-year period compared to fossil methane[94]—an almost identical effect. Methane from livestock is not part of a naturally balanced cycle because the unsustainable number of livestock currently produced globally means that biogenic methane accumulates in the atmosphere far faster than plant photosynthesis can cycle it back into ecosystems.

To evade responsibility for their huge methane emissions, several Big Meat and Dairy companies and trade groups have begun to push for governments to adopt GWP*—a dangerous and distorting new climate model when used, as the industry wants, at country or company level. Using GWP* allows the meat and dairy industry to misleadingly downplay the impact of its methane emissions and appear "climate neutral" whilst only making minor methane reductions. Meat and dairy industry bodies such as Meat & Livestock Australia and the U.S. National Cattlemen's Beef Association have reportedly already begun to make greenwashing claims based on GWP*[95], and to push governments to adopt the related "no additional warming" approach which lets the meat and dairy industry off the hook for reducing its emissions[96]. Under this pressure, countries like New Zealand (at the time of writing) and Ireland are considering diluting their biogenic methane reduction targets by aiming only for "no additional warming". This would enable their meat and dairy industries to continue emitting almost as much methane as they emitted in the recent past, locking in emissions despite the urgent need to significantly reduce methane this decade to limit climate chaos.

For further information on GWP*, we recommend reading Foodrise's policy briefing on GWP*[97], Changing Markets' report *Seeing Stars*[98], Greenpeace Aotearoa New Zealand's media brief, and Joint-Statement on GWP* and Livestock Methane signed by many organizations internationally[99].

Photo: Stefan Scheepmaker / Unsplash.com

CONCLUSION

This report has provided the latest estimates for the colossal greenhouse gas emissions of 45 major corporations of the global livestock industry—demonstrating that global meat and dairy companies continue to be key drivers of the climate crisis, with estimated emissions comparable to whole countries and some of the world's largest fossil fuel companies. We hope that this will add to the growing body of evidence for regulation of Big Meat and Dairy companies: policymakers must act to ensure far greater transparency and accountability from this polluting industry.

The science is clear: in addition to an urgent fossil fuel phaseout, significantly reducing farmed animal numbers will be essential to limit climate chaos. Like the fossil fuel industry, the Big Meat and Dairy industry will fight tooth and nail against the changes needed to ensure a habitable future. Policymakers need to enact policies that will hold Big Meat and Dairy companies to account, support a just transition for farmers and workers to more agroecological food systems rooted in food sovereignty—including more emphasis on nature restoration and healthy plant-based food production for direct human consumption—and to incentivize healthy sustainable diets among citizens. Our future depends on it.

SIGNIFICANTLY REDUCING FARMED ANIMAL NUMBERS WILL BE ESSENTIAL TO LIMIT CLIMATE CHAOS

Cows graze in front of German Parliament as part of a Greenpeace demonstration. Photo: © Chris Grodotzki / Greenpeace

POLICY RECOMMENDATIONS

We recommend that policymakers:

- Introduce mandatory reporting for Big Meat and Dairy companies of key industry data to ensure transparency and accountability, including:
  - Regular publication of livestock production, slaughter numbers, and milk intake in a consistent standardized format.
  - Strong climate disclosure requirements for public and private meat and dairy companies, including reporting of full Scope 1, 2, and 3 emissions, broken down by greenhouse gas, and according to a standardized methodology.
- As part of their UNFCCC-mandated updates to their 2030 and 2035 climate targets, governments should set binding targets for an absolute reduction in their agriculture GHG emissions, including separate methane reduction targets. These should be accompanied by emissions reduction plans, including separate methane action plans, with regular reports on progress.

Agricultural emissions reduction targets should be implemented through systemic solutions such as just transition strategies for livestock that eliminate overproduction and overconsumption of animal products, result in reduced herd sizes and protein diversification, facilitate a shift out of polluting industrial production systems, support farmer and worker livelihoods, and produce healthy and nutritious foods. These include:

- A time-bound strategy and implementation plan to shift public funds away from large-scale animal agriculture (including animal feed) towards nature restoration and ecological agriculture systems that center plant-based food production rooted in agroecology and food sovereignty principles, through a just transition that adequately supports farmers, workers, and citizens. This should include:
  - Subsidy reform to support this just transition.
  - Divestment of public pension funds and multilateral development banks from Big Meat and Dairy companies.
- Policies that incentivize a shift in dietary patterns towards healthy sustainable diets, primarily from ecologically produced plant-based foods—such as reforms to procurement of food for public institutions such as schools, government facilities, and hospitals, and reform to retail and catering business policies.
- Regulation to ensure that Big Meat and Dairy companies' currently externalized environmental and social costs are instead paid by the polluting company according to the "polluter pays" principle. For instance, by setting limits on pollution of water, air, and soils; taxing emissions (including methane and nitrous oxide); cracking down on deforestation from grazing and animal feeds; increasing protections for workers; restricting use of antibiotics; and increasing animal welfare standards.
- Fund public investment in the just transition to sustainable food systems through progressive taxation on society's wealthiest, and "polluter pays" taxes on polluting companies including Big Meat and Dairy companies and their investors.

