PLOS Climate

RESEARCH ARTICLE

Environmental claims, climate promises, and 'greenwashing' by meat and dairy companies

Maya Bach[1,2], **Loredana Loy**[1,2], **Katharine J. Mach**[1,2], **Sonali Shukla McDermid**[3], **Jennifer Jacquet**[1,2]*

1 Department of Environmental Science and Policy, Rosenstiel School of Marine, Atmospheric, and Earth Science, University of Miami, Miami, Florida, United States of America, **2** Leonard and Jayne Abess Center for Ecosystem Science and Policy, University of Miami, Coral Gables, Florida, United States of America, **3** Department of Environmental Studies, New York University, New York, New York, United States of America

* jjacquet@miami.edu

OPEN ACCESS

Citation: Bach M, Loy L, Mach KJ, Shukla McDermid S, Jacquet J (2026) Environmental claims, climate promises, and 'greenwashing' by meat and dairy companies. PLOS Clim 5(4): e0000773. https://doi.org/10.1371/journal.pclm.0000773

Editor: Muhammad Irfan Ashraf, University of Sargodha, PAKISTAN

Received: September 15, 2025

Accepted: February 24, 2026

Published: April 22, 2026

Data availability statement: All relevant data are within the paper and its Supporting information files.

Funding: The author(s) received no specific funding for this work.

Abstract

Animal agriculture has disproportionate environmental impacts relative to other forms of food production and accounts for at least 16.5% of all global greenhouse gas (GHG) emissions. Many of the largest meat and dairy companies are aware of these environmental concerns and have responded by making explicit environmental statements and commitments. In this study, we isolated the environmental claims made in the most recent sustainability reports and websites (2021–2024) of 33 of the world's largest meat and dairy companies. We identified 1,233 environmental claims, of which 68% (841) were climate-related. Of the 1,233 claims, 38% (467) were unverifiable future projections such as "achieve carbon neutrality by 2030" or "enable the restoration of 600 billion liters of water in water-stressed regions by 2030." Of the 33 companies, 17 have now made net-zero commitments, but as with oil and gas companies, the commitments appear to rely on plans to offset carbon emissions rather than to decarbonize. Companies provided supporting evidence for 356 (29%) of the 1,233 claims and provided scholarly scientific evidence to support only three of these claims, two of which were climate-related. We also examined each of the 1,233 environmental claims using a greenwashing framework and found that 98% (1,213) could be categorized as greenwashing, such as "produce net climate-neutral dairy by no later than 2050." Meat and dairy companies, which produce disproportionate amounts of pollution relative to other kinds of foods, have prioritized climate change in their sustainability initiatives. They make many promises and provide very little supporting evidence. Like the fossil fuel industry, which has used greenwashing over the last several decades to delay meaningful climate action, the meat and dairy industry may be misleading consumers and investors regarding whether and to what extent they are addressing environmental impacts, including climate change, with even less time to spare.

Competing interests: None of the authors has served or currently serves on the editorial board of PLoS Climate nor has acted as expert witnesses in relevant legal proceedings. Since 2023, JJ has been Associate Research Director of the Climate Social Science Network (CSSN), headquartered at Brown University, which provides her with research grants. Since 2025, both JJ and SSM sit on the advisory board for the Center for Environmental and Animal Protection (CEAP) at New York University (and received a $2500 stipend for the 2025-2026 academic year). JJ is also on the advisory board for the Sea Around Us at the University of British Columbia and the National Food Museum (both unpaid). Maya Bach is now an employee at the non-profit group Physicians Committee for Responsible Medicine but was not when the analysis was completed.

I. Introduction

In 2021, JBS, the largest meat company in the world with emissions larger than those of Italy [1], announced that it would be 'net zero' by 2040 [2]. JBS executives spread the word. The company ran a full-page ad in the *New York Times* and dedicated eight pages of its 2021 JBS sustainability report to its net-zero commitment [2]. In 2024, the Attorney General of New York, Letitia James, filed a lawsuit against JBS over this claim, alleging the statement was misleading, or 'greenwashing,' because the company had no clear and achievable plan to reach the 2040 target [2]. Here, we examined the extent of greenwashing efforts present across the global meat and dairy industry's sustainability reports.

Food systems are associated with high environmental impacts and account for approximately one-third of all anthropogenic greenhouse gas (GHG) emissions [3]. Animal-based foods, in general, have disproportionately high environmental impacts relative to other foods, and the animal agriculture sector has been singled out for its environmental impacts [4,5]. In terms of climate impacts, emissions from animal-based food production (including those from crops grown to feed these animals) represent 57% of total global food production emissions [6].

Over the past 50 years, many meat and dairy companies have shifted from small-scale farms to consolidated, large, intensified animal agriculture operations [7,8]. Although industrial meat and dairy operations emphasize marginal efficiency, they nonetheless result in substantial absolute GHG emissions: enteric methane produced from large numbers of ruminant animals (e.g., cows and sheep); methane and nitrous oxide generated from manure management; nitrous oxide emissions from fertilizer application for feed and forage crops; land use changes for feed production and grazing; fossil fuel use during feed and animal production and emissions from post-farm outputs (e.g., packaging, retail, and transportation) [4,9]. Using 2016 data, one study estimated that the largest 35 meat and dairy companies were responsible for 15% of animal agriculture emissions [10]. The largest companies are large emitters; a subsequent analysis using data from 2022/2023 estimated that, collectively, the top five emitters (JBS, Marfrig, Tyson, Minerva, and Cargill) account for approximately half (47%) of total GHG emissions among the 45 largest meat and dairy companies, and that their combined emissions exceed the emissions of individual major oil companies, including Chevron, Shell, and BP [11].

