Final report

Red meat greenhouse gas emissions update 2024

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Prepared by:	Dianne Mayberry Commonwealth Scientific and Industrial Research Organisation
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Abstract

This report provides updated estimates of emissions attributable to the Australian red meat industry based on the 2024 Australian National Greenhouse Gas Inventory. The report presents greenhouse gas emissions for beef cattle, sheep meat and goats in 2024, and recalculates emissions from 2005-2023 using current inventory data.

Net greenhouse gas emissions from the Australian red meat sector in 2024 were 58 Mt CO_2-e, representing 12% of Australia's total greenhouse gas emissions. Enteric methane remained the dominant source of emissions, while long-term reductions since 2005 were primarily driven by lower emissions from land-use change and increased vegetation regrowth. Beef cattle accounted for 84% of sector emissions and sheep meat 16%.

These results provide industry with an updated and nationally consistent emissions benchmark, helping track progress, identify major emissions sources, and inform future investment in methane mitigation, land management and emissions reduction strategies.

Executive summary

Background

Understanding the sources of, and changes in, greenhouse gas emissions from red meat production is important to help the red meat industry achieve its sustainability goals. In a previous project (B.CCH.7714), a method was developed to quantify greenhouse gas emissions from red meat production based on data from the Australian National Greenhouse Gas Inventory. This current project provides an updated estimate of emissions from red meat production in Australia from 2005 to 2024.

Objectives

The overarching project objectives are listed below, with all objectives fully completed.

- Calculate the GWP100 (AR5) greenhouse gas footprint of Australian red meat production and present the information:
    - By source of emissions
    - By source and by commodity (current year)
    - Net emissions by commodity
    - Net emissions by production sector (farm, feedlot, processing)
- Calculate net emissions for red meat of key alternate metrics: GWP20, GTP100, GTP20, GWP100 (AR6), GWP*, radiative forcing
- Calculate emissions by gas type for methane, nitrous oxide and carbon dioxide in absolute volume (megatonnes) and GWP100 (megatonnes CO_2e)

Methodology

Emissions from Australia's National Greenhouse Accounts 2023 Paris Agreement Inventory were allocated to beef cattle (on pasture and in feedlots), sheep meat and goats based on animal numbers, resource use and processing volumes.

Results/key findings

Emissions from the Australian red meat industry in 2024 were 58 Mt CO_2-equivalents. The biggest source of emissions is enteric methane fermentation (49 Mt CO_2-e), particularly from grazing beef cattle. These emissions are partially offset by removals from grazing landscapes.

Net emissions from the red meat industry have decreased by 61% since 2005. These changes are largely due to a reduction in the clearing and reclearing of forest and sparse woody vegetation, and an increase in vegetation growth and carbon storage. More recent changes in annual emissions are associated with changes to the number of livestock in response to climate conditions.

Benefits to industry

Annual reporting enables understanding of the red meat industries net emissions profile and contribution to national emissions, and can inform research and development priorities, as well as other strategic actions.

Future research and recommendations

The report provides recommendations of data that would improve the accuracy of these calculations, and capture improvements in efficiency made on-farm and in feedlots.

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1. Background

The Australian red meat industry is a source of greenhouse gas emissions that contribute to climate change. These include emissions from enteric fermentation, the degradation of animal waste, production of feed, land use change and processing of meat. With livestock managed over half the Australian continent (Australian Bureau of Statistics 2024), there is also an opportunity for extensive livestock systems to offset emissions through the storage of carbon in the soils and vegetation that comprise grazing landscapes.

As part of its sustainability goals and contributions to the Australian beef and sheep sustainability frameworks, the red meat industry has been benchmarking its greenhouse gas emissions footprint annually since 2015.

This report provides an update of greenhouse gas emissions (carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O)) from the Australian red meat sector based on the 2023-24 Paris Agreement Inventory (hereafter referred to as the *National Inventory*) published by Australia's National Greenhouse Accounts (Australian Government 2026a).

2. Objectives

1. Calculate the GWP100 (AR5) greenhouse gas footprint of Australian red meat production and present the information:
    a. By source of emissions
    b. By source and by commodity (current year)
    c. Net emissions by commodity
    d. Net emissions by production sector (farm, feedlot, processing)
2. Discuss the results summarising factors for contemporary change and compared to 2005.
3. Prepare a summary table of livestock numbers and red meat production volume.
4. Calculate net emissions for red meat of key alternate metrics and present a summary table:
    a. GWP20
    b. GTP100
    c. GTP20
    d. GWP100 (AR6)
    e. GWP*
    f. Radiative forcing
5. Comment on results of note from alternate metrics summarising factors for contemporary change and/or change to 2005.
6. Calculate emissions by gas type for methane, nitrous oxide and carbon dioxide in absolute volume (megatonnes) and GWP100 (megatonnes CO_2e)
7. Re-state methodology for attributing National Inventory emissions to the red meat sector, including where disaggregation of data occurs from the primary source National Inventory activity tables.
8. Document changes to methodology or data availability since previous report.
9. Provide as Appendix, a two- and three-year time series graph for net emissions as compared with annual net emissions (2005 – present)
10. Provide as Appendix, net emissions for sheep (meat and wool) for 2005, 2021-2024.
11. Provide as Appendix, briefing note on approximate impact to enteric methane attributable to sheep under the incumbent versus experimental flock numbers.

3. Methodology

3.1 Scope of reporting

This report provides an estimate of greenhouse gas emissions attributable to the red meat industry from 2004-05 to 2023-24. The scope of this assessment includes the domestic production and processing of beef cattle, sheep meat and goats. Emissions from dairy cattle[1], buffalo, wool production and wild-harvested animals (i.e., those not included in ABS livestock population data) were not included as part of the red meat sector. Offshore emissions from the transport, production and processing of live animals and red meat products after they left Australia were also excluded.

A detailed chart of accounts is included in Appendix 8.2, but in summary, emissions and removals from the following sources are included:

- Scope 1
    - enteric fermentation
    - manure management

[1] milking cows, cull dairy cows, replacement heifers, bobby calves/vealers and dairy bulls

    - agricultural soils, both direct and indirect soil emissions from grazing lands and the fraction of croplands used to support the production of feedlot rations
    - field burning of agricultural (crop and pasture) residues
    - liming and urea applications
    - land use and land use change relating to cropland, grassland, forest land and wetland available for grazing
- Scope 2 & 3
    - electricity and fuel use on farms, in feedlots and in processing

Specific gaps in this approach are identified in the chart of accounts. Due to data limitations, this analysis does not include scope 2 and 3 emissions associated with domestic transport of livestock, cropland used to produce grain fed to livestock outside of feedlots (e.g., confinement fed sheep), manufacture and transport of feed (e.g., hay and silage), manufacture and transport of fertiliser and other farming inputs, provision of services (e.g., insurance, consultants), capital goods (e.g., sheds, tractors) and waste disposal (e.g., compositing, landfill).

3.2 Data sources and allocation of emissions to the red meat industry

The report builds on the methods used in previous reporting periods (Mayberry 2025) and also seeks to align this approach with the Common Approach to Greenhouse Gas Accounting (Sevenster *et al.* 2023). The Common Approach provides aspirational, best-practice guidance for sector-level greenhouse gas accounting and aims to guide improvements in data collection and reporting across Australia's agricultural sectors over time.