ANNEX 1: THE GHG EMISSIONS OF THE 45 BIG MEAT AND DAIRY COMPANIES

NOTE: Figures provided in Table 1.1 use data for the year 2023 (for beef, pork and chicken processing), with the exception of dairy, where 2022 data was used as 2023 data wasn't available at the time of analysis. See "Annex 2: Methodology", p.28, for more info.

ANNOTATIONS: In their reply to the authors' opportunity-to-comment letter sent prior to the publication:

* Marfrig stated that their, yet unpublished, self-reported emissions based on the GHG Protocol methodology amounted to 46.2 $MtCO_2eq$ in 2022/23, incl. FLAG emissions (Forest, Land and Agriculture).

** Minerva stated that their self-reported emissions based on the GHG Protocol methodology amounted to total GHG emissions of 21.8 $MtCO_2eq$ (GWP100), composed of CO_2: 0.93, CH_4: 19.36, N_2O: 1.50 $MtCO_2eq$ (GWP100). According to the company's Sustainability Report 2024, this number refers to net emissions and includes offsets (Minvera (2025) Sustainability Report 2024, Minerva Foods).

*** Nestlé pointed to their non-financial statement 2024 for self-reported GHG emissions. This report does not contain 2022 data. The dairy and livestock related total GHG emissions reported for 2024 amounted to a total of 22.41 $MtCO_2eq$

**** Arla pointed to their published GHG emission figure of 18.1 $MtCO_2eq$ (Arla Annual Report 2024)

***** Friesland pointed to their published GHG emission figure of 18.2 $MtCO_2eq$ (FrieslandCampina Annual Report 2024)

****** Saputo pointed to their 'Promise Report 2024' for their reported GHG emissions. This report does not provide the full set of data (Scope 1-39) for 2023. For 2024 Saputo's emissions are given as 17.9 $MtCO_2eq$.

Table 1.1: The GHG emissions of the 45 Big Meat and Dairy companies assessed in this report (GWP100) in 2023/2022

Company Name	HQ Country	Total GHG emissions ($MtCO_2eq$)	Methane (CH_4, $MtCO_2eq$)	Carbon dioxide (CO_2, $MtCO_2eq$)	Nitrous oxide (N_2O, $MtCO_2eq$)
JBS	Brazil	240.66	121.96	90.13	28.57
Marfrig*	Brazil	72.63	40.02	24.83	7.78
Tyson	United States	57.29	28.25	19.17	9.88
Minerva**	Brazil	55.60	29.58	21.76	4.26
Cargill	United States	53.46	29.13	14.22	10.11
Dairy Farmers of America	United States	46.63	28.51	12.18	5.94
Lactalis	France	40.23	22.37	10.40	7.46
Yili	China	30.70	20.90	5.90	3.90
Amul	India	30.14	20.83	4.42	4.90
China Mengniu Dairy	China	29.78	20.27	5.72	3.78
Fonterra	New Zealand	25.17	14.78	8.27	2.11
WH Group	China	24.21	9.77	10.95	3.49
Nestlé***	Switzerland	24.03	13.37	6.21	4.46
Arla****	Denmark/Sweden	24.03	13.37	6.21	4.46
FrieslandCampina*****	Netherlands	19.05	10.59	4.92	3.53
Bigard	France	18.23	9.88	4.25	4.10
Danone	France	17.38	10.14	4.73	2.52
Saputo******	Canada	17.27	10.56	4.51	2.20
BRF	Brazil	15.47	1.85	11.11	2.51
Gruppo Cremonini	Italy	14.41	8.66	2.49	3.27
Glanbia	United States	14.13	8.64	3.69	1.80
Danish Crown	Denmark	12.60	5.39	4.12	2.78
California Dairies	United States	12.09	7.39	3.16	1.54
Müller	Germany	11.93	6.63	3.08	2.21
Vion Food Group	Netherlands	10.99	4.96	3.07	1,38
Agropur	Canada	10.52	6.43	2.75	1.34
Tönnies Group	Germany	10.43	3.79	4.36	2.28
Wen's Food Group	China	8.10	1.01	5.51	1.59
Muyuan Foodstuff	China	7.39	3.03	3.07	1.29
Charoen Pokphand	Thailand	6.95	1.23	4.53	1.20
Westfleisch	Germany	5.73	2.54	1.92	1.27
Aurora Alimentos	Brazil	5.57	1.18	3.40	0.98
New Hope Group	China	5.52	0.98	3.49	1.06
Japfa	Singapore	4.94	0.11	3.83	1.00
Zhengbang Group	China	4.71	1.93	1.96	0.82
Teys	Australia	4.25	2.71	0.96	0.58
Industrias Bachoco	Mexico	4.10	0.14	3.36	0.60
Wellhope Agritech	China	4.08	0.09	3.16	0.83
Grupo Vall Companys	Spain	3.67	1.01	1.86	0.79
Arab Company for Livestock Development (ACOLID)	United Arab Emirates	3.60	0.10	2.88	0.62
Fuijan Sunner Development	China	3.42	0.07	2.66	0.70
Koch Foods	United States	3.26	0.10	2.72	0.44
Perdue Farms	United States	2.99	0.09	2.50	0.40
Grupo Jorge	Spain	2.76	0.76	1.40	0.60
Continental Grain Company	United States	2.61	0.08	2.18	0.35

