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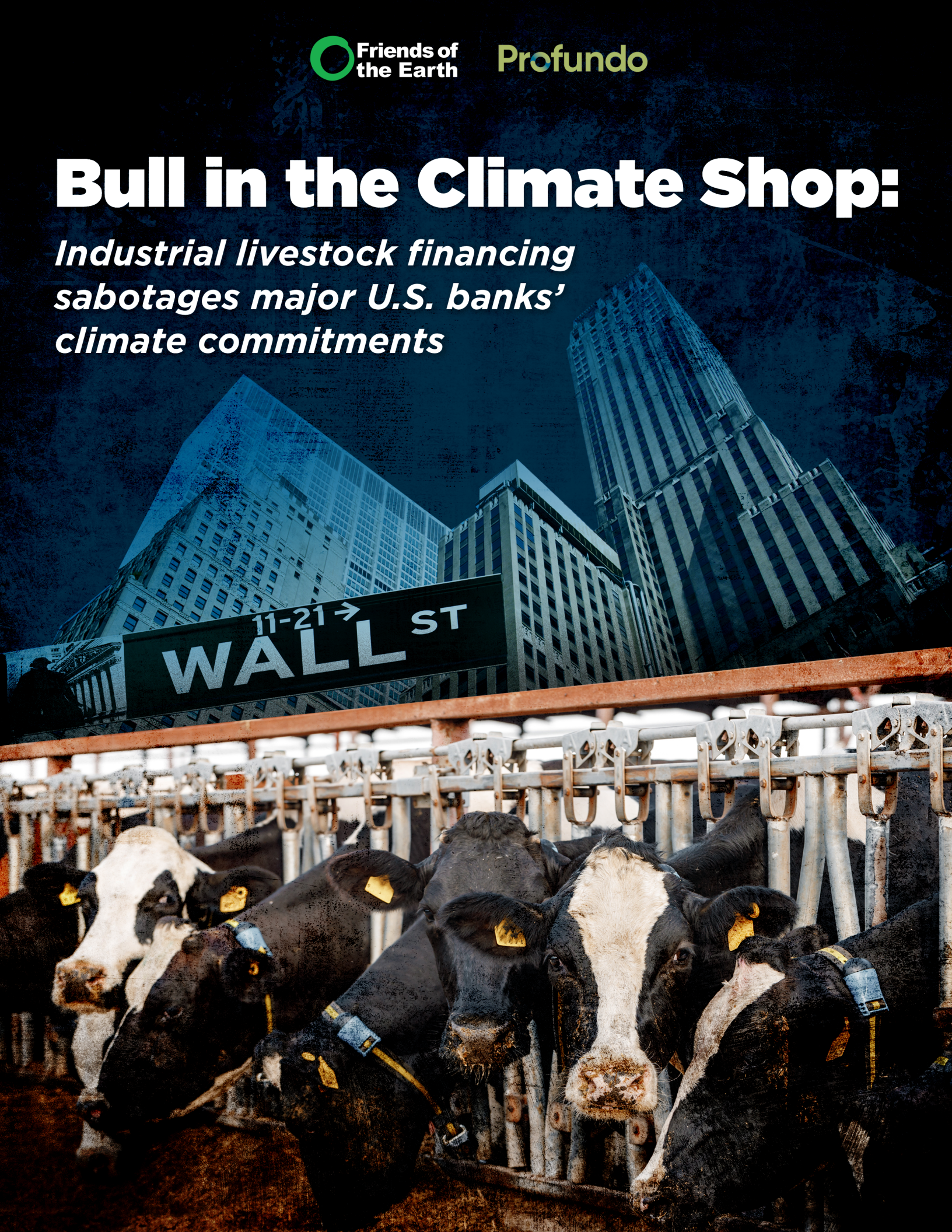
Bull in the Climate Shop:

Industrial livestock financing sabotages major U.S. banks' climate commitments



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Friends of the Earth United States, founded by David Brower in 1969, is the U.S. voice of the world's largest federation of grassroots environmental groups, with a presence in 75 countries. Friends of the Earth works to defend the environment and champion a more healthy and just world. We have provided crucial leadership in campaigns resulting in landmark environmental laws, precedent-setting legal victories and groundbreaking reforms of domestic and international regulatory, corporate and financial institution policies. Visit www.foe.org to learn more.

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Introduction: The cow-shaped hole in banks' climate commitments

> *"Over the prior decades, the big focus has been on reducing energy-related emissions; however, we know this is not enough to reach a net zero world — we also need to reduce emissions from the global food system."*
> *- Citigroup[2]*

Climate risk is financial risk. And U.S. banks are increasingly under pressure from policymakers, shareholders, and civil society to minimize climate risk by reducing the greenhouse gas (GHG) emissions attributable to the loans, underwriting, investments, and other financial services they provide.[3] According to Swiss Re, one of the world's largest reinsurance providers, the climate crisis could reduce global GDP by 11% to 14% by 2050 — a $23 trillion economic slowdown.[4]

Since 2021, banks across the globe have pledged[5] to slash financed and facilitated emissions.[i] As signatories to the Net Zero Banking Alliance, U.S. banks — including Bank of America, Citigroup, and JPMorgan Chase — committed to "transition the operational and attributable greenhouse gas (GHG) emissions from their lending and investment portfolios to align with pathways to net zero by 2050 or sooner."[6] To underscore the importance of tackling financed and facilitated emissions, Citigroup CEO Jane Frazer announced on her very first day on the job that the bank was "targeting net zero emissions by the year 2050."[7]

To meet these commitments, major U.S. banks have prioritized reducing GHG emissions from fossil fuel related financing and yet, year over year, they have continued to finance the sector.[8] These banks also continue to finance high-emitting industrial livestock production.[ii] Recent estimates of animal agriculture's contributions to global GHG emissions range from 11.2%[9] to 19.6%[10] and dramatically increase when factoring in emissions from land conversion (including deforestation) for animal feed production and grazing.[11] Some studies show that livestock alone will comprise roughly half of the total global 1.5°C emissions budget by 2030 and 80% by 2050.[12] According to our research, the GHG emissions of the 56 largest[iii] corporations involved in meat, dairy, and/or feed production are higher than the emissions of Japan, the world's eighth largest emitter.[iv]

Banks' inaction on industrial livestock and other agricultural emissions is not due to a lack of understanding about their importance. Leading U.S. banks have openly acknowledged the need to take action on agriculture-related emissions. According to JPMorgan Chase, "[I]nternational climate change targets cannot be achieved without action on food sustainability… food transition to a more sustainable future is one of our best tools for fighting climate change yet it continues to be neglected."[13] According to Citigroup, "[A]s the population of the world and the demand for food increase, the need to find solutions for mitigating emissions from the global food system becomes even more important."[14]

Based on our research, Bank of America, Citigroup, and JPMorgan Chase — dubbed the "Big Three" banks in this report — are the three largest U.S.-based lenders to the meat, dairy, and feed corporations reviewed for this report. They are also three of the top four largest global lenders to these corporations.[15] The Big Three and other banks' financing and underwriting of corporations such as JBS, Tyson, Cargill, and Nestlé enables the continued global expansion of livestock production, which is already chewing up increasing amounts of the world's GHG budget necessary to stay within 1.5°C of warming. If there is any hope for humanity to meet the goals of the Paris Agreement, banks must stop supporting this expansion. And they must stop now. This means that the Big Three and other major banks' climate goals are not credible if they fail to treat industrial livestock as a high-emitting sector and take swift and meaningful action to reduce and ultimately eliminate relevant financed and facilitated emissions.[16]

i The emissions linked to banks' lending services constitute financed emissions while those linked to their underwriting services constitute facilitated emissions. Financed emissions are included in the Greenhouse Gas Protocol as Scope 3, Category 15. (Greenhouse Gas Protocol, Carbon Trust, World Resources Institute, & World Business Council for Sustainable Development. (2013, April). Category 15: Investments - GHG. Technical Guidance for Calculating Scope 3 Emissions. https://ghgprotocol.org/sites/default/files/2022-12/Chapter15.pdf)

ii In this report we use 'industrial livestock' to represent meat (beef, pork, and poultry) and dairy as well as animal feed and soy. See the box "Defining industrial livestock" for more detail.

iii By production volume. See Annex 1 for details on company selection.

iv The total emissions using self-reported Refinitiv data is 1.14B tCO2e. Japan's emissions were 1.06B tCO2e in 2020 using https://www.climatewatchdata.org (viewed February 27, 2024).

Section 1: Big Three banks' support for meat, dairy, and feed corporations drives GHG emissions

> *"Investors are increasingly reckoning with these questions and recognizing that climate risk is investment risk. From Europe to Australia, South America to China, Florida to Oregon, investors are asking how they should modify their portfolios. They are seeking to understand both the physical risks associated with climate change as well as the ways that climate policy will impact prices, costs, and demand across the entire economy."*
> *- Larry Fink,[17] Chairman and CEO of BlackRock*

According to our analysis, between January 2016 and March 2023, U.S. banks[vii] channeled US$ 134 billion in loans and underwriting services[viii] to corporations involved in meat, dairy, and/or feed production. Two-thirds of this amount was made up of loans (US$ 89.5 billion) and the remainder was bond and share issuance underwriting (US$ 44.8 billion). A concentrated 97% of this financing came from the top 15 creditors, with Bank of America (US$ 26.5 billion), Citigroup (US$ 23.8 billion), and JPMorgan Chase (US$ 23.8 billion) alone constituting more than half (57%) of these funds at US$ 74B+ (see Figures A and B). Given their dominant financing roles to these corporations, we are calling on the Big Three to address their contribution to the expansion of industrial livestock production and its associated environmental and social impacts.

Defining Industrial Livestock

What is it? "Industrial livestock production" refers to animal breeding, rearing, slaughtering, processing, and/or feed operations involved in the mass production of meat, dairy and eggs. Typically controlled by multinational corporations, this production involves breeding and/or rearing hundreds or thousands of animals in concentrated feeding operations (mostly chickens, dairy cows, and pigs), feedlots (beef cows), or extensive, controlled grazing systems (beef cows) that are vertically integrated into international value chains.

The main sources of GHG emissions from industrial livestock include feed production and processing (including land use change), enteric fermentation from ruminants, and manure storage and processing.

Which players are involved? This report covers the largest 56 companies[v] by production volume across these six industrial livestock subsectors: animal feed, soy,[vi] beef, poultry, pork, and dairy. Throughout this report, we refer to these corporations involved in meat, dairy, and/or feed production as simply "meat, dairy, and feed corporations." See Annex 1, section 1 for more details on company selection.

A number of the corporations reviewed for this report are involved in non-livestock-related business activities. These include agri-commodity traders (e.g., ADM and Bunge) and food processing companies (e.g., Nestlé and Danone). Because these corporations do not disaggregate their emissions reporting by business segment or activity, their self-reported emissions figures are inclusive of non-livestock-related emissions. Therefore, financed and facilitated emissions data based on these self-reported emissions include non-livestock-related emissions. Financed and facilitated emissions figures based on corporations' *production volumes* exclude non-livestock-related emissions. (See Annex 1, section 1 for more details on company selection.)

v Refer to Annex 1 for methodology specifics of company selection. The 56 companies are: ACOLID - Arab Company for Livestock Development, ADM - Archer Daniels Midland, Agropur, Amul, Arla Foods, BRF, Bunge, California Dairies, Cargill, China Mengniu Dairy, COFCO Group, Cooperl Arc Atlantique, CP Group, Danish Crown, Danone, DFA - Dairy Farmers of America, DMK Deutsches Milchkontor, Fonterra Cooperative Group, ForFarmers, FrieslandCampina, Fujian Sunner, Glanbia, Groupe Bigard, Guangdong Haid Group, Guangdong Wens Foodstuff Group, Industrias Bachoco, Inner Mongolia Yili, JBS, Koch Foods, Land O'Lakes, LDC Group, Le Groupe Lactalis, Louis Dreyfus Company, Marfrig, Minerva, Muyuan Foodstuff, Nestlé, New Hope Group, NH Foods, Perdue Farms, Pipestone, Sanderson Farms, Saputo, Seaboard, Sichuan Dekon Group, Suguna Farms, Techgank Food, Tönnies Lebensmittel, Triumph Foods, Twins Group (Shuangbaotai Group), Tyson Foods, Vion Food Group, Wellhope Agri-Tech, WH Group, Yangxiang, Zhengbang Group. The 58 U.S. banks have financial relationships with 29 of these 56 corporations involved in meat, dairy, and/or feed production.

vi For soy trade, there is a lack of company disclosure and availability of comprehensive global data. Therefore, a group of leading soy traders were selected using their role in the important trade from Latin America (two-thirds of global exports by volume) as a proxy. See Annex 1 for more information on the company selection methodology.

vii The 58 U.S. banks included in this dataset are: Bank of America, Citigroup, JPMorgan Chase, Farm Credit Services Commercial Finance Group, Wells Fargo, Morgan Stanley, Goldman Sachs, US Bancorp, Truist Financial, Regions Financial, Bank of New York Mellon, Northern Trust, PNC Financial Services, Compeer Financial, AgChoice, Farm Credit, Greenstone Farm Credit, Comerica, M&T Bank, Fifth Third Bancorp, Jefferies Financial Group, UMB Financial, The Inter-American Development Bank, First Horizon, Arvest Bank, KeyCorp, MetLife, Trustmark Corporation, World Bank, Loop Capital, Lone Star Funds, BNCCorp, Academy Securities, 1st Farm Credit Services, Ares Management, First Citizens Bank, Capital One Financial, CL King & Associates, Bank Plus Corp, Blaylock Beal Van, Amarillo National, Bancorp, Intrust Financial Corporation, National Bank Holdings Corporation, Invesco, Voya Financial, Guggenheim Capital, Carlyle Group, Huntington Bancshares, CIC Partners, Federated Investors, BOK Financial, Farm Credit, AGCarolina Farm Credit, Northeast Securities, Shank Williams Cisneros & Co, Guzman & Co, First Capital Advisors Group, Badgerland Financial, Prestige Wealth Management Group.

viii For this report, loans and underwriting services include identified bond issuances, share issuances, corporate loans, revolving credit facilities, project finance and trade finance provided to the selected companies. For more detail, see Annex 1, Section 2.

Figure A: Bank of America, Citigroup, and JPMorgan Chase lead U.S. lending and underwriting to corporations involved in meat, dairy, and/or feed production* (2016-2023 March)

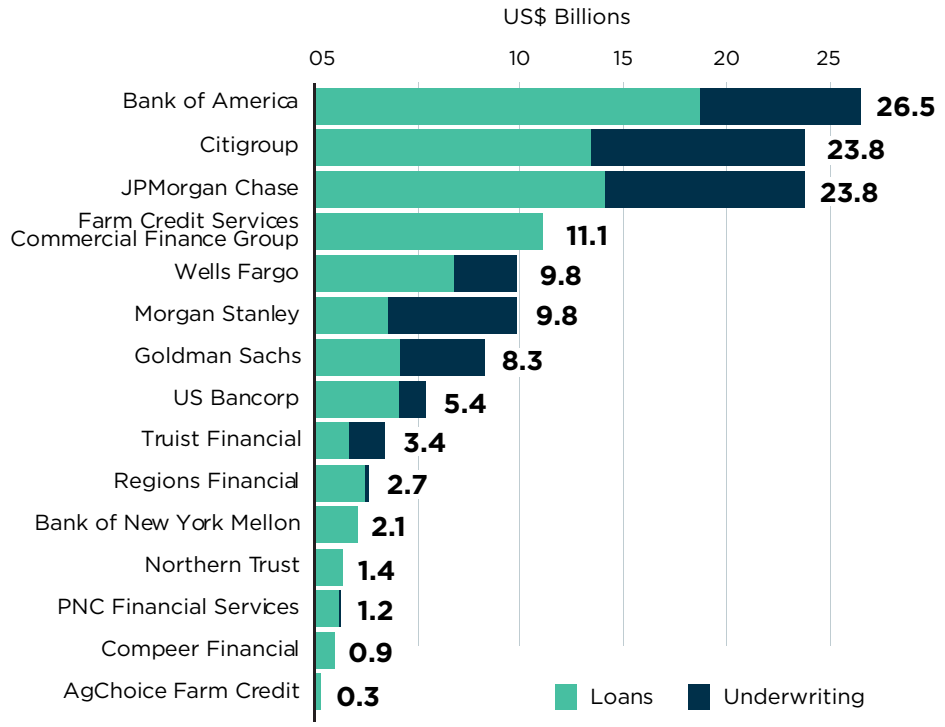
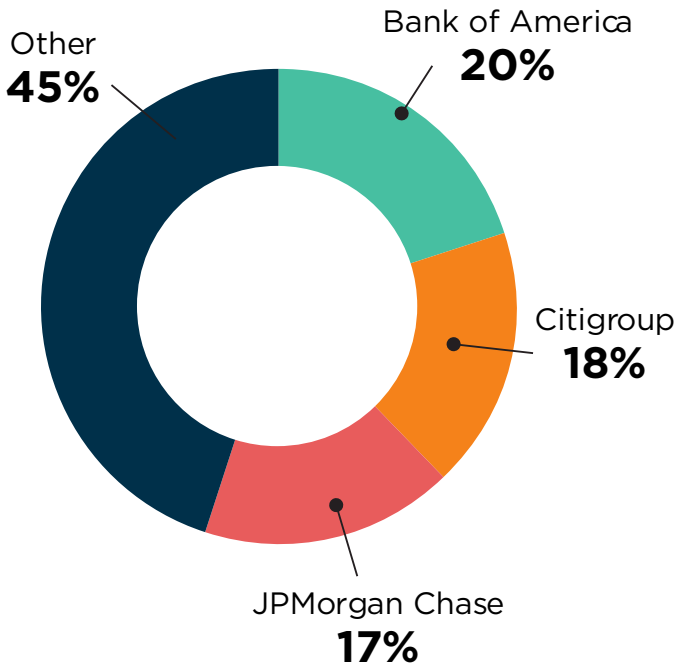


Figure B: Three U.S. banks account for over half of loans and underwriting to corporations involved in meat, dairy, and/or feed production* (2016-2023 March)



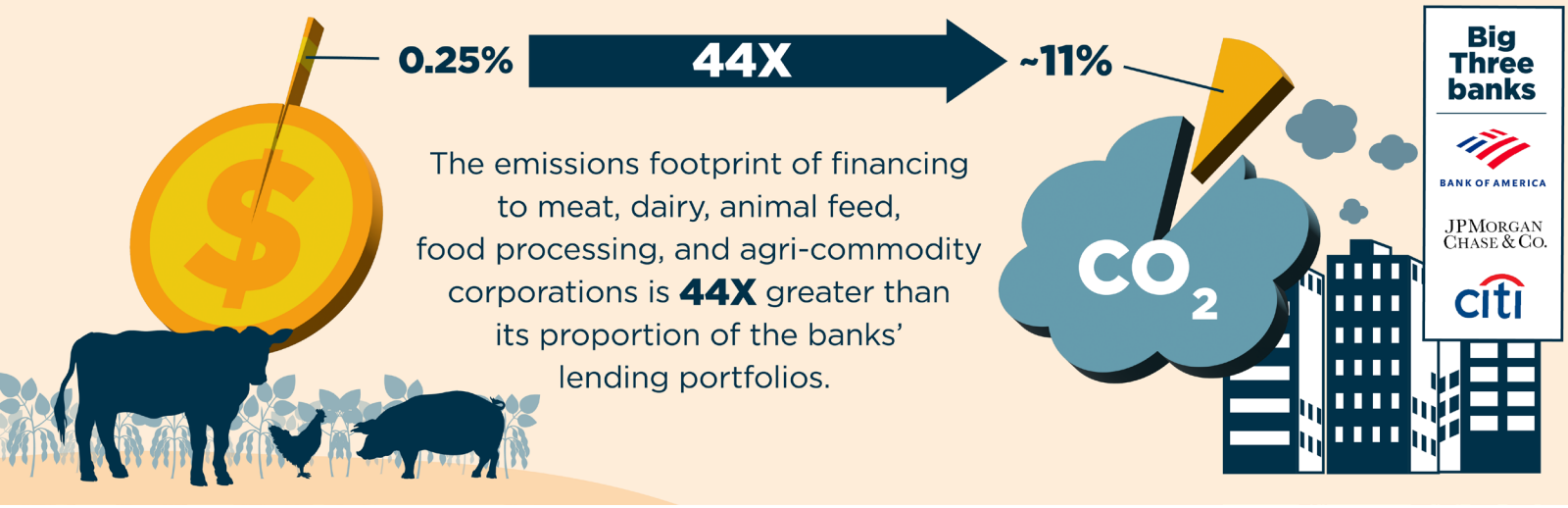
Source: Profundo financing research for this study (see Annex 1, Section 1 for methodology and company selection).
* "Corporations involved in meat, dairy, and/or feed production" refers to a subset of the 56 corporations reviewed for this report that received financial support from U.S. banks.