Calculations used in this report are based primarily on emissions reported by the Australian National Inventory, supplemented by other data on livestock populations and processing (Table 1). The Paris Agreement Inventory uses GWP100 values from the Fifth Assessment Report (AR5) and reports against the United Nations Framework Convention on Climate Change (UNFCCC) sectors. The Australian Government Department of Climate Change, Energy, the Environment and Water (DCCEEW) review and update activity data and the inventory methodology on an annual basis, and changes are applied retrospectively to previous years. Thus, the 2024 National Inventory and this report both supersede previous iterations.

Table 1. Key datasets used in this analysis

Data type	Activity data	How used in calculation	Source
General	Australia's National Greenhouse Accounts Paris Agreement inventory	Base data for calculations	Australia's National Greenhouse Accounts (Australian Government 2026a)
Livestock production	Beef produced	Emissions from processing	ABS Livestock Products, Table 9. Red meat produced – beef (Australian Bureau of Statistics 2026)
	Sheep meat produced	Meat-wool allocation; emissions from processing	ABS Livestock Products, Table 11. Red meat produced – mutton, Table 12. Red meat produced – lamb (Australian Bureau of Statistics 2026)
	Number of sheep live exported	Meat-wool allocation	2002-2024 from MLA markets (MLA 2026); 1990-2001 from

			ABS (Australian Bureau of Statistics 2019)
	Wool yields	Meat-wool allocation	1992-2024 AWI wool yield data (Australian Wool Innovation Ltd 2026); 1990-1991 ABS Livestock products, Table 16. Brokers and dealers receivals of taxable wool (Australian Bureau of Statistics 2022)
	Feedlot activity data (number cattle, days on feed, feed intake)	Allocation of cropland to feedlot	National Inventory Report (Australian Government 2026c)
	Feed intake by sheep, beef cattle and dairy cattle	Relative grazing pressure of different species	Provided by DCCEEW National Inventory team
	Livestock populations (cattle, sheep, goats, horses, deer, buffalo, donkeys/mules, alpacas, camels)	Relative grazing pressure of different species	National Greenhouse Accounts Activity tables. Livestock National (Australian Government 2026a)
Land and resource use	Crop yields	Allocation of cropland to feedlot	National Greenhouse Accounts Activity tables. Agriculture – crop (Australian Government 2026a)
	Area of irrigated pasture	Allocation of irrigated pasture emissions to red meat	Water Account, Australia (Australian Bureau of Statistics 2017)
	Lime and urea use on crop and pasture land	Allocation of lime and urea emissions to species	ABS Agricultural resource management practices (Australian Bureau of Statistics 2014)
	LULUCF emissions attributed to grazing	Allocation of LULUCF emissions to beef and sheep meat	National Greenhouse Accounts Activity tables. National Inventory by Economic Sector 2023-Data Tables 11-19A (Australian Government 2026a)

Under the Paris Agreement, emissions are reported for energy, industrial processes, agriculture, land use land use change and forestry (LULUCF) and waste. Most emissions from the red meat industry are from the agriculture and LULUCF sectors, with small contributions from the energy sector. Emissions reported by the National Inventory are allocated to the red meat industry based on animal numbers, feed intake, meat production and resource use as described by Mayberry *et al.* (2018). A broad summary of how emissions are allocated to the red meat industry is provided below, with details related to specific emissions categories in Table 2. For more details on the methods and data used by DCCEEW to calculate emissions, readers are referred to the National Inventory Reports (Australian Government 2026b; Australian Government 2026c).

Allocation of emissions between livestock species

The National Inventory reports emissions associated with livestock activities (enteric methane, manure management and degradation of urine and faeces in the field) for each species, and separates cattle into dairy cattle, beef cattle on pasture and beef cattle in feedlots. All emissions from beef cattle on pasture, beef cattle in feedlots and goats were reported directly from the inventory.

The national sheep flock produces both meat and wool, and emissions were attributed to either commodity using the protein mass allocation method (Wiedemann *et al.* 2015). This method calculates the amount of protein in animal liveweight and wool based on the volume of mutton and lamb produced (Australian Bureau of Statistics 2026), gross weight of live export sheep (Australian Bureau of Statistics 2019; MLA 2026) and greasy wool yields (Australian Bureau of Statistics 2022; Australian Wool Innovation Ltd 2026) for each year of the inventory. In 2024, 67% of protein produced by sheep was in meat and 33% in wool. The proportion of protein in meat (i.e., 0.67 in 2024) was applied to total sheep emissions to calculate emissions from sheep meat. Because the amount of meat and wool produced varies between years, this calculation was repeated for each year of data.

While goats also produce multiple commodities, insufficient data is available to disaggregate emissions between goat meat, dairy and fibre production, and all emissions associated with goats are attributed red meat production.

Attribution of cropland emissions to red meat

Cropland is used to produce grain and forage crops fed to cattle in feedlots, with emissions associated with soil tillage, application of fertilisers, degradation of organic matter, fire and land clearing. The proportion of emissions from cropland attributable to feedlot cattle production was estimated based on Wiedemann *et al.* (2017), who report average diet composition for domestic, mid-fed and long-fed cattle in Australian feedlots. The proportion of raw ingredients (e.g., barley, maize, sorghum) in feedlot diets was multiplied by annual feed intake (annual equivalent number of feedlot cattle × daily feed intake × 365) (Australian Government 2026c) to estimate the volume of each ingredient required. This was divided by annual production of each crop type (Australian Government 2026a) to calculate the proportion of crop emissions attributable to red meat production.

For emissions from crop residues, the proportion of emissions attributable to red meat production was calculated separately for barley, cotton (seed, seed meal, hulls), forage crops, maize, oilseeds (oil, meal), sugarcane (molasses), sorghum and wheat, as these are reported individually in the National Inventory (Australian Government 2026a).

The National Inventory reports emissions from the application of fertiliser to crops separately for cotton, sugar cane, irrigated crops and non-irrigated crops. Emissions from cotton and sugar cane were attributed to red meat as per emissions from crop residues. Emissions from irrigated and non-irrigated crops were allocated based on the proportion of crop production under irrigation or dryland production. Maize was assumed to be 50% dryland production, sorghum 75% dryland production, and winter cereals 100% dryland production (GRDC 2017; GRDC 2025).

All other emissions from crops (mineralisation due to loss of soil carbon, sewage sludge applied to land, LULUCF cropland) were not disaggregated by crop type or production system.

Grain is also fed as a supplement to grazing livestock in some years and regions. Emissions associated with cropland use from grazing animals were not included in this assessment due to lack of data on supplementation rates. This data gap could be filled through farm surveys, expert consultation or gross margin budgets.

Proportion of grazing lands used for beef, sheep-meat and goat production

Emissions from grazed lands (including pasture sown on cropland), grasslands and forests include emissions from application of fertiliser, degradation of organic matter, fire and land clearing. Grasslands and forest lands can also be a carbon sink, with carbon stored in above and below ground biomass. These emissions are reported by the National Inventory under the Agriculture and LULUCF sectors and are allocated to the red meat industry on a state/territory basis as described below.

Irrigated pasture – direct soil emissions and atmospheric deposition

The proportion of emissions from irrigated pasture (direct soil emissions and atmospheric deposition from fertiliser applied to pasture) allocated to red meat is calculated based on the proportion of irrigated pastureland used by beef cattle and sheep. The Australian Bureau of Statistics historically reported time-series data for the area of irrigated land used for various activities including *dairy production*, *production from meat cattle* and *production from sheep and other livestock* from 2009 until 2016 (Australian Bureau of Statistics 2017). For years where data was available, the proportion of irrigated pastureland used for *production from meat cattle* in each state/territory was applied to the National Inventory emissions from irrigated pastures to calculate beef cattle emissions from irrigated pastures. The same process was used to calculate emissions from sheep grazing irrigated pastures, except that the area of irrigated pasture used for *sheep and other livestock* is not able to be further disaggregated, and the entire area is allocated to sheep, then corrected for co-production of meat and wool as described above. While this may overestimate the area of irrigated pasture used for sheep production, the total emissions from irrigated pastures are small and this has minimal impact on the emissions included in the red meat inventory. Proportions of irrigated pasture used for beef or sheep production in 2009 were applied to earlier years, and proportions of irrigated pasture in 2016 were applied to later years.

