Final Report

AMPC
AUSTRALIAN MEAT PROCESSOR CORPORATION

Developing a sustainability assessment framework and strategy

Project Code
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1.0 Executive Summary

This report summarises the Thomas Foods International Consolidated Pty Ltd (TFI) carbon management project. This included a comprehensive baseline for the financial year 1 July 2022 to 30 June 2023. This assessment encompassed the carbon account (inclusive of scope 1, 2 and 3 emissions) and product carbon footprint results for TFI's Australian operations including red meat processing and distribution, separate to Thomas Cappo Seafoods and TFI USA. The analysis included an assessment of the product carbon footprint of beef, sheep meat and goat meat, measured at up to four points in the supply chain: liveweight at farm gate exit (& feedlot where relevant), boxed beef at exit from primary processing, and boxed beef at the point of transfer to the customer at the distribution centre in the port city destination. Additionally, selected energy and water data were reported according to the sustainability framework established by the company.

The assessment utilised National Greenhouse Gas (GHG) Inventory methods for determining livestock emissions, National Greenhouse Accounts and previous publications. The product carbon footprint was determined following the methods outlined in the ISO Standard 14067:2018 (ISO 2018) and LEAP (LEAP 2015a, 2015b). The carbon account was completed with reference to GHG Protocol guidelines.

Results

The business has a moderate scope 1 and 2 carbon account and a large scope 3 account, in relative terms for major corporate businesses (Table 1).

The primary source of Scope 1 emissions for FY 2022-23 was enteric methane from beef and sheep at the feedlot and farms owned by the company. Scope 1 and 2 emissions from the processing plants were also major emission sources.

Scope 3 emissions were predominantly from purchased livestock for processing or finishing in the company feedlot. Purchased sheep meat (lamb and mutton) contributed 64% of scope 3 emissions with other major contributions arising from purchased beef (direct purchase for feedlot finishing, processing, and boxed purchases) and goat purchases.

Of the scope 1, 2 and 3 account, scope 1 contributed 3% of emissions, scope 2 contributed 1.1% and scope 3 contributed 95.9%. This emissions profile is not unusual for meat businesses due to the relatively high carbon footprint (CF) of purchased livestock, compared to emissions from processing. However, it is more unique in the broader corporate business context, where scope 3 emissions are typically smaller.

The large contribution of scope 3 emissions was due to the high emissions arising from livestock. Land use (LU) and direct land use change (dLUC) emissions and removals were assessed for TFI owned facilities and resulted in minimal changes to the carbon account (<0.5%), but were subject to higher levels of uncertainty. Future practice changes have been made to increase soil carbon and measure this under an ACCU Scheme project, which should result in greater removals in the future.

Of those suppliers surveyed, there was notable variation caused by flock productivity and a breed effect, where shedding sheep tended towards higher CFs where dual purpose sheep had lower CFs due to impacts being allocated across both meat and wool.

Table 1. Carbon account and carbon footprint results FY 2022-23

Scope 1 & 2	Scope 3	Product carbon footprint – sheep meat
t CO_2-e	t CO_2-e	kg CO_2-e kg LW

131,605	3,097,419	6.6

With respect to the carbon footprint, boxed beef from the business had emissions of 25.4-30.3 kg CO_2-e kg boxed product ready for export, with the range reflecting differences in the production system.

The average impacts of boxed lamb were 14.4 kg CO_2-e kg boxed product ready for export. Impacts varied slightly between processing plants, largely reflecting variation in the production efficiency between the plants.

Emission reduction pathways and consumer survey

A scenario analysis was undertaken for the business with a series of strategies focused on scope 1 and 2, and scope 3 emission reductions.

The scenario pathways were created using a comprehensive approach that included screening and shortlisting of 44 potential emission reduction options. These options were evaluated based on their technical and economic feasibility, potential impact, and alignment with Thomas Foods International Consolidated Pty Ltd's strategic goals. The shortlisting process identified key strategies for scope 1 and 2 pathways including energy efficiency in processing, implementing low methane supplements, and enhancing removals via soil carbon sequestration. These scenarios are the first step towards more detailed plans. Given the size and scale of the emission reduction task and the complexity of reducing agricultural emissions, achieving short-term abatement will be more difficult than for businesses primarily dealing with energy-related emissions.

Scope 3 emission reduction is more complex as it relates to emission reduction on thousands of supplier farms. While the full cost of this cannot be carried by the meat processing company, there is a key role to play in co-ordinating activities, managing funding for decarbonisation, and in measuring, monitoring and verifying (MMV). This is a major undertaking in the large and complex supply chain managed by TFI.

Research was conducted as part of the project on consumer attitudes and interest in carbon in the USA market. The findings showed that consumers favoured terms such as "reduced emissions" or "reduced carbon" and preferred natural feed additives.

Conclusions and recommendations

The present analysis provides Thomas Foods International Consolidated Pty Ltd with a comprehensive carbon account and a product carbon footprint based on best practice methods. This analysis is a suitable starting point for corporate reporting and disclosure requirements though further work will be required to model temperature impacts and in climate risk management which was out-of-scope in the present study.

The project began the important work of engaging suppliers in emission reduction and this work will be vital for the future success of decarbonisation. Market support, via co-funding or premium market access, is vital for delivering a supply chain decarbonisation program into the future. Considering stakeholder sentiment, this is likely to be a long-term initiative beginning with change that focuses on dual benefits for productivity and carbon reduction.

The following summary of key recommendations were made based on the findings of the report:

- Implement emission reduction strategies.
- Enhance producer engagement.
- Expand carbon sequestration projects.
- Regularly review and update sustainability framework.
- Set emission reduction targets.

2.0 Introduction

Thomas Foods International Consolidated Pty Ltd (TFI) is a meat processing and distribution company that grows, supplies, and distributes meat and seafood globally to 85 countries. The company is an Australian-owned family business, with both domestic and international operations in North America, Europe, UK, China, and Japan.

The company recognises the need to assess, report and reduce environmental impacts to meet customer expectations and new regulatory requirements in Australia. This ultimately covers the full supply chain, from production to processing, and post-port operations.

In order to create a common understanding for the company, TFI established a Sustainability and Innovation working group, and in conjunction with Integrity Ag, set a draft sustainability framework in early 2023. The sustainability framework outlined key indicators for GHG emissions, energy, water and waste, with the focus most strongly on GHG emissions in response to customer requirements and emerging regulation. This report presents the sustainability framework, the carbon baseline for the company and the emission reduction plan developed as part of an AMPC co-funded project.