Our findings show that between January 2016 and March 2023, the Big Three's top 10 meat, dairy, and feed clients combined (Table A) accounted for more than 93% of the funding through loans and underwriting services provided to the corporations reviewed for this report.

Table A: Top 10 meat, dairy, and feed clients of Bank of America, Citigroup, and JPMorgan Chase (2016-2023)

Bank	Company	Loans (US$ min)	Underwriting (US$min)	Total (US$min)
Bank of America	ADM - Archer Daniels Midland	5,043	899	5,941
	Nestlé	3,300	2,325	5,625
	Tysons Food	3,606	1.023	4,629
	Cargill	3,068	726	3,794
	WH Group	406	765	1,171
	Agropur	1,088		1,088
	JBS	44	768	811
	DFA - Dairy Farmers of America	606	75	681
	Saputo	519	111	630
	Minerva		628	628
	Other	*1,036*	*480*	*1,516*
Bank of America Total		**18,715**	**7,801**	**26,515**
Citigroup	Nestlé	4,218	3,477	7,695
	ADM - Archer Daniels Midland	4,668	978	5,645
	Danone	990	1,905	2,894
	Cargill	1,576	1,051	2,626
	China Mengniu Dairy	279	1,425	1,704
	Bunge	572	629	1,202
	Louis Dreyfus Company	493	178	671
	FrieslandCampina	317	71	389
	BRF		366	366
	WH Group	155		155
	Other	*188*	*245*	*432*
Citigroup of America Total		**13,456**	**10,323**	**23,779**
JPMorgan Chase	Nestlé	3,300	2,590	5,890
	ADM - Archer Daniels Midland	3,093	944	4,037
	Cargill	2,941	913	3,854
	Danone	1,672	1,905	3,576
	Tysons Food	1,239	629	1,868
	Bunge	329	691	1,020
	Minerva		747	747
	DFA - Dairy Farmers of America	479	75	554
	Marfrig		365	365
	Louis Dreyfus Company	190	150	340
	Other	*869*	*637*	*1,506*
JPMorgan Chase Total		**14,112**	**9,645**	**23,757**
Total		**46,283**	**27,769**	**74,051**

Source: Profundo financing research for this study (see Annex 1 for methodology and company selection).



Section 2: Reducing financing for meat, dairy, and feed corporations can have an outsized impact on banks' emissions

While the US$ 74B+ in financing provided by the Big Three has provided significant support for the expansion of industrial livestock production, this amount constitutes a minor fraction of the banks' overall lending and underwriting. But companies involved in meat, dairy, and/or feed production punch above their weight in their contribution to the banks' GHG emissions footprint. Our analysis found that the Big Three banks' lending to the meat, dairy, animal feed, food processing, and agri-commodity corporations reviewed for this report represent ***just 0.25%*** of the banks' total loans outstanding but roughly ***11% of their reported financed emissions.***[ix] This means the emissions footprint of financing to these companies is 44X greater than its proportion of the banks' lending portfolios[x] (see Figure C).

The impact on the emissions footprints of each of the Big Three is as follows:

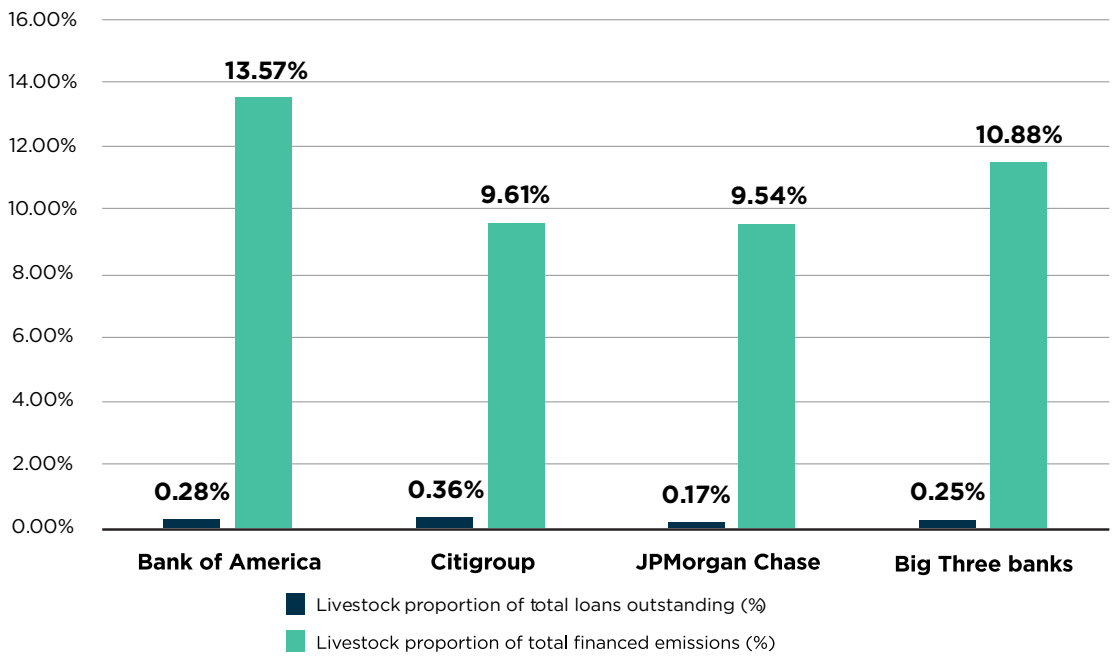
- For Bank of America, lending to these corporations represents only 0.28% of its outstanding loans but accounts for approximately 14% of the bank's reported total financed emissions (see more details in Table A2-A in Annex 2).
- For Citigroup, lending to these corporations represents 0.36% of its outstanding loans portfolio while accounting for approximately 10% of its total financed emissions.
- For JPMorgan Chase, lending to these corporations represents a mere 0.17% of its total US$ 1.1 trillion in outstanding loans while accounting for approximately 9.5% of its total financed emissions

For the Big Three, curtailing support for meat, dairy, and feed corporations would affect a tiny fraction of the banks' lending portfolios but would result in significant reductions in their financed emissions and enable progress towards their climate commitments.

ix In this analysis, "financed emissions" and "total financed emissions" refer to banks' self-reported financed emissions (all of which currently excludes agriculture-based emissions) combined with our estimates of the banks' financed emissions from the meat, dairy, animal feed, food processing, and agri-commodity corporations reviewed for this report. Therefore, neither "reported financed emissions" nor "total financed emissions" should be presumed to account for any bank's *actual* total financed emissions.

x These figures use companies' self-reported financed emissions data only. Facilitated emissions are also a significant form of emissions associated with banks. However, these are not considered on the balance sheet of banks as underwriting services are not balance sheet items or exposures.

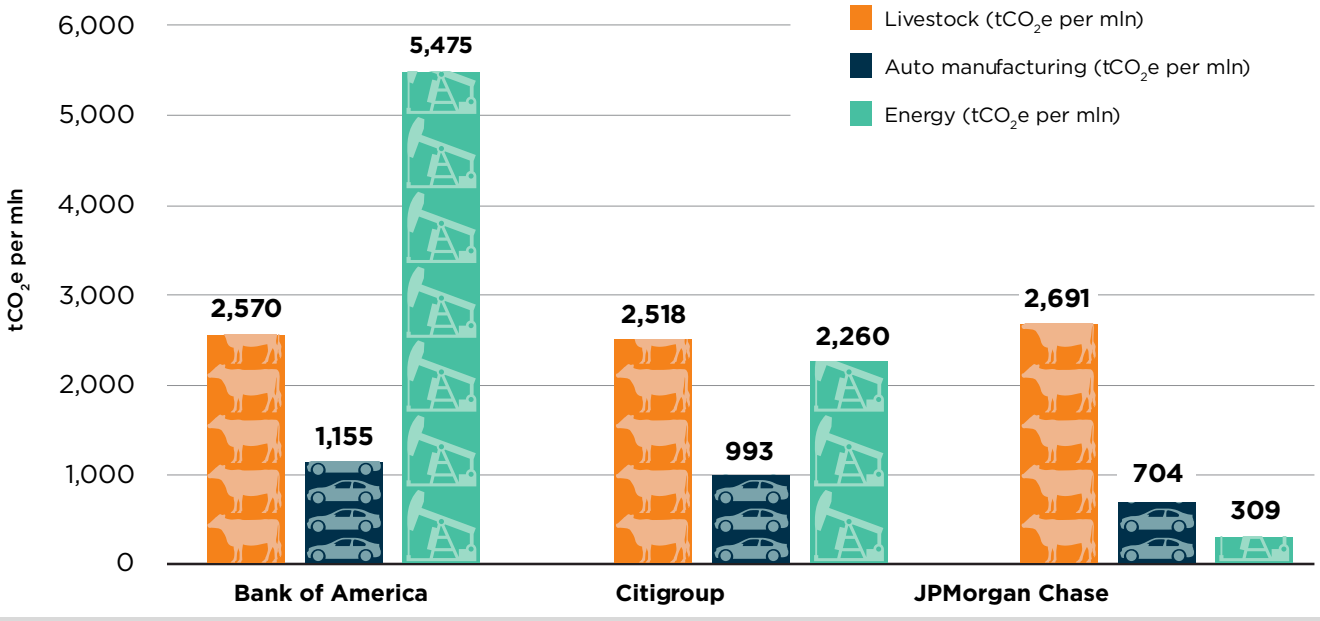
Figure C: Lending to corporations involved in meat, dairy, and/or feed production* comprises a tiny proportion of banks' lending portfolios but a significant proportion of their financed emissions



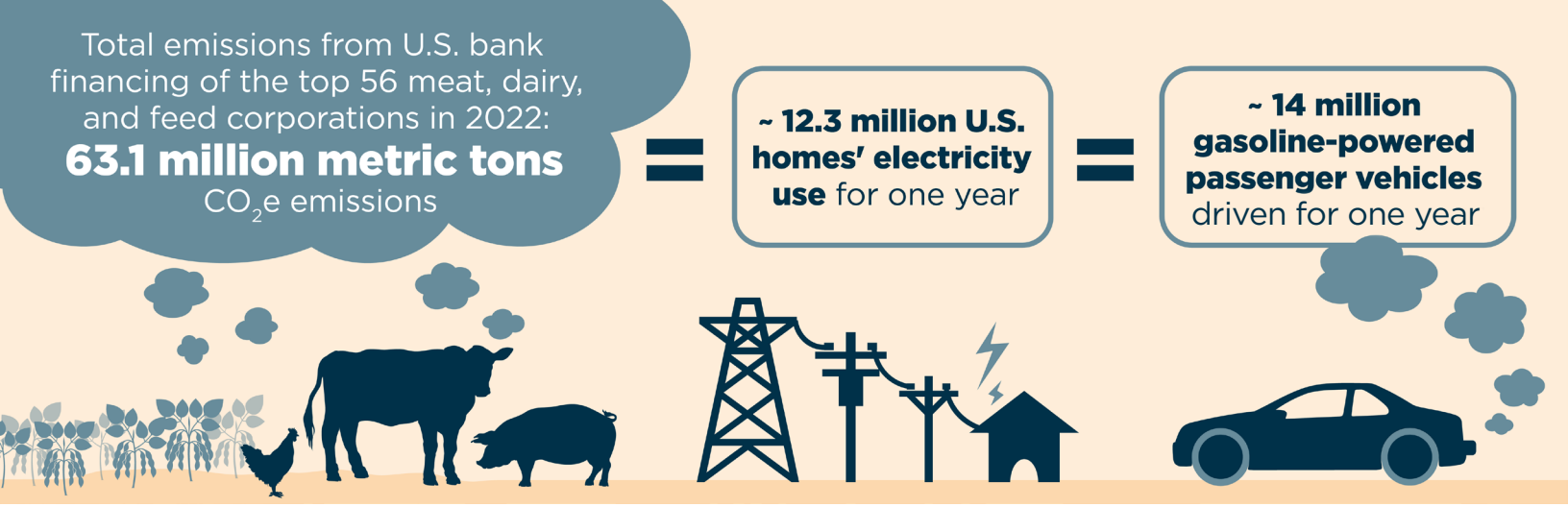
Sources: Bank of America Annual Report 2022,[18] Bank of America TCFD Report 2022,[19] Citigroup Annual Report 2022,[20] Citigroup TCFD Report 2022,[21] JPMorgan Chase Annual Report 2022,[22] JPMorgan Chase Climate Report 2023.[23]
Note: These figures are financed emissions only, and utilize only company self-reported emissions figures. Facilitated emissions, as seen above, are also a significant form of emissions associated with banks. However, these are not considered on the balance sheet of banks as underwriting services are not balance sheet items or exposures.
* "Corporations involved in meat, dairy, and/or feed production" refers to a subset of the 56 corporations reviewed for this report that received financial support from the Big Three.

When comparing financed emissions intensity (metric tons CO_2e per million U.S. dollars financed) with other sectors, the importance of emissions from meat, dairy, and feed corporations becomes clearer. Bank of America's relevant financed emissions intensity is more than 2X that for auto manufacturing. Citigroup's is 2.5X that of auto manufacturing and slightly higher than the energy sector. JPMorgan Chase's is almost 4X that of auto manufacturing and almost 9X that of its reported emissions intensity of operational oil and gas (see Figure D).

Figure D: Emissions intensity of meat, dairy, and feed corporations* is comparable to energy and auto manufacturing



Sources: Bank of America TCFD Report 2022,[24] Citigroup TCFD Report 2022,[25] JPMorgan Chase Climate Report 2023,[26] Profundo calculations for livestock.
Note: The energy sector refers to the oil and gas value chain, from upstream exploration and production to downstream refining and marketing.
* "Meat, dairy, and feed corporations" refers to a subset of the 56 corporations reviewed for this report that received financial support from the Big Three.



Section 3: The emissions footprint of Bank of America, Citigroup, and JPMorgan Chase's financing of meat, dairy, and feed corporations

> "There is no silver bullet to meet the world's energy and climate goals. But we can start by prioritizing emissions reductions, developing meaningful short- and long-term goals and crafting innovative policy solutions. The curve toward net zero can still be bent before it's too late."
> *- Jamie Dimon,[27] CEO JPMorgan Chase*

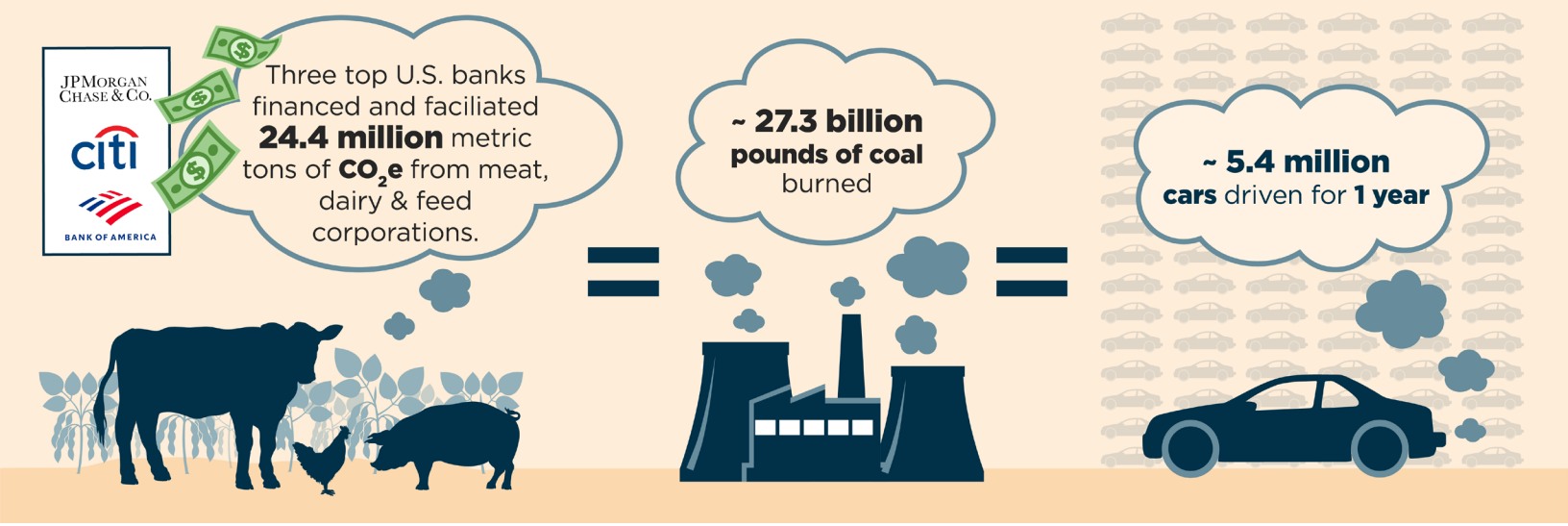
Our analysis found that in 2022, the 58 largest U.S. banks' financing of the meat, dairy, animal feed, food processing, and agri-commodity corporations reviewed for this report was linked to approximately 63.1 million metric tons CO_2e financed and facilitated emissions,[xi] which is similar to the amount emitted by Austria in 2020.[28] This breaks down into:

- 51.6 million metric tons CO_2e in financed emissions. More than the annual emissions of Chile in 2020.[29]
- 11.5 million metric tons CO_2e in facilitated[xii] emissions. More than the annual emissions of Lithuania in 2020.[30]

"Without reducing and cutting down on meat consumption and the associated high-intensity agriculture systems, we will not be able to keep global warming to 1.5°C degrees." - Professor Hans Pörtner, scientist and co-chair of the UN Intergovernmental Panel on Climate Change[16]

xi GHG emissions figures from the meat, dairy, animal feed, food processing, and agri-commodity corporations reviewed for this report represent these corporations' total GHG emissions because these companies do not disaggregate emissions by business segment or activity. Thus, the emissions figures for diversified companies that have non-livestock-related emissions, such as agri-commodity traders (e.g., ADM and Bunge) and food processing companies (e.g., Nestlé and Danone), include non-industrial livestock emissions. The financed and facilitated emissions data contained in this report therefore also include non-industrial livestock emissions (as is standard practice when using PCAF methodology, see Annex 1, Section 3).

xii Facilitated emissions calculations reflect banks' estimated contributions to total values of stock or bond issuances. See Annex 1, Section 2.5.1 and Section 3.1.1 for more information.

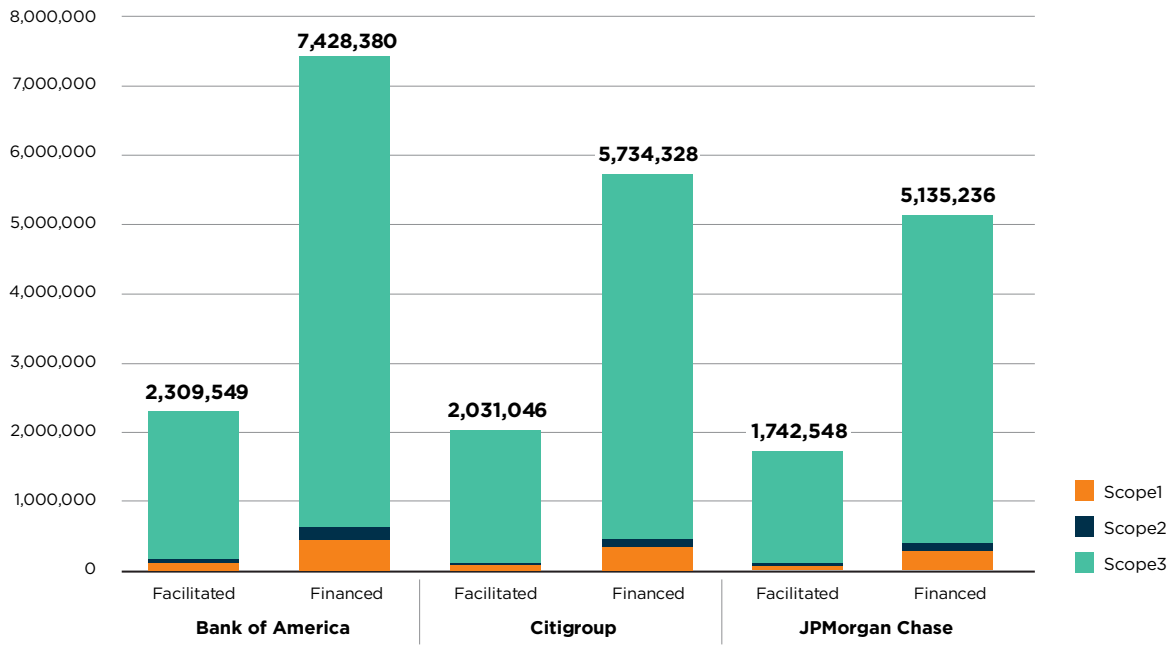


Notably, Bank of America, Citigroup, and JPMorgan Chase were responsible for over 35% of the total financed emissions[xiii] (18 million metric tons CO_2e) and more than 52% of facilitated emissions (6 million metric tons CO_2e) totaling 24.4 million metric tons CO_2e. This is equivalent to 27.3 billion pounds of coal burned or the exhaust from 5.4 million cars over the course of a year.[31] Bank of America had the highest emissions linkage in 2022, followed by Citigroup and then JPMorgan Chase (see Figure E).