Updated data on the area of irrigated pasture used by different livestock would improve this allocation.

Non-irrigated pasture – direct soil emissions and atmospheric deposition

Direct and indirect emissions from non-irrigated pastures (direct soil emissions from pasture residues, direct soil emissions and atmospheric deposition from fertiliser applied to pasture) reported under the Agriculture sector are allocated to the red meat industry based on relative feed intake.

Total pasture intake of grazing animals was estimated as follows. Total feed intake of beef cattle, dairy cattle and sheep was taken from time-series spreadsheets provided by DCCEEW, and it was assumed that beef cattle and sheep consume 100% pasture and that feed intake of dairy cattle is 60% pasture (Dairy Australia 2024; Gollnow *et al.* 2014). Feed intake of goats was estimated using goat population data reported by the National Inventory (Australian Government 2026c), and assuming an average liveweight of 38.5 kg (Australian Government 2026b) and pasture intake of 2% liveweight. Feed intake of other grazing species (horses, deer, buffalo, donkeys/mules, alpacas, camels) was estimated using livestock population data from the National Inventory (Australian Government 2026c), default liveweight values provided by the IPCC (Gavrilova *et al.* 2019) and assuming pasture intake of 2% liveweight.

The proportion of pasture intake for beef cattle, sheep and goats was applied to National Inventory emissions from non-irrigated pastures to calculate emissions attributable to red meat. The proportion of grazing land used for sheep production is corrected for co-production of meat and wool as outlined above.

Leaching emissions from irrigated and non-irrigated pasture

Emissions from leaching are climate dependent, and proportionally much greater on dairy land compared to pastures grazed by beef cattle, sheep and goats (Australian Government 2026c). Indirect emissions from N leaching and runoff from pastures were allocated to beef cattle, sheep and goats based on the proportion of indirect leaching emissions from manure for each species.

LULUCF

Emissions from grazing that occur under LULUCF are now reported directly by the National Inventory in the National Inventory by Economic Sector Data Tables (Australian Government 2026a). This includes relevant emissions from grasslands, forest land, cropland and wetlands. The proportion of LULUCF grazing emissions attributed to red meat production were calculated based on relative feed intake of beef cattle, sheep and goats as per the process used for non-irrigated pastures.

Energy use on farm, in-feedlots and in processing

General energy use in feedlots was calculated based on energy required per 1000-head day (Wiedemann *et al.* 2017), number of cattle in feedlots and days on feed (Australian Government 2026c). Energy used for feed milling and delivery was calculated based on energy required per tonne of feed (Wiedemann *et al.* 2017) and feed intake.

On-farm energy use for beef cattle was calculated based on tonnes of dry matter intake (Wiedemann *et al.* 2016) and numbers of animals. On-farm energy use for sheep was calculated based on energy per 1000 ewes joined (Wiedemann *et al.* 2015) and number of breeding ewes, then attributed to either meat or wool production based on the protein mass allocation method described above.

Greenhouse gas emissions from energy use in feedlots and on-farm were calculated based on energy content and emissions factors of electricity, gas, petrol, and diesel (DCCEEW 2022; DCCEEW 2023; DCCEEW 2024; DISER 2021).

Energy use from processing was calculated based on reported emissions per tonne of red meat and the proportion of emissions attributed to energy consumption (All Energy Pty Ltd 2021; Ridoutt 2025; Ridoutt *et al.* 2015; Ridoutt and Sikes 2023), and volume of meat produced (Australian Bureau of Statistics 2026). The method accounts for improvements in processing efficiency captured in the Red Meat Processing Sector Environmental Performance Reviews conducted every 2-5 years.

Table 2. Overview of methods used in the Paris Agreement Inventory (Australian Government 2025c), and the basis of allocation of these emissions to the red meat industry.

Emissions source	Emissions relevant to red meat production	National inventory method	Allocation of emissions to the red meat industry
Agriculture			
Enteric methane	Methane produced as a by-product of digestion by ruminants	Emissions from cattle and sheep are based on estimated dry matter intake of livestock in each season (summer, autumn, winter, spring). Emissions from goats are calculated as using average emissions of 5kg CH_4/head/year.	All emissions from beef cattle feedlot, beef cattle pasture and goats were reported directly from the national inventory. Emissions from sheep were corrected for the co-production of meat and wool. Emissions from all other livestock were excluded.
Manure management	Methane from decomposition of organic matter under anaerobic conditions; N_2O from deposition of N volatilized from manure management systems	Based on estimated manure production and N excreted in faeces and urine	All emissions from beef cattle feedlot, beef cattle pasture and goats were reported directly from the national inventory. Emissions from sheep were corrected for the co-production of meat and wool. Emissions from all other were livestock excluded.
Agricultural soils	Direct and indirect emissions of N_2O from soils following application of fertiliser to crops and pastures, urine and dung deposited by grazing animals, decomposition of crop and pasture residues, mineralisation due to loss of soil carbon, and cultivation of histols.	Based on volume of inorganic or organic fertiliser applied to soil, and volume of faeces and urine excreted by grazing animals	Direct emissions from animal waste applied to soils (beef cattle – feedlot) and direct and indirect emissions from urine and dung from beef cattle and goats were reported directly from the national inventory. Emissions from sheep were corrected for the co-production of meat and wool. Emissions from all other livestock were excluded. Direct and indirect emissions from cropland were included based on the proportion of cropland required to supply grain to feedlots. Direct and indirect emissions from pasture were calculated based on the proportion of pasture used for beef, sheep meat and goat production. The area of pasture used for sheep production was corrected for the co-production of meat and wool.
Field burning of agricultural residues	Methane and N_2O emissions from stubble burning	Based on annual crop production, amount of crop residue remaining after harvest/grazing, fraction of annual crop that is burnt, and burning efficiency.	Emissions were included based on the proportion of cropland required to supply feedlots.

Liming	CO_2 emissions from reaction of carbonates with acids in soil.	Volume of lime and dolomite applied to soils multiplied by default IPCC emissions factors	The proportion of emissions attributed to red meat was calculated based on the proportion of lime and dolomite used for beef and sheep farming compared to other agricultural sectors. Volume of lime used for sheep farming was corrected for the co-production of meat and wool.
Urea application	Loss of CO_2 fixed in urea during the manufacturing process.	Volume of urea applied to soils multiplied by IPCC default emissions factor.	The proportion of emissions attributed to red meat was calculated based on the proportion of urea fertiliser used for beef and sheep farming compared to other agricultural sectors. Volume of urea fertiliser used for sheep farming was corrected for the co-production of meat and wool.
Land use, land use change and forestry			
Forest land	Emissions from burning, land clearing and soils; carbon storage in growth of woody vegetation.	Carbon stock changes and emissions are modelled using the Full Carbon Accounting Model (FullCAM) using spatial data on land use, land clearing, forest planting, natural regeneration and the area, timing of prescribed burns and wildfires, area under grazing and grazing intensity. The modelling accounts for spatial and temporal variations in climate, soil and vegetation.	The National Inventory provides data on total LULUCF emissions attributed to grazing and cropping on a national and state/territory basis. Within each state or territory, emissions from grazing were attributed to beef cattle, sheep or goats based on relative feed intake. The area of grazing land used for sheep production was corrected for the co-production of meat and wool. Emissions from cropping were attributed to beef cattle – feedlot based on the proportion of cropland required to supply grain to feedlots.
Cropland	Emissions from changes in management practices from changes in crop type and land use.		
Grassland	Emissions from changes in fire management, grazing intensity, presence of sparse woody vegetation and land clearing.		
Wetland	Methane emissions from ponded pastures		

3.3 Analysis of emissions

Unless otherwise stated, emissions in this report are presented as Mt of CO_2-equivalents (CO_2-e) per financial year, calculated using GWP100 values from the AR5 report (Table 3). This is consistent with national reporting by the Australian Government, and in line with recommendations from the Common Approach to Greenhouse Gas Accounting (Sevenster *et al.* 2023).