3.0 Project Objectives

The project objectives as specified in the signed Agreement are as follows:

1. Develop an endorsed sustainability framework and emission reduction strategy for the Thomas Foods International Consolidated Pty Ltd and the Australian supply chain to meet existing and expected customer requirements; guide data capture and reporting to meet company and customer needs and implement this in the TFI supply chain.
2. Determine the carbon account (inventory) and carbon footprint of the TFI facilities and supply chain (scope 1, 2 and 3 emissions) through to the end customer, engaging producers, processing plants and post-processing. At the supplier farm level, implement a system to enable data provision and tracking of improvements in emissions over time towards a carbon neutral target by 2030.
3. Develop a net emission reduction strategy and trial options to reduce net emissions on selected, proactive farms and in collaboration with research organisations. Specifically, this will include a commercial trial using novel feed supplements for goat, lambs and cattle, and a wide range of other options may also be considered (subject to revision of project scope and budget approval).
4. Gather consumer insights to inform the development and commercialisation of new products featuring low / no carbon and / or climate positive net impacts. Exact market(s) to be determined based on consumer market research findings.
5. Develop a reporting platform and strategy that aligns with internal and external communication needs. This will include developing a public-facing report that will summarise key elements of the sustainability strategy, deliver results from the sustainability assessment (GHG, energy, water, waste etc.), and showcase proactive steps being taken to reduce emissions, together with any other actions or goals proposed for the future.

4.0 Methodology

The project was implemented in four major stages.

Stage 1 included establishment of the Sustainability Framework and company working group, and early-stage engagement of livestock suppliers.

Stage 2 involved a detailed data collection project within TFI to identify and collect all necessary data for the project.

Stage 3 involved implementing a net emission reduction pilot at one TFI farm, Mount Schanck. A series of workshops followed to engage farmers throughout the supply region to collect information on carbon footprints of lamb and goat, and to engage farmers around emission reduction.

Stage 4 involved analysis of the carbon account and carbon footprint, development of emission reduction scenarios, testing consumer sentiment with respect to carbon branding of red meat products, and reporting.

The carbon baseline assessment for the TFI consolidated group, with the exclusion of TFI's Asia, UK and European entities, was completed for financial year 1 July 2022 to 30 June 2023. This assessment included the carbon account (inclusive of scope 1, 2 and 3 emissions) and product carbon footprint results of the main products. The analysis included assessment of the product carbon footprint of beef, measured at four points in the supply chain: liveweight at farm & feedlot exit ('farm gate'), boxed beef at exit from primary processing, and boxed beef at the point of transfer to the customer at the distribution centre in the port city destination. Additionally, selected energy and water data were reported according to the sustainability framework established by the company.

The assessment utilised National Greenhouse Gas (GHG) Inventory methods for determining livestock emissions, National Greenhouse Accounts and previous publications. The product carbon footprint was determined following the methods outlined in the ISO Standard 14067:2018 and LEAP (LEAP 2015b, 2015a).

4.1 Project scope

The carbon baseline assessment for the TFI consolidated group, with the exclusion of TFI's Asia, UK and European entities, was completed for financial year 1 July 2022 to 30 June 2023. This assessment included the carbon account (inclusive of scope 1, 2 and 3 emissions) and product carbon footprint results of the main products including beef, sheep meat and goat meat. Impacts were measured at four points in the supply chain: liveweight at farm & feedlot exit ('farm gate'), boxed beef at exit from primary processing, and boxed beef at the point of transfer to the customer at the distribution centre in the port city destination. Additionally, selected energy and water data were reported according to the sustainability framework established by the company.

We report carbon account and carbon footprint emissions using reference units that are aligned with the post-processing stage. The carbon account was reported as metric tonnes of CO_2-e. The carbon footprint was reported at kilograms of CO_2-e per kilogram of liveweight at the farm gate, and kilograms of CO_2-e per kilogram of boxed product at the processing gate and delivery to the USA customer.

4.2 Selection of environmental indicators

The selected environmental indicators reported here for the supply chain analysis align with those endorsed for 2023/24 in the draft TFI Sustainability Framework and those that were in-scope for the project. Most indicators in the current year focus on GHG accounting to align with customer requirements and new regulations. In addition to carbon indicators, supply chain energy and water indicators were also measured using LCA methodology, following ISO 14040/44 and previously published methods by the author (Wiedemann et al. 2015). The final framework is subject to ongoing review with key stakeholders and is intended to be an evolving tool to meet current and future company and stakeholder needs.

4.3 GHG calculation methods

Climate change impacts were modelled as the amount of greenhouse gas emissions (GHG) throughout the supply chain using the business accounting framework (scope 1, 2, 3 emissions, see below).

The impacts were then converted to carbon dioxide equivalent units (CO_2-e) for 100-year global warming potentials (GWP_{100}) using AR6 values of 273 for N_2O and 27 for methane.

Emissions were disaggregated into scope 1, scope 2 and scope 3 sources (Figure 1) according to the GHG Protocol (Ranganathan et al. 2004). These emission sources are described as follows:

- Scope 1: “Direct GHG emissions occur from sources that are owned or controlled by the company.”
- Scope 2: “Accounts for GHG emissions from the generation of purchased electricity consumed by the company.”
- Scope 3: “Are a consequence of the activities of the company but occur from sources not owned or controlled by the company. Some examples of scope 3 activities are extraction and production of purchased materials; transportation of purchased fuels; and use of sold products and services.” These can be further broken down into two sources.
    - Upstream emissions: This included emissions from all purchased inputs, including primary production of purchased livestock, purchased feed, packaging, chemicals, and fuel. All major emission sources were included in the present analysis.
    - Downstream emissions: Where livestock were processed by other companies as a “toll kill” these impacts were included. Transport impacts were included to the USA through to the facility gate but did not extend to customer and consumer. Transport to markets other than the USA was not included.