According to our research, agri-commodity traders Cargill, ADM, and Bunge, with their significant role in feed production, and meat giants like JBS are some of the worst climate offenders in the banks' financed emissions (see Table B), in large part due to their extensive Scope 3 emissions (see Annex 2, Tables A2-B and A2-C for more detail). Nestlé also drove a large proportion of the financed emissions from lending services for all three banks. Cargill, ADM, Bunge, and Nestlé account for the bulk of financed emissions for all three banks (Bank of America, 76%; Citigroup, 92%, and JPMorgan Chase, 86%).

The picture is similar for facilitated emissions from issuance underwriting services, with Nestlé, Cargill, and ADM accounting for a significant majority across all three banks (Bank of America, 64%; Citigroup, 96%; JPMorgan Chase, 95%). However, notably, for Bank of America, JBS contributed the most facilitated emissions in 2022, due to a single bond issuance package causing more than 815,000 metric tons CO_2e in facilitated emissions.

Figure E: Bank of America, Citigroup, and JPMorgan Chase financed and facilitated emissions from corporations involved in meat, dairy, and/or feed production* (2022, metric tons CO2e)**



Source: Profundo financing research for this report and Profundo financed and facilitated emissions calculations (see Annex 1 for methodology).
* "Corporations involved in meat, dairy, and/or feed production" refers to a subset of the 56 corporations reviewed for this report that received financial support from the Big Three.
** The emissions data in this chart is likely underreported because it is undercounting the importance of methane (see below for more detail).

xiii Financed emissions, which for the Big Three are primarily through lending services, are based on the outstanding value of loans on the 31st of December 2022 which includes loans provided in the years before 2022.

Table B: The worst climate offenders contributing to Bank of America, Citigroup, and JPMorgan Chase's financed and facilitated emissions from corporations involved in meat, dairy, and/or feed production

Bank	Client	Scope 1 (tCO_2e)	Scope 2 (tCO_2e)	Scope 3 (tCO_2e)	Total (tCO_2e)	%
Financed Emissions						
Bank of America	ADM - Archer Daniels Midland	237,246	37,432	2,075,166	2,349,844	32%
	Cargill	68,005	39,806	1,842,400	1,950,212	26%
	Saputo	18,418	16,965	786,826	822,210	11%
	Nestlé	20,101	9,603	678,304	708,008	10%
	Bunge	9,854	7,723	569,502	587,080	8%
Citigroup	ADM - Archer Daniels Midland	237,246	37,432	2,075,166	2,349,844	41%
	Cargill	48,699	28,505	1,319,353	1,396,557	24%
	Bunge	19,400	15,205	1,121,207	1,155,813	20%
	Nestlé	11,803	5,639	398,300	415,742	7%
	WH Group	24,265	14,023	137,570	175,859	3%
JPMorgan Chase	Cargill	59,143	34,619	1,602,305	1,696,066	33%
	ADM - Archer Daniels Midland	133,587	21,077	1,168,469	1,323,133	26%
	Bunge	20,270	15,887	1,171,483	1,207,640	24%
	Tyson Foods	35,698	18,268	285,044	339,010	7%
	Nestlé	5,068	2,421	171,017	178,506	3%
Facilitated Emissions						
Bank of America	JBS	53,606	16,046	745,647	815,300	35%
	Cargill	27,205	15,924	737,051	780,180	34%
	Nestlé	12,833	6,131	433,032	451,995	20%
	ADM - Archer Daniels Midland	22,321	3,522	195,241	221,084	10%
	BRF	5,307	2,298	12,977	20,582	1%
	Saputo	457	421	19,530	221,084	12%
Citigroup	Nestlé	24,886	11,889	839,770	876,545	43%
	Cargill	29,658	17,360	803,506	850,524	42%
	ADM - Archer Daniels Midland	22,321	3,522	195,241	221,084	11%
	Danone	1,734	749	59,829	62,311	3%
	BRF	5,307	2,298	12,977	20,582	1%
JPMorgan Chase	Cargill	29,658	17,360	803,506	850,524	49%
	Nestlé	12,833	6,131	433,032	451,995	26%
	ADM - Archer Daniels Midland	36,057	5,869	315,389	357,135	20%
	Danone	1,734	749	59,829	62,311	4%
	BRF	5,307	2,298	12,977	20,582	1%

Source: Profundo financing research for this report and Profundo financed and facilitated emissions calculations (see Annex 1 for methodology).

Section 4: Even the Big Three are in the dark due to underreporting and obscuring of GHG data

Banks may not be aware of the true emissions footprint of their financing of corporations involved in meat, dairy, and/or feed production because the majority of these are either not yet reporting or are underreporting their Scope 3 emissions.[xiv] For example, in its most recent available report via CDP, JBS declined to report on Scope 3 emissions from the 'purchased goods and services' category, despite the fact that the company's sourcing of livestock and poultry from over 50,000 producers[41] accounts for up to 97% of its climate footprint.[42]

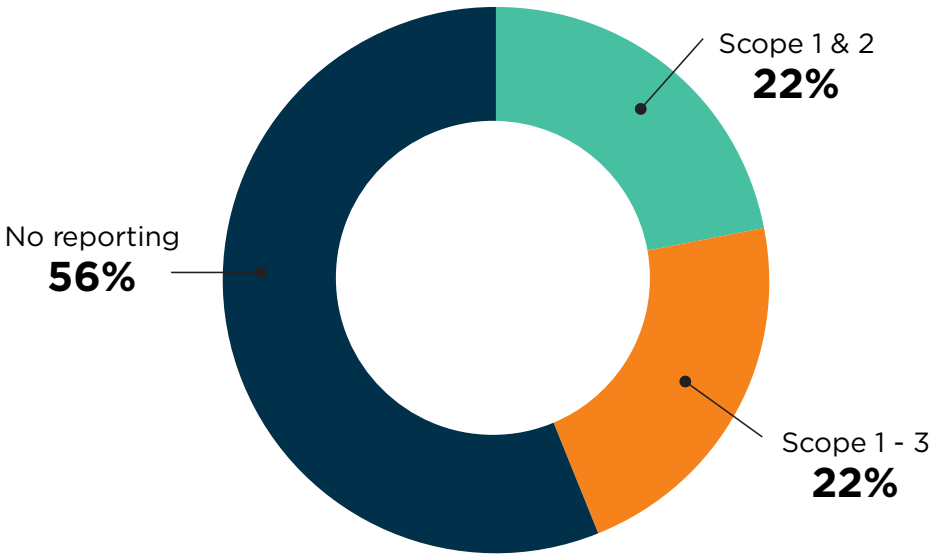
The lack of transparency effectively masks the true extent of these companies' climate impacts: Scope 3 emissions generally account for 90% or more of agricultural companies' emissions.[43] For example, about 95% of Nestlé's GHG emissions (as the second largest dairy processor in the world)[44] are Scope 3.[45]

Gaps in emissions reporting are misleading financiers about associated climate risks.[46] Of the 56 corporations involved in meat, dairy, and/or feed production reviewed for this report, only 22% disclose Scope 3 emissions (see Figure F); 56% do not report emissions at all.

Financiers acknowledge that without Scope 3 data they do not have the information they need to make good financial decisions; the Task Force on Climate-related Financial Disclosures (TCFD) found in a survey that financiers[xv] find Scope 3 metrics and targets useful for informing their financial decisions.[47] Citigroup agrees: "[A]ny business that commits to being net zero must ensure all elements of their supply chain are net zero. Companies and organizations are therefore responsible for their Scope 1 (direct emissions), as well as their Scope 2 and Scope 3 emissions (indirect emissions)."[48] Banks must help to hold their clients responsible for transparency and disclosure of all GHG emissions.

"For some companies, the production-based model emissions are four times greater than the self-reported emissions."

Figure F: Majority of meat, dairy, and feed corporations reviewed for this report fail to report or underreport emissions (CO_2e)



Source: Refinitiv, company GHG emissions data.

xiv Scope 3 emissions are the result of activities in a company's value chain. While a portion of companies engaged in the industrial livestock value chain are primary producers, for companies that are not primary producers, all on-farm practices including agricultural production and land-use change in addition to processing, distribution, manufacturing, and waste are part of their Scope 3 emissions.

xv 'Financiers' here refers to a group of financial institutions responding to a TCFD survey.

JBS: risks to financiers, people, and the planet

JBS S.A. is the world's largest meat company. It's notorious for having been repeatedly implicated in and exposed to scandals tied to climate change, deforestation, biodiversity loss, human rights abuses, and corruption, whether as a parent company or through its network of subsidiaries and suppliers.[32] Most recently, JBS has been in the spotlight of multiple government investigations. In 2022, an audit by Brazilian prosecutors found significant 'irregularities' in JBS's beef sourcing, indicating concerns that JBS is contributing to illegal deforestation in the Amazon rainforest.[33] In June 2023, the U.S. Senate Finance Committee hosted a hearing investigating cattle supply chains and deforestation in the Amazon,[34] where Senators zeroed in on JBS's practice of "cattle laundering."[35] Cattle laundering is the process by which ranchers move cattle from "dirty" ranches responsible for deforestation to "clean" ranches, so that by the time they arrive at slaughterhouses the forest destruction has been obscured.[36] In the same month, the National Advertising Review Board affirmed JBS should discontinue several claims about reaching net zero by 2040 since it does not yet have a plan to do so.[37]

Alongside these recent scandals, in 2023 JBS announced a plan to restart its decade-long attempt to list shares on the New York Stock Exchange via a dual listing under a new Dutch parent company ("JBS N.V."). JBS's last attempt to execute an initial public offering (IPO) in the U.S. in 2017 was undermined by the company's role in "the largest corruption inquiry in history,"[38] which resulted in a record-breaking US$ 3.2 billion fine[39] to settle five separate investigations into JBS's business practices.

Despite JBS's controversial reputation, Bank of America and Citigroup are some of the latest financiers to underwrite JBS bonds.[40] If U.S. banks are serious about reducing climate emissions, they must not provide any new financial support to JBS.

The financed and facilitated emissions analysis based on self-reported emissions figures published by the meat, dairy, and feed corporations reviewed for this report (see Annex 1, Section 3) provides an incomplete picture of these companies' climate impact. Using a geographically sensitive production-based methodology[xvi] to calculate emissions for the 49 meat and dairy companies that are part of the 56 reviewed for this report,[xvii] our analysis reveals a more comprehensive view. For some companies, the production-based model emissions are four times greater than the self-reported emissions (see Table C).

Table C*: Indicative comparison between data sources of emissions per meat and dairy company

Group	Self-reported tCO2e (GWP100)	Production-based model tCO2e (GWP100)
Agropur	2,876,058	10,362,000
BRF	1,162,844	19,319,232
FrieslandCampina	7,273,000	21,004,000
JBS	71,107,884	239,857,910
Sanderson Farms	1,663,491	3,075,191
Tyson Foods	36,372,366	57,124,747

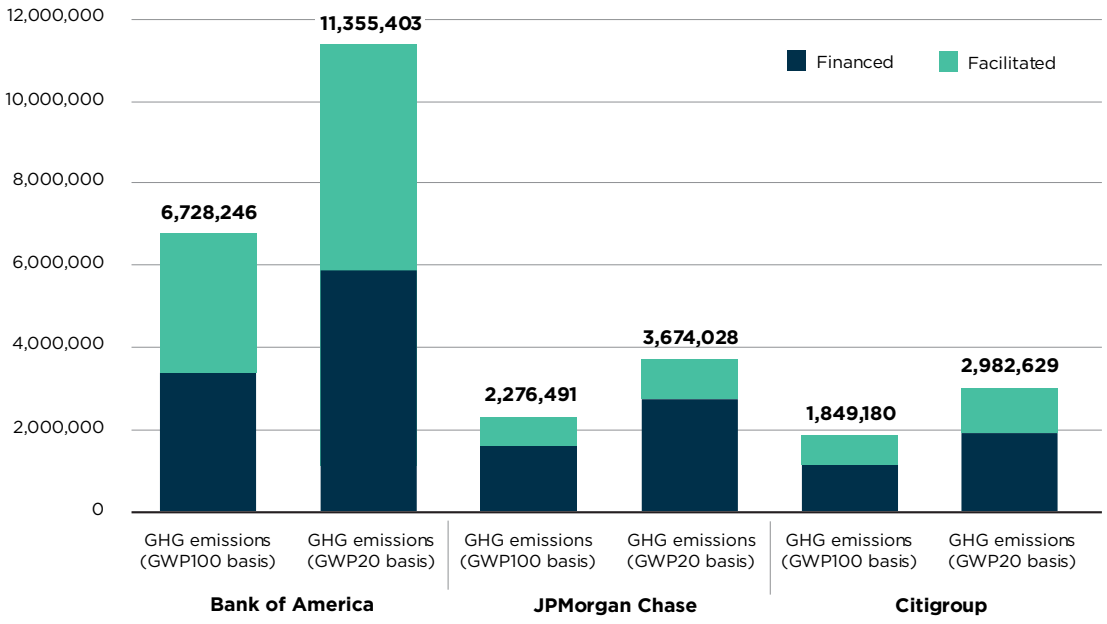
Source: Profundo financed and facilitated emissions calculation underlying emissions data (see Annex 1 for methodology).
* We do not have relevant data for the agri-commodity traders.

xvi In November 2022, Changing Markets Foundation and Institute for Agriculture and Trade Policy (IATP) published a report estimating the GHG emissions and detailed methane emissions of 15 meat and dairy companies using a model based on the UN Food and Agriculture Organization's Global Livestock Environmental Assessment Model (GLEAM) version 2.0 model (2017) (see Annex 1, Section 3.2.2). The authors of this report were granted access to the IATP model, and expanded the number of companies covered to 49 meat and dairy companies in order to calculate the financed and facilitated emissions for U.S. banks based on their financing of these meat and dairy companies. Therefore, the non-meat operations of Cargill, the non-dairy operations of Nestlé, and the soy trade and feed corporations, for example, are excluded from the calculations. Thus, this report was unable to do a full comparison of emissions across all 56 meat, dairy, and feed corporations reviewed for this report.

xvii This model is based on the 49 meat and dairy companies of the 56 meat, dairy, and feed corporations reviewed for this report and does not include feed and soy trade corporations: ACOLID - Arab Company for Livestock Development, Agropur, Arla, BRF - Brasil Foods, California Dairies, Cargill (for beef and poultry), China Mengniu Dairy, Cooperl Arc Atlantique, CP Group, Dairy Farmers of America, Danish Crown, Danone, DMK, Fonterra, FrieslandCampina, Fujian Sunner, Glanbia, Groupe Bigard, Guangdong Wens Foodstuff Group, Industrias Bachoco, JBS, Koch Foods, Lactalis, LDC Group (for poultry), Marfrig, Minerva, Muyuan Foodstuff, Nestlé, New Hope Group, NH Foods, Perdue Farms, Pipestone, Sanderson Farms, Saputo, Seaboard, Sichuan Dekon Group, Suguna Farms, Techbank Food, Tönnies Lebensmittel, Triumph Foods, Twins Group (Shuangbaotai Group), Tyson, Vion Food Group, Wellhope Agri-Tech, WH Group, Yangxiang, Yili, Zhengbang Group.

When calculating GHG emissions from financing meat and dairy companies[xviii] for each of the Big Three banks (see Figure G) using production data, it becomes clear that Bank of America's total financed and facilitated emissions are more than those of Citigroup and JPMorgan Chase combined. Bank of America's relationships with Brazilian meat giant JBS and Canadian dairy company Agropur are significant drivers of the bank's high financed and facilitated emissions from meat and dairy. Together these two companies accounted for approximately 60% (JBS at 42% and Agropur at 18%)[xix] of Bank of America's financed and facilitated emissions from meat and dairy clients.

Figure G: Bank of America, Citigroup, and JPMorgan Chase's total financed and facilitated GHG emissions from meat and dairy clients* using the production-based model (2022, metric tons CO_2e)



Source: Profundo financing research for this report and Profundo financed and facilitated emissions calculations (see Annex 1 for methodology).
* "Meat and dairy clients" refers to a subset of the 56 corporations reviewed for this report that received financial support from the Big Three.

Section 5: Methane is the Achilles' heel of banks' net zero ambitions

Livestock is responsible for one-third of all anthropogenic methane (CH_4) emissions,[49] roughly the same as the methane emissions from oil, coal, and natural gas combined.[50]

Methane is an extremely potent but short-lived gas with roughly *80X* the global warming potential (GWP)[xx] of CO2 over a 20-year period.[51] According to the United Nations Environment Programme's Global Methane Assessment, methane emissions should be reduced by at least 30% by 2030 in order to limit global temperature rise to levels aligned with the goals of the Paris Climate Agreement.[52] GHG emissions reductions from industrial livestock are critical for reaching the methane reductions needed to meet the Paris Agreement goals, and addressing emissions from financing of corporations involved in industrial livestock production is a crucial way for financial institutions to help meet their climate commitments.

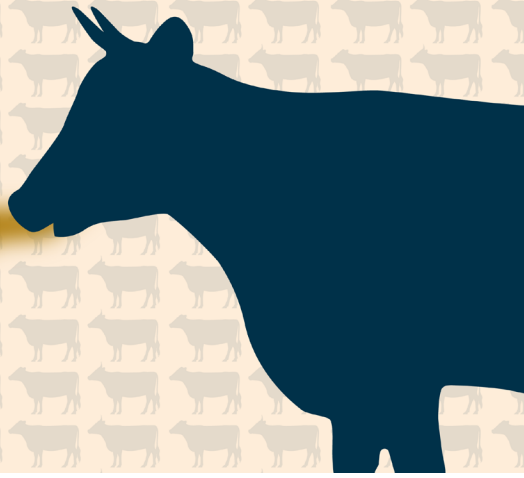
Using the GWP100 metric to measure the methane emissions from the 24 meat and dairy companies that received loans or underwriting support from the 58 U.S. banks reviewed for this report, we calculated a total of 20.7 million metric tons CO_2e of methane emissions (12.5 million metric tons CO_2e financed and 8.2 million metric tons CO_2e facilitated). This means methane accounts for 49.6% of the 58 U.S. banks' financed and facilitated emissions from meat and dairy clients.

xviii As mentioned above, the model used for these calculations is based on the 49 meat and dairy companies that are part of the 56 corporations reviewed for this report. The model does not include feed or soy trade corporations.

xix Using the GWP100 metric, JBS accounted for 2.8 million metric tons CO2e of Bank of America's emissions, and Agropur accounted for 1.2 million metric tons CO2e. Using the GWP20 metric, these companies accounted for 4.6 million metric tons CO2e and 2.3 million metric tons CO2e, respectively.

xx Global Warming Potential (GWP) is a measure of the relative global warming effects of different gases. It assigns a value to the amount of heat trapped by a certain mass of a gas relative to the amount of heat trapped by a similar mass of carbon dioxide over a specific period of time. The larger the GWP, the more that a given gas warms the Earth compared to CO2 over that time period. The time period usually used for GWP (particularly for comparing countries) is 100 years (GWP100), however 20 years is more relevant because methane has a much shorter lifespan (roughly 12 years).

In 2022, three top U.S. banks financed and faciliated **12.7 million metric tons CO_2e** of methane emissions from meat and dairy corporations, which is equivalent to **~ 127 million cows belching for a year**.



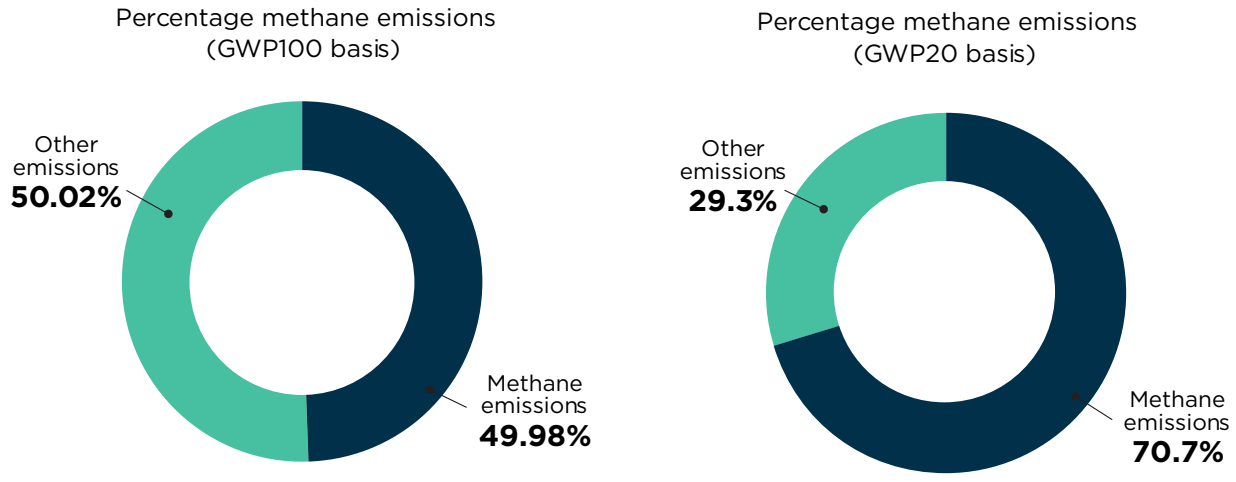
This figure is already quite significant, topping the methane emissions of Uruguay in 2020.[53] However, calculating these emissions using the GWP20 metric to take into account methane's extreme near-term warming potential, these figures *more than double* to a total of 48.4 million metric tons CO_2e (29.3 million metric tons CO_2e financed, 19.1 million metric tons CO_2e facilitated). Using the GWP20 metric bumps up methane to 70.3% of the U.S. banks' total meat and dairy related GHG emissions (see Figure H).