ANNEX 2: METHODOLOGY

Friends of the Earth U.S., Foodrise, Greenpeace Nordic, Institute for Agriculture and Trade Policy, and Changing Markets Foundation commissioned the not-for-profit research firm Profundo to estimate the total GHG emissions of 45 Big Meat and Dairy companies.

Publicly available data was gathered on the total number of animals processed by individual meat and dairy companies to identify the key processors in four sectors: beef, pork, chicken, and milk. The resulting list of big meat and dairy companies cannot be fully comprehensive due to the scarcity of published, company specific production data.

In total, 45 Big Meat and Dairy companies that process beef, pork, poultry or milk were included within the scope of this report. In some cases, there was overlap between the sectoral lists (the same company was one of the largest producers or processors in more than one sector), which is why the final number of companies is 45.

- **Beef:** Twelve key beef processors (2023 data), based on a variety of sources (there was no publicly available ranking of the key processors). We have not included an extended list of 15 beef processors because outside the 12 companies chosen, processing figures decline significantly due to industry concentration—and there is also low data availability. Self-reported data from company reports was used where possible.

- **Pork:** Fifteen key pork processors (2023 data), based on a variety of sources (there was no publicly available ranking of the key processors). Self-reported data from company reports was used where possible.

- **Poultry:** Fifteen key poultry processors (2023 data), based primarily on Poultry International (2024), "Top world broiler and egg rankings 2024" —except where data was available through own-company reporting.

- **Dairy:** Fifteen of key dairy processors (2022 data), based on IFCN Dairy's dataset, as published by Dairy News (2023) "Who are the current top 20 milk processors?"

In most cases, actual slaughter numbers were used. Where only slaughter capacity was available, slaughter numbers were calculated via company-reported utilization rates where possible, and via industry-average utilization rates where these were not available (assumed as 91% for beef, 96% for pork and 86.6% for poultry). Figures assumed for animals processed per year by each company can be found in Tables 2.1 to 2.4 opposite—and further details about underlying data sources and assumed utilization rates can be found in the dataset accompanying this report.[100]

All companies were contacted prior to publication of this report by the authors to provide them with an opportunity to comment on the processing numbers used and the resulting estimated GHG emissions, as well as on other statements made in relation to their company. Where appropriate, answers to these letters have been incorporated into this report. Company self-reported emission estimates often differed from our analysis. For a more detailed discussion of possible reasons for these differences see Greenpeace Nordic's *Turning down the Heat* (2014) that relied on the same methodology as applied in this report.

Table 2.1: Major beef processing companies by annual beef processing volume (2023)

Company	HQ Country	Number of cattle processed per year (reported or based on capacity use)
JBS	Brazil	20,815,142
Marfrig	Brazil	6,740,320*
Cargill	United States	7,750,000
Tyson	United States	6,367,400
Minerva	Brazil	3,873,800
Bigard	France	1,931,153
Gruppo Cremonini	Italy	1,864,146
Vion Food Group	Netherlands	765,709*
Danish Crown	Denmark	762,000
Teys	Australia	750,000
Westfleisch	Germany	380,800
Tönnies Group	Germany	364,000

* Unpublished figure, number submitted by company to the authors in response to an opportunity-to-comment letter sent prior to publication.