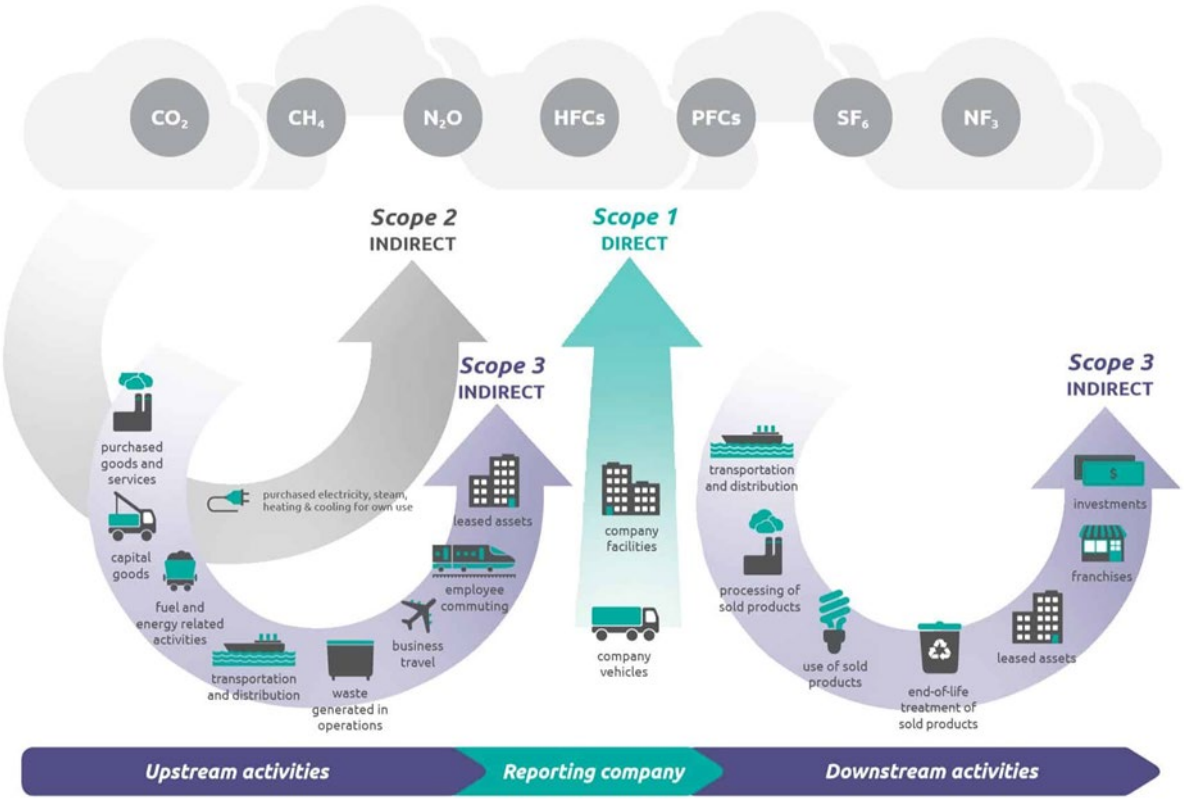


Figure 1. Scope 1, 2 and 3 emissions sources (Ranganathan et al. 2004)

The temporal boundary for the carbon account was between the period 1 July 2022 and 30 June 2023 with the exception of the Southern Cross feedlot which was analysed for 1 January 2022 to 31 December 2022.

4.3.1 Handling co-production

Co-products are produced at several points along the TFI's Australian supply chain. In the carbon footprint and scope 3 assessment, impacts were allocated between co-products and only impacts from the meat supply chain were attributed to TFI. At the primary production level, this assessment followed the methods outlined in Wiedemann et al. (2016) to divide burdens between sub-systems on the TFI operated farms. For sheep, the co-products of wool and liveweight were handled using the protein mass allocation (PMA) method (Wiedemann, et al., 2015). Economic allocation was then applied to the co-products from primary meat processing (e.g. meat, hides), following the general guidance of The Livestock Environmental Assessment and Performance (FAO 2016). The economic allocation at the primary processing stage used 2022-23 sales revenue data as supplied by TFI.

5.0 Project Outcomes

5.1 Sustainability framework

A summary of the major project results presented in the company sustainability framework is provided here (see Table 2). The study focused on carbon indicators to address the most pressing customer and regulatory needs. Other indicators were identified and will be populated in subsequent years. Targets were under consideration at the time of completion of the draft, and these will be informed by the emission reduction scenario planning (see below).

Table 2. TFI Sustainability Framework and Results

SDG	Focus area	Priority	Indicator	FY21	FY23	Reported % reduction	Target
 	Climate change and energy	Reduce GHG emissions	Net emissions: Mt of CO_2-e generated by sheep and goats - scope 3		2,218,180		
			Net emissions: Mt of CO_2-e generated by beef scope 3		703,792		
			TFI USA facility scope 1 and 2 emissions (t CO_2-e)	3,769	6,664		
			TFI AUS processing plants scope 1 and 2 emissions (t CO_2-e)		49,402		
			TFI AUS feedlot scope 1 and 2 emissions (t CO_2-e)		29,870		
			TFI AUS farm scope 1 and 2 emissions (t CO_2-e)		31,104		
			CF (kg of CO_2-e per kg LW^{-1}) for sheep		6.6		
			CF (kg of CO_2-e per kg LW^{-1}) for goats		26.5		
			CF (kg of CO_2-e per kg LW^{-1}) for TFI feedlot beef		10.4		
			CF (kg of CO_2-e per kg LW^{-1}) for third party purchased beef		11.1		
			TFI USA facility scope 1 and 2 emission intensity (lb CO_2-e lb $meat^{-1}$ sold)	0.07	0.07		
			TFI AUS processing plants scope 1 and 2 emission intensity (kg CO_2-e kg LW^{-1})		See carbon report		
			TFI AUS feedlot scope 1 and 2 emission intensity (kg CO_2-e kg LWG^{-1})		3.4		
			TFI AUS farm		see Table 3		

			CF (kg of CO_2-e per kg LW^{-1})				
			Deforestation		scan supply regions in 2025/26		
			TFI USA supply chain emissions (scopes 1, 2 & 3) (USA facility)	5,726,727 kg CO_2-e	6,775,351 kg CO_2-e		
			Weighted CF (kg CO_2-e kg boxed $meat^{-1}$) (USA facility)		25.9		
  	Water use		TFI USA facility direct city water supply (gal/lb meat sold)	0.04	n.r		
			TFI AUS processing plants direct water use (L/kg HSCW)		2.0		
			Lamb water footprint (L/kg boxed meat)		271.7		
			TFI USA facility indirect water use (gal/lb meat sold)		n.r		
	Energy use		TFI USA facility tonnes protein / GJ	2.7	2.9		
			TFI USA facility renewable energy (%)	23%	20%		
			TFI AUS processing plants direct total fossil energy (MJ/kg HSCW)		Tbd		
			TFI AUS processing plants % renewable energy		Tbd		
			TFI AUS feedlot direct total fossil energy (MJ/kg LW sold)		Tbd		
			TFI AUS feedlot and farm % renewable energy		Tbd		
			TFI AUS farm direct total fossil energy (MJ/kg LW sold)		Tbd		

SDG	Focus area	Priority	Indicator	FY21	FY23	Reported % reduction	Target
	Waste		Kilograms of solid waste per tonne hot standard carcase weight (HSCW) when processing meat		Tbd		
			Tonnes of food waste recovered along the supply chain		Tbd		
			TFI USA facility % waste diverted from landfill	79%	88%		
			TFI AUS processing facility direct mixed waste (kg/kg meat sold)		Tbd		
			TFI AUS feedlot direct mixed waste (kg/kg LW sold)		Tbd		
			TFI AUS farm direct mixed waste (kg/kg LW sold)		Tbd		
			Packaging recyclability (% of packaging – USA facilities)	13.9% (USA facility)	Tbd		

Detailed PCF results at three stages of the supply chain were determined and reported in Table 3.