Two factors obscure this impact. The first is companies' general failure to disclose Scope 3 emissions (which is where the bulk of methane emissions occur),[54] as discussed in Section 4 of this report. The second is that the few that do disclose use the GWP100 metric for methane emissions. This masks not only the ramifications of these emissions for banks' carbon footprints but also the critical need to diminish methane in the near term, given its dangerous warming potential during the next two decades.

Financing from the Big Three to meat and dairy companies accounted for 12.7 million metric tons CO_2e of methane emissions (GWP20 basis), equating to 127 million cows belching for a year (see Table D).[55] Tracking with the overall GHG emissions data, our research found that Bank of America's financed and facilitated methane emissions from meat and dairy companies totaled more than those of Citigroup and JPMorgan Chase combined, due to its relationship with methane bombs such as JBS. Bank of America's underwriting of JBS *alone* accounted for 87% of its facilitated methane emissions from meat and dairy companies.

A handful of other corporations are responsible for the majority of the Big Three's financed methane emissions (using GWP20): for Bank of America 92% are from Cargill, Tyson, Agropur, and Saputo; for Citigroup 82% are from Cargill, Nestlé, and FrieslandCampina; for JPMorgan Chase, 88% are from Cargill, Tyson, and FrieslandCampina. Cargill and Nestlé are responsible for the bulk of facilitated methane emissions for Citigroup (80%) and JPMorgan Chase (75%) (see Table D).

Figure H: Significance of methane in meat and dairy company* financed and facilitated GHG emissions for U.S. banks



Source: Profundo financing research for this report and Profundo financed and facilitated emissions calculations (see Annex 1 for methodology).
* "Meat and dairy company" refers to a subset of the 56 corporations reviewed for this report that received financial support from U.S. banks.

Table D: Methane is a major part of the Big Three's financed and facilitated emissions (2022, metric tons CO2e, GWP20 basis)

Bank	Group	Financed		Facilitated		Total		
		GHG emissions	CH_4 emissions	GHG emissions	CH_4 emissions	GHG emissions	CH_4 emissions	Methane % of total emissions
Bank of America	JBS	-	-	4,597,405	3,269,380	4,597,405	3,269,380	71%
	Agropur	2,259,084	1,787,798	-	-	2,259,084	1,787,798	79%
	Cargill*	856,612	657,794	342,687	263,150	1,199,299	920,944	77%
	Saputo	1,129,269	893,683	28,029	22,182	1,157,298	915,865	79%
	Tyson Foods	1,045,275	732,310	-	-	1,045,275	732,310	70%
	Nestlé	250,091	188,253	159,659	120,181	409,751	308,434	75%
	BRF	-	-	383,921	81,182	383,921	81,182	21%
	WH Group	303,371	190,583	-	-	303,371	190,583	63%
Bank of America Total		**5,843,702**	**4,450,420**	**5,511,701**	**3,756,074**	**11,355,403**	**8,206,495**	**72%**
Citigroup	Cargill	613,424	471,050	373,585	286,876	987,009	757,926	77%
	FrieslandCampina	722,343	543,733	-	-	722,343	543,733	75%
	Nestlé	146,854	110,542	309,624	233,065	456,478	343,607	75%
	BRF	-	-	383,921	81,182	383,921	81,182	21%
	WH Group	255,654	160,607	-	-	255,654	160,607	63%
	Danone	25,497	19,666	63,726	49,153	89,223	68,819	77%
	China Mengniu Dairy	80,503	67,460	-	-	80,503	67,460	84%
	CP Group	7,499	1,341	-	-	7,499	1,341	18%
Citigroup Total		**1,851,774**	**1,374,398**	**1,130,856**	**650,276**	**2,982,629**	**2,024,674**	**68%**
JPMorgan Chase	Cargill	744,981	572,073	373,585	286,876	1,118,566	858,949	77%
	Tyson Foods	877,111	614,496	-	-	877,111	614,496	70%
	FrieslandCampina	722,343	543,733	-	-	722,343	543,733	75%
	BRF	-	-	383,921	81,182	383,921	81,182	21%
	WH Group	255,654	160,607	-	-	255,654	160,607	63%
	Nestlé	63,054	63,054	159,659	120,181	222,713	167,644	75%
	Danone	25,497	19,666	63,726	49,153	89,223	68,819	77%
	CP Group	4,498	804	-	-	4,498	804	18%
JPMorgan Chase Total		**2,693,138**	**1,958,841**	**980,891**	**537,392**	**3,674,028**	**2,496,233**	**68%**
Total		**10,388,614**	**7,783,659**	**7,623,447**	**4,943,742**	**18,012,061**	**12,727,401**	**71%**

Source: Profundo financing research for this report and Profundo financed and facilitated emissions calculations (see Annex 1 for methodology).
* The production-based model only includes meat and dairy companies, therefore the inclusion of Cargill's emissions here pertains only to its beef operations.

"Given that methane comprises the majority of emissions from meat and dairy companies, making reductions in related financed and facilitated emissions is of particular importance for any bank that has committed to aligning its portfolio with a net zero pathway."

The planet is facing potentially catastrophic climate tipping points.[56] And the near-term positive climate impacts of rapidly reducing methane could help avoid reaching them. Given that methane comprises the majority of emissions from meat and dairy companies, making reductions in related financed and facilitated emissions is of particular importance for any bank that has committed to aligning its portfolio with a net zero pathway.

JPMorgan Chase has already acknowledged that "investors, policymakers, insurance providers, and non-governmental organizations, are recognizing that reducing methane emissions is a pragmatic opportunity and are beginning to take action."[57] For the bank, this includes engaging with clients in the oil and gas sector on their operational methane emissions and reduction strategies.[58] The even larger impact of industrial livestock-based methane emissions on the planet raises the question of why neither JPMorgan Chase nor any of the other Big Three are addressing them and points to a major gap in these and other major U.S. lenders' climate commitments.

GWP* — a new controversial industry metric

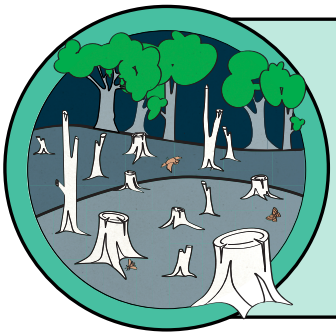
The global warming potential (GWP) metric that is currently standard for climate emissions accounting is GWP100. This metric represents the global warming potential of any non-CO_2 greenhouse gas over a 100-year time frame. For gases that have higher warming potential on a shorter time frame, particularly methane, GWP20 (referring to a 20-year time frame) is a more relevant metric.

Now, the meat and dairy industry and its lobby groups are pushing for a new metric for methane emissions accounting that could undermine recommendations for rapid methane cuts to limit near-term temperature rise aligned with a 1.5°C pathway. This metric, GWP*, could allow meat and dairy giants to claim climate neutrality with only small methane emission reductions; this could alter how methane emissions are assessed and have profound implications. For example, if Tyson were to reach a 30% reduction in emissions by 2030 using GWP100, the company would still need to address roughly 58.5 million metric tons of CO_2e — similar to the annual emissions of Peru.[59] However if Tyson uses GWP* for the same reductions and timeline the company could claim negative emissions of roughly -82.6 million metric tons of CO_2e.[60]

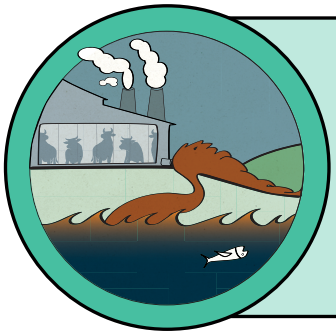
Beyond GHG emissions: additional impacts and risks embedded in industrial livestock value chains

"We believe that we must continue to deliver great returns while also delivering progress on social and environmental priorities." - *Brian Moynihan,[61] president and CEO of Bank of America and co-chair of the Sustainable Markets Initiative*

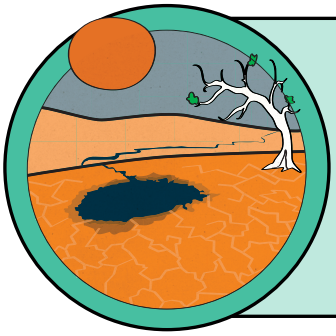
There is no question that urgent, absolute reductions in industrial livestock-based emissions are vital to avert the worst impacts of the climate crisis. Yet the myriad other important negative environmental and social impacts from industrial livestock should also motivate banks to reduce their financing of corporations involved in meat, dairy, and/or feed production, particularly if they want to align their lending with their broader sustainability goals and commitments. These include:



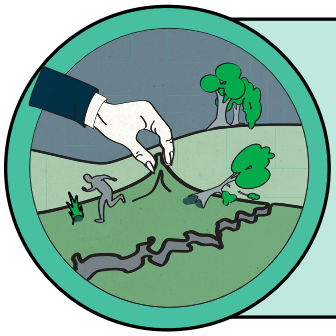
Deforestation and biodiversity loss: Industrial livestock production is one of the biggest drivers of deforestation and biodiversity loss[62] with an estimated 48% of global tropical deforestation caused by production of cattle and animal feed.[63] According to the Brazilian government, cattle are the largest driver of deforestation in the Amazon (about 80%),[64] despite a commitment from the largest cattle companies over a decade ago to buy cattle only from land without forest loss. Habitat loss and pesticides pollution from feed production are also key drivers of biodiversity loss.[65]



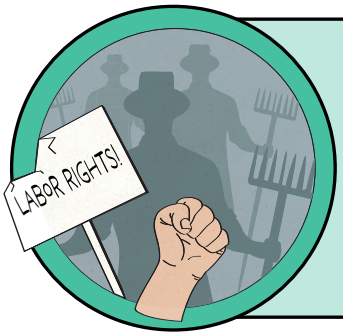
Polluting land and waterways: Large quantities of concentrated animal waste pollute surrounding soil and waterways, often making it the largest contributor of eutrophication and accelerating growth of dead zones. Pesticides[66] used in feed production pollute soil[67] and groundwater,[68] and are linked to a wide range of health effects including cancers, neurodevelopmental disorders and neurological diseases like Parkinson's, reproductive disorders like infertility, and endocrine disruption.[69]



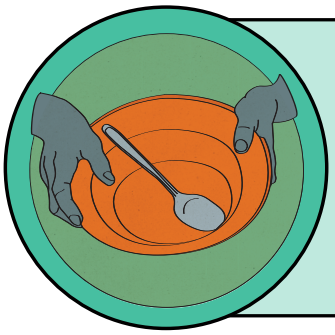
Freshwater depletion: Industrial livestock production accounts for 70% of agriculture's outsized water footprint[70] at a time when the UN Food and Agriculture Organization (FAO) warns of extreme water shortages by 2025.[71]



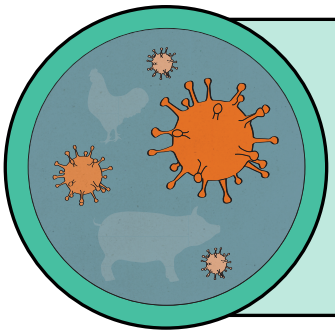
Land-grabbing: It is common for industrial livestock companies to purchase cattle from producers who are raising animals on land stolen from Indigenous and local communities, including customary land.[72] These producers are commonly called "land-grabbers."[73]



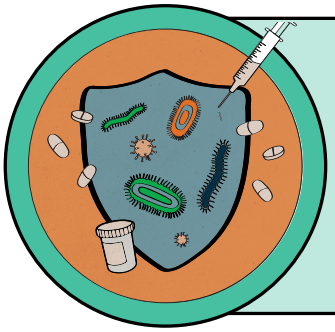
Violation of labor rights: Industrial livestock and slaughterhouse workers rank among the world's most vulnerable to injury, illness, and lack of legal protections.[74]



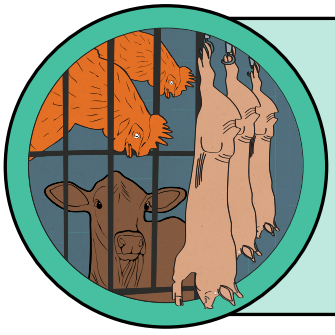
Exacerbating food insecurity: Industrial livestock consume roughly 75% of the world's soy[75] and 36-40% of all cereals[76] but provide only 18% of global calories,[77] leading the FAO to warn against further use of grain for animal feed.



Infectious diseases and zoonotic pandemics: Industrial livestock production facilities, including concentrated animal feeding operations (CAFOs) and slaughterhouses, are breeding grounds for infectious diseases. Recent outbreaks of highly pathogenic avian influenza (HPAI)[78] and African swine fever (ASF)[79] have cost livestock conglomerates billions of dollars in losses. The potential for such novel pathogens to infect humans[80] makes industrial livestock operations "high risk" sources of the next global pandemic.[81]



Antimicrobial resistance: Industrial livestock's reliance on antibiotics is a leading cause of antimicrobial resistance, which currently kills 700,000 people each year. By 2050, it could claim 10 million lives annually.[82]



Animal cruelty: Prolonged extreme confinement, painful mutilations, and extreme overcrowding in highly polluted environments all contribute to animal stress, disease, and mortality, and involve operational and reputational risks for corporations and lenders.[83]

The impacts of industrial livestock as a whole are disastrous and are not unique to any one company. Each of these impacts can involve regulatory, reputational, and/or operational risks. Taken together and combined with industrial livestock's significant emissions, these interconnected impacts are predicted to intensify as global temperatures continue to rise. According to a recent analysis by the US$ 70 trillion Farm Animal Investment Risk and Return Initiative (FAIRR), this will cost the world's largest livestock producers US$ 24 billion dollars in earnings by 2030, pushing more than half of them into operating losses.[84]

Conclusion: Facing the bull in the climate shop

> *"Achieving net zero emissions will require a whole economy transition — every company, every bank, every insurer and investor will have to adjust their business models."* - *Mark Carney,[85] Co-Chair, Glasgow Financial Alliance for Net Zero and UN Special Envoy for Climate Action*

The data presented in this report makes it clear that none of the largest U.S. banks will be able to align their lending portfolios with the goals of the Paris Agreement or honor their net zero commitments unless they look beyond fossil fuels to industrial livestock.

Financing to meat, dairy, animal feed, food processing, and agri-commodity corporations accounts for just 0.25% of the Big Three banks' lending portfolios but roughly 11% of their reported[xxi] financed emissions. Taking immediate action to reduce and ultimately eliminate these emissions is not only necessary — but strategic. For each bank, further diminishing an already small proportion of their lending portfolio would reap outsized emissions reduction benefits and propel them toward meeting their climate commitments.

Such action would also be timely. When the Big Three signed onto the Net Zero Banking Alliance in 2021, they committed to setting GHG emissions reduction targets for priority sectors — including agriculture — by the end of 2024.[86] As Bank of America, Citigroup, and JPMorgan Chase and other global banks prepare to address emissions from agriculture, they must properly address the impact of their lending to and underwriting of corporations involved in meat, dairy, and/or feed production.

The Big Three banks must urgently follow-through on their commitments to transition the operational and attributable GHG emissions from their lending and investment portfolios to align with pathways to reach net zero by 2050 or sooner.[87] In order to ensure the integrity of this commitment, the Big Three must treat industrial livestock as a high-emitting sector. Thus, we are calling on the Big Three and all major U.S. banks to set, publish, and implement agriculture sector-specific 1.5°C targets and action plans that include the following:

Key recommendations for meeting climate commitments

1 Halt all new financing that enables the expansion of industrial livestock production:

- **a.** No issuance of new corporate or project-based financing or revolving credit facilities to corporations involved in meat, dairy, and/or feed production;
- **b.** No renewals of any such existing loans or facilities;
- **c.** No underwriting of bonds, IPOs, or secondary offerings; and
- **d.** No investment in publicly traded securities.

2 Require meat, dairy, and feed clients to disclose third-party verified 1.5°C targets and action plans that align with IPCC[88] or an equivalent science-based sectoral pathway. At a minimum, banks should require that these clients:

- **a.** Disclose 100% of their disaggregated (CH_4, CO_2, N_2O) GHG emissions across all Scopes (1-3);
- **b.** Set and disclose near-term and long-term timebound absolute reduction targets for CH_4, CO_2, N_2O;
- **c.** Prioritize reduction of CH_4, and adopt absolute CH_4 emissions reductions of at least 30% from 2020 levels by 2030;[xxii] and
- **d.** Achieve emissions reductions by reducing the number of animals in global supply chains and without reliance on carbon offsets, credits or similar mechanisms.[xxiii]

xxi In our analysis, "financed emissions" and "total financed emissions" refer to banks' self-reported financed emissions (all of which currently excludes agriculture-based emissions) combined with our estimates of the banks' financed emissions from the meat, dairy, animal feed, food processing, and agri-commodity corporations reviewed for this report. Therefore, neither "financed emissions" nor "total financed emissions" should be presumed to account for any bank's actual total financed emissions.

xxii This aligns with the Global Methane Pledge: https://www.globalmethanepledge.org/.

xxiii Corporations involved in meat, dairy, and/or feed production cannot adequately reduce their GHG footprints by purchasing carbon credits. Issues with carbon credits include: impermanence, double counting, lack of assurance, and an absence of market regulation. (Open Markets Institute & Friends of the Earth. (2023). *Agricultural carbon markets, payments, and data: Big ag's latest power grab*. Friends of the Earth. https://foe.org/wp-content/uploads/2023/02/Carbon-Markets-Report_ExecutiveSummary_Final.pdf)

3 Address the additional social and environmental harms from industrial livestock production by requiring meat, dairy, animal feed, food processing, and agri-commodity clients (at the corporate group[89] level) to:

- **a.** Halt deforestation and biodiversity loss;
- **b.** Respect human and labor rights, including the rights of Indigenous Peoples and local communities, as well as the right to Free, Prior and Informed Consent;
- **c.** Enact zero tolerance for violence against human rights, land, and environmental defenders;
- **d.** Establish a robust grievance mechanism; and
- **e.** Adopt strong animal welfare criteria.

Given the fierce urgency of the climate crisis, it is incumbent on all financial actors — who themselves rely on a sustainable and relatively stable global economy — to acknowledge the role of industrial livestock production in warming the planet and driving concurrent market-disrupting environmental and social disasters.

The data is clear: climate risk is financial risk. But the impact of U.S. banks' support for the continued expansion of industrial livestock extends well beyond their portfolios and enterprise value to the broader climate system, the stability of financial markets, and the long-term portfolio returns on which global economic growth ultimately relies.[90]

Beginning now, the Big Three and other banks must take swift and meaningful action to reduce — and ultimately eliminate — financed and facilitated emissions from corporations involved in meat, dairy, and/or feed production. Taking action on a tiny proportion of their portfolios will have an outsized impact on the banks' ability to honor their climate commitments and align with global leaders' recent pledge[91] to help drive forward the urgent adaptation and transformation of agriculture and food systems.

"For each bank, further diminishing an already small proportion of their lending portfolio would reap outsized emissions reduction benefits and propel them toward meeting their climate commitments."

Techno-fixes cannot bring industrial livestock production into alignment with the goals of the Paris Agreement

While absolute emissions reductions from industrial livestock are necessary for banks to meet their climate commitments, none of the 56 corporations involved in meat, dairy, and/or feed production reviewed for this report have committed to reducing production. This is not because these corporations are ignorant of the need to reduce emissions from the sector. Quite the contrary. Many have acknowledged this need. But they also claim that intensity reductions (emissions per kg of product) will suffice.