Table 2.2: Major pork processing companies by annual pork processing volume (2023)

Company	HQ Country	Number of pigs processed per year (reported or based on capacity use)
WH Group	China	49,169,000
JBS	Brazil	38,750,707
Tyson	United States	20,573,280
Tönnies Group	Germany	17,790,000
Danish Crown	Denmark	15,877,000**
Vion Food Group	Netherlands	12,034,611*
Muyuan Foodstuff	China	13,260,000
BRF	Brazil	9,639,552
Grupo Vall Companys	Spain	8,505,747
Zhengbang Group	China	8,450,000
Bigard	France	8,381,963
Aurora Alimentos	Brazil	7,300,000
Charoen Pokphand	Thailand	7,200,690
Westfleisch	Germany	6,600,000
Grupo Jorge	Spain	6,400,000

* Unpublished figure, number submitted by company to the authors in response to an opportunity-to-comment letter sent prior to publication.

** This includes 252,000 sows

Table 2.3: Major poultry processing companies by annual poultry processing volume (2023)

Company	HQ Country	Number poultry processed per year (reported or based on capacity use)
JBS	Brazil	3,609,141,600
Tyson	United States	1,942,200,000
BRF	Brazil	1,612,145,600
Wen's Food Group	China	1,183,000,000
Cargill	United States	1,128,600,000
Japfa	Singapore	981,000,000
Wellhope Agritech	China	810,000,000
Charoen Pokphand	Thailand	751,347,032
Fuijan Sunner Development	China	680,000,000
Koch Foods	United States	670,000,000
Arab Company for Livestock Development (ACOLID)	United Arab Emirates	662,200,000
New Hope Group	China	657,780,000
Industrias Bachoco	Mexico	640,000,000
Perdue Farms	United States	615,000,000
Continental Grain Company	United States	535,600,000

Table 2.4: Major dairy processing companies by annual milk intake (2022)

Company	HQ Country	Milk intake per year (tonnes)
Dairy Farmers of America	United States	29,700,000
Lactalis	France	22,600,000
Fonterra	New Zealand	17,600,000
Nestlé	Switzerland	13,500,000
Arla	Denmark/ Sweden	13,500,000
Saputo	Canada	11,000,000
FrieslandCampina	Netherlands	10,700,000
Yili	China	10,000,000
China Mengniu Dairy	China	9,700,000
Amul	India	9,600,000
Glanbia	United States	9,000,000
California Diaries	United States	7,700,000
Danone	France	6,700,000
Müller	Germany	6,700,000
Agropur	Canada	6,700,000

Emissions calculations

The Institute for Agriculture and Trade Policy (IATP) and GRAIN developed a methodology for calculating the GHG emissions from meat and dairy companies in their 2018 report Emissions Impossible. This methodology used the Global Livestock Environmental Assessment Model (GLEAM) version 2.0 model (2017) developed by the Food and Agriculture Organization of the United Nations (FAO) and IPCC AR5 GWP figures. The GLEAM model takes into consideration multiple factors such as animal type, geographic location of livestock and relevant factors such as feed, enteric fermentation, and pasture among others. The FAO's GLEAM 2.0 model was used to determine the GHG emissions per kilo of beef, pork, poultry and milk (emissions factors) for each company. The GLEAM model includes regionalized slaughter weights, carcass dressing percentages, and GHG emission intensity values on a per-tonne-of-product basis. IATP and GRAIN then multiplied the production quantity by the emissions factors to get the totals for each company. IATP and Changing Markets Foundation also used this methodology in their subsequent 2022 report *Emissions Impossible: Methane Edition*, in order to calculate the GHG emissions of 15 companies (five meat and 10 dairy) using AR6 GWP figures, as well as to estimate their methane emissions for the first time.

Since the release of the *Emissions Impossible* report series, an updated GLEAM model (version 3.0) was published (2022). IATP and Changing Markets Foundation granted the authors of this report access to their underlying data and methodology. The research for this report updated the relevant figures in the IATP model with GLEAM 3.0 model figures. GLEAM 3.0 uses updated emissions factors based on the IPCC's AR6 report (see Annex 4, p.34).