Table 3. Product carbon footprint (PCF) for FY 2022-23 for Thomas Foods International Consolidated Pty Ltd, reported by stage of supply chain

Product			
	Farm gate kg CO2-e kg LW	Processing gate kg CO2-e kg boxed product	Delivered USA customer kg CO2-e kg boxed product
PCF (scope 1, 2 & 3) – sheep meat	6.6	14.4	15.9
PCF (scope 1, 2 & 3) – goat	26.5	63.0	63.9
PCF (scope 1, 2 & 3) – beef – TFI feedlot	10.2	25.4	25.9
PCF (scope 1, 2 & 3) – beef purchases	11.1	27.3	27.8
PCF (scope 1, 2 & 3) – beef boxed purchases	n.r*	30.3	30.9

** product purchased post-processing. Back calculating this figure gives a LW basis result of 13.1 kg CO_2-e equivalent to the national average.*

5.2 Emission reduction

More than 44 emission reduction options were identified and screened, including low methane supplements, pasture improvement, genetic selection, and renewable energy implementation. The report outlines pathways for scope 1, 2, and 3 emission reductions, with varying levels of ambition and success rates.

Emission reduction scenarios were examined using four levels of ambition, conservative, pioneering, industry leading and aspirational. To explore the range of possibilities, the first three of these strategies were modelled as emission reduction scenarios from 2024 to 2040.

These strategies have not been endorsed by TFI. They were modelled to examine possible options for the company and as a first step towards emission reduction planning.

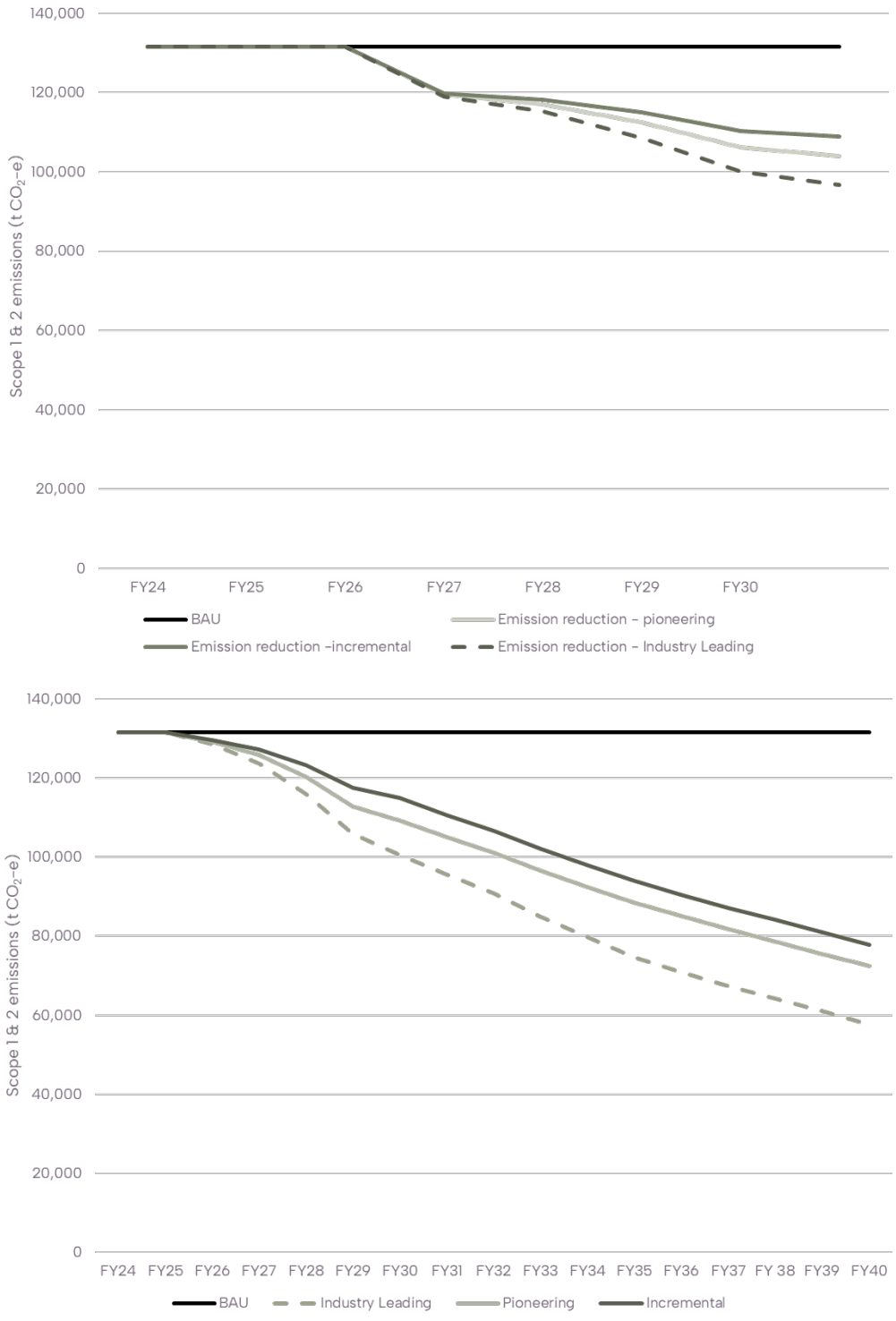


Figure 2. Scope 1 and 2 emission reduction scenarios for TFI (Top: 2024-2030, bottom: 2024-2040)