The science says otherwise. Namely, that GHG intensity-reducing technologies[xxiv] that allow for the expansion of livestock production could result in a net increase of absolute emissions, particularly in high producing and consuming regions.[92]

One widely touted 'solution,' methane biodigesters, not only face both practical[93] and economic[94] barriers to implementation,[xxv] but may also result in a total net increase in emissions. Research has shown that leakage alone could mean that biomethane would "provide minimal to zero climate benefits."[95] Adding to this, biodigesters may incentivize increasing herd sizes, which could result in higher emissions from enteric fermentation (methane) and feed production.[96] Methane biodigesters also do nothing to mitigate ammonia or nitrous oxide emissions.[97]

Other emissions intensity reduction schemes such as feed additives,[98] genetic engineering,[99] and masks[100] tend to rely on technologies that are still undergoing research and development and are unlikely to be deployable at scale with sufficient speed or efficacy.

xxiv These include more digestible feeds, improved feeding practices, using different grasses and legumes, breeding cattle for higher growth rates, improving veterinary care, improving grazing management.

xxv The US EPA reports that as of January 2023, there are just 343 manure biodigesters installed among the country's ~450,000 animal feeding operations/~21,500 concentrated animal feeding operations. (United States Environmental Protection Agency. (n.d.). AgSTAR Data and Trends. https://www.epa.gov/agstar/agstar-data-and-trends#:~:text=In%20the%20United%20States%2C%20as,to%20these%20biogas%20recovery%20systems; USDA & EPA. (n.d.). Unified National AFO Strategy Executive Summary. https://www.epa.gov/sites/default/files/2015-10/documents/exexsum.pdf; EPA. (2021, May 11). *NPDES CAFO Permitting Status Report: National Summary, Endyear 2020.* https://www.epa.gov/ sites/default/files/2021-05/documents/cafo_status_report_2020.pdf)

Annex 1 - Methodology

This annex presents the research methodology used to analyze U.S. bank financial flows to and financed and facilitated emissions from corporations involved in meat, dairy, and/or feed production. Annex 1 is organized as follows: Section 1 details the selection methodology for the 56 meat, dairy, animal feed, food processing, and agri-commodity corporations; Section 2 presents the financial flows research methodology; and Section 3 outlines the methodology used for the financed and facilitated emissions analyses.

Section 1: Company selection methodology

This report researched U.S. bank financial flows to 56 of the most important players in six industrial livestock subsectors: beef, dairy, pork, poultry, animal feed and soy trade. Table A1-A below presents an overview of the corporations included in the scope of the research. A number of the selected corporations are active in multiple subsectors. The table denotes involvement as a top actor in a subsector. For example, ADM falls within the top 5 soy trade companies, but not within the top 10 feed producers, even though the company does produce animal feed.[xxvi]

Further details on the specific metrics and selection criteria per subsector can be found below.

Table A1-A: Overview of selected companies

Top producers	HQ Country	Beef	Dairy	Feed	Pork	Poultry	Soy trade	No. of sectors	U.S. bank link
ACOLID - Arab Company for Livestock Development	Saudi Arabia					X		1	N
ADM - Archer Daniels Midland	United States						X	1	Y
Agropur	Canada		X					1	Y
Amul	India		X					1	N
Arla Foods	Denmark		X					1	N
BRF	Brazil			X	X	X		3	Y
Bunge	United States						X	1	Y
California Dairies	United States		X					1	N**
Cargill	United States	X		X		X	X	4	Y
China Mengniu Dairy	China		X					1	Y
COFCO Group	China						X	1	Y
Cooperl Arc Atlantique	France				X			1	N
CP Group	Thailand			X	X	X		3	Y
Danish Crown	Denmark	X						1	N
Danone	France		X					1	Y
DFA - Dairy Farmers of America	United States		X					1	Y
DMK Deutsches Milchkontor	Germany		X					1	Y
Fonterra Cooperative Group	New Zealand		X					1	Y
ForFarmers	Netherlands			X				1	N
FrieslandCampina	Netherlands		X					1	Y
Fujian Sunner	China					X		1	N

xxvi E.g., ADM also produces feed but is not among the top 10 animal feed producers considered in this analysis.

Table A1-A: Overview of selected companies (continued)

Top producers	HQ Country	Beef	Dairy	FEED	Pork	Poultry	Soy trade	No. of sectors	U.S. bank link
Glanbia	United States		X					1	N**
Groupe Bigard	France	X						1	N
Guangdong Haid Group	China			X				1	N
Guangdong Wens Foodstuff Group	China			X	X	X		3	N
Industrias Bachoco	Mexico					X		1	Y
Inner Mongolia Yili	China		X					1	Y
JBS	Brazil	X		X		X		3	Y
Koch Foods	United States					X		1	Y
Land O'Lakes	United States			X				1	Y
LDC Group	France				X			1	N
Le Groupe Lactalis	France		X					1	N
Louis Dreyfus Company	Netherlands						X	1	Y
Marfrig	Brazil	X						1	Y
Minerva	Brazil	X						1	Y
Muyuan Foodstuff	China			X	X			2	N
Nestlé	Switzerland		X					1	Y
New Hope Group	China			X				2	N
NH Foods	Japan	X						1	Y
Perdue Farms	United States				X			1	Y
Pipestone	United States					X		1	N**
Sanderson Farms*	United States					X		1	Y
Saputo	Canada		X					1	Y
Seaboard	United States				X			1	Y
Sichuan Dekon Group	China				X			1	N
Suguna Farms	India					X		1	N
Techbank Food	China				X			1	N
Tönnies Lebensmittel	Germany	X						1	N
Triumph Foods	United States				X			1	N
Twins Group (Shuangbaotai Group)	China			X	X			2	N**
Tyson Foods	United States	X		X		X		3	Y
Vion Food Group	Netherlands	X						1	N
Wellhope Agri-Tech	China					X		1	N
WH Group	China				X			1	Y
Yangxiang	China				X			1	Y
Zhengbang Group	China				X			1	Y

Source: Profundo financing research for this report.
* Sanderson Farms was acquired by a joint venture between Cargill and Continental Grain in July 2022.
** This research did not identify any financial links based on the data sources available to the researchers. However, given that these corporations are domiciled in the U.S., it is more than likely that they are also financed by U.S. financial institutions.

The following tables detail the selection metrics and rankings per subsector. The 15 largest poultry producers were selected by the number of heads slaughtered (Table A1-B). The 15 biggest pork producers were selected by the number of sows produced (Table A1-C). The 10 largest beef companies were selected based on the estimated number of heads slaughtered (Table A1-D). The 15 largest dairy companies were selected based on their milk intake (Table A1-E). The top 10 feed producers were selected based on their feed production volumes (Table A1-F). For soy traders, there is a lack of company disclosure and comprehensive global data availability. Therefore, a group of leading soy traders were selected using their role in the important trade from Latin America (two-thirds of global exports by volume) as a proxy. The five corporations included in the selection are also all involved in the soy trade from the U.S., the other largest soy exporter[101] (see Table A1-G).

Table A1-B: Top 15 poultry companies (broiler producers)

Rank	Top Producers	HQ Country	Heads slaughtered 2021 (millions)
1	JBS	Brazil	4,425
2	BRF	Brazil	2,190
3	Tyson Foods	United States	1,900
4	Guangdong Wens Foodstuff Group	China	925
5	CP Group	Thailand	685
6	Koch Foods	United States	655
7	Sanderson Farms	United States	632
8	Wellhope Agri-Tech	China	625
9	Industrias Bachoco	Mexico	620
10	Perdue Farms	United States	620
11	Cargill	United States	604
12	LDC Group	France	579
13	ACOLID - Arab Company for Livestock Development	Saudi Arabia	562
14	Suguna Farms	India	517
115	Fujian Sunner	China	510

Source: Watt Poultry International[102]

Table A1-C: Top 15 pork producers

Rank	Top Producers	HQ Country	Number of sows 2020 (1,000 heads)
1	Muyuan Foodstuff	China	2,624
2	Guangdong Wens Foodstuff Group	China	1,800
3	WH Group	China	1,225
4	Zhengbang Group	China	1,200
5	New Hope Group	China	1,200
6	CP Group	Thailand	1,180
7	Techbank Food	China	500
8	Triumph Foods	United States	443
9	Sichuan Dekon Group	China	400
10	BRF	Brazil	389
11	Pipestone	United States	384
12	Seaboard	United States	384
13	Twins Group (Shuangbaotai Group)	China	250
14	Yangxiang	China	250
15	Cooperl Arc Atlantique	France	245

Source: Pig Progress[103]

Table A1-D: Top 10 beef slaughterhouses

Rank	Top Producers	HQ Country	Heads slaughtered (1,000 heads, estimates)
1	JBS	Brazil	21,114
2	Marfrig	Brazil	8,700
3	Cargill	United States	8,000
4	Minerva	Brazil	6,868
5	Tyson Foods	United States	6,367
6	Groupe Bigard	France	1,477
7	Vion Food Group	Netherlands	910
8	NH Foods	Japan	639
9	Danish Crown	Denmark	500
10	Tönnies Lebensmittel	Germany	420

Sources: The National Provisioner,[104] JBS,[105] Minerva Foods,[106] Marfrig,[107] Cargill,[108] Tyson Foods,[109] Linéaires,[110] Vion Food Group,[111] NH Foods,[112] FAO,[113] The Land,[114] Danish Crown,[115] Statista[116]

Table A1-E: Top 15 dairy producers

Rank	Top producers	HQ Country	Feed production 2021 (1,000 mt)
1	DFA - Dairy Farmers of America	United States	28.6
2	Le Groupe Lactalis	France	21.7
3	Fonterra Cooperative Group	New Zealand	18.7
4	Arla Foods	Denmark	13.7
5	Nestlé	Switzerland	13.6
6	FrieslandCampina	Netherlands	11.8
7	Saputo	Canada	10.5
8	Amul	India	10.3
9	Inner Mongolia Yili	China	9.6
10	China Mengniu Dairy	China	9
11	Glanbia	United States	8.4
12	California Dairies	United States	7.7
13	Danone	France	7.5
14	Agropur	Canada	6.6
15	DMK Deutsches Milchkontor	Germany	6.6

Source: IFCN Dairy[117]

Table A1-F: Top 10 feed producers

Rank	Top producers	HQ Country	Feed production 2021 (1,000 mt)
1	CP Group	Thailand	28,175
2	New Hope Group	China	28,000
3	Guangdong Haid Group	China	19,630
4	Cargill	United States	19,600
5	Land O'Lakes	United States	13,500
6	Muyuan Foodstuff	China	13,100
7	JBS	Brazil	11,000
7	Twins Group (Shuangbaotai Group)	China	11,000
9	BRF	Brazil	10,071
10	ForFarmers	Netherlands	10,000
10	Tyson Foods	United States	10,000
10	Guangdong Wens Foodstuff Group	China	10,000

Source: Feed Strategy[118]

Table A1-G: Top 5 soy traders

Rank	Top traders	HQ Country	Soy handling Latin America 2019/20 (1,000 mt, estimates)
1	Cargill	United States	20,145
2	Bunge	United States	17,836
3	ADM - Archer Daniels Midland	United States	16,580
4	COFCO Group	China	12,431
5	Louis Dreyfus Company	Netherlands	11,930

Source: Trase.earth[119]
Note: Due to a lack of comprehensive data disclosure, the traders' role in soy trade from Argentina, Bolivia, Brazil, and Paraguay was used as a proxy.

Section 2: Financing research methodology

This section outlines the types of finance included in our analysis, the calculated elements in the corporate financing research, and financial research data sources. It is organized as follows: Sub-section 2.1 describes the types of finance included in the analysis; Sub-section 2.2 delineates the scope of identified financing; Sub-section 2.3 presents the data sources used to conduct the analysis; Sub-section 2.4 provides the time scope applied to the analysis; and Sub-section 2.5 details the methodology used to calculate the financing contributions where these were not provided.

2.1 Types of finance

This section outlines the different types of financing, how they were researched, and the implications for the analysis. Financial institutions can invest in companies through a number of modalities: credit, underwriting, and investment.

Financial institutions can provide credit to a company. This includes providing various types of short-and long-term corporate loans and credit facilities. Financial institutions can also facilitate companies' access to credit in the broader financial market by underwriting share and bond issuances. Financial institutions can invest in the equity and debt of a company by holding shares and bonds. This report focused on credit and underwriting.

2.1.1 Corporate loans

Corporate loans are generally issued by commercial and/or investment banks and can be either short-term or long-term in nature. Short-term loans (including trade credits, current accounts, leasing agreements, etc.) have a maturity of less than a year. They are mostly used as working capital for day-to-day operations. Short-term debts are often provided by a single bank, which does not ask for substantial guarantees from the company.

A long-term loan has a maturity of at least one year, but generally three to ten years. Long-term corporate loans are particularly useful for financing expansion plans, which only generate rewards for borrowers after some period of time.

A borrowing company may use a corporate loan (also known as corporate financing) to support any of the company's activities. Often, long-term loans are extended by a loan syndicate, which is a group of banks brought together by one or more arranging banks. The loan syndicate will only undersign the loan agreement if the company can provide certain guarantees that interest and repayments on the loan will be fulfilled.

2.1.2 Project finance

One specific form of corporate loan is project finance. This is a loan that is earmarked for a specific project, or "use of proceeds."

2.1.3 General corporate purposes / working capital / revolving credit facilities

Often a company will receive a loan for general corporate purposes or for working capital. On occasion, such a loan's "use of proceeds" is reported as "general corporate purposes," while the loan is in fact earmarked for a certain project. This is difficult to ascertain.

2.1.4 Share issuances (underwriting)

Issuing shares on a stock exchange gives a company the opportunity to increase its equity, either by attracting a large number of new shareholders or increasing the equity of its existing shareholders.

When a company offers its shares on a stock exchange for the first time, this is called an initial public offering (IPO). When a company's shares are already traded on a stock exchange, this is called a secondary offering of additional shares.

To arrange an IPO or a secondary offering, a company needs the assistance of one or more (investment) banks, which will promote the shares and find shareholders. The role of investment banks in this process is very important. However, this role is temporary. The investment bank purchases the shares initially and then promotes the shares and finds shareholders. This is the process of underwriting an IPO or secondary offering.

Underwriting is a crucially important service for companies. It provides companies with access to capital markets and provides a guarantee that its shares will be bought at a predetermined minimum price.

Once the underwriting financial institution has sold all issued shares it has underwritten, these shares are no longer included in the balance sheet or the portfolio of the financial institution

2.1.5 Bond issuances (underwriting)

Issuing bonds can best be described as cutting a large loan into small pieces and selling each piece separately. Bonds are issued on a large scale by governments, but also by corporations. Like shares, bonds are traded on a stock exchange. To issue bonds, a company needs the assistance of one or more (investment) banks, which underwrite a certain amount of the bonds. Underwriting bonds is, in effect, buying these securities with the intention of selling them to investors. If a bank fails to sell all bonds it has underwritten, it will end up owning the bonds.

2.1.6 (Managing) shareholdings

Banks can, through the funds they are managing, buy shares of companies, making them equity owners, or co-owners, of those companies. Shareholding gives banks a direct influence on a company's strategy. The magnitude of this influence depends on the size of the shareholding.

This research did not cover the asset management (shareholding) function of the selected banks.

2.1.7 (Managing) investments in bonds

Banks can also buy companies' bonds. The main difference between owning shares and bonds is that the owner of a bond is not a co-owner of the issuing company; rather, the owner of a bond is a creditor of the company. The buyer of each bond is entitled to repayment after a certain number of years and to a certain interest during each of these years.

This research did not cover the asset management (bondholding) function of the selected banks.

2.2 Scope of financing

For each of the subsidiaries of the 56 corporations involved in meat, dairy, and/or feed production for which financing was identified, this research determined whether the subsidiary was engaged in the industrial livestock value chain, or not. Borrowing/issuing subsidiaries that were not engaged in the industrial livestock value chain were excluded from the further financial analysis. It should be noted, however, that the majority of financing is attracted at the corporate group level. As such, it is often not possible to disaggregate the proportions of financing attributable to industrial livestock production. This is particularly the case with commodity traders, where there is a lack of data on the proportions of their traded commodities destined for animal feed and human consumption.

2.3 Data sources

During the financial data collection process, this research utilized financial databases (Bloomberg, Refinitiv, Trade Finance Analytics, and IJGlobal), company reports (annual, interim, quarterly), as well as other company publications, company register filings, and media and analyst reports.

2.4 Research period

Corporate loans, credit, and underwriting facilities provided to the 56 selected meat, dairy, and feed corporations were researched for the period January 2016-March 2023.

2.5 Financial institution financing contributions

Financial databases often record loans and issuance underwriting when these are provided by a syndicate of financial institutions. Databases generally do not provide information on bilateral transactions, i.e., between one bank and the company in question. Company reports and publications, company register filings, and the media will also provide information on loans provided bilaterally.

The level of detail per deal often varies. Some financial databases and other sources may omit the maturity date or term of the loan, the use of proceeds, or even the exact issue date. Financial databases often do not report on the proportions of a given syndicated loan that can be attributed to the participants in it. In such instances, this research calculated an estimated contribution based on the rules of thumb described below.

2.5.1 Loans & underwriting services

Individual bank contributions to syndicated loans and underwriting (bond and share issuance underwriting) were recorded to the largest extent possible where these details were included in financial databases or company or media publications.

In many cases, the total value of a loan or issuance is known, as well as the number of banks that participate in this loan or issuance. However, the amount that each individual bank commits to the loan or issuance often has to be estimated.

This research attempted to calculate each individual bank's commitment on the basis of the fee they received as a proportion of the total fees received by all financial institutions. This proportion (e.g., Bank A received 10% of all fees) was then applied to the known total deal value (e.g. 10% x US$ 10 million = US$ 1 million for Bank A).

Where deal fee data was missing or incomplete, this research used the book ratio. The book ratio (see formula below) is used to determine the spread over bookrunners[xxvii] and other managers.

Book ratio = (number of participants - number of bookrunners)/(number of bookrunners)

Table A1.2-A shows the commitment assigned to bookrunner groups with our estimation method. When the number of total participants in relation to the number of bookrunners increases, the share that is attributed to bookrunners decreases. This prevents very large differences in amounts attributed to bookrunners and other participants.

xxvii The bookrunner is the primary underwriter in a bond or share issuance. For loans the equivalent is mandated lead arranger. These financial institutions are responsible for leading the development of the deal.

Table A1.2-A: Commitment to assigned bookrunner groups

Book ratio	Loans	Issuances
> 0.33	75%	75%
> 0.67	60%	75%
> 1.5	40%	75%
> 3.0	<40%*	<75%*

* In case of deals with a book ratio of more than 3.0 we use a formula which gradually lowers the commitment assigned to the bookrunners as the book ratio increases. The formula used for this: (1/√book ratio)/1.443375673. The number in the denominator is used to let the formula start at 40% in case of a book ratio of 3.0. As the book ratio increases the formula will go down from 40%. In case of issuances the number in the denominator is 0.769800358.

Section 3: Financed and facilitated emissions

This section details the methodology used to estimate the financed and facilitated emissions of the Big Three through their financial relationships with the selected meat, dairy, animal feed, food processing, and agri-commodity corporations and is organized as follows: Sub-section 3.1 presents the methodology used to calculate the attribution factor for financial institutions (i.e., what proportion of company emissions are attributable to a specific financial institution); Sub-section 3.2 outlines the data sources used for emissions data; and Sub-section 3.3 details the limitations of the financed and facilitated emissions estimation methodology.

3.1 Attribution methodology

3.1.1 Partnership Carbon Accounting Financial (PCAF) methodology

This research used the Partnership Carbon Accounting Financial (PCAF) methodology to calculate financed and facilitated emissions. PCAF was developed and is used by financial institutions around the world to measure and disclose their financed emissions, i.e., the emissions financed by their loans and investments (Bank of America and Citigroup are both signatories to PCAF).

Scope 3 emissions are corporate value chain emissions. For the financial sector, the GHG Protocol (GHGP) classifies the Scope 3 corporate value chain emissions as Category 15 investment activities.

To calculate the emissions attributable to a financial relationship with a borrower or issuer, PCAF suggests the calculation of an attribution factor, i.e., a factor with which to calculate the proportion of emissions generated by a specific company that can be attributed to a given financial institution based on the value and nature of the financial relationship. The denominator used in the formulas of this calculation varies slightly between types of companies. For listed companies, enterprise value (EV) is used based on market capitalization + total borrowings + minority interest, i.e., enterprise value including cash (EVIC). For non-listed companies, the denominator is equity + total borrowings + minority interest.

Attribution factor calculation for listed companies:

Attribution factor=(Outstanding amount)/(Enterprise value including cash (EVIC))

Attribution factor calculation for non-listed companies:

Attribution factor=(Outstanding amount)/(Total equity+debt)

PCAF states that using EVIC helps to avoid issues with negative enterprise values due to the inclusion of cash (not deducting cash as in the regular enterprise value definition) as well as issues with attributing more than 100% of a company's emissions to financial institutions. This attribution factor is then multiplied by the emissions of the borrower or issuer to estimate attributable emissions financed by a given financial institution through its financial relationship with the company.[120]

For example, Bank A has US$ 1 million loans outstanding to Company B on 31 December 2022. At year-end 2022, Company B has an EVIC of US$ 100 million (US$ 25 million equity + US$ 75 million debt). Therefore, the attribution factor is 1%. The emissions of Company B are: Scope 1 at 100 metric tons CO_2e, Scope 2 at 300 metric tons CO_2e, and Scope 3 at 1,000 metric tons CO2e. Bank A has 1% attributable financed emissions of each Scope: Scope 1 are 1 metric ton CO_2e, Scope 2 are 3 metric tons CO_2e, and Scope 3 are 10 metric tons CO_2e. This would total 14 metric tons CO_2e financed emissions through the bank's relationship with this specific borrower/issuer.