Efforts to reduce emissions of GHGs such as carbon dioxide, nitrous oxide, and methane are critical to slowing the rate of global warming [12]. Animal agriculture accounts for roughly 32% of anthropogenic methane emissions globally. Given methane's short atmospheric lifespan and potent heat-trapping capacity (28 times that of carbon dioxide on a 100-year timescale), immediate reductions in methane emissions support achieving more ambitious climate change mitigation goals [12,13]. This is something at least some elements of the meat and dairy industry have been aware of since 1989 [14].

Sustainability in agriculture is considered to include production practices that minimize impact on the environment, public health, human communities, and animal welfare [15], which are concerns shared by consumers [16], citizens and legislators,

and to some extent the companies themselves. One response has been an increase in companies publicly committing to sustainable practices [17]. Meat and dairy companies use various consumer-facing communications (i.e., social media, executive interviews, websites, sustainability reports, and advertising) to influence both consumers and investors. The information in company sustainability reports varied in scope and scale; reports typically include information about memberships, various certifications, traceability, global accountability, targets, and supply chain goals [18].

Some communications from companies may be classified as greenwashing, defined as "the dissemination of false or deceptive information regarding an organization's environmental strategies, goals, motivations, and actions" [19, p. 1]. Greenwashing involves policies or practices that appear environmentally friendly but have little meaningful impact, and can include promises about the future ("future-washing" per Hill et al., 2025 [20]), particularly when there is no clear effort to achieve such a promise, such as some have deemed to be the case regarding JBS's net-zero pledge [2,21]. Greenwashing by highly polluting industries is more concerning than greenwashing by less polluting industries because greenwashing can lead consumers and policymakers to believe these polluting industries are more environmentally friendly than they are, and may allow companies to continue harmful practices that undermine climate mitigation and sustainability goals (e.g., national climate commitments) [19]. The effects of greenwashing may also translate to continued support by investors, consumers, governments, corporate customers, and the public [22].

Here, we examined the largest global meat and dairy companies' environmental claims, the proportion of these claims that were focused on climate-related issues, the proportion that included promises about future company efforts, including net-zero climate-related pledges, and the number of claims for which companies provided evidence, including scholarly literature. We then systematically assessed these environmental claims using the Nemes et al. framework [21] to distinguish genuine efforts from greenwashing.

II. Methods

We used publicly available materials related to sustainability for the world's 35 largest meat and dairy companies [23]. Two companies were excluded: Dean Foods, which filed for bankruptcy in 2019 and was acquired by Dairy Farmers of America (DFA) in 2020, and Guangdong Wens Foodstuff Group Co., Ltd., a pork producer in China, because it did not have a sustainability report or publicly available information in English. We used the most recently published sustainability reports (spanning 2021–2024) for 28 companies and the company websites for the five companies that did not publish a sustainability report as our primary data sources (see S1 Data). Data was collected exclusively from publicly available company websites (see SM).

Each environmental claim was recorded and manually coded; no AI tools were used in this study. We categorized each claim as climate-related or not. Environmental claims encompass environmental benefits or activities (e.g., land restoration to protect biodiversity). Climate-related claims refer to climate-specific activities or impacts that involve GHG emissions (e.g., land restoration to capture carbon) or diverse adaptation and mitigation actions. Examples of climate-related claims include transitioning to renewable energy in operations, improving operational efficiencies, or developing methane-suppressing feed additives. Environmental claims that were not climate-related, or at least not primarily so, included activities such as restoring land to promote biodiversity, reducing plastic packaging, or minimizing food waste. Non-environmental claims in sustainability reports (e.g., employee health and safety, animal health, nutrition) were excluded from the analysis. For claims with supporting evidence, we categorized the kind of evidence provided (e.g., from a scholarly article, a multi-stakeholder initiative, a government agency, another company, an industry organization or trade group, an intergovernmental body, a non-governmental organization (NGO), an academic institution, or undefined). For scholarly articles, the citations were documented.

Claims not supported with scholarly evidence were further evaluated using the framework developed by Nemes et al. [21], which offers a structured approach (with 13 sub-categories) for identifying and categorizing greenwashing in corporate social sustainability communications. We excluded some of the Nemes et al. [21] questions that were not relevant

to our materials, such as those referring to marketing budgets and visual symbols. Justifications were provided for both greenwashing and non-greenwashing classifications.

Inter-coder reliability was assessed in two phases, after the first author classified all environmental claims. Another coder (JJ) evaluated a subset of claims (62 or ~5%) and found one that she did not classify as environmental, which was removed from the analysis. There was 100% agreement that the remaining 61 claims constituted 'greenwashing', but there was low agreement among coders regarding the sub-categories of greenwashing (e.g., vagueness, empty claims, etc.) per Nemes et al. [21]. As a result, the authors do not report the results of the sub-categories of greenwashing. A separate inter-coder reliability analysis of an additional 62 claims (~5%) to designate future- vs. non-future oriented claims (which included net-zero pledges) resulted in 91% agreement. Four claims were reclassified as 'future-oriented' on the basis of this disagreement.

III. Results

Environmental claims are mostly climate-related

A total of 1,233 environmental claims (ranging from 1 claim each in the case of Koch Foods and Arab Livestock Company to a maximum of 106 claims by Danone) were made across 33 meat and dairy company sustainability reports and websites. Out of these 1,233 claims, 841 (68%) were classified as climate-related because they directly or indirectly addressed GHG emissions or the impact of climate change (S1 Data). This highlights the extent to which climate change has become a primary lens through which meat and dairy companies frame their sustainability commitments.