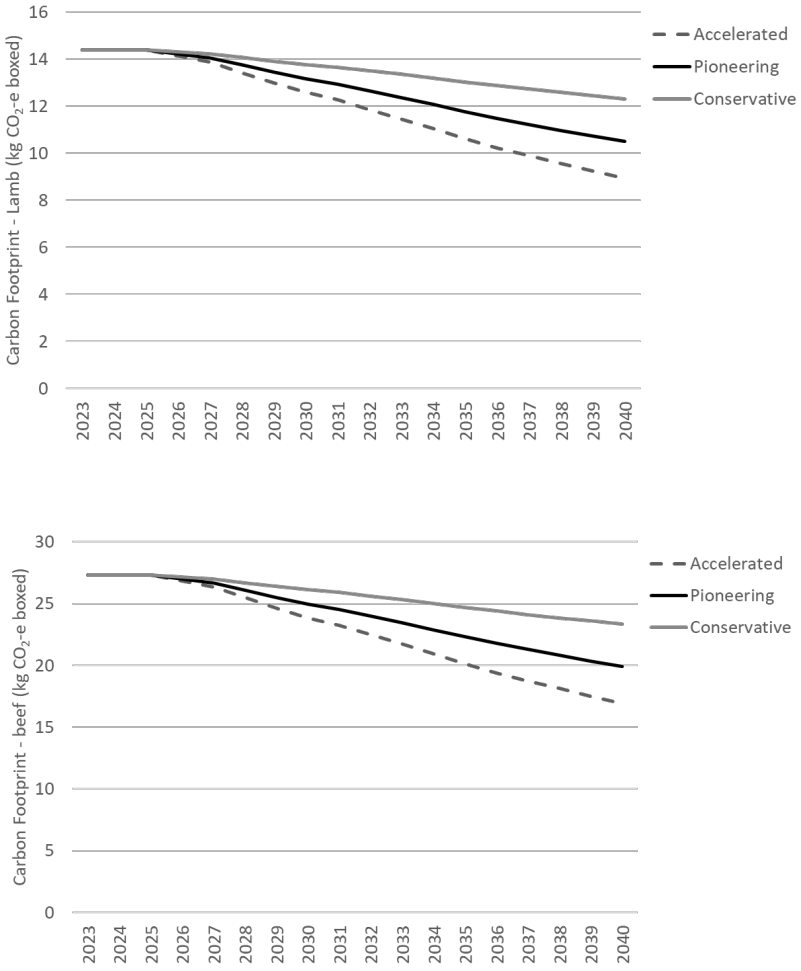


Figure 3. TFI boxed lamb (top) and beef (bottom) carbon footprint with three levels of mitigation

In addition to the emission reduction scenario modelling, the company established a carbon pilot project. The first was the Mount Schanck carbon project, which included an ACCU Scheme soil project and tree planting on Mount Schanck station, owned by TFI. An emission reduction program at Southern Cross feedlot to reduce livestock emissions during feedlot finishing is also being investigated.

The soil project was baselined in 2024 and is progressing well. The project carbon estimation areas (CEAs) registered on the property summed to 1,569 ha. Measured baseline soil carbon varied from 1.7% to 2.4% (0-30cm depth) across these CEAs, with carbon stocks varying from 54.7-81.4 t SOC ha. There was a trend towards lower soil carbon on the less developed areas, indicating potential to increase SOC with better management. Measured SOC was also lower across the area than predicted, indicating potential to increase across the whole area.

Projected annual soil carbon sequestration (which will be measured after 5 years) ranged from 749-2247 t CO_2-e prior to discounts being applied. Tree planting areas were 4.4 ha during the project and further plans totalling 7.8 ha. This 7.8 ha area had a potential sequestration rate of 173 t CO_2-e by 2030, which was the peak rate. This declined over the forward estimates as tree growth slowed. Sequestration potential from trees was constrained by the amount of available land that could be diverted from pasture production, which at this location was minimal.

Note that sequestration projections will be confirmed through measurement over the next 5 years, and the actual outcomes will be influenced by both management and climate effects which could result in outcomes differing from the projections.

For the feedlot project, a short list of abatement options have been determined and costed.

5.3 Producer engagement

Producers were engaged throughout the project, providing input to the TFI Sustainability Framework, participating in the carbon footprinting, and contributing to planning scope 3 emission reduction. These engagement activities primarily occurred via workshops held in each of the regions supplying the processing plants. As part of supporting project funding from the SA Government, a producer engagement day was held on 30th July 2024 at Mount Schanck, which was attended by 40 producers and service providers. Overall, over 100 producers and service providers were engaged in the project.

Overall, workshop attendance was quite good but completion of individual product carbon footprints were below the targeted number of producers.

5.4 Consumer survey – carbon reduced products

Driving emission reduction through complex, international red meat supply chains will require cost coverage or premiums in the marketplace. To evaluate the interest from consumers in the USA market, a survey was undertaken by the Midan Group, titled the Thomas Foods: 2025 Consumer Sustainability Research'. The findings are summarised here.

5.4.1 Respondent makeup

the survey used a national sample of 1,010 US residents:

- Ages 18-77
- Shared or primary responsibility for grocery shopping
- Shared or primary responsibility for food preparation
- Have purchased beef or ground beef in the past three months
- Have purchased sustainable food products from grocery stores, restaurants, and/or online in the past six months

Some percentages in the report may not equal 100% due to rounding.

5.4.2 Sustainability method question wording

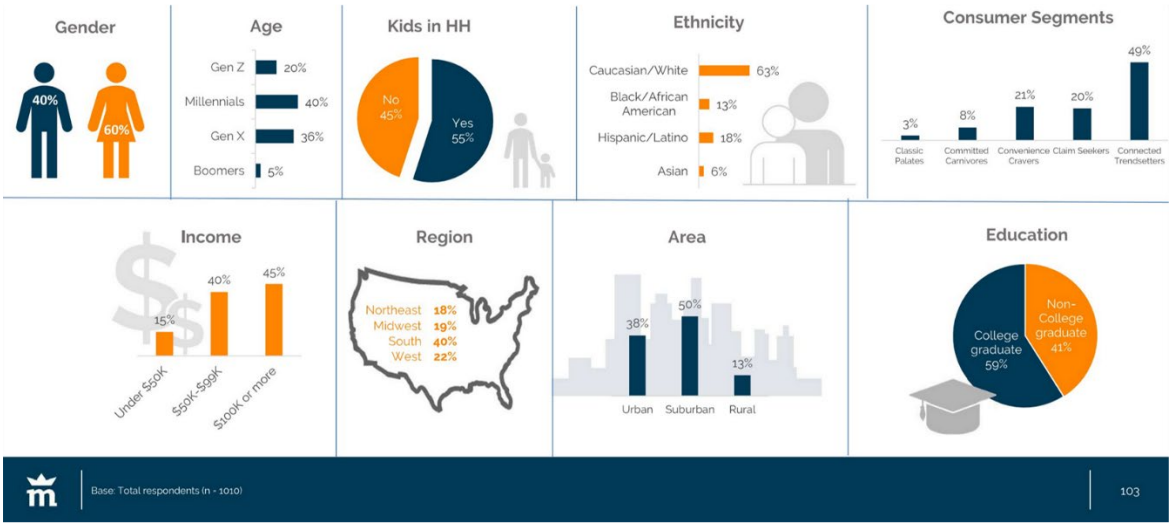
Survey questions related to the sustainability methodologies tested start out with the wording "How likely would you be to purchase a beef product that had a lower carbon footprint…" and then follow with one of the three specific methods tested:

- Because the cattle were fed a methane reducing diet – referred to in report as **Methane Reducing Diets.**
- As a result of using a natural cattle feed additive, such as seaweed, garlic and citrus, etc. – referred to in the report as **Natural Feed Additive.**
- As a result of using a synthetic or man-made cattle feed additive – referred to in report as **Synthetic Feed Additive.**