The PCAF methodology currently requires financial institutions only to report on the financed Scope 1 and 2 emissions of the companies with which they have financial relationships. However, while PCAF currently only requires the reporting of Scope 3 emissions attributable to companies engaged in energy (oil and gas) and mining, this analysis reports on Scope 3 emissions attributable to all sectors.

For Scope 3 emissions, PCAF is following a phased-in approach where reporting of Scope 3 emissions from companies in certain sectors is required in 2021 (oil and gas, and mining), with additional sectors in 2024 (transportation, construction, buildings, materials, and industrial activities) and all sectors in 2026. Where Scope 3 financed emissions of companies are reported, these are reported separately. This separate reporting allows for the reporting of these figures, while acknowledging the potential of double counting issues with Scope 1 and Scope 2 emissions of financial institutions' other borrowers and investees.

The current PCAF methodology is only applicable to on-balance sheet financial relationships. However, PCAF recognizes that financial institutions also contribute to emissions through their capital markets activities — bond and share issuance underwriting services. They have developed a proposed methodology for these facilitated emissions, which is currently open to comments. This research has used the currently proposed attribution calculation methodology, as follows:

Attribution factor=(Facilitated amount)/(Enterprise value including cash (EVIC))

It is important to note that facilitated emissions must be reported separately from financed emissions in order to avoid double counting. However, this double counting between facilitated and financed emissions only occurs from the investment in bonds and equities channel of financed emissions. Since this current research did not include the investment activities of the selected banks in this analysis, there is no risk of double counting between financed and facilitated emissions for these institutions in this piece of research.

3.1.2 EVIC data

Financial relationships with U.S. banks were identified for 29 of the 56 selected companies (exclusive of asset management arms). For all companies, EVIC figures were calculated, identified, or estimated at the corporate group level — not the subsidiary level for which financing was identified. This is because emissions data is only reported at the corporate group level. EVIC data was retrieved from Refinitiv where available, or from company publications where EVIC figures were not available in Refinitiv. For three companies, no EVIC figures could be identified: Dairy Farmers of America (DFA), Koch Foods, and Perdue Farms. These companies are, therefore, excluded from financed and facilitated emissions analyses.

3.2 Emissions data

Emissions data used for the financed and facilitated emissions analyses comes from two main sources: company self-reported emissions data (see Annex 1, Sub-section 3.2.1) and emissions data based on the production-focused model developed by the Institute for Agriculture and Trade Policy (IATP) and Changing Markets Foundation for their Emissions Impossible: Methane Edition report (2022). (See Annex 1, Sub-section 3.2.2.)

3.2.1 EVIC data Company self-reported emissions data ("Refinitiv methodology")

Research contained in this report relies on company emissions data from Refinitiv. Refinitiv obtains company-level CO_2 emissions data from a number of sources. Firstly, it obtains company-level CO_2 emissions data from CDP. Secondly, it obtains company-level CO_2 emissions data from company reports and publications. Thirdly, Refinitiv uses its own methodology to estimate emissions per company (Scope 1-3) when reported values are not available. Refinitiv states that it uses three models in order of preference to estimate emissions values where these are not reported: CO_2 model, Energy model, and Median model.[121]

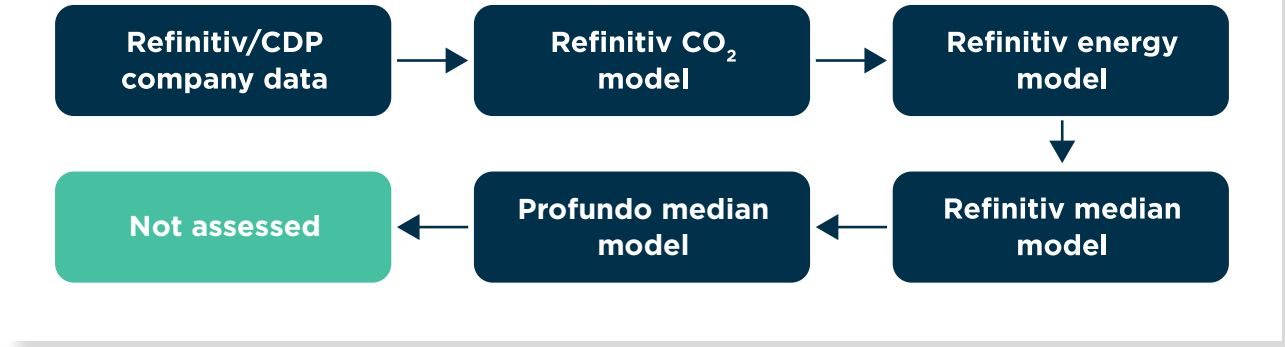
- The CO_2 model uses emissions data for the company from the previous year(s), adjusting for changes in revenue and number of employees, to estimate the emissions for the current year.
- When it is not possible to apply the CO_2 model, the Energy model is used. The Energy model uses energy consumed (or energy produced for electric utility companies), adjusted for number of employees and revenue, compared with sector peers based on 8-, 6-, 4- or 2-digit The Refinitiv Business Classification (TRBC) codes. Selection of TRBC level depends on the number of available energy consumption ratios per relevant level. If there is an insufficient number of energy consumption level ratios at the 8-digit level, then the 6-digit level is used. If there is an insufficient number of energy consumption level ratios at the 6-digit level, then the 4-digit level is used. And so on.

- When it is not possible to apply the Energy model, the Median model is used. The Median model is similar to the Energy model as it bases its estimations on sector peers. Firstly, the CO_2 emissions per employee are calculated for all industry peers based on 8-, 6-, 4- or 2-digit TRBC codes. Selection of TRBC level depends on the number of available energy consumption ratios per relevant level. The median of all these companies is then applied to the company for which CO_2 emissions are missing. The same process is then carried out for CO_2 emissions per revenue, i.e., CO_2 emissions per dollar revenue are calculated for all industry peers on the basis of 8-, 6-, 4- or 2-digit TRBC codes. The median of all these companies is then applied to the company for which CO_2 emissions are missing. The average of these two figures — estimated CO_2 emissions for total employees and estimated CO_2 emissions for total revenues — is then taken as the estimated CO_2 emissions for the company in question.

Where data was missing for 2022, emissions data from 2021 was used. These figures were then adjusted for changes in the number of employees and total revenues. The CO_2 per employee and CO_2 per dollar revenue were calculated for the year for which data was available. These ratios were then applied to the figures for the number of employees and total revenues for 2022, and the average of these figures was taken as the estimated CO_2 emissions for the 2022.

Where there was no emissions data available from Refinitiv, Profundo used the Median model approach described above based on the available data in Refinitiv. Profundo calculated the CO_2 emissions per employee and per dollar revenue ratios for companies where emissions data was available using Refinitiv data. These ratios were then applied to companies for which emissions data was missing at the TRBC 8 level — industry. The 6, 4 and 2 levels — industry group, business sector and economic sector — were not used, as these are considered far too broad to make reasonably accurate estimations of CO_2 emissions at the corporate level for this research. Figure A1.3-A provides a visual representation of the emissions data estimation methodology.

Figure A1.3-A: Emissions data estimation methodology



Sources: Refinitiv[122] and Profundo.

It should be noted that companies do not disaggregate their emissions per business segment or activity. Therefore, the company-reported emissions figures in this report represent the total company emissions, not their industrial livestock specific emissions. For diversified companies, such as agri-commodity traders (e.g. ADM and Bunge) and food processing companies (e.g. Nestlé and Danone), total emissions figures therefore include non-industrial livestock emissions.

As mentioned above, we used PCAF methodology to calculate banks' financed and facilitated emissions; PCAF suggests the calculation of an attribution factor, i.e., a factor with which to calculate the proportion of emissions generated by a specific company that can be attributed to a given financial institution based on the value and nature of the financial relationship. Because the majority of lending and underwriting activities occur at the corporate group level, our calculations reflect attribution factors calculated at the group, rather than subsidiary level. This means that for diversified companies, non-industrial livestock value chain emissions are reflected in the profiled banks' financed and facilitated emissions calculations.

3.2.2 IATP production-based estimated emissions ("IATP methodology")

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.[123] This methodology uses 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 geographic location of livestock and relevant factors such as feed, enteric fermentation, and pasture among others. IATP and Changing Markets Foundation used this methodology in their subsequent 2022 report Emissions Impossible: Methane Edition, in order to calculate the GHG emissions of 15 companies (5 meat and 10 dairy) using AR6 GWP figures.[124]

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.

For meat and dairy companies not covered by IATP's Emissions Impossible report series, this report calculated emissions using the IATP model based on production volumes for meat producers and milk intake for dairy companies, and the geographic location of production ("IATP methodology"). All figures and sources can be shared for verification on request. Emissions from feed and soy trade companies were not included in this part of the emissions analysis because they were not included in the IATP model upon which this report's analysis was based. However, IATP does include feed used by meat and dairy companies in their model.

3.2.3 Comparing financed and facilitated emissions calculations methodologies using companies' self-reported emissions data ("Refinitiv methodology") and livestock production-based emissions data ("IATP methodology")

We used two methods for calculating banks' financed and facilitated emissions from the corporations reviewed for this report. The first ("Refinitiv methodology") used the meat, dairy, animal feed, food processing, and agri-commodity corporations' self-reported data from Refinitiv combined with our estimates of these corporations' emissions using the Refinitiv Median, CO2, and Energy models (see Annex 1, Section 3.2.1). The second ("IATP methodology") used livestock production data for the meat and dairy companies and IATP's proprietary production-based GHG emissions calculation methodology (see Annex 1, Section 3.2.2).

Financed and facilitated emissions figures from the meat, dairy, animal feed, food processing, and agri-commodity corporations reviewed for this report generated using the Refinitiv methodology reflect these corporations' total GHG emissions because these companies do not disaggregate emissions by business segment or activity. Thus, the self-reported emissions figures for diversified companies that have non-livestock-related emissions, such as agri-commodity traders (e.g., ADM and Bunge) and food processing companies (e.g., Nestle and Danone), include non-industrial livestock emissions in the Refinitiv methodology. (This is standard practice when using PCAF methodology, Annex 1, Section 3.)

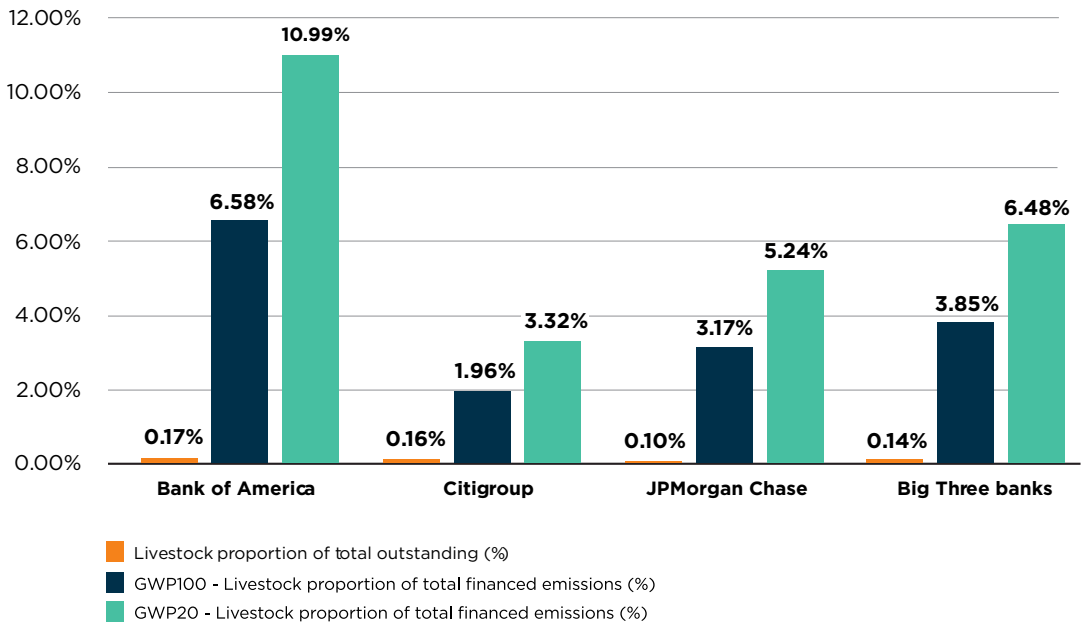
To calculate the livestock only-related emissions, we used the IATP methodology (Annex 1, Section 3.2.2). This methodology only looks at relevant data for the 49 meat and dairy companies that are part of the 56 reviewed for this report and does not include feed and soy trade corporations. While not directly comparable to self-reported data, these production-based calculations provide a clearer indication of the climate impact from the meat and dairy companies reviewed for this report. Based on FAO's GLEAM 3.0 methodology, the production-based data accounts for all production-based and related emissions (Scope 1 through Scope 3). These cover upstream emissions (including land use change, fertilizer use, pesticides use, energy use, and transport), on-farm emissions (including enteric fermentation and energy consumption) and downstream (post-farm) emissions (including transport, primary processing, and packaging). As discussed in Section 4 of the report, the production-based figures are 4X greater than the self-reported emissions for some companies. Thus, banks need to be aware that self-reported emissions from any company involved in meat, dairy, and feed production may be far lower than actual figures.

3.2.4 Non-livestock emissions vs livestock emissions, portfolio proportions figures from IATP

Using the production-based "IATP methodology" (livestock-only) company emissions data, we calculated the Big Three's financed and facilitated emissions from the meat and dairy corporations reviewed for this report.

We found that livestock-related lending accounts for 0.14% of the Big Three's outstanding loans portfolio and 3.85% of the banks' total financed emissions using GWP100. Using GWP20, the financed emissions figure increases to 6.48%. This means the emissions footprint of financing to meat and dairy companies is 28X (GWP100) and 46X (GWP20) greater than its proportion of the banks' lending portfolios.

Figure A1.3-B: Livestock's proportion of the Big Three banks' lending and financed emissions (IATP methodology)



Source: Bank of America Annual Report 2022,[125] Bank of America TCFD Report 2022,[126] Citigroup Annual Report 2022,[127] Citigroup TCFD Report 2022,[128] JPMorgan Chase Annual Report 2022,[129] JPMorgan Chase Climate Report 2023.[130]
Note: These figures are financed emissions only, and are based on the IATP methodology emissions figures. Facilitated emissions are also a significant form of emissions associated with banks. However, these are not considered on the balance sheet of banks as underwriting services are not balance sheet items or exposures.

While the 3.85% IATP methodology calculation is not directly comparable to the 11% Refinitiv methodology calculation, it is indicative of how much livestock-related emissions contribute to the Big Three's total lending portfolio emissions. Important also, it is nearly impossible for banks to directly or exclusively address the relatively lower "livestock-only" financed and facilitated emissions because the vast majority of their lending to and underwriting of meat, dairy, and feed corporations occurs at the corporate level. Thus, reducing financed and facilitated emissions from industrial livestock requires that banks limit lending to and underwriting of corporations involved in meat, dairy, and/or feed production.

3.3 Limitations

3.3.1 Calculating the proportion of financed emissions from industrial livestock

This research sought to identify the total financed emissions of the Big Three banks in order to gain an understanding of what proportion of their total financed emissions resulted from lending to the meat, dairy, animal feed, food processing, and agri-commodity corporations reviewed for this report. However, this proved impossible. Bank of America, Citigroup, and JPMorgan Chase do not report their total financed emissions. Rather, all choose to report on a number of sectors, meaning that their total emissions are much higher than what is publicly reported.

JPMorgan Chase reports on its financed and facilitated emissions from 9 sectors: 1) energy mix (Scope 3 end use); 2) oil and gas operational (Scope 1 & 2); 3) electric power (Scope 1); 4) auto manufacturing (Scope 1-3); 5) iron and steel (Scope 1 & 2); 6) cement (Scope 1 & 2); 7) aviation (Scope 1); 8) shipping (Scope 1); and 9) aluminum (Scope 1 & 2).[131]

Bank of America reports on its financed emissions for four sectors of its lending portfolio: 1) auto manufacturing; 2) energy - oil and gas; 3) energy - others; and 4) power (Scope 1 only).[132]

Citigroup reports on six sectors: 1) energy (Scope 1-3); 2) power; 3) auto manufacturing (Scope 1-3); 4) commercial real estate (Scope 1-2); 5) thermal coal (Scope 1-3); and 6) steel (Scope 1-3).[133]

As the banks do not report their total financed or facilitated emissions, and none of the banks report on financed and facilitated emissions from the agricultural sector, this research has combined banks' self-reported financed emissions with estimated financed emissions from the corporations involved in meat, dairy, and/or feed production reviewed for the report to calculate banks' financed and/or facilitated emissions. Although these figures cannot be considered actual totals, they are indicative figures given that the banks profiled in this analysis report financed and/or facilitated emissions from all of the other most emissions-intensive industries.

Annex 2 - Detailed tables

This annex includes greater detail on the findings mentioned in the report.

Table A2-A: Selected meat, dairy, animal feed, food processing, and agri-commodity clients' contributions to the Big Three's financed emissions (2022)

Financial institution	Total loans outstanding 31 Dec 2022 (US$ mln)	Selected clients' loans outstanding 31 Dec 2022 (US$ mln)	Selected clients' proportion of total loans outstanding (%)	Total self-reported financed emissions (mln tCO_2e)	Selected clients' financed emissions using self-reported data (mln tCO_2e) Scope 1-3*	Combined financed emissions (self-reported + selected clients', mln tCO_2e)	Selected clients' proportion of total financed emissions
Bank of America	1,045,747	2,890	0.276%	47.31	7.43	54.74	13.57%
Citigroup	640,247	2,277	0.356%	53.93	5.73	59.66	9.61%
JPMorgan Chase	1,135,647	1,908	0.168%	48.71	5.14	53.85	9.54*
Total	2,821,641	7,075	0.251%	101.24	18.30	168.24	10.88

Sources: Bank of America Annual Report 2022,[134] Bank of America TCFD Report 2022,[135] Citigroup Annual Report 2022,[136] Citigroup TCFD Report 2022,[137] JPMorgan Chase Climate Report 2023.[138]

* These figures are financed emissions only, and utilize only company self-reported emissions figures. Facilitated emissions are also a significant form of emissions associated with banks. However, these are not considered on the balance sheet of banks as underwriting services are not balance sheet items or exposures.

Table A2-B: Financed emissions per selected meat, dairy, animal feed, food processing, and agri-commodity client of Bank of America, Citigroup, and JPMorgan Chase using self-reported data (2022, metric tons CO_2e)

Bank	Client	Scope 1	Scope 2	Scope 3	Total	Methane % of total emissions
Bank of America	ADM - Archer Daniels Midland	237,246	37,432	2,075,166	2,349,844	32%
	Cargill	68,005	39,806	1,842,400	1,950,212	26%
	Saputo	18,418	16,965	786,826	822,210	11%
	Nestlé	20,101	9,603	678,304	708,008	10%
	Bunge	9,854	7,723	569,502	587,080	8%
	Tyson Foods	42,542	21,771	339,694	404,006	5%
	Agropur	21,222	14,536	310,437	346,196	5%
	WH Group	28,794	16,641	163,247	208,682	3%
	Land O'Lakes	2,089	1,440	29,671	33,200	.04%
	Louis Dreyfus Company	2,750	1,262	14,930	18,943	.04%
Bank of America Total		**451,021**	**167,180**	**6,810,179**	**7,428,380**	
Citigroup	ADM - Archer Daniels Midland	237,246	37,432	2,075,166	2,349,844	41%
	Cargill	48,699	28,505	1,319,353	1,396,557	24%
	Bunge	19,400	15,205	1,121,207	1,155,813	20%
	Nestlé	11,803	5,639	398,300	415,742	7%
	WH Group	24,265	14,023	137,570	175,859	3%
	FrieslandCampina	8,746	5,970	129,696	144,412	3%
	Danone	694	300	23,938	24,931	0.4%
	Louis Dreyfus Company	3,423	1,571	18,582	23,575	0.4%
	Land O'Lakes	1,392	960	19,781	22,134	0.4%
	China Mengniu Dairy	388	1,793	13,529	15,710	0.3%
	CP Group	480	1,923	7,350	9,753	0.2%
Citigroup Total		**356,536**	**113,322**	**5,264,470**	**5,734,328**	
JPMorgan Chase	Cargill	59,143	34,619	1,602,305	1,696,066	33%
	ADM - Archer Daniels Midland	133,587	21,077	1,168,469	1,323,133	26%
	Bunge	20,270	15,887	1,171,483	1,207,640	24%
	Tyson Foods	35,698	18,268	285,044	339,010	7%

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Table A2-B: Financed emissions per selected meat, dairy, animal feed, food processing, and agri-commodity client of Bank of America, Citigroup, and JPMorgan Chase using self-reported data (2022, metric tons CO_2e) (continued)

Bank	Client	Scope 1	Scope 2	Scope 3	Total	Methane % of total emissions
JPMorgan Chase	Nestlé	5,068	2,421	171,017	178,506	3%
	WH Group	24,265	14,023	137,570	175,859	3%
	FrieslandCampina	8,746	5,970	129,696	144,412	3%
	Danone	694	300	23,938	24,931	0.5%
	Land O'Lakes	1,392	960	19,781	22,134	0.4%
	Louis Dreyfus Company	2,569	1,179	13,949	17,697	0.3%
	CP Group	288	1,153	4,409	5,850	0.1%
JPMorgan Chase Total		**291,719**	**115,858**	**4,727,659**	**5,135,236**	
Total		**1,099,276**	**396,361**	**16,802,308**	**18,297,945**	

Source: Profundo financing research for this report.