The most recent available company production figures (see Tables 2.1 to 2.4, p. 29) were put into the IATP model with updated GLEAM 3.0 factors to calculate emission estimates for CO_2, CH_4 and N_2O (expressed in CO_2e) per company.

NOTE: We use American billions in this report—so 1 billion = 1,000 million.

Comparison with the emissions of fossil fuel companies and countries

For the comparison of the emissions estimated here for meat and dairy companies with those reported for fossil fuel companies and countries, this report refers to calculations according to other sources: the Carbon Majors Database[101] for fossil fuel companies and Our World in Data[102] for countries. Due to the lack of standardization across industries and use cases, such comparisons are for illustrative purposes only.

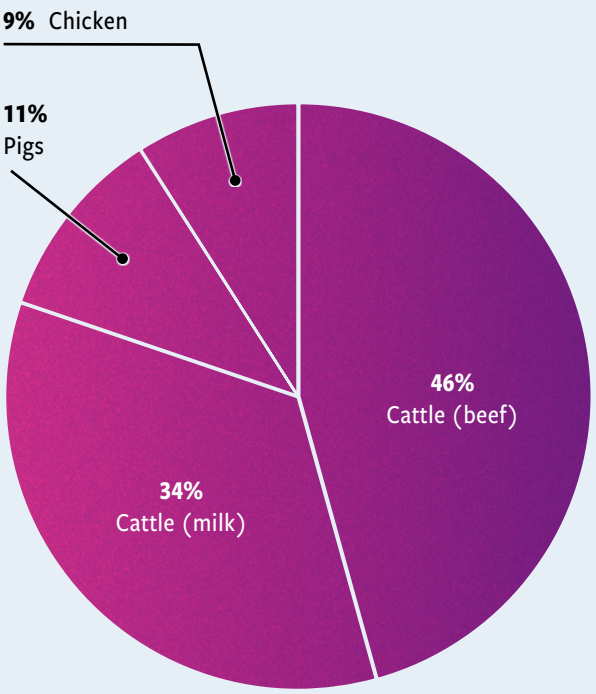
ANNEX 3: GHG EMISSIONS BY ANIMAL TYPE, GHG TYPE AND SOURCE

Source of emissions: By animal type

80% of the estimated total emissions from the 45 Big Meat and Dairy companies was from cattle (46% from beef cattle, 34% from dairy cattle), 11% was from pigs, and 9% was from chicken. See Figure 7, right.

This is consistent with estimates that ruminant livestock (such as cattle, sheep, goats, and bison) cause an estimated 77% of total global livestock emissions, with 62% caused by beef and dairy cattle alone.[103] All ruminant livestock—regardless of production method—tend to cause significantly higher emissions and land use than almost any other food source.[104] This is due primarily to enteric fermentation (cattle burps—and to a lesser extent, farts—of methane) and land use change, as well as animal feed production and manure. On average, beef (from beef herds) causes 62 times more emissions compared with pulses, per 100g protein[105]. Research suggests that even beef from dairy herds using some of the lowest emissions production methods causes over 11 times more emissions than pulses per 100g protein.[106 i] To avert climate crisis, a significant reduction in ruminant livestock numbers—in line with models like the EAT-Lancet Planetary Health Diet[107]—is therefore essential, whatever the production system. Shifting to more extensive and agroecological rearing of cattle can have many benefits—including for soils, biodiversity and animal welfare—but must be practiced at a sustainable small scale to ensure reductions in emissions and land use[108]. Many agroecological and regenerative farming practices require only a small number of animals to be integrated into the system, and some do not rely on animals at all.

Figure 7:
GHG emissions of 45 Big Meat and Dairy companies, by species



Source: Foodrise et al (2025)

i Beef from dairy herds tends to register as having lower emissions than beef from beef herds per kg of protein, primarily because more protein is produced per cow (both dairy and beef, rather than just beef). The figures here for "lowest-emitting beef from dairy herds" refers to tenth percentile dairy beef impacts—that is, the emissions from producers whose lower-emissions production methods mean they cause lower emissions than 90% of other producers of beef from dairy cattle. The *average* emissions for beef from dairy herds is higher—over 21 times higher than for pulses per 100g protein.

Industrial pork and chicken production also have a considerable environmental impact, particularly when looking beyond emissions to other factors. Research has found that pork and chicken still cause considerably higher emissions than most plant-based proteins—pork has on average over nine times higher emissions than pulses, and chicken has over seven times higher emissions than pulses, per 100g protein.[109] Their emissions are mainly from animal feed production as well as pig manure, which particularly when stored in large lagoons is also a significant source of methane emissions (see Figure 8, opposite). Pigs and poultry are also often reared in intensive industrial systems, which drive other environmental and social harms (see Box 1: Intensive production systems, p.14).