5.4.3 Consumer segmentation overview and demographics

Table 4. Midan Meat Consumer Segmentation Overview

Connected Trendsetters (14%)	Claim Seekers (24%)	Convenience Cravers (17%)	Committed Carnivores (23%)	Classic Palates (22%)
• Love cooking and eating meat and poultry • Like to give and receive recommendations for meat products • Early adopters • Open to experimenting • Very active with social media and online shopping	• Average engagement with meat • High engagement with poultry • Very motivated by natural and environmental claims • Willing to pay more for meat with claims • Open to experimenting	• Not very engaged with meat or poultry • Don't have time for a sit-down meal with meat • Not a confident meat cook • Rely on convenience products for cooking meat • Skew younger and male	• Very engaged with meat – love to cook and eat it • Open to experimenting • Not motivated by health claims • Feel meat is too expensive • Lower income, but willing to try new products and brands with a coupon or discount	• Eat meat regularly but not very emotionally attached • Not that into cooking • Older, but not motivated by health claims • Feel meat is too expensive • Lower income and respond to sale prices
Insight: This segment is already heavily engaged but can be reached online with recommendations.	**Insight**: This segment is a prime target for increasing their consumption by enticing them with production claims.	**Insight**: This segment will need fast and easy solutions to overcome their lack of skills and time.	**Insight**: This segment is willing to try new things but has monetary constraints, so deals may be needed to motivate.	**Insight**: This segment is not into cooking nor highly proactive, so they may be a limited opportunity.



6.0 Discussion

6.1 Carbon account

TFI views sustainability holistically and the framework was established to report on many indicators of environmental sustainability. However, a key pressure from customers is the carbon footprint of the products sold by the company.

During the course of the project, new regulations, the Climate-Related Financial Disclosures, were also released and these regulations brought a stronger focus onto carbon and climate impacts. As a result of these regulations, company carbon accounts will be reportable for TFI and this project provided an insight into the work required to assess scope 1, 2 and 3 emissions. One finding for the company was that NGERS reporting, which covered the meat processing facilities but not livestock emissions from the farms or feedlots, was not the major source of scope 1 and 2 emissions. The farms and feedlot in aggregate had higher emissions, despite being relatively small in comparison to the meat processing business. The agricultural emission sources, which are not reportable under NGERS, were more difficult to determine because data systems were not in place prior to the project to collect the needed information, and because methods for agricultural and land sector emission sources are less developed than they are for NGERS reportable emission sources. The project delivered key findings for the business through developing this comprehensive scope 1, 2, and 3 account and will enable better reporting systems to be established to meet future requirements. Land Use and direct Land Use Change emissions were evaluated. Using available methods, this resulted in <0.3% change to the carbon account, with the assumption that carbon did not change in soil under pasture used for livestock grazing (as recommended by IPCC and industry guidance).

6.2 Carbon footprint

The carbon footprint for sheep and cattle purchased by the company was lower than the national average for sheep or beef. Sheep meat impacts were fractionally lower than the national average, largely because the flock composition and productivity in the areas where TFI operate were slightly better than the national average. TFI operates its main operations in regions with slightly higher proportions of productive, dual purpose lamb enterprises and slightly lower proportions of Merino sheep. This resulted in a slightly lower carbon footprint for suppliers.

Similarly, the regions where the company sourced cattle and the predominance of feedlot finished beef resulted in the beef CF being lower than the national average for slaughter cattle (13.1 kg CO_2-e kg LW^{-1}).

Results for goat meat were higher than sheep, and were higher from wild-harvest than farmed production. Farmed goats had higher impacts than sheep mainly because they were older at market weight than lambs, generating higher lifetime emissions, and because there was only one product, meat, instead of meat and wool from sheep. Goat meat yields were lower than lamb meat yields, further increasing impacts when measured and a boxed product basis. Impacts from wild-harvested goats were difficult to assess. In the present study, all flock emissions from the wild-goat herd was included in the carbon footprint for conservativeness, though this could be deemed a “non-anthropogenic” emission source because wild goats are not managed as part of any agricultural system and only enter the system at the point of harvesting. Further work is needed to determine the best way to measure and report emissions from goats, including how to handle wild harvest and emissions from wild herds as part of carbon footprint assessments.

There are a range of publications available for comparison that provide insight across the various products from TFI’s Australian supply chain. Results for boxed beef were assessed at the processor gate, and at the point of hand-over to TFI USA. Results were then compared to other publicly reported boxed beef results in both Australia and the US, where a comprehensive and comparable product carbon footprint of US beef was available. This comparison is presented in Figure 4 below.

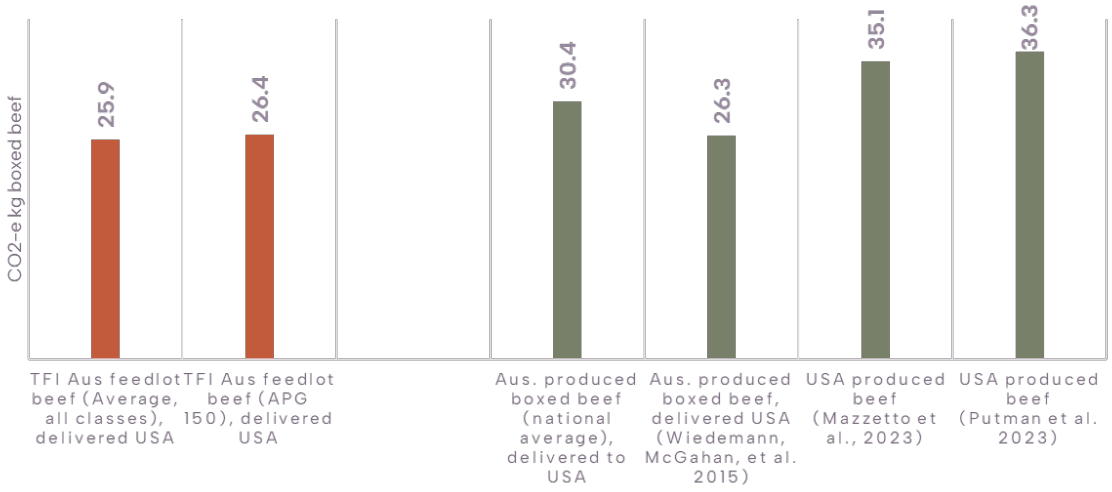


Figure 4. Comparison of product carbon footprint - boxed beef delivered to the USA

Results compared favourably to other reported studies with TFI beef delivered into the USA at below the Australian average and USA national average. The industry benchmark study, Wiedemann et al. (2015), assessed short fed and grass-fed beef into the USA market, based on cattle produced in central Qld, southern Qld, northern and central NSW (a region covering 35% of Australia's beef production). Australian boxed beef shipped to USA was between 26.3 and 30.5 kg CO_2-e/kg boxed beef (recalculated with updated AR6 GWP_{100} values), with lower values from short-fed export cattle, and higher values from grass-fed cattle and all results reflecting sea shipping, to Philadelphia (Wiedemann et al., 2016). TFI beef exported to the USA had an average CF of 27 CO_2-e kg boxed beef for sea transport to the east coast.