The CO_2-e metric allows comparison between different gases by indicating the amount of energy each gas absorbs relative to CO_2 (Lynch 2019). There are several different CO_2-e metrics that can be expressed over different timescales; usually 20 or 100 years (Table 3). Emissions can also be reported using the GWP* and radiative forcing metrics, which are described in more detail below. These alternative metrics can be used for sensitivity assessments based on their relevance for specific sector objectives (Sevenster *et al.* 2023) but are not currently recommended for primary reporting purposes.

Table 3. Global warming and global temperature potentials used in presentation of emissions results. Values are exclusive of climate-carbon feedbacks (Myhre et al. 2013). Values used in the 2024 Paris Agreement Inventory and this report are highlighted in grey.

	GWP100 AR6[1]	***GWP100 AR5***	***GWP20 AR5***	***GTP100 AR5***	***GTP20 AR5***
CO_2	*1*	*1*	*1*	*1*	*1*
CH_4	*27*	*28*	*84*	*4*	*67*
N_2O	*273*	*265*	*264*	*234*	*277*

[1] The IPCC Sixth Assessment Report (AR6; Forster *et al.* (2021)) uses updated GWP100 values, including the differentiation between CH_4 from fossil and non-fossil origins. The fossil GWP value (30) is applied to fossil fuel fugitive emission sources such as coal mining, and industrial processes where the carbon within methane is of fossil origin (Greenhouse Gas Protocol 2024). All other sources of methane emissions, including from the combustion of fossil fuels, use the non-fossil GWP value (27). These values are not yet used in Australia's National Inventory.

Global warming potential; GWP100 and GWP20

GWP is the most widespread CO_2-e and is a measure of how much energy a greenhouse gas traps in the atmosphere over a given time period relative to CO_2. It is calculated by multiplying the volume of each gas by the GWP metric (Table 3).

GWP*

The GWP* climate metric assesses the future warming potential associated with a permanent change in the rate of emission of short-lived greenhouse gases such as CH_4. To quantify the change in rate, emissions need to be assessed over a time interval. The developers of GWP* use a 20-year time interval, arguing that this smooths out short-term fluctuations in emission rates that may not reflect permanent change (Allen *et al.* 2018). The GWP* result for methane was calculated following (Smith *et al.* 2021) and using the AR5 GWP100 values in Table 3.

$$Emissions\ = 1.13\frac{r \cdot H \cdot \Delta E(t)}{\Delta t} + 1.13 \cdot s \cdot E(t)$$

Where:

r = represents the response to changing emission flow or *rates*; 0.75

s = represents the long-term equilibration of emission *stocks*; 0.25

H = time horizon used for GWP calculations; 100 years

$\Delta E(t)$ = change in emissions over 20 years, calculated using GWP100

Δt = time period of interest; 20 years

$E(t)$ = emissions in current year, calculated using GWP100

Long-lived greenhouse gases, namely CO_2 and N_2O, were assessed using the conventional GWP100 metric values of 1 and 265 (Myhre *et al.* 2013). Results were reported as CO_2-e emissions by combining the amounts of all three gases.

Global Temperature change Potential; GTP100 and GTP20

The 100-year and 20-year GTP (GTP100 and GTP20, respectively) reports the modelled change in global mean surface temperature at a point in time 100 or 20 years after a pulse emission. GTP is calculated as for GWP, using the AR5 values in Table 3.

Radiative forcing climate footprint

The radiative forcing footprint combines radiative forcing from current year emissions and the radiative forcing from historical emissions remaining in the atmosphere (Ridoutt 2021). Due to their long lifetime, historical emissions of CO_2 and N_2O are highly important as they accumulate over time. Methane emissions have a much shorter atmospheric lifetime and the radiative forcing curve from a pulse emission decays comparatively quickly. The profile of radiative forcing over time informs whether progress is being made toward radiative forcing stabilisation, which is a requirement for climate stabilisation. In this study, the radiative forcing associated with a pulse emission was calculated using parameters and equations reported in Myhre *et al.* (2013). The warming potential of emissions (radiative forcing) is reported as milli watts per square meter (mW/m^2).

3.4Changes since the last report and changes to future reporting

Changes to National Inventory methods

In line with their international reporting requirements, DCCEEW reviews and updates the methods and data used to calculate national emissions every year. These revisions improve the accuracy of reported emissions and are applied retrospectively to previous inventories. Changes to the National Inventory methods that are of relevance to the red meat industry reporting are summarised in Table 4. Planned improvements that may be implemented in future inventory releases are also highlighted.

The main changes this year relate to emissions from manure. Allocation of emissions between pasture and farm dams is now based on a spatial map of farm dams, rather than applying a constant fraction. This has resulted in a decrease in emissions from grazing animals (beef cattle pasture, sheep, goats) in the Manure Management category. There is also a new emissions factor for emissions from urine and dung deposited by grazing animals, based on where animals are grazing – in dry or wet climate zones. The resulting decrease in these emissions is captured in the Agricultural Soils category.

In addition to changes in methods, there have also been changes in activity data. In particular, the Australian Bureau of Statistics continues to update their sheep and cattle time-series population

data, with the new 'experimental' methods incorporating multiple data sources and replacing the previous data based on annual surveys. The impact of updated population data on emissions compared to previous inventories is very small.

Activity data for land conversion, re-clearing and regrowth that underpin emissions from LULUCF have not been updated since the 2022 Inventory. This is because DCCEEW are updating methods to monitor forest cover change, and the scale and complexity of these changes mean they are not yet complete. The incorporation of these methods into future inventories may impact emissions attributed to the red meat sector, but the scale and direction of these potential changes is unknown.

Changes to allocation of emissions to the red meat sector

There have been minor changes this year in how emissions from cropping are attributed to beef cattle in feedlots. Previously, the proportion of cropland emissions attributed to feedlot cattle was based on the total area of cropland required (Wiedemann et al. 2017), with a fixed proportion applied to all cropland emissions. In the current inventory, emissions from specific crop types are attributed to feedlot cattle wherever they are listed individually in the National Inventory (i.e., for crop residues and some fertiliser-related emissions). The change in emissions attributed to the red meat sector is very small. This approach could be further refined in future years based on updated data on feedlot diet composition.

Table 4. A summary of relevant changes to national inventory calculations in 2023-24 and planned improvements described in the National Inventory report (Australian Government 2026b).