However, many climate-related claims were vague or related to non-material areas of production. For example, ABP Group launched an R&D initiative on a 280-acre beef farm to "look at ways at introducing a more all-round sustainable beef production model for the dairy herd" [24, para. 7]. There were no clear metrics or definition of what ABP meant by "sustainable beef production," and while this initiative, along with similar pilot programs, may generate small-scale emissions reductions, it did not seem to lead to significant emissions reductions across the company's operations.

Many claims cited alignment with climate initiatives (e.g., Science Based Targets initiative [SBTi]) or government policies as evidence of climate action and progress. German-based DMK Food Group, for example, "joined SBTi in 2021. In line with the Paris Agreement, DMK is committed to contributing to limiting global warming to well below 2 degrees Celsius" [25, p. 11]. It is very difficult to discern whether any of these initiatives correspond to meaningful climate action.

Finally, companies often highlighted minor improvements as evidence of climate action. Le Groupe Lactalis, for instance, "replaced a boiler with more efficient equipment" at a site in Luxembourg, estimating savings of "around 1,350 tCO_2e per year" [26, p. 56]. While this boiler replacement may have led to small emissions reductions from that site, such claims may distract from the company's largest sources of emissions.

Future promises, including net-zero pledges

Of the 1,233 claims, 38% (467) were promises about the future, and 73% (343) of these future-oriented claims were climate-related. The greatest number of future promises were made by dairy-based companies Nestlé (55) and Danone (49), followed by meat-based companies Danish Crown (34), Cargill (26), and Marfrig (26).

Of the 33 companies, 17 (52%) made a net-zero or climate-neutrality commitment, with all except Dairy Farmers of America setting specific target years (Table 1). Net-zero commitments varied significantly in coverage and target year for achievement, although ten companies set targets for 2050. For companies that did not make explicit net-zero commitments, nine mentioned other climate goals, such as taking steps to measure or reduce Scope 1 (direct emissions from a company's own operations), Scope 2 (indirect emissions from energy use), and Scope 3 (all other indirect emissions across the value chain, such as deforestation) emissions. The dairy companies made stronger climate commitments with more companies setting net-zero targets and addressing all emissions. Patterns in other sectors suggest that ownership

Table 1. Net-zero targets by each of the 33 meat and dairy companies categorized by scope and target year. Seventeen companies have made some net-zero commitment and 16 have not. Some companies made other specific near-term climate commitments, such as "30% Scope 3 emission reductions per kg of milk and whey by 2030" [27, p. 34] (S1 Data).

Scope	2030	2035	2040	2045	2050	No target year	No net-zero target
Scope 1 & 2	–	–	–	Vion Food Group	–	–	Bachoco, China Yurun Food Group
Scope 1, 2, & 3	CP Group	Minerva Foods	JBS, BRF	–	Tyson Foods, Arla Foods, Lactalis, Nestlé, California Dairies, Friesland-Campina, Danone, Fonterra, Saputo, Danish Crown	Dairy Farmers of America	Perdue, Marfrig, Smithfield, Cargill, ABP Food Group, DMK Food Group, Hormel Foods
Scope not explicit	–	–	Coren	–	–	–	Groupe Bigard, Tönnies Group, New Hope Group, Arab Company for Livestock Development, Koch Foods, NH Foods, National Beef

https://doi.org/10.1371/journal.pclm.0000773.t001

may play a role in net-zero: in a sample of 69 U.S. oil companies, net-zero commitments were more common specifically in cases when BlackRock held some ownership [28]. Consistent with this pattern, BlackRock owns shares in nine of the 17 meat and dairy companies with net-zero commitments in our sample (S1 Data).

Evidence for claims

Of all 1,233 environmental claims, 356 (29%) offered supporting evidence (see S1 Data for types of supporting evidence cited). More than half (52%) of these 356 claims referenced an internal pilot program or case study. Three claims made by three different companies—Fonterra, California Dairies, Inc., and Perdue—referenced scholarly literature, with two of the three studies classified as climate-related and two of the three studies published in journals closely aligned with the agriculture industry (Table 2). More than two-thirds of environmental claims lacked any evidence, making it difficult to assess their credibility.

Prevalence of greenwashing

Out of the 1,233 environmental claims, 1,213 (98%) could be classified as containing indicators of greenwashing using the Nemes et al. framework [21].

There was a large disparity in the number of claims made by companies. Part of the reason for that is that the volume of available material varied widely. Five companies, ABP, Coren Group, Koch Foods, National Beef Company, and New Hope Group, did not publish a report at all. Some, such as California Dairies and Tönnies Lebensmittel, published relatively brief sustainability reports of 20 pages each (in contrast, the report FrieslandCampina was 281 pages long, as documented in S1 Data). In addition to annual reports, Nestlé and Danone published supplemental environmental-focused reports alongside their annual sustainability reports, offering a significantly larger volume of claims to assess. However, not all of it can be explained by the number of pages of sustainability material produced; Vion Food Group's report was 176 pages long, but they made relatively few environmental claims (Fig 1). Another factor in the disparity in the number of claims by company is that different companies prioritize the environment in different ways. For instance, JBS and Marfrig dedicated approximately 32% of their reports to environmental topics, while Tyson's report was relatively short (54 pages) and allocated only 13% to environmental issues.