The carbon footprint of USA beef produced and consumed was reported by Asem-Hiablie et al. (2019) and recalculated by Mazzetto, Falconer & Ledgard (2023). This provided "average" impacts of US beef, principally reflecting grain-finished cattle weight across the US production regions. When assessed with a comparable function unit (boxed product), impacts were 35.1 CO_2-e/kg beef. Other recent research has shown a similar carbon footprint for beef produced, processed and distributed in the USA of 36.3 CO_2-e/kg boxed beef (Putman, Rotz & Thoma 2023). The main differences observed were higher farm-gate results for the USA studies, largely influenced by higher manure related emissions compared to Australia.

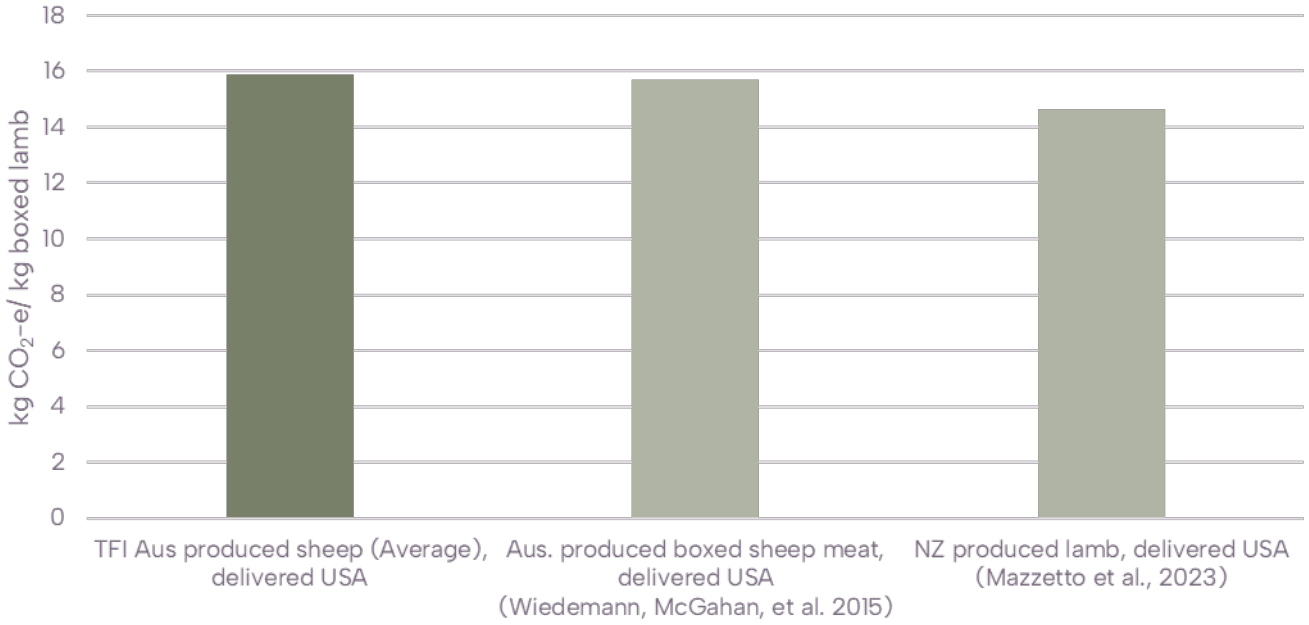


Figure 5. Comparison of product carbon footprint - boxed lamb delivered to the USA

6.3 Supplier engagement

There were a range of factors cited by farmers why they were reluctant to share carbon results across the supply chain. This included time pressure to supply data, seasonal impacts including lower commodity prices, causing businesses to refocus on “core” activities, a sense that there was “not much in this for me” and growing “noise” in the market where farmers may have been invited to multiple different courses or to complete different calculators. Major programs that ran at the same time as TFI included programs by state governments, banks, other processors and retailers, and individual service providers promoting services in carbon baselining. One problem in this environment was the variation in methods that were being used, which resulted in “emission intensities” that were generated in one program being of little use for TFI because they were not standardised according to international conventions and were not verified, making them unsuitable for conveying to customers.

When discussing decarbonisation, farmers generally agreed they were at the “ground level” and needed to learn a lot. However, pressures on time made it difficult to prioritise. There was a further sentiment expressed by a small number of older farmers that this was “the next generation’s problem” or that it was “beyond me at my stage”.

When observed more broadly beyond the TFI program across other work Integrity Ag is engaged in, we have seen much lower rates of engagement from sheep producers compared to cattle.

Possible reasons contributing to this are the mixed farming enterprises common with sheep, where many produce wool, lamb and cereals, making market signals less clear than in cattle where more enterprises are single-sector.

Overall, this led to the conclusion that the sheep meat supply chain took a conservative view of emission reduction and that mitigation practices were likely to be relatively slow to adopt.

6.4 Consumer survey

The survey found that when it comes to beef production terms, 92% of sustainable food shoppers were familiar with ‘grass feeding’ and 71% were familiar with feed additives in cattle production. This may imply that consumers are increasingly interested in the practices that impact quality and sustainability of beef.

Sustainable food shoppers see themselves as educated on a variety of topics (grass feeding, cattle additives, etc.). Males, Millennials, Households with children, Connected Trendsetters, high income earners, and highly educated, within the West and Northeast tend to be more aware of most of the terms tested. TFI should invest in providing additional education on any new or unfamiliar technology, doing so in a mindful way that addresses current knowledge on various topics and avoids talking down to the consumer.

Sustainable food shoppers trust climate statements (e.g., climate positive, reduced carbon, etc.) when they see it on a package of beef. Of the climate statements tested, at least seven out of ten consumers trusted all statements 'a lot' or 'somewhat'. It is recommended to use 'climate positive', 'reduced emissions' or 'carbon' in messaging, as these statements held the higher percentage of trust.

Sustainable food shoppers that shop weekly have a higher degree of trust across all (a natural feed additive, methane reducing diet and a synthetic/man-made feed additive), while less frequent shoppers are more sceptical, especially when it comes to 'a synthetic/man-made additive', with only 13% having a high degree of trust. This implies that if TFI were to use any of these statements, it would be easiest to persuade shoppers that are shopping more frequently. A consideration would be to develop an influencer strategy to use frequent shoppers as advocates to help reduce the trust barrier for less frequent shoppers.

In future messaging, it is advised to use language such as 'a natural feed additive' instead of terms similar to 'methane reducing diet' and/or 'synthetic/man-made feed additive'. 'Natural feed additive' performed highest across key study measures: purchase intent, willingness to pay and trust.