Source	Changes this year	Planned improvements
Enteric methane	• New sheep flock time-series data	• Review methods and parameters to estimate enteric methane from sheep • Periodic review of feed and animal characteristics • Review of feedlot cattle activity data • Estimation of abatement from feed technologies
Manure management	• New method for calculating manure methane emissions from grazing livestock	• Revise method to calculate N_2O emissions from manure mass
Agricultural soils	• New emissions factors for urine and dung deposited from grazing animals • Updated method for allocating manure from grazing livestock to pasture or farm dams • Updated method to allocate fertiliser use to production systems • Revisions to soil carbon losses for N mineralisation • Introduction of state-based emissions factors for emissions from crop residues	• Improved source data on emissions factors for inorganic fertilisers • Consider disaggregation of emissions factors for urea and non-urea fertilisers • Investigate state-based emissions factors for urine and dung deposited by grazing animals and animal waste applied to soil
Field burning ag residues	None	None
Liming	• Activity data from 2017 has been extrapolated to reflect increasing use of agricultural lime	• Alternative sources of activity data will be investigated
Urea application	None	• Investigate use of country specific emissions factors
Forest land	• Updated climate and fire time series data • Refinements to non-temperate fire model in FullCAM	• Improved calibrations for forest growth and disturbance • Improved methods to measure forest cover change
Cropland	• Updated climate and fire time series, crop and grass yields	• Refined spatial allocation of crop species and yields • Improved modelling of below ground debris pool • Improved estimated of tillage impacts • Review of stubble management practices
Grassland	• Updated climate and fire time series, crop and grass yields • Refinements to non-temperate fire model in FullCAM, particularly the savanna grassland component	• Improvements to FullCAM model including spatialisation of grass yields and improvements in grazing pressure mechanism • Improved resolution of forest change data • Improved calibrations for forest growth and disturbance
Wetlands (ponded pasture)	• Updated climate and fire time series data	• Improvements to reservoir model

4. Results

4.1 Emissions reported using GWP100 values

Total net greenhouse gas emissions attributable to the red meat industry in 2024 were 58.3 Mt CO_2-e, and 12% of national greenhouse gas emissions (Table 5). Since 2005, emissions from the red meat industry have decreased, both in absolute terms (by 61% and 92 Mt CO_2-e), and as a proportion of national emissions. Net emissions from the red meat industry have also decreased by 11 Mt CO_2-e between 2023 and 2024. In both cases, the decrease in emissions is driven by decreased emissions from land use, land use change and forestry – particularly in Queensland and New South Wales. Long-term trends are associated with a decline in land conversion (from forest land to other uses) and regrowth of forest on previously cleared land. In more recent years, changes in emissions are driven by climate impacts, and carbon stocks in vegetation peaked in 2021 and 2022 due to wet conditions associated with La Niña.

Table 5. Greenhouse gas emissions from the Australian red meat sector. Values are Mt CO_2-equivalents calculated using GWP100 values from the AR5 report.

Source	2005	2020	2021	2022	2023	2024
Agriculture	53.4	48.2	50.6	51.2	53.9	54.1
Enteric fermentation	*48.4*	*43.0*	*45.2*	*45.7*	*48.2*	*48.5*
Manure management	*1.21*	*1.20*	*1.22*	*1.28*	*1.32*	*1.38*
Agricultural soils	*3.43*	*3.41*	*3.48*	*3.55*	*3.71*	*3.53*
Field burning of agricultural residues	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*
Liming and urea	*0.42*	*0.61*	*0.66*	*0.69*	*0.73*	*0.61*
Land use, land use change and forestry	93.9	4.52	-19.2	-17.8	12.5	1.52
Energy	3.01	2.61	2.54	2.61	2.63	2.65
Farm and feedlot	*1.55*	*1.40*	*1.45*	*1.47*	*1.55*	*1.56*
Processing	*1.46*	*1.21*	*1.09*	*1.14*	*1.08*	*1.09*
Total red meat emissions	**150**	**55**	**34**	**36**	**69**	**58**
Total national emissions	608	477	440	444	485	466
Proportion total national emissions (%)	25	12	8	8	14	12

On a species basis, the majority (84%) of emissions attributed to the red meat industry are from beef cattle production (Table 6 and 7), reflecting the large volume of enteric methane produced and area of land used for grazing. This is supported by the dominance of on-farm emissions, compared to those from feedlots and processing (Table 8).

Table 6. Greenhouse gas emissions from the Australian red meat sector by species in 2024. Values are Mt CO_2-equivalents calculated using GWP100 values from the AR5 report.

Source	Beef cattle	Sheep meat	Goats
Agriculture	43.4	10.6	0.07
Enteric fermentation	*39.0*	*9.44*	*0.06*
Manure management	*1.21*	*0.17*	*0*
Agricultural soils	*2.71*	*0.82*	*0.01*
Field burning of agricultural residues	*0.02*		
Liming and urea	*0.42*	*0.19*	
Land use, land use change and forestry	3.59	-2.04	-0.03
Energy	1.9	0.75	
Total emissions per species	**48.9**	**9.33**	**0.05**
Proportion of red meat emissions (%)	84	16	<1

Table 7. Greenhouse gas emissions from the Australian red meat sector by species. Values are Mt CO_2-equivalents calculated using GWP100 values from the AR5 report.

	2005	2020	2021	2022	2023	2024
Beef	129	47.3	29.6	30.3	60.2	48.9
Sheep meat	20.8	7.97	4.29	5.70	8.75	9.33
Goats	0.19	0.07	0.02	0.02	0.07	0.05

Table 8. Greenhouse gas emissions from the Australian red meat sector by species. Values are Mt CO_2-equivalents calculated using GWP100 values from the AR5 report.

	2005	2020	2021	2022	2023	2024
Farm	147	52.7	31.4	33.3	66.3	55.4
Feedlot	1.74	1.44	1.45	1.54	1.61	1.71
Processing	1.46	1.21	1.09	1.14	1.08	1.09

Across all livestock types, enteric methane fermentation was the major source of emissions in 2024, contributing 48 Mt CO_2-e (Table 5). The majority (78%) of enteric methane emissions are from grazing beef cattle (37.9 Mt CO_2-e, Table 6). Enteric methane emissions from sheep meat are also an important contributor (9.4 Mt CO_2-e), whilst emissions from feedlot cattle (1 Mt CO_2-e) and goats (0.06 Mt CO_2-e) are minor.

The volume of emissions from enteric methane and manure management is directly related to national herd and flock sizes, which have been increasing since 2020 (Table 9).

While total sheep numbers were substantially higher in 2005 compared to 2024, emissions are reported here for the portion associated with sheep meat production. In 2005, 50% of sheep emissions were associated with meat production, and this has risen to 67% in 2024 following an increase in the volume of lambs slaughtered. Lamb slaughter rates peaked in 2024 as producers started to sell off animals in response to dry seasonal conditions. The Common Accounting Framework (Sevenster *et al.* 2023) allows for an accounting period of 2-3 years for sheep and cattle production to reflect the production lag between good or bad seasons and stock numbers (Appendix 8.3).

Table 9. Livestock numbers and red meat production. Population data is from the National Inventory activity tables (Australian Government 2026a) and livestock products are from Australian Bureau of Statistics (2026) and Australian Wool Innovation Ltd (2026). Volume of goat meat produced is not reported by the ABS.