Out of the 1,233 environmental claims, 20 (<2%) did not contain indicators of greenwashing (S1 Data). These claims were generally neutral and verifiable, such as "in the United States alone, 30–40% of food produced is never consumed"

Table 2. Claims with supporting scholarly literature. Of the 1,233 environmental claims, three were supported by scholarly literature.

Company	Claim	Supporting scholarly literature cited by the company
Fonterra [29]	Develop and deploy the methane reduction potential of organisms as early life or daily dose treatments for cows (e.g., Kowbucha).	Alvarez-Hess PS, Jacobs JL, Kinley RD, Roque BM, Neachitan ASO, Chandra S, et al. Twice daily feeding of canola oil steeped with Asparagopsis armata reduced methane emissions of lactating dairy cows. Anim Feed Sci Technol. 2023;297:115579. doi: 10.1016/j.anifeedsci.2023.115579.
California Dairies, Inc. [30]	Continually improving production efficiency through improved cow care, comfort, nutrition, and genetics has allowed our farms to reduce the carbon footprint of each gallon of milk produced by more than 45% over the past 50 + years.	Naranjo A, Johnson A, Rossow H, Kebreab E. Greenhouse gas, water, and land footprint per unit of production of the California dairy industry over 50 years. J Dairy Sci. 2020;103(4):3760-3772. doi: 10.3168/jds.2019-16576.
Perdue [31]	Launched FREEDOM FLY: black soldier fly larvae poultry treats with a 100% USA supply chain.	Smetana S, Schmitt E, Mathys A. Sustainable use of *Hermetia illucens* insect biomass for feed and food: Attributional and consequential life cycle assessment. Resour Conserv Recycl. 2019;144:285-296. doi: 10.1016/j.resconrec.2019.01.042.

https://doi.org/10.1371/journal.pclm.0000773.t002

[32, p. 36], a statement supported by the U.S. Department of Agriculture (USDA) [33]. Rather than emphasizing specific initiatives, these claims often focused on broader market, industry, or company trends.

IV. Discussion

The most recent sustainability reports and websites (2021–2024) for the 33 largest meat and dairy companies showed that they made more than 1,000 environmental claims. While this sector has many environmental impacts (e.g., Steinfeld et al. 2006 [5]), the issue that seems to most concern the companies is climate change; roughly two-thirds of environmental claims could be classified as climate-related.

Given that companies made so many environmental claims in their sustainability reports and websites, we also performed a cursory examination of capital expenditures (CAPEX) provided in the same sources. Of the 33 meat and dairy companies, 12 provided assigned monetary values for specific environmental or climate-related investments that totalled USD $4.82 billion in reported CAPEX, the majority of which was Nestlé's commitment of approximately USD $4.0 billion "toward net-zero initiatives" (S1 Data). Around USD $4.40 billion (91%) of total CAPEX appeared to be allocated to climate-related initiatives, with Nestlé's USD $4.0 billion making up the majority of expenditures. Ten of the 12 companies with disclosed CAPEX are among the 17 companies that have made net-zero commitments, including BRF, California Dairies, Danish Crown, Danone, Fonterra, JBS, Minerva, Nestlé, Saputo, and Vion Food Group (Table 1). The other 21 companies provided qualitative descriptions, combined CAPEX values, operational spending, grants, or philanthropic activities. Some companies made high-level, aspirational statements about the environment without detailing specific initiatives (e.g., Koch Foods Sustainability in Action Program "as proof of our commitment to sustainability" [34]). Four of the highest emitting companies (Le Groupe Lactalis, Tyson, Arla Foods, and FrieslandCampina) according to a 2022/2023 analysis [13] have made net-zero commitments but did not disclose CAPEX for sustainability or climate-related initiatives.

More than one-third of environmental claims (467 total) were future promises for which the companies almost never laid out plans for implementation and which rarely get evaluated for their practicality. Companies provided supporting evidence for nearly one-third (29%) of environmental claims, but provided scholarly scientific evidence to support only three claims. We also examined each of these 1,233 claims using the Nemes et al. [21] greenwashing framework and found that 98%