To reduce these numerous harms and to fit within planetary boundaries, it is therefore essential to reduce the overproduction and excessive consumption of animal protein of all types. Ruminant livestock reductions bring the biggest emissions and land use savings whilst pig and poultry reduction also lead to considerable emissions savings, as well as other environmental and social benefits such as reduced pandemic risks arising from intensive production methods[110], less food-feed competition[111], and less deforestation-risks linked to soy in feed[112].

Sources of emissions: By GHG type and source

Overall, methane accounted for 51% of the estimated GHG emissions caused by the 45 Big Meat and Dairy companies, 34% was carbon dioxide, and 15% was nitrous oxide. There is considerable variation between species, as shown in Figure 8.

For instance, cattle have a higher proportion of methane emissions (57% of the total for beef cattle and 61% of the total for dairy cattle). Pigs have a more even split of methane (38%), carbon dioxide (46%) and nitrous oxide (17%). Carbon dioxide accounts for the majority of emissions from chicken production (81%). For all the livestock types, around 13-17% of emissions were from nitrous oxide emissions. Overall, GHG emissions for cattle were higher across all greenhouse gas types.

To understand the origins of these emissions, it is also helpful to look at the underlying causes. The main causes were enteric fermentation (42%), feed production including synthetic fertilizer and manure fertilizer emissions (20%), manure management (15%), land use change (10%, of which 9% was pasture expansion and the remainder soy), post-farm emissions (9%), and direct and indirect energy (4%). These key causes of livestock emissions are explained briefly below:

- **Enteric fermentation:** Methane emissions produced by ruminant livestock—in this study, cattle—burping (and to a lesser extent, farting) as result of the digestion of grass and other animal feed.

- **Animal feed:** The production, processing, and distribution of animal feed generates emissions, particularly as a result of fertilizers used to grow cereals and grass for animal feed. Both synthetic fertilizers and manure cause emissions of the powerful GHG nitrous oxide when wrongly or over-applied to soils. Additionally, the process of producing synthetic fertilizers and pesticides involves fossil fuels both as chemical feedstocks and as an energy source during the manufacturing process[113]—producing carbon dioxide.

- **Manure:** Livestock manure, particularly when it is stored in large piles or disposed of in lagoons, produces methane as it decomposes anaerobically (in the absence of oxygen) and nitrous oxide. This occurs particularly when large numbers of animals are managed in a confined area, such as a factory farm—especially of beef cattle, dairy cows, and pigs.

- **Land use change:** Meat, aquaculture, egg, and dairy production already use 83% of the world's farmland, despite providing only 37% of protein and 18% of calories for human consumption globally[114]. This makes animal agriculture an out-sized driver of land use change, where nature is converted to agricultural production. Around 41% of global tropical deforestation is caused by expanding pastures for cattle production, whilst a further 7% is caused by soy production, primarily for animal feed[115]. In addition to these emissions from direct land use change, livestock uses considerable amounts of land which could alternatively be used for nature restoration to sequester carbon (and restore biodiversity). These so-called "opportunity costs" have not been captured in the emissions estimates in this report. Nearly a quarter of current global pastureland was converted from formerly native forest[116].

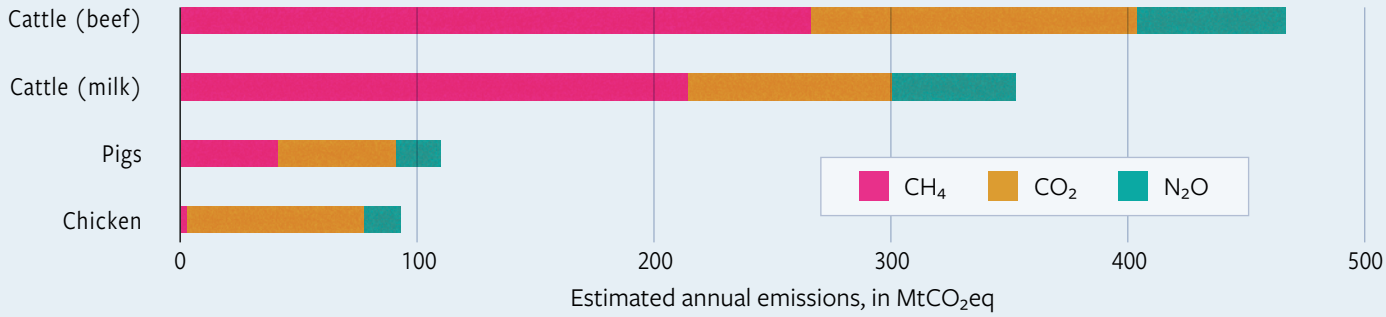
- **Post-farm emissions:** Finally, emissions are caused by the processing and transport of meat and dairy after they have left the farm-gate.