	2005	2020	2021	2022	2023	2024
Beef						
Beef cattle pasture (million head)	26.4	24.2	25.3	25.4	26.7	26.9
Beef cattle feedlot (million annual equivalents[1])	0.82	1.11	1.06	1.19	1.17	1.34
Beef produced[2] (million tonnes)	2.13	2.35	1.92	1.87	2.00	2.38
Sheep						
Total sheep (million head)	101	66.1	74.3	76.8	77.9	75.0
Lamb & mutton produced (million tonnes)	0.59	0.69	0.66	0.68	0.78	0.92
Wool produced (greasy)	0.48	0.28	0.29	0.31	0.32	0.32
Goats						
Total goats (million head)	0.46	0.46	0.46	0.46	0.46	0.46

[1] Number of animals adjusted for days on feed; [2] Excluding veal

4.2 Emissions reported using alternative metrics

The Paris Agreement Inventory reports emissions using GWP100 values from the AR5 report, and it is recommended that MLA also use these values in reporting emissions from the red meat industry until the National Inventory adopts the AR6 report GWP100 values.

Emissions from the red meat sector were calculated using alternative climate metrics (Table 3) for the Agriculture category only since DCCEEW does not disaggregate the LULUCF emissions by economic sector emissions by gas type. GWP* values are not available for 2005 as 20 years of data is required for the calculation. These are therefore reported from 2020 onwards.

Across the GWP and GTP metrics, emissions from the Agriculture category are strongly influenced by enteric methane emissions, and therefore animal numbers. Emissions show consistent trends and are similar in 2005 and 2024 for GWP100 (AR5, A56), GWP20, GTP100 and GTP20 (Table 10). Values are higher when a shorter time period is used (e.g., GWP20 compared to GWP100), and the GTP values are lower than GWP. GWP100 emissions calculated using the AR6 values are slightly smaller compared to those calculated using AR5 values because methane emissions are higher than those from CO_2 and N_2O.

Table 10. Agriculture greenhouse gas emissions (excluding LULUCF and energy) from the red meat industry expressed using different climate metrics. Values for GWP and GTP are calculated using values from Table 3. GWP values for 2005 were unable to be calculated due to insufficient timeseries data.*

Metric	Unit	2005	2020	2021	2022	2023	2024
GWP100, AR5	Mt CO_2-e	53.4	48.23	50.6	51.2	53.9	54.1
GWP20, AR5	Mt CO_2-e	152	136	143	144	152	153
GTP100, AR5	Mt CO_2-e	10.7	10.2	10.6	10.8	11.3	11.2
GTP20, AR5	Mt CO_2-e	122	110	115	116	123	123
GWP100, AR6	Mt CO_2-e	51.8	46.8	49.0	49.7	52.3	52.4
GWP*	Mt CO_2-e		-12.3	-0.30	1.22	22.0	17.6
Radiative forcing	mW/m^3	3.55	4.44	4.46	4.48	4.52	4.56

Most CH_4 emissions from the red meat industry are from enteric fermentation, and there has been a slight increase in total CH_4 emissions from the red meat industry between 2020 and 2024 in response to increasing numbers of both cattle and sheep (Table 11). As a short-lived but powerful climate pollutant, reductions in CH_4 are important to reduce global warming and support targets set by the Global Methane Pledge to reduce global CH_4 emissions by 30% of 2020 levels by 2030. Methane emissions from the LULUCF category (unable to be reported here) are mostly from biomass burning (wildfires and controlled burns) with small contributions from flooded pastures.

Table 11. Methane, nitrous oxide and carbon dioxide emissions from the red meat sector. Emissions are from the Agriculture category only. CO2-e are calculated using GWP100 values from AR5 as per Table 3.

Gas	Unit	2005	2020	2021	2022	2023	2024
Methane	Mt, raw gas	1.76	1.57	1.65	1.66	1.75	1.77
Carbon dioxide	Mt, raw gas	0.42	0.61	0.66	0.69	0.73	0.61
Nitrous oxide	Mt, raw gas	0.01	0.01	0.01	0.01	0.02	0.01
Methane	Mt, CO_2-e	49.3	43.9	46.1	46.6	49.1	49.5
Carbon dioxide	Mt, CO_2-e	0.42	0.61	0.66	0.69	0.73	0.61
Nitrous oxide	Mt, CO_2-e	3.70	3.75	3.81	3.91	4.06	3.93

Large scale reductions in CH_4 emissions will require activities that reduce enteric CH_4 production. While options to reduce enteric emissions (e.g., feed additives) are starting to become available, financial and technical barriers to their implementation still exist, especially in extensive grazing systems. In addition, methodologies will be required to recognise and account for the impact of such interventions on direct enteric methane if these advancements are to be reflected in the National Inventory's reporting of the sector. DCCEEW have flagged inclusion of abatement technologies as a planned improvement, though this depends on the availability of adequate supporting data (Australian Government 2026b).

Nitrous oxide emissions are mostly from the degradation of animal waste and crop residues and the application of fertiliser to crops and pasture. Carbon dioxide emissions are associated with fossil fuel combustion (e.g., in farm machinery) and land use changes.

5. Conclusion

5.1 Key findings

- Net greenhouse gas emissions attributable to the Australian red meat industry in 2024 were 58.3 Mt CO_2-e, representing 12% of Australia's national emissions
- Emissions attributable to the red meat industry have fallen by 61% since 2005 (from 150 to 58 Mt CO_2-e), largely due to reduced emissions associated with land conversion in the LULUCF category
- More recent changes in emissions from red meat production are due to changes in cattle and sheep population numbers in response to climate conditions
- Enteric methane remains the dominant emissions source at 48.5 Mt CO_2-e, accounting for 83% of emissions from the red meat sector

5.2 Benefits to industry

Annual reporting of greenhouse gas emissions from red meat production enables MLA, and the industry more broadly, to identify the main sources of emissions, prioritise areas for further RD&E, and monitor changes over time.

6. Future research and recommendations

The following limitations of the method used to attribute emissions from the National Inventory to the red meat industry have been identified based on the Common Approach to Sector-Level Greenhouse Gas Accounting for Australian Agriculture report (Sevenster *et al.* 2023). Research and funding to address these limitations would increase the accuracy of the red meat industry greenhouse gas footprint.

- Emissions attributable to the red meat industry in this report are incomplete due to data limitations, with specific gaps identified in the chart of accounts in Appendix 8.2. Of the emissions not included, emissions from transport should be prioritised as they are likely to be the largest source of additional emissions.
- Emissions from energy and the area of cropland used to support cattle in feedlots are based on historic life cycle assessments (Wiedemann *et al.* 2017; Wiedemann *et al.* 2016; Wiedemann *et al.* 2015). The efficiency of these systems is likely to have changed since the assessments were completed. More current data would enable these improvements to be captured in reporting of emissions, though the impact on total emissions associated with red meat production would be small.
- Data on where and how goats are managed is scarce. Better data on goat populations and the volume of goat meat produced would enable more complete reporting of emissions associated with the goat industry.

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8. Appendix

8.1 Common acronyms used in this report

ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
ABS	Australian Bureau of Statistics
AR5	IPCC Fifth Assessment Report
CH_4	Methane
CO_2	Carbon dioxide
CO_2-e	Carbon dioxide equivalent
GTP	Global Temperature Potential
GWP	Global Warming Potential
IPCC	Intergovernmental Panel on Climate Change
LULUCF	Land use, land use change and forestry
N_2O	Nitrous oxide
UNFCCC	United Nations Framework Convention on Climate Change

8.2 Chart of accounts for red meat greenhouse gas emissions

The following chart of accounts is based on the Common Approach to Sector-Level Greenhouse Gas Accounting for Australian Agriculture (Sevenster *et al.* 2023).