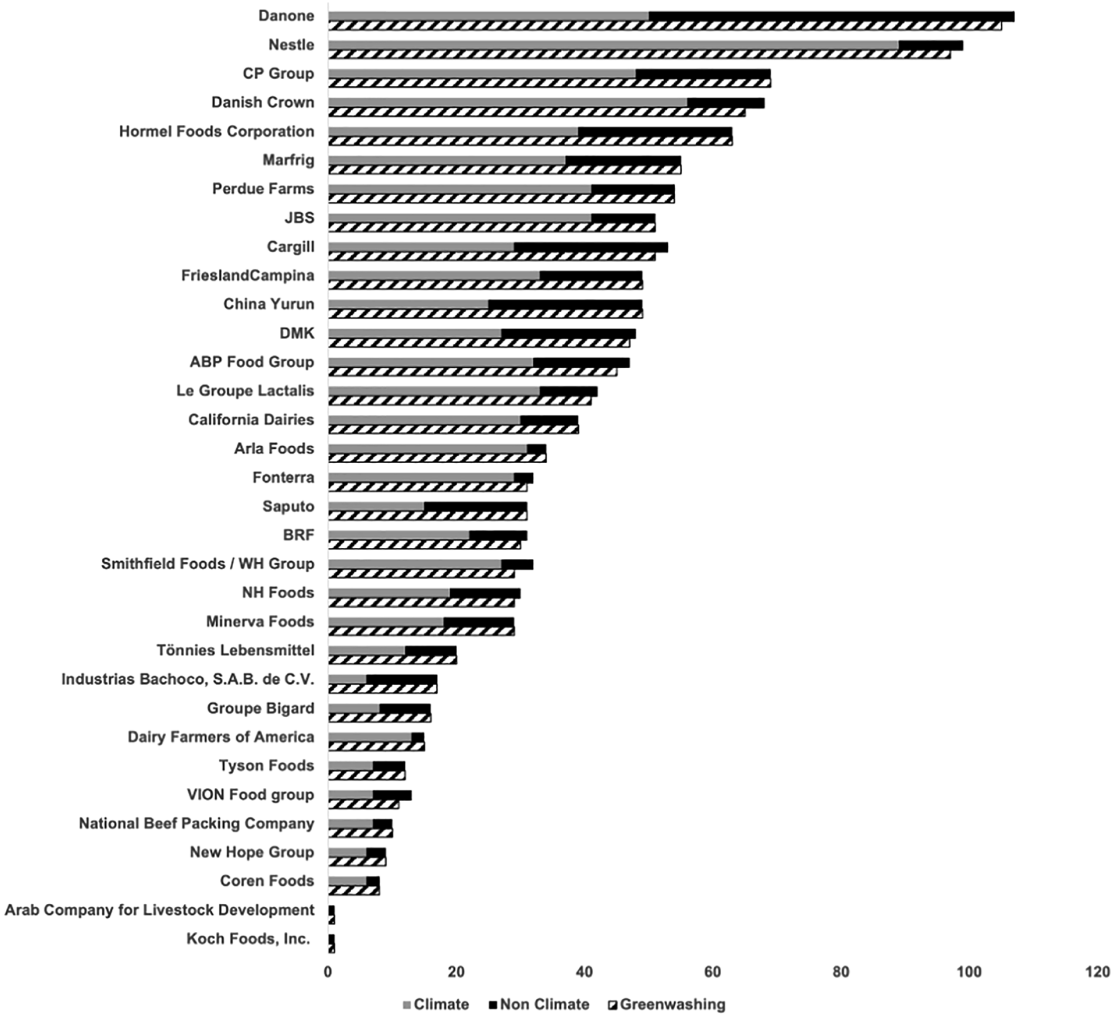

Fig 1. Environmental claims, climate-related and greenwashing. Number of environmental claims made by the 33 largest meat and dairy companies, broken down into climate-related and non-climate-related claims, alongside the number of those environmental claims that were classified as greenwashing.

https://doi.org/10.1371/journal.pclm.0000773.g001

(1,213) could be categorized as greenwashing. The common use of vague language (e.g., 'sustainable food producer') and limited information surrounding how emissions are being measured (e.g., 'data-driven approach') call into question the credibility of these claims. Rather than pursuing transformative change, many companies appear to prioritize minor efficiency gains and heavily publicize small-scale or pilot initiatives that do little to impact the broader environmental footprint of animal agriculture. These findings indicate that climate change now functions as the primary lens through which meat and dairy companies present "sustainability" and other environmental issues are relatively peripheral.

As of September 2020, just four of the largest 35 meat and dairy companies had made an explicit net-zero commitment [10]. Here we find that 17 of the 33 largest meat and dairy companies have now made a net-zero or equivalent commitment (Fig 1). Yet many companies that have made net-zero commitments provided little evidence on how they plan to achieve it [e.g., 35]. A study that looked into the net-zero pledges of BP, Chevron, ExxonMobil, and Shell found no plans to reduce or phase out the production and sales of hydrocarbons and instead found that these companies were planning

to rely on offsets to achieve net-zero emissions [36]. Likewise, meat and dairy companies appear to have no scalable ways to end their emissions, and their net-zero plans, when discussed, similarly rely on carbon offsets to achieve the stated goals. They also do little to nothing to address the other forms of pollution from meat and dairy production.

JBS and Tyson Foods set a net-zero target of 2040 and 2050, respectively. Both companies opt for what Trencher et al. [36] refer to as 'conservative pathways', which make limited efforts to shift away from emissions-intensive systems as opposed to 'transformative pathways', whereby companies would cut emissions by reducing reliance on such systems. Tyson [37] framed their net-zero commitment as one that "continually aspire[s] to achieve net-zero emissions." JBS [38] included a footnote to its net-zero commitment noting that "whether the company is successful in achieving this very ambitious goal will depend on numerous factors outside of the company's control." That does not stop JBS from having an entire website dedicated to net zero that leans on the reputations of the NGOs and universities JBS funds [35,38], including Colorado State University's AgNext program, which is directed by a former sustainability executive for JBS [39]. As with oil and gas companies, JBS and Tyson continue to expand operations. In 2022, Tyson opened two new facilities and announced a $200 million expansion of its Amarillo, Texas, plant [37, p. 22]. JBS opened two new facilities in Brazil and a plant in Missouri, as well as stating it would "pursue additional value-enhancing growth opportunities" [38, p. 5, p. 11].

In contrast to these ambitious plans to grow production, the climate initiatives that companies described in detail were generally small-scale, confined to local sites, or existed only in pilot form. These initiatives, which may reduce emissions to a certain degree, rarely cover a significant portion of a company's total operations. For example, Arla Foods, the world's fourth-largest dairy company and a cooperative of over 12,700 farmers, launched a "regenerative agriculture pilot" on 24 farms, representing just 0.0019% of its total global operations [27]. Arla Foods also reported "installing solar panels on the roof of a cheese packaging site in Oswestry, UK, which can cover 12% of the site's annual electricity needs" [27, p. 37]. As one of the world's largest dairy companies operating in over 32 countries [27], such a narrow, site-specific practice is small relative to the scale of its overall environmental footprint. Several claims referenced technologies that have yet to be implemented at scale, such as JBS's commitment to reduce emissions by "incorporating high-quality forages and feed additives" [38] and Fonterra's partnership with genetics companies to "breed low methane emitting cows" [29]. These efforts may give the illusion of progress while failing to address the primary source of emissions.