Table A2-C: Facilitated emissions per selected meat, dairy, animal feed, food processing, and agri-commodity client of Bank of America, Citigroup, and JPMorgan Chase using self-reported data (2022, metric tons CO_2e)

Bank	Client	Scope 1	Scope 2	Scope 3	Total	Methane % of total emissions
Bank of America	JBS	53,606	16,046	745,647	815,300	35%
	Cargill	27,205	15,924	737,051	780,180	34%
	Nestlé	12,833	6,131	433,032	451,995	20%
	ADM - Archer Daniels Midland	22,321	3,522	195,241	221,084	10%
	BRF	5,307	2,298	12,977	20,582	1%
	Saputo	457	421	19,530	20,408	1%
Bank of America Total						
Citigroup	Nestlé	24,886	11,889	839,770	876,545	43%
	Cargill	29,658	17,360	803,506	850,524	42%
	ADM - Archer Daniels Midland	22,321	3,522	195,241	221,084	11%
	Danone	1,734	749	59,829	62,311	3%
	BRF	5,307	2,298	12,977	20,582	1%
Citigroup Total		**83,906**	**35,818**	**1,911,322**	**2,031,046**	

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Table A2-C: Facilitated emissions per selected meat, dairy, animal feed, food processing, and agri-commodity client of Bank of America, Citigroup, and JPMorgan Chase using self-reported data (2022, metric tons CO_2e) (continued)

Bank	Client	Scope 1	Scope 2	Scope 3	Total	Methane % of total emissions
JPMorgan Chase	Cargill	29,658	17,360	803,506	850,524	49%
	Nestlé	12,833	6,131	433,032	451,995	26%
	ADM - Archer Daniels Midland	36,057	5,689	315,389	357,135	20%
	Danone	1,734	749	59,829	62,311	4%
	BRF	5,307	2,298	12,977	20,582	1%
JPMorgan Chase Total		**85,589**	**32,227**	**1,624,732**	**1,742,548**	
Total		**291,225**	**112,387**	**5,679,531**	**6,083,143**	

Source: Profundo financing research for this report.

Table A2-D: Total financed and facilitated GHG emissions, and total financed and facilitated methane emissions per selected meat and dairy client of Bank of America, Citigroup, and JPMorgan Chase using production-based data (2022, GWP100 basis metric tons CO_2e)

Investor Parent	Group	Financed		Facilitated		Total	
		GHG emissions	CH^4 emissions	GHG emissions	CH^4 emissions	GHG emissions	CH^4 emissions
Bank of America	JBS	-	-	2,750,133	1,394,717	2,750,133	1,394,717
	Agropur	1,247,290	762,674	-	-	1,247,290	762,674
	Cargill	487,411	280,615	-	112,260	682,399	392,875
	Sapouto	623,494	381,245	15,476	9,463	638,970	390,708
	Tyson Foods	634,514	312,403	-	-	634,514	312,403
	BRF	-	-	341,951	34,632	341,951	34,632
	Nestlé	144,393	80,309	92,181	51,269	236,574	131,578
	WH Group	196,416	81,303	-	-	196,416	81,303
Bank of America Total		**3,333,518**	**1,898,548**	**3,394,728**	**1,602,340**	**6,728,246**	**3,500,889**
JPMorgan Chase	Cargill	423,893	244,046	212,569	122,381	636,462	366,427
	Tyson Foods	532,433	262,144	-	-	532,433	262,144
	Friesland-Campina	417,053	231,956	-	-	417,053	231,956

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Table A2-D: Total financed and facilitated GHG emissions, and total financed and facilitated methane emissions per selected meat and dairy client of Bank of America, Citigroup, and JPMorgan Chase using production-based data (2022, GWP100 basis metric tons CO_2e) (continued)

Investor Parent	Group	Financed		Facilitated		Total	
		GHG emissions	CH^4 emissions	GHG emissions	CH^4 emissions	GHG emissions	CH^4 emissions
JPMorgan Chase	BRF	-	-	2,750,133	1,394,717	2,750,133	1,394,717
	WH Group	165,522	68,515	-	-	165,522	68,515
	Nestlé	36,405	20,248	92,181	51,269	128,586	71,517
	Danone	14,397	8,390	35,983	20,969	50,380	29,358
	CP Group	4,105	343	-	-	4,105	343
JPMorgan Chase Total		**1,593,807**	**835,641**	**682,684**	**229,251**	**2,276,491**	**1,064,892**
Citigroup	Cargill	349,038	200,950	212,569	122,381	561,607	323,331
	Friesland-Campina	417,053	231,956	-	-	417,053	231,956
	BRF	-	-	341,951	34,632	341,951	34,632
	Nestlé	84,788	47,157	178,765	99,425	263,553	146,583
	WH Group	165,522	68,515	-	-	165,522	68,515
	Danone	14,397	8,390	35,983	20,969	50,380	29,358
	China Mengniu Dairy	42,272	28,778	-	-	42,272	28,778
	CP Group	6,844	572	-	-	6,844	572
Citigroup Total		**1,079,913**	**586,318**	**769,268**	**277,407**	**1,849,180**	**863,725**
Grand Total		**6,007,238**	**3,320,507**	**4,846,680**	**2,108,999**	**10,853,917**	**5,429,506**

Source: Profundo financing research for this report.

1 Morris, V. (2021, November 16). Opinion: The cow-shaped hole in Biden's methane plan. *Politico*. https://www.politico.com/news/agenda/2021/11/16/methane-emissions-cows-agriculture-climate-change-522550

2 Citi GPS: Global Perspectives & Solutions. (2022, July). *Food and Climate Change: Creating Sustainable Food Systems for a Net Zero Future*. Citi. https://www.citigroup.com/global/insights/citigps/food-and-climate_20220719

3 Andreoni, M. (2022, May 10). How shareholders are pushing big banks for climate action. *The New York Times*. https://www.nytimes.com/2022/05/10/climate/banks-shareholders-climate-action.html

4 Flavelle, C. (2021, April 22). Climate change could cut world economy by $23 trillion in 2050, insurance giant warns. *The New York Times*. https://www.nytimes.com/2021/04/22/climate/climate-change-economy.html

5 United Nations Environment Programme Finance Initiative. (2021, April 21). *43 banks launch Net-Zero Banking Alliance as part of consolidated Glasgow COP climate action.* Retrieved December 11, 2023, from https://www.unepfi.org/industries/banking/43-banks-launch-net-zero-banking-alliance-as-key-part-of-consolidated-glasgow-cop-climate-action/

6 United Nations Environment Programme Finance Initiative. (n.d.). *The commitment: Net-Zero Banking Alliance*. Retrieved December 11, 2023, from https://www.unepfi.org/net-zero-banking/commitment

7 Fraser, J. (2021, April 22). *Jane Fraser remarks, leaders summit on climate*. Citigroup. Retrieved December 11, 2023, from https://www.citigroup.com/citi/news/executive/210422Ea.htm#:~:text=Solving%20climate%20change%20must%20be,emissions%20by%20the%20year%202050

8 Rainforest Action Network, BankTrack, Indigenous Environmental Network, Oil Change International, Reclaim Finance, Sierra Club, & Urgewald. (2023). *Banking on climate chaos: Fossil fuel finance report 2023.* https://www.bankingonclimatechaos.org/wp-content/uploads/2023/08/BOCC_2023_vF.pdf

9 FAO. (2022). *GLEAM 3 Dashboard.* In: Shiny Apps. Retrieved December 11, 2023, from https://foodandagricultureorganization.shinyapps.io/GLEAMV3_Public

10 Xu, X., Sharma, P., Shu, S., Lin, T.S., Ciais, P., Tubiello, F.N., Smith, P., Campbell, N., & Jain, A.K. (2021). Global greenhouse gas emissions from animal-based foods are twice those of plant-based foods. Nature Food, 2, 724-732. https://doi.org/10.1038/s43016-021-00358-x

11 Hayek, M.N., & Miller, S.M. (2021). Underestimates of methane from intensively raised animals could undermine goals of sustainable development. *Environmental Research Letters, 16*(6), 063006. https://doi.org/10.1088/1748-9326/ac02ef

12 Harwatt, H. (2019). Including animal to plant protein shifts in climate change mitigation policy: a proposed three-step strategy. *Climate Policy*, *19*(5), 533–541. https://doi.org/10.1080/14693062.2018.1528965

13 Oken, E., Patel, V., Variankaval, R., Alla, V., & Goldstein, G.M. (2022, February). *Establishing a Framework for Food and Agriculture Sustainability Transition ("FAST").* JPMorgan Chase & Co. https://www.jpmorgan.com/content/dam/jpm/cib/complex/content/investment-banking/center-for-carbon-transition/Establishing_a_Framework_for_Food_and_Agriculture_Sustainability_Transition.pdf

14 Citi GPS: Global Perspectives & Solutions. (2022, July). *Food and Climate Change: Creating Sustainable Food Systems for a Net Zero Future*. Citi. https://www.citigroup.com/global/insights/citigps/food-and-climate_20220719

15 Feedback. (2024). *Still Butchering the Planet: The big-name financiers bankrolling livestock corporations and climate change – 2024 update.* https://feedbackglobal.org/wp-content/uploads/2024/03/Feedback-2024-Still-Butchering-the-Planet-Report.pdf

16 Nicolás, E.S., & Sprick, C. (29 May 2022). Dismay over EU Plans to Keep Paying to Promote Meat. *EUobserver.* Retrieved December 11, 2023, from https://euobserver.com/green-economy/155052

17 Fink, L. (2020). *Larry Fink's 2020 letter to CEOs: A fundamental reshaping of finance*. BlackRock. Retrieved December 11, 2023, from https://www.blackrock.com/us/individual/larry-fink-ceo-letter

18 Bank of America. (2023). *Annual Report 2022,* p. 138. https://investor.bankofamerica.com/regulatory-and-other-filings/annual-reports/content/0000070858-23-000121/0000070858-23-000121.pdf

19 Bank of America. (2022). *Task Force on Climate-related Financial Disclosures (TCFD) Report 2022 - Managing our Future*, p. 45. https://about.bankofamerica.com/content/dam/about/report-center/esg/2022/BOA_TCFD_2022%209-22-2022-VOX220929%20split%20paragraph%20Secured.pdf

20 Citigroup. (2023). *2022 Annual Report*, p. FS-11. https://www.citigroup.com/rcs/citigpa/storage/public/citi-2022-annual-report.pdf

21 Citigroup. (2023). *Taskforce on Climate-Related Financial Disclosures Report 2022 - Citi's Approach to Climate Change and Net Zero*, p. 58. https://www.citigroup.com/rcs/citigpa/storage/public/taskforce-on-climate-related-financial-disclosures-report-2022.pdf

22 JPMorgan Chase. (2023). *Creating Possibility: Annual Report 2022*, p. 55. https://www.jpmorganchase.com/content/dam/jpmc/jpmorgan-chase-and-co/investor-relations/documents/annualreport-2022.pdf

23 JPMorgan Chase. (2023). *2023 Climate Report*, p. 34. https://www.jpmorganchase.com/content/dam/jpmc/jpmorgan-chase-and-co/documents/Climate-Report-2023.pdf

24 Bank of America. (2022). *Task Force on Climate-related Financial Disclosures (TCFD) Report 2022 - Managing our Future*, p. 45. https://about.bankofamerica.com/content/dam/about/report-center/esg/2022/BOA_TCFD_2022%209-22-2022-VOX220929%20split%20paragraph%20Secured.pdf

25 Citigroup. (2023). *Taskforce on Climate-Related Financial Disclosures Report 2022 - Citi's Approach to Climate Change and Net Zero*, p. 58. https://www.citigroup.com/rcs/citigpa/storage/public/taskforce-on-climate-related-financial-disclosures-report-2022.pdf

26 JPMorgan Chase. (2023). *2023 Climate Report*, p. 34. https://www.jpmorganchase.com/content/dam/jpmc/jpmorgan-chase-and-co/documents/Climate-Report-2023.pdf

27 Marsh, A. (2022, December 22). JPMorgan announces new climate targets covering aviation, cement. *Bloomberg*. https://www.bloomberg.com/news/articles/2022-12-22/jpmorgan-announces-new-climate-targets-covering-aviation-cement

28 Energy Institute. (2023, June 26). Carbon dioxide emissions in the European Union in 2000, 2010 and 2022, by country (in million metric tons) [Graph]. *Statista*. Retrieved December 11, 2023, from https://www.statista.com/statistics/1171389/co2-emissions-european-union

29 World Resources Institute. (2022). *Climate Watch*. Retrieved December 11, 2023, from https://www.climatewatchdata.org

30 World Resources Institute. (2022). *Climate Watch*. Retrieved December 11, 2023, from https://www.climatewatchdata.org

31 United States Environmental Protection Agency. (2023, July). *Greenhouse Gas Equivalencies Calculator.* Retrieved October 17, 2023, from https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

32 Global Witness, Changing Markets Foundation, Rainforest Action Network, Environmental Justice Foundation, Feedback Global, World Animal Protection, Associação Indígena Tato'a, Mighty Earth, Milieudefensie, BankTrack, Friends of the Earth U.S., Greenpeace, Oxfam Novib, De Eerlijke Geldwijzer, EIA, SOMO/Centre for Research on Multinationals, Envol Vert, Society for Threatened Peoples, Rainforest Relief, & AidEnvironment. (2023, September 20). *JBS S.A. dual listing on New York Stock Exchange: A collective warning of risks to people, planet and investors.* Global Witness. https://www.globalwitness.org/documents/20581/Risks_of_JBS_Dual_Listing_2023_A_Collective_Warning_to_Financial_Services__QiecUcT.pdf

33 Mano, A. (2022, December 15). Brazil audit finds 17% of cattle bought by JBS came from 'irregular' ranches. *Reuters*. https://www.reuters.com/business/environment/brazil-audit-finds-17-cattle-bought-by-jbs-came-irregular-ranches-2022-12-15

34 The United States Senate Committee On Finance. (2023, June 22). *Cattle supply chains and deforestation of the Amazon* [Video]. Retrieved December 11, 2023, from https://www.finance.senate.gov/hearings/cattle-supply-chains-and-deforestation-of-the-amazon

35 Chairman Wyden, R. (2023, June 22). *Wyden hearing statement on cattle supply chains, Amazon deforestation.* The United States Senate Committee on Finance. https://www.finance.senate.gov/imo/media/doc/06222023_wyden_statement.pdf

36 Chairman Wyden, R. (2023, June 22). *Wyden hearing statement on cattle supply chains, Amazon deforestation.* The United States Senate Committee on Finance. https://www.finance.senate.gov/imo/media/doc/06222023_wyden_statement.pdf

37 BBB National Programs. (2023, June 20). *National Advertising Review Board recommends JBS discontinue "net zero" emissions by 2040 claims.* Retrieved December 11, 2023, from https://bbbprograms.org/media-center/dd/narb-jbs-net-zero-emissions

38 Chenoweth, N. (2022, October 8). How PwC got tangled in a fight between ATO and the boys from Brazil. *The Australian Financial Review.* https://www.afr.com/companies/financial-services/how-pwc-got-tangled-in-a-fight-between-ato-and-the-boys-from-brazil-20220921-p5bjvm

39 Magalhaes, L., & Kiernan, P. (2017, May 31). JBS parent to pay $3.2 billion to settle corruption investigations in Brazil. *The Wall Street Journal.* https://www.wsj.com/articles/jbs-parent-to-pay-3-16-billion-to-settle-corruption-charges-in-brazil-1496232139

40 Magalhaes, L., & Kiernan, P. (2017, May 31). JBS parent to pay $3.2 billion to settle corruption investigations in Brazil. *The Wall Street Journal.* https://www.wsj.com/articles/jbs-parent-to-pay-3-16-billion-to-settle-corruption-charges-in-brazil-1496232139

41 JBS USA. (n.d.). *Suppliers: 2021 key facts and figures*. Retrieved December 11, 2023, from https://sustainability.jbsfoodsgroup.com/chapters/suppliers

42 DeSmog, Institute for Agriculture and Trade Policy, & Feedback Global. (2022, April 21). World's largest meat company, JBS, increases emissions in five years despite 2040 net zero climate target, continues to greenwash its huge climate footprint. *Institute for Agriculture and Trade Policy.* Retrieved February 27, 2023, from https://www.iatp.org/media-brief-jbs-increases-emissions-51-percent

43 CDP. (2023). *CDP technical note: Relevance of scope 3 categories by sector.* https://cdn.cdp.net/cdp-production/cms/guidance_docs/pdfs/000/003/504/original/CDP-technical-note-scope-3-relevance-by-sector.pdf

44 Changing Markets Foundation & Institute for Agriculture and Trade Policy. (2022). *Emissions impossible: Methane edition*. Institute for Agriculture and Trade Policy. https://www.iatp.org/emissions-impossible-methane-edition

45 World Economic Forum. (2021). *Net-zero challenge: The supply chain opportunity.* https://www3.weforum.org/docs/WEF_Net_Zero_Challenge_The_Supply_Chain_Opportunity_2021.pdf

46 World Economic Forum. (2021). *Net-zero challenge: The supply chain opportunity.* https://www3.weforum.org/docs/WEF_Net_Zero_Challenge_The_Supply_Chain_Opportunity_2021.pdf

47 Taskforce on Climate-related Financial Disclosures. (2021, October). *Metrics, targets, and transition plans consultation: Summary of responses.* https://assets.bbhub.io/company/sites/60/2021/10/October_2021_Metrics_Targets_and_Transition_Plans_Consultation_Summary_of_Responses.pdf

48 Citi GPS: Global Perspectives & Solutions. (2022, July). *Food and Climate Change: Creating Sustainable Food Systems for a Net Zero Future.* Citi. https://www.citigroup.com/global/insights/citigps/food-and-climate_20220719

49 Jackson, R.B., Saunois, M., Bousquet, P., Canadell, J.G., Poulter, B., Stavert, A.R., Bergamaschi, P., Niwa, Y., Segers, A., & Tsuruta, A. (2020). Increasing anthropogenic methane emissions arise equally from agricultural and fossil fuel sources. *Environmental Research Letters, 15*(7), 071002. https://doi.org/10.1088/1748-9326/ab9ed2

50 United Nations Environment Programme & Climate and Clean Air Coalition. (2021). *Global methane assessment: Benefits and costs of mitigating methane emissions.* United Nations Environment Programme. https://www.ccacoalition.org/sites/default/files/resources//2021_Global-Methane_Assessment_full_0.pdf

51 Intergovernmental Panel on Climate Change (IPCC). (2023). Climate Change 2021 – The Physical Science Basis: Working Group I Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. *Cambridge University Press*. https://doi.org/10.1017/9781009157896

52 United Nations Environment Programme & Climate and Clean Air Coalition. (2021). *Global methane assessment: Benefits and costs of mitigating methane emissions.* United Nations Environment Programme. https://www.ccacoalition.org/sites/default/files/resources//2021_Global-Methane_Assessment_full_0.pdf

53 World Resources Institute. (2022). *Climate Watch*. Retrieved December 11, 2023, from https://www.climatewatchdata.org

54 Changing Markets Foundation & Institute for Agriculture and Trade Policy. (2022). *Emissions impossible: Methane edition*. Institute for Agriculture and Trade Policy. https://www.iatp.org/emissions-impossible-methane-edition

55 Quinton, A. (2019, June 27). Cows and climate change: Making cattle more sustainable. *UC Davis*. Retrieved December 11, 2023, from https://www.ucdavis.edu/food/news/making-cattle-more-sustainable

56 McKay, D.I.A., Staal, A., Abrams, J.F., Winkelmann, R., Sakschewski, B., Loriani, S., Fetzer, I., Cornell, S., Rockström, J., & Lenton, T.M. (2022). Exceeding 1.5°C global warming could trigger multiple climate tipping points. *Science*, *377*(6611). https://doi.org/10.1126/science.abn7950

57 Lopez, G., & Ratner, B. (2023). *The Methane Emissions Opportunity.* JPMorgan Chase & Co. https://www.jpmorgan.com/content/dam/jpm/cib/complex/content/redesign-custom-builds/carbon-compass/JPMC_methane.pdf