A little over half of respondents agreed that they expect all beef products to be produced this way in the future if it were possible to lower the carbon footprint by feeding cattle a methane reducing diet or by utilising a natural or synthetic/man-made feed additive. This expectation is stronger among younger cohorts; who tend to place greater future responsibility on brands and companies compared to older cohorts.

7.0 Conclusions / Recommendations

The Carbon Management Project provided the first comprehensive assessment of the company's carbon baseline and product carbon footprint and outlines strategies and early-stage emission reduction projects. More broadly, the project established a comprehensive sustainability framework which will be used to drive sustainability in the company and supply chain into the future. The report highlights several key findings:

A baseline carbon assessment showed the Scope 1 and 2 emissions were dominated by livestock emissions from the feedlot and farms, which were a larger emission source than energy related scope 1 and 2 emissions from the meat processing plants.

The largest scope 3 emission sources were identified as purchased livestock and meat products, arising from significant contributions from enteric methane from livestock.

More than 44 emission reduction options were identified and screened, including low methane supplements, pasture improvement, genetic selection, and renewable energy implementation. The report outlines pathways for scope 1, 2, and 3 emission reductions, with varying levels of ambition and success rates. Two pilot projects were evaluated and moved towards implementation.

7.1 Recommendations

Based on the findings of the report, the following recommendations are made:

7.1.1 Implement emission reduction strategies:

- Prioritise the implementation of low methane supplements in both grazing and feedlot operations to achieve significant emission reductions.
- Invest in renewable energy projects, such as on-site solar and biogas infrastructure, to reduce reliance on fossil fuels and lower overall emissions.
- Investigate and analyse opportunities to reduce waste at every level in the meat processing business to reduce onsite emissions (in effluent treatment/irrigation) and offsite in landfill. This activity will meet dual objectives; reducing emissions and improving circularity, both of which are priorities for the company and for the sector.

7.1.2 Enhance producer engagement:

- Continue to engage producers through workshops and demonstration days to increase participation in carbon footprinting and emission reduction activities.
- Create partnership programs to incentivise emission reduction and removal in the supply chain.
- Develop reporting and monitoring capability around land management – natural capital, biodiversity, Land Use and Land Use Change emissions and removals, and deforestation to address future risks and harness opportunities.

7.1.3 Expand carbon sequestration projects:

- Develop and expand soil carbon and tree planting projects across TFI properties to achieve long-term carbon removals and enhance biodiversity.
- Evaluate opportunities for native tree regeneration on properties like Southern Cross Pastoral to further increase carbon sequestration.

7.1.4 Regularly review and update sustainability framework:

- Conduct annual reviews of the Sustainability Framework to ensure it remains aligned with customer expectations, regulatory requirements, and scientific advancements. This is recommended to include a Materiality Assessment to formalise the priorities.
- Incorporate new indicators and metrics as they become relevant to provide a comprehensive assessment of TFI's environmental impact.

7.1.5 Set emission reduction targets:

- Establish clear emission reduction targets based on the identified pathways and scenarios, considering both short-term and long-term goals.
- Monitor progress regularly and adjust strategies as needed to ensure targets are met and exceeded.
- By implementing these recommendations, TFI can effectively reduce its carbon footprint, meet customer and regulatory expectations, and contribute to global efforts to mitigate climate change.

8.0 References

Asem-Hiablie, S, Battagliese, T, Stackhouse-Lawson, KR & Alan Rotz, C 2019, 'A life cycle assessment of the environmental impacts of a beef system in the USA', *The International Journal of Life Cycle Assessment*, vol. 24, no. 3, The International Journal of Life Cycle Assessment, pp. 441–455, viewed <http://link.springer.com/10.1007/s11367-018-1464-6>.

FAO 2016, *Greenhouse gas emissions and fossil energy use from small ruminant supply chains: Guidelines for assessment. Livestock Environmental Assessment and Performance Partnership.*

ISO 2018, *ISO 14067:2018 - Greenhouse gases - Carbon footprint of products - Requirements and guidelines for quantification*, International Organisation for Standardisation (ISO), Geneva, Switzerland.

LEAP 2015a, *Environmental performance of large ruminant supply chains*.

LEAP 2015b, *Greenhouse Gas Emissions and Fossil Energy Use from Small Ruminant Supply Chains: Guidelines for Assessment*, Food and Agriculture Organization of the United Nations (FAO), Livestock Environmental Assessment Program (LEAP), Rome, Italy.

Mazzetto, AM, Falconer, S & Ledgard, S 2023, 'Carbon footprint of New Zealand beef and sheep meat exported to different markets', *Environmental Impact Assessment Review*, vol. 98, no. May.

Putman, B, Rotz, CA & Thoma, G 2023, 'A comprehensive environmental assessment of beef production and consumption in the United States', *Journal of Cleaner Production*, vol. 402, Elsevier, p. 136766, viewed <https://linkinghub.elsevier.com/retrieve/pii/S0959652623009241>.

Ranganathan, J, Corbier, L, Bhatia, P, Schmitz, S, Oren, K, Dawson, B, Spannagle, M, McMahon, M, Boileau, P, Frederick, R, Vanderborght, B, Thomson, F, Kitamura, K, Woo, C, Phankida, N, Miner, R, Segalen, L, Koch, J, Bhattacharjee, S, Cummis, C, Breidenich, C, Eaton, R, Gillenwater, M, Marache, M, Acosta, R, Camobreco, V & Cook, E 2004, *The greenhouse gas protocol: A corporate accounting and reporting standard*, World Business Council for Sustainable Development & World Resources Institute, Geneva.

Wiedemann, S, Ledgard, S, Henry, B, Yan, M, Mao, N & Russell, S 2015, 'Application of Life Cycle Assessment to Sheep Production Systems: Investigating Co-Production of Wool and Meat Using Case Studies From Major Global Producers', *The International Journal of Life Cycle Assessment*, vol. 20, no. 4, pp. 463–476.

Wiedemann, S, McGahan, E & Murphy, C 2016, 'Environmental impacts and resource use from Australian pork production assessed using life-cycle assessment. 1. Greenhouse gas emissions', *Animal Production Science*, vol. 56, no. 9, pp. 1418–1431.

Wiedemann, S, McGahan, E, Murphy, C, Yan, M, Henry, B, Thoma, G & Ledgard, S 2015, 'Environmental impacts and resource use of Australian beef and lamb exported to the USA determined using life cycle assessment', *Journal of Cleaner Production*, vol. 94, Elsevier Ltd, pp. 67–75, viewed <http://dx.doi.org/10.1016/j.jclepro.2015.01.073>.

Wiedemann, SG, Yan, M-J & Murphy, CM 2016, 'Resource use and environmental impacts from Australian export lamb production: a life cycle assessment', *Animal Production Science*, vol. 56, no. 7, p. 1070, viewed <http://www.publish.csiro.au/?paper=AN14647>.