The trivial and/or small-scale nature of claims was not just related to climate. For example, NH Foods' reduction in "the width of the tape used" for sausage products, "from 18mm to 15mm" [40, p. 16], likely offers negligible environmental benefit and applies to just one of many products the company manufactures (see S1 Data for specific claim). Similarly, Hormel Foods' addition of the 'How2Recycle' logo to 326 products [41] does not appear to equate to substantial, meaningful benefits (e.g., [42,43].

The degrees of greenwashing revealed by this research may have legal implications, particularly in the U.S., where 'commercial speech' (such as these reports) is held to different legal standards than 'political speech' (which includes lobbying), for which there is little legal recourse [44]. In 2023, California passed new emissions reporting policies for large public and private companies doing business in the state [45]. Part of the reason for the lawsuit filed in 2024 by the New York Attorney General against JBS was the company's failure to provide a transparent and feasible pathway to achieve net-zero emissions by 2040 [2]. In addition to the lawsuit against JBS, cases involving misleading advertising have been or are being pursued against Danish Crown [46], Tyson [37], Arla Foods [27], and Fonterra [29].

The Nemes et al. framework [21] was a valuable tool for identifying greenwashing, but there were several shortcomings. First, it was not able to account for differences in the scope or impact of claims. For example, China Yurun's claim to "provide microwaves in the cafeteria to encourage employees to bring their own lunch," [47, p. 49] is not equivalent in terms of scope or impact to JBS's claim to "capture and eliminate the majority of GHG emissions at the Brooks, Alberta, beef facility" [35]. Second, Nemes et al. [21] does not account for the reliability or scientific credibility of the claims based on the information provided by the companies. Without a way to evaluate the evidence supporting a claim, it may be difficult to determine how genuine or misleading that claim may be. Third, Nemes et al. [21] did not

distinguish between present-day actions and future commitments, although a later version of the framework added a category called “future-washing” under the ‘empty claims’ category [20]. Finally, Nemes et al. [21] relied on qualitative assessments that are highly subjective, particularly for the subcategories of greenwashing, and led to inconsistent evaluations across users.

In future research, the findings we present here could be corroborated by incorporating surveys or individual interviews with producers and consumers, which could provide greater insight into how and why environmental claims are made and how they are understood. In addition, disaggregating claims by geographic region may also provide insights into how climate messaging varies geographically with differing regulatory frameworks.

By no means are promises, unverifiable claims, or greenwashing unique to the meat and dairy industry. Similar activities are common across all kinds of companies and sectors [e.g., 19]. The animal-free fashion company, Stella McCartney, for instance, sells a handbag with “an innovative and environmentally friendly coating that actively sequesters NO2 and purifies the air” [48]—a claim that could also be classified as greenwashing. The problem in the meat and dairy case is that greenwashing activities extend both the social and financial license to operate in a disproportionately polluting sector relative to other possible foods. Sustainability reporting strengthens public perception and can boost a company’s image, making it more attractive to investors [49]. JBS, for example, raised $1 billion through sustainability-linked bonds linked to its net-zero pledge [35]. Just as the fossil fuel industry has used greenwashing over the last several decades to delay meaningful climate action (e.g., [50]), the meat and dairy industry may also be using these empty claims to delay climate action with even less time to spare.

Supporting information

S1 Data. Companies & data sources, environmental claims made by meat and dairy companies, supporting evidence cited for environmental claims, examples of environmental claims without greenwashing indicators, net-zero or equivalent claims made by companies, and capital expenditures.
(XLSX)

Author contributions

Conceptualization: Maya Bach, Loredana Loy, Katharine J. Mach, Sonali Shukla McDermid, Jennifer Jacquet.

Data curation: Maya Bach.

Formal analysis: Maya Bach, Loredana Loy, Katharine J. Mach, Sonali Shukla McDermid, Jennifer Jacquet.

Investigation: Maya Bach.

Methodology: Maya Bach, Loredana Loy, Katharine J. Mach, Sonali Shukla McDermid, Jennifer Jacquet.

Project administration: Katharine J. Mach, Jennifer Jacquet.

Supervision: Loredana Loy, Katharine J. Mach, Jennifer Jacquet.

Validation: Jennifer Jacquet.

Visualization: Maya Bach.

Writing – original draft: Maya Bach.

Writing – review & editing: Maya Bach, Loredana Loy, Katharine J. Mach, Sonali Shukla McDermid, Jennifer Jacquet.