GHG Flux	Category	Source category	Item	Scope	Included in this assessment
Emissions	Agriculture	Enteric fermentation	CH4 emissions from enteric fermentation	1	Yes
		Manure management	CH4 emissions from manure management	1	Yes
			N2O emissions from manure management (direct)	1	Yes
			N2O emissions from manure management, atmospheric deposition (indirect)	1	Yes
			N2O emissions from manure management, leaching and run off (indirect)	1	Yes
		Agricultural Soils (direct)	N2O emissions- fertilisers (inorganic, organic) applied to crop	1	Yes
			N2O emissions- animal waste and sewage sludge applied to crop	1	Yes
			N2O emissions- fertilisers (inorganic, organic) applied to pasture	1	Yes
			N2O emissions- animal waste and sewage sludge applied to pasture	1	Yes
			N2O emissions- urine and dung deposited by grazing animals	1	Yes
			N2O emissions- crop residue (crops and pastures)	1	Yes
			N2O emissions from cultivation of histosols (if relevant)	1	Yes
			N2O emissions- mineralisation due to loss of soil organic carbon from cropland remaining cropland	1	Yes
		Agricultural soils (indirect)	N2O emissions – Deposition	1	Yes
			N2O emissions – Leaching and run off	1	Yes
		Residue burning	CH4 and N2O emissions from field burning of stubble	1	Yes
		Application of lime and urea	CO2 emissions - lime and urea application	1	Yes
	Energy & materials	Inputs for agricultural processes	CO2-e emissions on farm fuel use for pasture management and crop and forage production (for tractors, agricultural aircraft, harvester, etc.)	1	Yes
			CO2-e emissions grid-supplied electricity	2	Yes
			CO2-e emissions grid-supplied electricity (pre-combustion)	3	Yes
			CO2-e emissions for feed produced off farm	3	Partial. Feedlots only
			CO2-e emissions embedded in farm inputs (fertiliser, pesticides, fuel, etc.)	3	No
			CO2-e emissions transport of fuel, fertilisers, pesticides, and other inputs to farm	3	No
			CO2-e emissions-services (insurance, consultants, etc.)	3	No

	LULUCF	Forestland converted to cropland	CO2 emission due to change in soil carbon	1	Yes
			CO2 emission due to change in live biomass	1	Yes
			CO2 emission due to change in dead organic matter	1	Yes
			CO2-e emissions due to controlled burning	1	Yes
			N2O emissions- N mineralisation associated with a change in soil organic matter	1	Yes
			N2O emissions-Leaching and run-off from mineralised N	1	Yes
		Forestland converted to grassland	CO2 emission due to change in soil carbon	1	Yes
			CO2 emission due to change in live biomass	1	Yes
			CO2 emission due to change in dead organic matter	1	Yes
			CO2-e emissions due to controlled burning	1	Yes
			N2O emissions- N mineralisation associated with a change in soil organic matter	1	Yes
			N2O emissions-Leaching and run-off from mineralised N	1	Yes
			CH4, and N2O emissions from savanna burning	1	Yes
		Wetlands converted to cropland	CO2-e emissions wetlands converted to cropland (crops and temporary pasture)	1	Yes
		Wetlands converted to grassland	CO2-e emissions wetlands converted to grassland (permanent pasture)	1	Yes
		Cropland remaining cropland	CO2 emission due to change in soil organic carbon (crops and temporary pasture)	1	Yes
		Wetlands remaining wetlands	CH4 emission from other Constructed Water Bodies (dams)	1	Yes
		Grassland remaining grassland	CO2 emission due to change in soil organic carbon (permanent pasture)	1	Yes
			CO2-e emissions -Sparse woody vegetation transition (permanent pasture)	1	Yes
			CO2-e emissions due to controlled burning (permanent pasture)	1	Yes
			N2O emissions-N mineralization (direct) (permanent pasture)	1	Yes
			N2O emissions-N mineralized, leaching and run off (indirect) (permanent pasture)	1	Yes
			CH4, and N2O emissions from savanna burning	1	Yes
	Capital goods & services		CO2-e emissions-capital goods on farm and off-farm storage (equipment, tractor, sheds, harvester, etc.)	3	No
			CO2-e emissions-capital goods on manufacturing stages (equipment, sheds, chiller, etc.)	3	No
	Waste treatment		CO2-e emissions from all off-farm solid waste disposal (transport, composting, landfill)	3	No
			CO2-e emissions from all on-farm solid waste disposal (transport, spreading, composting)	1	No

			CO2-e emissions from all wastewater disposal and treatment during manufacturing	3	No
	Energy & materials	Post farm processing	CO2-e emissions fuel use	3	Partial
			CO2-e emissions electricity use	3	Yes
			CO2-e emissions embedded in fuel used	3	Partial
			CO2-e emissions embedded in electricity supply chain	3	Partial
			CO2-e emissions embedded in material inputs (packaging, ingredients, etc)	3	No
			CO2-e emissions embedded in capital goods	3	No
			CO2-e emissions embedded in services	3	No
Removals	LULUCF	Cropland converted to forestland	CO2 removal due to change in soil organic carbon	1	Yes
			CO2 removal due to change in living biomass	1	Yes
			CO2 removal due to change in dead organic matter	1	Yes
		Grassland converted to forestland	CO2 removal due to change in soil organic carbon	1	Yes
			CO2 removal due to change in living biomass	1	Yes
			CO2 removal due to change in dead organic matter	1	Yes
		Cropland remaining cropland	CO2 removal due to change in soil organic carbon (crops and temporary pasture)	1	Yes
		Grassland remaining grassland	CO2 removal due to change in soil organic carbon (permanent pasture)	1	Yes

8.3 Supporting evidence and additional results

8.3.1 Two- and three-year time series of emissions

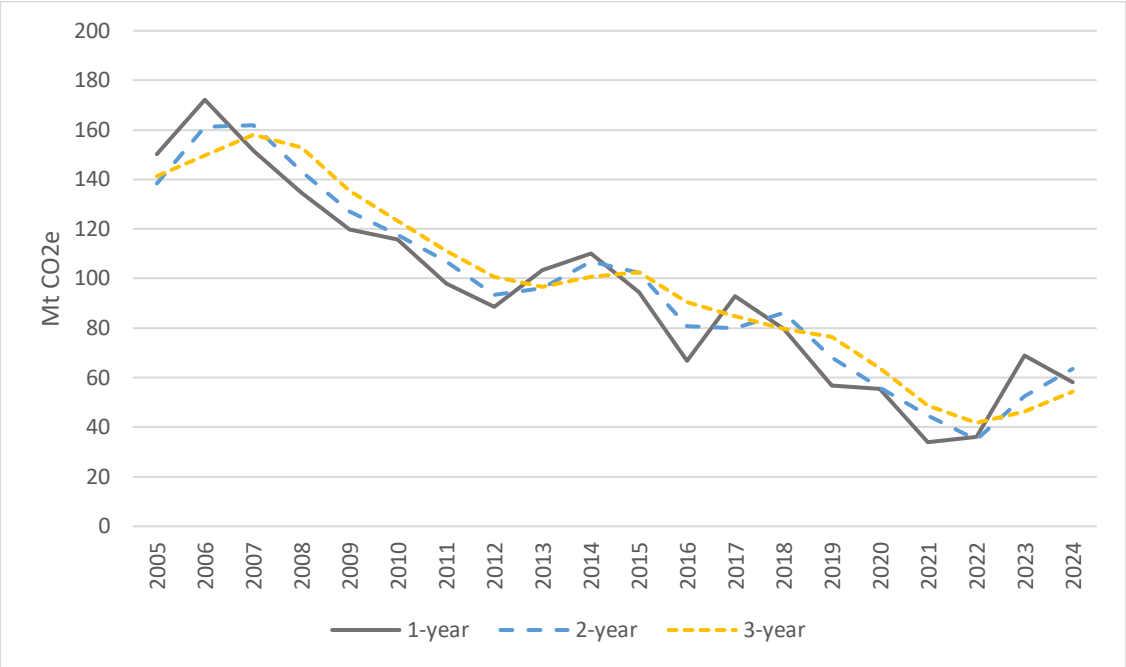


Figure 1. Net greenhouse gas emissions attributed to the red meat industry presented as annual values or 2- and 3-year rolling averages.