These causes are significantly different between species, as shown in Figure 9 below[i].

The largest source of cattle emissions is enteric fermentation—causing an estimated 55% of beef cattle and 49% of dairy cattle GHG emissions for the Big Meat and Dairy companies studied. Meanwhile, the largest drivers of GHG emissions for pigs are feed production (39%) and manure management (40%). For chickens, emissions associated with feed account for an estimated 51% of GHG emissions. The total overall emissions associated with feed is still slightly higher for beef and dairy cattle compared to pigs and chickens, though similar.

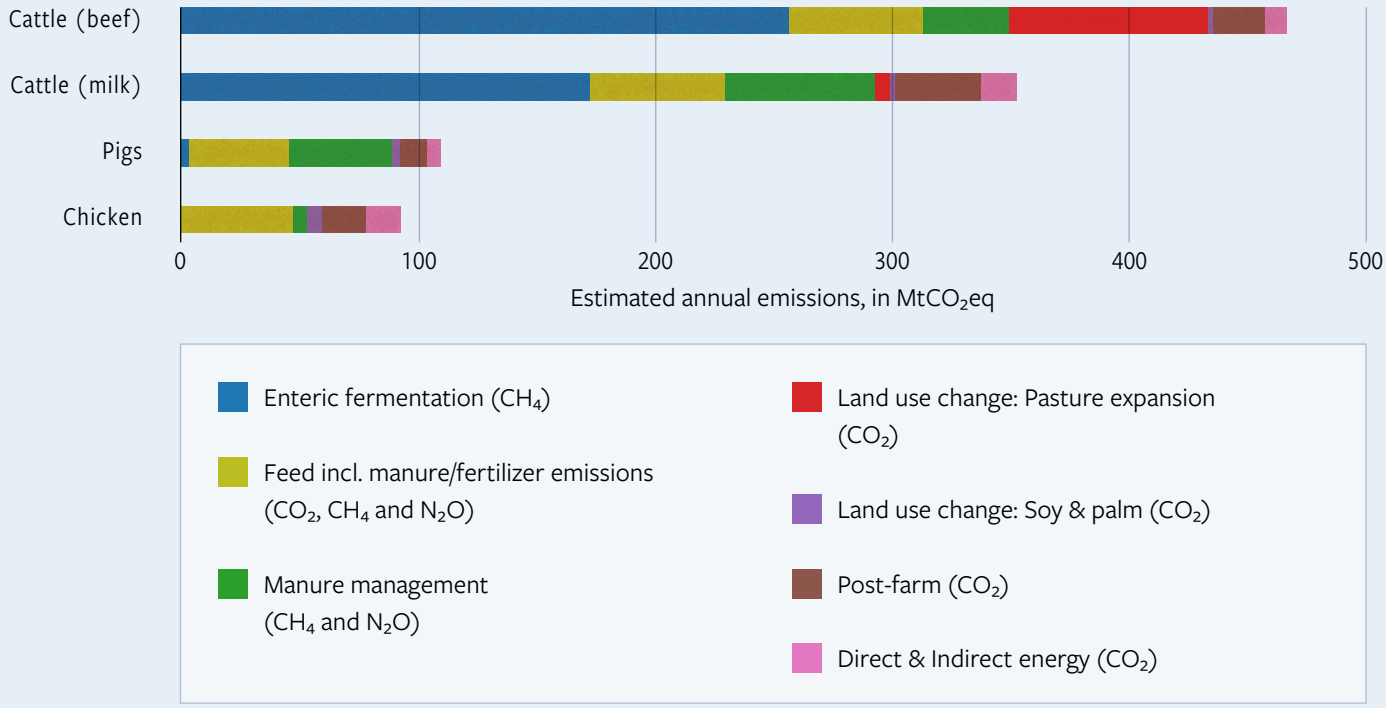
i It should be noted that these emissions figures are estimates based on the FAO's GLEAM 3.0 database—other studies may find variations in the precise proportion of emissions from different sources. For instance, some studies—like Poore and Nemecek (2018)—estimate higher levels of land use change associated with animal feed (such as soy) for pork and poultry meat. More data transparency and reporting is required to assess a detailed breakdown of the emissions from different companies.