References

1. Institute for Agriculture and Trade Policy, DeSmog. World’s largest meat company, JBS, increases emissions in five years despite 2040 net zero climate target, continues to greenwash its huge climate footprint [Internet]. Minneapolis, MN: IATP; 2022 [cited 2025 Sep 12]. https://www.iatp.org/media-brief-jbs-increases-emissions-51-percent

2. Office of the New York State Attorney General. Attorney General James sues world's largest beef producer for misrepresenting climate impact [Internet]. New York, NY: NYS Office of the Attorney General; 2024 [cited 2025 Sep 12]. Available from: https://ag.ny.gov/press-release/2024/attorney-general-james-sues-worlds-largest-beef-producer-misrepresenting
3. Crippa M, Solazzo E, Guizzardi D, Monforti-Ferrario F, Tubiello FN, Leip A. Food systems are responsible for a third of global anthropogenic GHG emissions. Nat Food. 2021;2(3):198–209. https://doi.org/10.1038/s43016-021-00225-9 PMID: 37117443
4. Poore J, Nemecek T. Reducing food's environmental impacts through producers and consumers. Science. 2018;360(6392):987–92. https://doi.org/10.1126/science.aaq0216 PMID: 29853680
5. Steinfeld H, Gerber P, Wassenaar T, Castel V, Rosales M, de Haan C. Livestock's long shadow: Environmental issues and options. Rome: FAO; 2006. https://www.fao.org/3/a0701e/a0701e.pdf
6. Xu X, Sharma P, Shu S, Lin T-S, Ciais P, Tubiello FN, et al. Global greenhouse gas emissions from animal-based foods are twice those of plant-based foods. Nat Food. 2021;2(9):724–32. https://doi.org/10.1038/s43016-021-00358-x PMID: 37117472
7. Leonard C. The meat racket: The secret takeover of America's food business. New York: Simon & Schuster Paperbacks; 2015.
8. Yoon I, Oh S-H, Kim SW. Sustainable animal agriculture in the United States and the implication in Republic of Korea. J Anim Sci Technol. 2024;66(2):279–94. https://doi.org/10.5187/jast.2024.e19 PMID: 38628690
9. Twine R. Emissions from animal agriculture—16.5% is the new minimum figure. Sustainability. 2021;13(11):6276. https://doi.org/10.3390/su13116276
10. Lazarus O, McDermid S, Jacquet J. The climate responsibilities of industrial meat and dairy producers. Climatic Change. 2021;165(1–2). https://doi.org/10.1007/s10584-021-03047-7
11. Friends of the Earth U.S., Foodrise, Greenpeace Nordic, Institute for Agriculture and Trade Policy, Changing Markets Foundation. Roasting the planet: Big meat and dairy's big emissions. Washington (DC): Friends of the Earth U.S.; 2025.
12. Intergovernmental Panel on Climate Change. Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II, and III to the Sixth Assessment Report of the IPCC [Internet]. Lee H, Romero J, editors. Geneva: IPCC; 2023. Available from: https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_LongerReport.pdf
13. GRAIN, Institute for Agriculture and Trade Policy IATP. Emissions impossible: how big meat and dairy are heating up the planet. Barcelona (Spain): GRAIN. 2022.
14. Jacquet J, Morris V, Loy L, Eshel G. Early US meat industry knowledge and response to global warming. Environ Res Lett. 2025;20(3):031006. https://doi.org/10.1088/1748-9326/adb6c0
15. Béné C, Oosterveer P, Lamotte L, Brouwer ID, de Haan S, Prager SD, et al. When food systems meet sustainability – Current narratives and implications for actions. World Dev. 2019;113:116–30. https://doi.org/10.1016/j.worlddev.2018.08.011
16. Alonso ME, González-Montaña JR, Lomillos JM. Consumers' concerns and perceptions of farm animal welfare. Animals (Basel). 2020;10(3):385. https://doi.org/10.3390/ani10030385 PMID: 32120935
17. Székely N, Vom Brocke J. What can we learn from corporate sustainability reporting? Deriving propositions for research and practice from over 9,500 corporate sustainability reports published between 1999 and 2015 using topic modelling technique. PLoS One. 2017;12(4):e0174807. https://doi.org/10.1371/journal.pone.0174807 PMID: 28403158
18. Amundsen VS, Osmundsen TC. Becoming certified, becoming sustainable? Improvements from aquaculture certification schemes as experienced by those certified. Marine Policy. 2020;119:104097. https://doi.org/10.1016/j.marpol.2020.104097
19. Aronczyk M, McCurdy P, Russill C. Greenwashing, net-zero, and the oil sands in Canada: The case of Pathways Alliance. Energy Res Soc Sci. 2024;112:103502. https://doi.org/10.1016/j.erss.2024.103502
20. Hill S, Nemes N, Montgomery AW, Scanlan S, McNally B, Tubiello F, et al. Testing the greenwashing assessment framework. Ecol Soc. 2025;30(2):31. https://doi.org/10.5751/es-16106-300231
21. Nemes N, Scanlan SJ, Smith P, Smith T, Aronczyk M, Hill S, et al. An Integrated Framework to Assess Greenwashing. Sustainability. 2022;14(8):4431. https://doi.org/10.3390/su14084431
22. de Freitas Netto SV, Sobral MF, Ribeiro AR, Soares GR. Concepts and forms of greenwashing: a systematic review. Environ Sci Eur. 2020;32(1):19. https://doi.org/10.1186/s12302-020-0300-3
23. GRAIN, Institute for Agriculture and Trade Policy (IATP). Emissions impossible: How big meat and dairy are heating up the planet [Internet]. 2018. Available from: https://www.grain.org/article/entries/5976-emissions-impossible-howbig-meat-and-dairy-are-heating-up-the-planet
24. ABP Food Group. Standing up for tomorrow [Internet]. [cited 2025 Apr 5]. Available from: https://abpsustainabilitystory.com/on-the-farm/demonstration-farms/
25. DMK Group. Responsibility report 2024: An update on sustainability at DMK [Internet]. 2024. Available from: https://perma.cc/3WLV-6KHT
26. Groupe Lactalis. Sustainability report 2022 [Internet]. 2022. Available from: https://assets.ctfassets.net/c4xiawjy3foe/6HaqOLuO9XJ4qa-57nIPQ/127c269091c1031c445b8b1ddf506860/LAC_LACTALIS_2023-SUSTAINABILITY-REPORT_EN_VMEL_03062024.pdf
27. Arla. Annual report. 2023. Available from: https://www.arla.com/4a7998/contentassets/9aadd1ae29024f708f72e7c3ba8e79aa/arla_annual-report-2023_uk.pdf