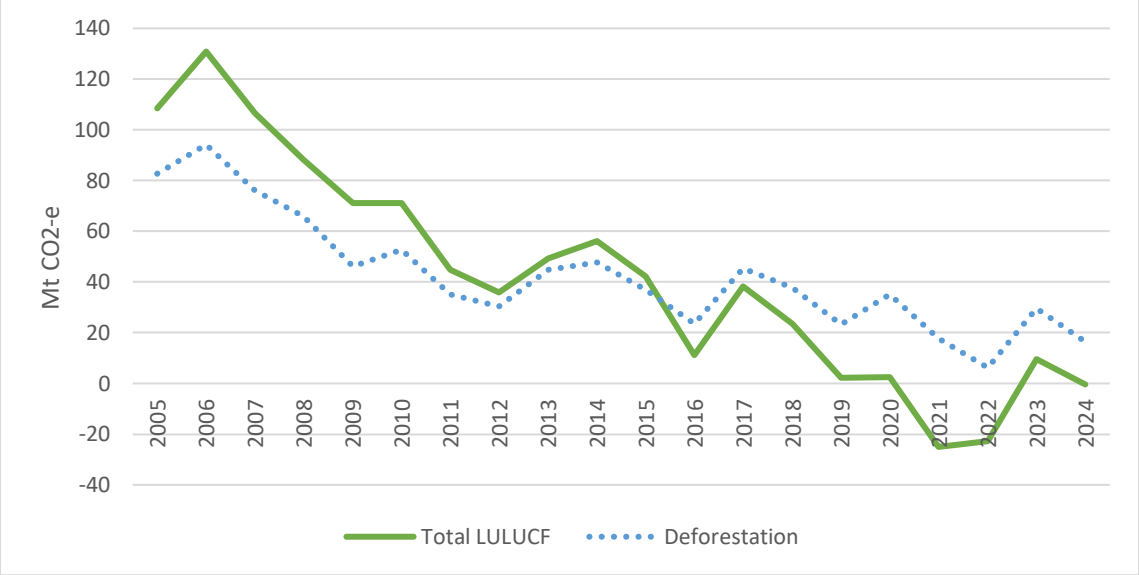


Figure 2. National LULUCF and deforestation emissions from grazing lands. Data is from the National Inventory by Economic Sector data tables (Australian Government 2026a) and is for all grazing systems, not just those associated with red meat production.

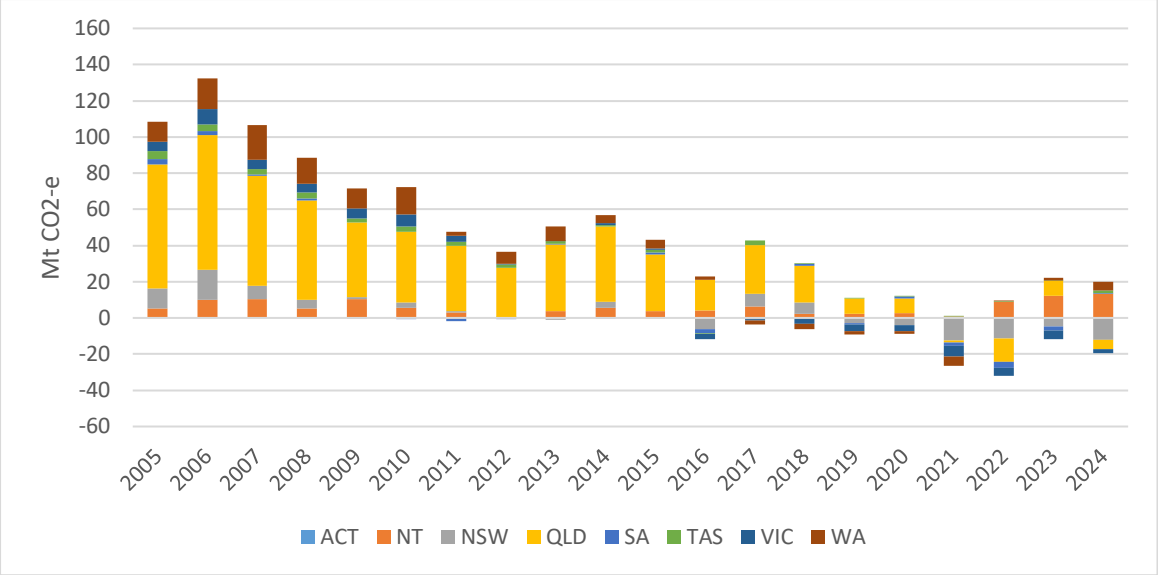


Figure 3. State and territory emissions from LULUCF on grazing lands. Data is from the National Inventory by Economic Sector data tables (Australian Government 2026a) and is for all grazing systems, not just those associated with red meat production.

8.3.2 Net emissions for sheep meat & wool

Table 12. Greenhouse gas emissions from sheep production in Australia – excluding emissions associated with the harvest and processing of wool. Values are Mt CO_2 equivalents calculated using GWP100 values from the AR5 report.

Source	2005	2020	2021	2022	2023	2024
Agriculture	21.2	13.9	15.6	16.2	16.4	15.8
Enteric fermentation	19.1	12.3	13.9	14.4	14.6	14.0
Manure management	0.34	0.22	0.25	0.26	0.26	0.25
Agricultural soils	1.58	1.10	1.20	1.24	1.26	1.21
Field burning of agricultural residues	0.00	0.00	0.00	0.00	0.00	0.00
Liming and urea	0.19	0.27	0.29	0.30	0.32	0.28
Land use, land use change and forestry	189	-2.54	-9.80	-7.95	-3.82	-3.02
Energy	1.20	0.90	0.94	0.95	0.98	0.97
Farm	*0.32*	*0.27*	*0.25*	*0.25*	*0.26*	*0.28*
Processing	*0.88*	*0.62*	*0.69*	*0.70*	*0.72*	*0.69*
Total sheep emissions	41.4	12.3	6.76	9.16	13.6	13.7

8.3.3 Impact of updated livestock population data on emissions

Calculation of livestock emissions in the National Inventory are underpinned by population data from the Australian Bureau of Statistics. The ABS is currently updating how they estimate livestock populations, replacing the previous survey-based method with a new approach that draws on more robust datasets including levy-payer and NLIS data. Updated population data is currently published as 'experimental' values and continues to be updated. Revisions of sheep and cattle population data between publication of the 2023 and 2024 National Inventory reports has led to very small adjustments in published emissions. Changes in enteric methane emissions are shown below as an example.

Table 13. Change in enteric methane emissions from sheep (inclusive of meat and wool production) between the 2023 and 2024 National Inventories.

Year	2023 inventory (Mt CO_2-e)	2024 inventory (Mt CO_2-e)	Change (Mt CO_2-e)	Change (%)
2005	19.0	19.1	0	0
2020	12.5	12.3	-0.2	-2%
2021	13.4	13.9	+0.5	+4%
2022	13.8	14.4	+0.6	+4%
2023	14.3	14.6	+0.3	+2%