58 Lopez, G., & Ratner, B. (2023). *The Methane Emissions Opportunity.* JPMorgan Chase & Co. https://www.jpmorgan.com/content/dam/jpm/cib/complex/content/redesign-custom-builds/carbon-compass/JPMC_methane.pdf

59 World Resources Institute. (2022). *Climate Watch*. Retrieved December 11, 2023, from https://www.climatewatchdata.org

60 Carter, N., & Urbancic, N. (2023, November). *Seeing stars: The new metric that could allow the meat and dairy industry to avoid climate action.* Changing Markets Foundation. https://changingmarkets.org/wp-content/uploads/2023/11/Seeing-stars-final-9-11-2023.pdf

61 Bank of America (2023, January 19). *The environment and our global economy.* Retrieved December 11, 2023, from https://about.bankofamerica.com/en/making-an-impact/sustainable-markets-initiative

62 Poore, J. & Nemecek, T. (2018). Reducing food's environmental impacts through producers and consumers. *Science, 360*(6392), 987–992. https://doi.org/10.1126/science.aaq0216

63 Pendrill, F., Persson, U.M., Godar, J., & Kastner, T. (2019). Deforestation displaced: Trade in forest-risk commodities and the prospects for a global forest transition. *Environmental Research Letters, 14*(5), 055003. https://doi.org/10.1088/1748-9326/ab0d41

64 Moutinho, P., Guerra, R., & Azevedo-Ramos, C. (2016). Achieving zero deforestation in the Brazilian Amazon: What is missing?. *Elementa: Science of the Anthropocene, 4*, 000125. https://doi.org/10.12952/journal.elementa.000125

65 IPBES. (2019). *Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.* IPBES secretariat. https://doi.org/10.5281/zenodo.3831673

66 Diaz, R. J., & Rosenberg, R. (2008). Spreading dead zones and consequences for marine ecosystems. *Science, 321*(5891), 926–929. https://doi.org/10.1126/science.1156401; Díaz, R. J., & Rosenberg, R. (2011). Introduction to environmental and economic consequences of hypoxia. *International Journal of Water Resources Development*, *27*(1), 71–82. https://doi.org/10.1080/07900627.2010.531379;
Ripple, W. J., Wolf, C., Newsome, T.M., Galetti, M., Alamgir, M., Crist, E., Mahmoud, M.I., Laurance, W.F., & et al. (2017). World Scientists' Warning to Humanity: A Second Notice. *BioScience*, *67*(12), 1026–1028. https://doi.org/10.1093/biosci/bix125

67 Gunstone, T., Cornelisse, T., Klein, K., Dubey, A., & Donley, N. (2021). Pesticides and soil invertebrates: A hazard assessment. *Frontiers in Environmental Science*, *9*, 643847. https://doi.org/10.3389/fenvs.2021.643847

68 Bexfield, L. M., Belitz, K., Lindsey, B. D., Toccalino, P. L., & Nowell, L. H. (2020). Pesticides and pesticide degradates in groundwater used for public supply across the United States: occurrence and human-health context. *Environmental Science & Technology, 55*(1), 362-372. https://doi.org/10.1021/acs.est.0c05793

69 *Pesticide-Induced Diseases Database*. (n.d.). Beyond Pesticides. Retrieved February 26, 2024, from https://www.beyondpesticides.org/resources/pesticide-induced-diseases-database/overview

70 Food and Agriculture Organization of the United Nations. (2017). *Water for sustainable food and agriculture.* https://www.fao.org/3/i7959e/i7959e.pdf

71 Food and Agriculture Organization of the United Nations. (n.d.). *Water Scarcity.* Land & Water. Retrieved February 26, 2024, from https://www.fao.org/land-water/water/water-scarcity/en/#:~:text=By%202025%2C%201800%20million%20people,m3%20per%20year%20per%20capita

72 Free, prior, and informed consent (FPIC). (n.d.). Forest Peoples Programme. Retrieved February 26, 2024, from https://www.forestpeoples.org/en/guiding-principles/342

73 de Abreu, A. & OCCRP. (2022, July 8). *How illegal land grabs in Brazil's Amazon feed the global beef industry.* OCCRP. Retrieved February 26, 2024, from https://www.occrp.org/en/investigations/how-illegal-land-grabs-in-brazils-amazon-feed-the-global-beef-industry

74 Smith, S. M. (2017, July). How safe are the workers who process our food?. *Monthly Labor Review,* U.S. Bureau of Labor Statistics. https://doi.org/10.21916/mlr.2017.19

75 Ritchie, H. (2021, February 7). *Is our appetite for soy driving deforestation in the Amazon?.* Our World in Data. Retrieved February 26, 2024, from https://ourworldindata.org/soy

76 Makkar, H.P.S. (2018). Review: Feed demand landscape and implications of food-not feed strategy for food security and climate change. *Animal, 12*(8), 1744-1754. https://doi.org/10.1017/S175173111700324X

77 Poore, J., & Nemecek, T. (2018). Reducing food's environmental impacts through producers and consumers. *Science, 360*(6392), 987-992. https://doi.org/10.1126/science.aaq0216

78 Greene, J.L. (2015). *Update on the Highly-Pathogenic Avian Influenza Outbreak of 2014-2015.* Congressional Research Service. https://fas.org/sgp/crs/misc/R44114.pdf

79 van der Zee, B. (2019, October 31). Quarter of world's pig population 'to die due to African swine fever.' *The Guardian.* https://www.theguardian.com/world/2019/oct/31/quarter-of-worlds-pig-population-to-die-of-african-swine-fever; Reus, A. (2019, August 14). WH Group profit hurt by African swine fever. *Feed Strategy.* Retrieved February 26, 2024, from https://www.feedstrategy.com/animal-health-veterinary/african-swine-fever/article/15440718/wh-group-profit-hurt-by-african-swine-fever

80 Cohen, J. (2020, June 29). Swine flu strain with human pandemic potential increasingly found in pigs in China. *Science.* https://www.sciencemag.org/news/2020/06/swine-flu-strain-human-pandemic-potential-increasingly-found-pigs-china; World Health Organization. (n.d.). *Avian influenza A(H7N9) virus.* Retrieved February 26, 2024, from https://www.who.int/docs/default-source/wpro---documents/emergency/surveillance/avian-influenza

81 The FAIRR Initiative. (2020, June 2). *Over 70% of animal agriculture firms at "high risk" of fostering future zoonotic pandemics* [Press release]. Retrieved February 26, 2024, from https://www.fairr.org/article/over-70-of-animal-agriculture-firms-at-high-risk-of-fostering-future-zoonotic-pandemics

82 Murray, C. J. L., Ikuta, K. S., Sharara, F., Swetschinski, L. R., Aguilar, G. R., Gray, A. P., Han, C., Bisignano, C., Rao, P. C., Wool, E., Johnson, S., Browne, A. J., Chipeta, M. G., Fell, F., Hackett, S., Haines–Woodhouse, G., Hamadani, B. H. K., Kumaran, E. a. P., McManigal, B., . . . Naghavi, M. (2022). Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis. *The Lancet*, 399, 629-655, (10325). https://doi.org/10.1016/ S0140-6736(21)02724-0

83 FAIRR. (2016). *Factory Farming: Assessing Investment Risks*. FAIRR. https://www.fairr.org/resources/reports/factory-farming-assessing-investment-risks; FAIRR. (2019). *Protein Producer Index*. FAIRR. https://www.fairr.org/resources/reports/coller-fairr-protein-producer-index-2019; Sustainability Accounting Standards Board (SASB). (2023). *Meat, Poultry, and Dairy Sustainability Accounting Standard*. https://d3flraxduht3gu.cloudfront.net/latest_standards/meat-poultry-and-dairy-standard_en-gb.pdf; Sinergia Animal. (2023). *Financial Institutions and Animal Welfare*. https://drive.google.com/file/d/1eG8Zyk8rp0u-3H6ZiYP4JnXJahr_0qpg/view

84 FAIRR. (2023). Coller FAIRR *Climate Risk Tool: The Financial Impact of Climate Change on the Livestock Sector*. https://go.fairr.org/2023-Coller-FAIRR-Climate-Risk-Tool-Public-Report

85 Farand, C. (2020, February 29). *Net zero goal 'greatest commercial opportunity of our time,' says Mark Carney*. Climate Home News. https://climatechangenews.com/2020/02/27/net-zero-goal-greatest-commercial-opportunity-time-says-mark-carney

86 United Nations Environment Programme Finance Initiative. (2022, October 14). *Industry-Led, United Nations-Convened Net-Zero Banking Alliance Frequently Asked Questions.* https://www.unepfi.org/wordpress/wp-content/uploads/2022/08/FAQ-General_public-facing-1.pdf

87 United Nations Environment Programme Finance Initiative. (n.d.). *The commitment: Net-Zero Banking Alliance*. https://www.unepfi.org/net-zero-banking/commitment

88 Intergovernmental Panel on Climate Change (IPCC) (Ed.). (2023). Mitigation pathways compatible with long-term goals. In: Climate change 2022 - Mitigation of climate change: Working group III contribution to the sixth assessment report of the Intergovernmental Panel on Climate Change. *Cambridge University Press*, 295-408. https://doi.org/10.1017/9781009157926.005

89 Accountability Framework Initiative. (n.d.). *Definitions.* Retrieved December 11, 2023, from https://accountability-framework.org/use-the-accountability-framework/definitions

90 The Shareholder Commons. (2022, September). *Climate Change & the engagement gap: Why investors must do more than move the needle, and how they can.* https://theshareholdercommons.com/wp-content/uploads/2022/09/Climate-Change-Case-Study-FINAL.pdf

91 Conference of the Parties (COP) 28. (2023). *COP28 UAE Declaration on Sustainable Agriculture, Resilient Food Systems and Climate Action*. https://stopfinancingfactory-farming.com/app/uploads/2023/12/cop28-uae-declaration.pdf

92 Waite, R., & Zionts, J. (2022). *7 opportunities to reduce emissions from beef productio*n. World Resources Institute. https://www.wri.org/insights/opportunities-reduce-emissions-beef-production

93 Environmental Protection Agency (EPA). (2023, January 4). *Is anaerobic digestion right for your farm?*. https://www.epa.gov/agstar/anaerobic-digestion-right-your-farm

94 University of Missouri Extension. (n.d.). *E3A: Anaerobic Digester Applications for the Farm or Ranch*. https://extension.missouri.edu/media/wysiwyg/Extensiondata/Pub/pdf/energymgmt/em0703.pdf

95 Zhou, Y., Swidler, D., Searle, S., & Baldino, C. (2021). *Life-Cycle Greenhouse Gas Emissions of Biomethane and Hydrogen Pathways in the European Union*. International Council on Clean Transportation (ICCT). https://theicct.org/sites/default/files/publications/lca-biomethane-hydrogen-eu-oct21.pdf

96 Association of Irritated Residents, Leadership Counsel for Justice & Accountability, Food & Water Watch, & the Animal Legal Defense Fund. (2022). *Petition for Reconsideration of the Denial of the Petition for Rulemaking to Exclude All Fuels Derived from Biomethane from Dairy and Swine Manure From the Low Carbon Fuel Standard Program*. https://foe.org/wp-content/uploads/2022/06/2022-03-28-Petition-for-Reconsideration-TOC-Updated.pdf

97 Bowman, M., & Woroniecka, K. (2020). *Green Gas Without the Hot Air - Defining the true role of biogas in a net zero future*. Feedback Global. https://feedbackglobal.org/wp-content/uploads/2020/09/Feedback-2020-Green-Gas-Without-the-Hot-Air-report.pdf

98 Hegarty, R., Cortez-Passetti, R., Dittmer, K., Wang, Y., Shelton, S., Emmet-Booth J., Wollenberg, E., McAllister, T., Leahy, S., Beauchemin, K., & Gurwick, N. (2021). *An evaluation of emerging feed additives to reduce methane emissions from livestock*. Edition 1. Climate Change, Agriculture and Food Security (CCAFS) and the New Zealand Agricultural Greenhouse Gas Research Centre (NZAGRC) initiative of the Global Research Alliance (GRA). https://globalresearchalliance.org/wp-content/uploads/2021/12/An-evaluation-of-evidence-for-efficacy-and-applicability-of-methane-inhibiting-feed-additives-for-livestock-FINAL.pdf

99 Sicard, C. (2023, April 25). *Can CRISPR cut methane emissions from cow guts?*. UC Davis. https://www.ucdavis.edu/food/news/can-crispr-cut-methane-emissions-cow-guts

100 ZELP. (n.d.). https://www.zelp.co/

101 U.S. Soybean Export Council (n.d.), *Member directory – U.S. Soybean Export Council*. https://ussec.org/directory/member-directory

102 Watt Poultry International (2021). *World's top 50 broiler producers*. Retrieved August 2023, from https://poultryunion.org/f/poultryint202110-dl_1.pdf

103 Maulsby, D. (2021, June 18). *Who are the world's mega pork producers?*. Pig Progress. Retrieved June 2023, from https://www.pigprogress.net/world-of-pigs/who-are-the-worlds-mega-pork-producers

104 The National Provisioner (2023, April 4). *2022 Top 100 Meat and Poultry Processors.* Retrieved August 2023, from https://www.provisioneronline.com/articles/114545-2022-top-100-meat-and-poultry-processors

105 JBS. (2023). *1Q2023 Institutional Presentation*. https://api.mziq.com/mzfilemanager/v2/d/043a77e1-0127-4502-bc5b-21427b991b22/c0ee19d-726b-31e7-57a4-14f100087d18?origin=1

106 Minerva Foods. (2023). *1Q23 Corporate Presentation*. https://api.mziq.com/mzfilemanager/v2/d/7f2b381f-831b-4aed-b111-417a5585b53b/e404fa51-3733-3e04-022d-85f03bffc977?origin=1

107 Marfrig. (n.d.). *Our operations*. Retrieved June 2023, from https://ri.marfrig.com.br/en/grupo-marfrig/global-capacity/our-operations

108 Cargill. (n.d.). *Sustainable beef.* Retrieved June 2023, from https://www.cargill.com/sustainability/sustainable-beef#:~:text=Our%20presence,and%20by%2Dproducts%20each%20year

109 Tyson Foods. (n.d.). *Tyson Foods Facts.* Retrieved June 2023, from https://ir.tyson.com/about-tyson/facts/default.aspx

110 Carluer-Lossouarn, F. (2022, November 7). *Bigard: les chiffres clés du n° 1 de la boucherie*. Linéaires. Retrieved June 2023, from https://www.lineaires.com/les-produits/bigard-les-chiffres-cles-du-n-1-de-la-boucherie

111 Vion Food Group. (n.d.). *Beef.* Retrieved June 2023, from https://www.vionfoodgroup.com/en/beef

112 NH Foods Ltd. (2021). *NH Foods Group Sustainability Report 2021*, p. 7. https://www.nipponham.co.jp/eng/csr/report/res/pdf/2021/sustainability_report/2021_all_web.pdf

113 Food and Agriculture Organization of the United Nations. (2023). *Crops and livestock products.* FAOSTAT. Retrieved June 2023, from https://www.fao.org/faostat/en/#data/QCL

114 The Land. (2023, June 4). *Behind the scenes at NH Foods: What works in the branded beef game.* Retrieved June 2023, from https://z-upload.facebook.com/thelandnews-paper/posts/10159860682488353;

115 Danish Crown. (n.d.). *Feeding the future - Strategy 2021-2026: A growing beef.* Retrieved June 2023, from https://www.danishcrown.com/en-gb/about-us/who-we-are/strat-egy/strategy-2021-2026/a-growing-beef

116 Statista. (2021, June). *Schlachtungen von Rindern durch die Tönnies-Gruppe bis 2020.* Retrieved June 2023, from https://de.statista.com/statistik/daten/studie/827702/umfrage/schlachtungen-von-rindern-der-toennies-gruppe

117 IFCN. (2021, December 10). *Top Dairy Processors commit to climate goals and show strong performance in challenging times* [Press release]. Retrieved August 2023, from https://ifcndairy.org/top-dairy-processors-commit-to-climate-goals

118 Roembke, J. (2022, September 8). *Top Feed Companies: 144 global producers rank in 2022.* Feed Strategy. Retrieved June 2023, from https://www.feedstrategy.com/business-markets/feed-production-by-region/article/15443042/top-feed-companies-144-global-producers-rank-in-2022

119 Trase.earth. (2023). *Supply chains.* Retrieved June 2023, from https://supplychains.trase.earth/explore

120 Partnership for Carbon Accounting Financials (PCAF). (2020). *The Global GHG Accounting and Reporting Standard for the Financial Industry*. https://ghgprotocol.org/sites/default/files/standards/The%20Global%20GHG%20Accounting%20and%20Reporting%20Standard%20for%20the%20Financial%20Industry_0.pdf

121 Refinitiv (n.d.), *Refinitiv ESG Carbon Data and Estimate Models*. https://www.refinitiv.cn/content/dam/marketing/en_us/documents/fact-sheets/esg-carbon-data-estimate-models-fact-sheet.pdf

122 Refinitiv (n.d.), *Refinitiv ESG Carbon Data and Estimate Models*. https://www.refinitiv.cn/content/dam/marketing/en_us/documents/fact-sheets/esg-carbon-data-estimate-models-fact-sheet.pdf

123 Institute for Agriculture and Trade Policy (IATP) & GRAIN. (2018). *Emissions impossible: how big meat and dairy are heating up the planet*. IATP. https://www.iatp.org/sites/default/files/2018-08/Emissions%20impossible%20EN%2012.pdf

124 Changing Markets Foundation & Institute for Agriculture and Trade Policy. (2022). *Emissions impossible: Methane edition*. Institute for Agriculture and Trade Policy. https://www.iatp.org/emissions-impossible-methane-edition

125 Bank of America. (2023). *Annual Report 2022,* p. 138. https://investor.bankofamerica.com/regulatory-and-other-filings/annual-reports/content/0000070858-23-000121/0000070858-23-000121.pdf

126 Bank of America. (2022). *Task Force on Climate-related Financial Disclosures (TCFD) Report 2022 - Managing our Future*, p. 45. https://about.bankofamerica.com/content/dam/about/report-center/esg/2022/BOA_TCFD_2022%209-22-2022-VOX220929%20split%20paragraph%20Secured.pdf

127 Citigroup. (2023). *2022 Annual Report*, p. FS-11. https://www.citigroup.com/rcs/citigpa/storage/public/citi-2022-annual-report.pdf

128 Citigroup. (2023). *Taskforce on Climate-Related Financial Disclosures Report 2022 - Citi's Approach to Climate Change and Net Zero*, p. 58. https://www.citigroup.com/rcs/citigpa/storage/public/taskforce-on-climate-related-financial-disclosures-report-2022.pdf

129 JPMorgan Chase. (2023). *Creating Possibility: Annual Report 2022*, p. 55. https://www.jpmorganchase.com/content/dam/jpmc/jpmorgan-chase-and-co/investor-relations/documents/annualreport-2022.pdf

130 JPMorgan Chase. (2023). *2023 Climate Report*, p. 34. https://www.jpmorganchase.com/content/dam/jpmc/jpmorgan-chase-and-co/documents/Climate-Report-2023.pdf

131 JPMorgan Chase. (2023). *2023 Climate Report*, p. 34. https://www.jpmorganchase.com/content/dam/jpmc/jpmorgan-chase-and-co/documents/Climate-Report-2023.pdf

132 Bank of America. (2022). *Task Force on Climate-related Financial Disclosures (TCFD) Report 2022 - Managing our Future*, p. 45. https://about.bankofamerica.com/content/dam/about/report-center/esg/2022/BOA_TCFD_2022%209-22-2022-VOX22

133 Citigroup. (2023). *Taskforce on Climate-Related Financial Disclosures Report 2022 - Citi's Approach to Climate Change and Net Zero*, p. 58. https://www.citigroup.com/rcs/citigpa/storage/public/taskforce-on-climate-related-financial-disclosures-report-2022.pdf

134 Bank of America. (2023). *Annual Report 2022,* p. 138. https://investor.bankofamerica.com/regulatory-and-other-filings/annual-reports/content/0000070858-23-000121/0000070858-23-000121.pdf

135 Bank of America. (2022). *Task Force on Climate-related Financial Disclosures (TCFD) Report 2022 - Managing our Future*, p. 45. https://about.bankofamerica.com/content/dam/about/report-center/esg/2022/BOA_TCFD_2022%209-22-2022-VOX220929%20split%20paragraph%20Secured.pdf

136 Citigroup. (2023). *2022 Annual Report*, p. FS-11. https://www.citigroup.com/rcs/citigpa/storage/public/citi-2022-annual-report.pdf

137 Citigroup. (2023). *Taskforce on Climate-Related Financial Disclosures Report 2022 - Citi's Approach to Climate Change and Net Zero*, p. 58. https://www.citigroup.com/rcs/citigpa/storage/public/taskforce-on-climate-related-financial-disclosures-report-2022.pdf

138 JPMorgan Chase. (2023). *2023 Climate Report*, p. 34. https://www.jpmorganchase.com/content/dam/jpmc/jpmorgan-chase-and-co/documents/Climate-Report-2023.pdf