28. Desai H, Lam P, Li B, Rajgopal S. An analysis of carbon reduction pledges of the U.S. oil and gas companies. SSRN J. 2022. https://doi.org/10.2139/ssrn.4300455
29. Fonterra Co-operative Group Limited. Sustainability report 2023: Pūrongorongo toitūtanga Te Mātāpuna [Internet]. 2023. Available from: https://view.publitas.com/fonterra/2023-sustainability-report
30. California Dairies Inc. Sustainable dairy: Now and tomorrow (Sustainability report) [Internet]. 2019. Available from: https://issuu.com/californiadairiesinc/docs/caldairies-sr-03.16.23_-_sp
31. Perdue Farms. Perdue Farms fiscal year 2024: Company stewardship report [Internet]. 2024. Available from: https://perma.cc/E8ZB-43YJ
32. Smithfield Foods. Good stewards. Good work. Good food: 2023 sustainability impact report [Internet]. 2023. Available from: https://assets-us-01.kc-usercontent.com/2d80ba31-2f39-008c-c58b-646f56b50e5e/6d494aeb-bcc1-453d-8416-d673f9733e23/Smithfield_Sustainability_Report_2023.pdf
33. United States Department of Agriculture. Why should we care about food waste? [Internet]. 2024. Available from: https://www.usda.gov/about-food/food-safety/food-loss-and-waste/why-should-we-care-about-food-waste
34. Koch Foods. Corporate responsibility & practices [Internet]. [cited 2025 Sep 10]. Available from: https://kochfoods.com/about-us/corporate-responsibility-practices/
35. JBS SA. JBS Annual Sustainability Report 2021 [Internet]. 2021. Available from: https://sustainability.jbsfoodsgroup.com/
36. Trencher G, Blondeel M, Asuka J. Do all roads lead to Paris? Clim Change. 2023;176:83. https://doi.org/10.1007/s10584-023-03564-7
37. Tyson Foods. Growing a more sustainable future: Sustainability report 2022 [Internet]. 2022. Available from: https://www.tysonfoods.com/sustainability
38. JBS SA. JBS Annual Sustainability Report 2023 [Internet]. 2023. Available from: https://jbsfoodsgroup.com/articles/jbs-releases-2023-sustainability-report
39. Morris V, Jacquet J. The animal agriculture industry, US universities, and the obstruction of climate understanding and policy. Climatic Change. 2024;177(3). https://doi.org/10.1007/s10584-024-03690-w
40. NH Foods Ltd. Sustainability report 2023 [Internet]. 2023. Available from: https://www.nipponham.co.jp/eng/csr/report/res/pdf/2023/sustainability_report/index.pdf
41. Hormel Foods. Better us, better world: Global impact report 2023 [Internet]. 2023. Available from: https://www.hormelfoods.com/wp-content/uploads/Hormel-Foods-2023-Global-Impact-Report.pdf
42. Latkin C, Dayton L, Scherkoske M, Countess K, Thrul J. What predicts climate change activism?: An examination of how depressive symptoms, climate change distress, and social norms are associated with climate change activism. J Clim Chang Health. 2022;8:100146. https://doi.org/10.1016/j.joclim.2022.100146 PMID: 36777085
43. Singh N, Walker TR. Plastic recycling: A panacea or environmental pollution problem. Npj Mater Sustain. 2024;2(1):17. https://doi.org/10.1038/s44296-024-00024-w PMID: 39114578
44. Wentz J, Franta B. Liability for public deception: linking fossil fuel disinformation to climate damages. Environ Law Rep. 2022;52:10995.
45. 2021 Annual Report [Internet]. Iatp.org. 2021 [cited 2025 Sep 12]. Available from: https://www.iatp.org/2021-annual-report
46. Danish Crown. Food can make a difference: Annual report 2022/23 [Internet]. 2023. Available from: https://www.danishcrown.com/media/h3sh5cdq/2022-2023-annual-report-en.pdf
47. China Yurun Food Group Limited. Environmental, social and governance report [Internet]. 2023. Available from: https://www.hkexnews.hk/listedco/listconews/sehk/2024/0426/2024042601138.pdf
48. Stella McCartney. Spring 2025 Collection: Falabella Fold Over Enamel Tote Bag [Internet]. London, UK: Stella McCartney. [cited 2026 Feb 13]. Available from: https://www.stellamccartney.com/us/en/women/spring-2025-collection/falabella-fold-over-enamel-tote-bag-234387WP04557745U.html
49. Sneiderienė A, Legenzova R. Greenwashing prevention in environmental, social, and governance (ESG) disclosures: A bibliometric analysis. Res Int Bus Fin. 2025;74:102720. https://doi.org/10.1016/j.ribaf.2024.102720
50. Supran G, Oreskes N. Rhetoric and frame analysis of ExxonMobil's climate change communications. One Earth. 2021;4(5):696–719. https://doi.org/10.1016/j.oneear.2021.04.014