Figure 8: **Estimated GHG emissions for the 45 meat and dairy companies split by animal species and GHG** ($MtCO_2eq$, GWP100)



Source: Foodrise et al (2025)

Figure 9: **Estimated GHG emissions for the 45 meat and dairy companies split by species and sources of GHG** (CO_2eq, GWP100)



Source: Foodrise et al (2025)

ANNEX 4: GLEAM 3.0 VS GLEAM 2.0

Disclaimer: The meat and dairy company emissions estimates provided in this report are not comparable with estimates from previous reports in the *Emissions Impossible* series, due to key differences in methodology. They should therefore not be used to infer that the emissions of specific companies have increased or decreased over time. The primary reason for this is that calculations in this report are based on FAO's GLEAM 3.0 livestock emissions factors, to ensure the most scientific estimates based on the most up-to-date information. Previous *Emissions Impossible* reports were based on GLEAM 2.0, since GLEAM 3.0 was not available at the time.

One difference between GLEAM 2.0 and 3.0 is that GLEAM 3.0 uses updated emissions factors based on the IPCC's AR6 report—which updated the GWP100 values to 27 for non-fossil origin methane, and to 273 for nitrous oxide[117]. Previous models of GLEAM had used older IPCC GWP100 values where methane and nitrous oxide were assigned higher GWP100 values relative to carbon dioxide.

As a result of this and other changes between GLEAM 2.0 and 3.0, the FAO's overall estimate of global emissions declined slightly. GLEAM estimates of total global livestock emissions have declined from 7.1 $GtCO_2eq$ per year (14.5% of total anthropogenic GHG emissions) in the FAO's 2013 *Tackling Climate Change Through Livestock*[118] to 6.2 $GtCO_2$-eq (12% of global emissions) in GLEAM 3.0 (2023)[119]. Since GLEAM 3.0 was used to estimate the emissions of the Big Meat and Dairy companies in this report, these estimates were therefore also slightly lower than if GLEAM 2.0 had been used.

GLEAM 3.0 was developed with meat and dairy industry input, such as the International Feed Industry Federation, the International Meat Secretariat, and members of FAO's Livestock Assessment and Performance Partnership (LEAP), which includes many meat and dairy industry organizations. It is therefore possible that GLEAM's methodologies may have been influenced by this input[120].

The FAO's GLEAM 3.0 estimates for global livestock emissions are towards the lower end of academic estimates—the FAO estimates that the global livestock sector is responsible for 12% of the total anthropogenic emissions globally[121], whilst at the upper-end of estimates in peer-reviewed studies, livestock could be responsible for as much as 19.6% of anthropogenic emissions globally[122]. The emissions estimates in this report are therefore likely to be conservative. Low estimates can have an impact on accurately determining companies' emissions. For instance, it is likely that the FAO understates the emissions impact of intensive feedlot cattle systems, according to some analyses[123]. This means that emissions estimates for Big Meat and Dairy companies relying on intensive cattle systems—such as those based in the U.S., where feedlot systems are particularly prevalent—are likely to be under-estimated.

Both GLEAM 2.0 and 3.0 are imperfect sources but were selected because they are one of the most reputable and comprehensive data sources available.

ANNEX 5: CLARIFICATIONS

Subsidiaries

Within the scope of this report, we include subsidiaries of companies under the umbrella of the parent company. So, for instance, we count JBS USA and Pilgrim's Pride as part of their parent company, JBS.

Cooperatives

A handful of the companies in this report are farmer-owned cooperatives—such as Fonterra, which is a New Zealand-based multinational publicly traded dairy co-operative owned by around 9,000 New Zealand farmers; Arla, which is an international dairy cooperative owned by over 9,000 farmers mainly based in Europe; Amul, an Indian dairy cooperative; and FrieslandCampina which is a Dutch multinational dairy cooperative. We have included these companies within scope as Big Meat and Dairy companies because they are vertically integrated into international value chains—and their core business is still the mass-production of meat and dairy at unsustainable scale.

Industrial poultry shed. Photo: © David Tadevosian / Shutterstock.com

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Dairy Factory Farm in Caparroso, Spain. Photo: © Tania Garnica / Greenpeace

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