Livestock Improvement Corporation Limited

GHG Inventory Report | 2022-2023

There's always room for improvement

Executive summary

LIC has committed to becoming carbon neutral by 2050 in line with the New Zealand Government's Climate Change Response (Zero Carbon) Amendment Act 2019 and in accordance with its pledge as a signatory to the Climate Leaders Coalition. This report details LIC's year-four greenhouse gas (GHG) emissions for the period 1 June 2022 to 31 May 2023 against LIC's 2018/19 base year.

LIC has defined the following science-based climate change targets to reduce greenhouse gas emissions and limit the temperature increase to 1.5°C of pre-industrial levels:

- 46.2% reduction of Scope 1 and 2 emissions (excluding biogenic methane) by 2030 against the 2018/19 base year
- 28.88% reduction of Scope 3 emissions (excluding biogenic methane) by 2030 against the 2018/19 base year
- 10% reduction of biogenic methane by 2030 against 2018/ emissions

Below is a summary of LIC's 2022/23 emissions compared to the 2018/19 base year.

Comparison of total GHG emissions by the scope for 2022/23 to base year (2018/19).

Scope	2018/19 tCO_2-e base year	2019/20 tCO_2-e	2020/21 tCO_2-e	2021/22 tCO_2-e	2022/23 tCO_2-e	tCO_2-e Variation from base year
Scope 1 direct emissions	4,452.02	4,414.04	4,575.55	4,258.91	4,386.60	-1.47% ▼
Scope 2 indirect emissions	377.09	401.39	368.47	345.87	363.50	-3.60% ▼
Scope 3 indirect emissions	7,914.71	6,662.51	5,996.13	6,059.26	6,374.44	-19.46% ▼
Total emissions	12,743.82	11,477.94	10,940.15	10,664.04	11,124.54	-12.71% ▼

Scope	2018/19 CH_4 (tCO_2-e) base year	2019/20 CH_4 (tCO_2-e)	2020/21 CH_4 (tCO_2-e)	2021/22 tCO_2-e	2022/23 tCO_2-e	CH_4 (tCO_2-e) Variation from base year
Scope 1 biogenic methane emissions	3,231.13	3,285.33	3,229.50	3,410.82	3,521.21	8.98%▲
Scope 3 biogenic methane	12.22	9.54	10.38	13.23	12.53	2.55%▲
Total emissions	3,243.35	3,294.87	3,239.87	3,424.05	3,533.74	8.95%▲

Scope	2018/19 CH_4 (tCO_2-e)	2019/20 CH_4 (tCO_2-e) base year	2020/21 CH_4 (tCO_2-e)	2021/22 tCO_2-e	2022/23 tCO_2-e	CH_4 (tCO_2-e) Variation from base year
Scope 3 biogenic methane (waste)	689.44	191.02	23.29	20.36	22.42	-88.26% ▼

In the 2022/23 season, LIC's total GHG emissions were reduced by 12.7% from the base year, and in comparison, to the 2021/22 season total emissions increased by 4.3%. Total biogenic methane emissions increased by 8.95% compared to the base year, and biogenic methane emissions increased by 3.2% compared to the 2021/22 reporting year. Scope 3 biogenic methane emissions from waste

were reduced by 88.3% from the 2019/20 base year[1] and increased by 10.1% from the 2021/22 reporting year.

Scope 1 emission decreases are predominantly the result of less fuel (diesel and petrol) usage. Scope 2 emissions are relatively stagnant. Some of the decreases in 3 emissions are likely attributed to improved data capture for staff commuting and business-related travel. Direct methane emission increases are the result of having more animals present on LIC sites in 2022/23 than in previous reporting years.

Indirect methane emissions were reduced significantly because of an improvement in the way LIC's waste management emissions are captured. Indirect methane emissions are a very small contributor to LIC's overall GHG emissions, so this significant change does not greatly affect overall emissions.

This report provides LIC with a comparison of LIC's 2022/23 GHG emissions against the 2018/19 baseline and enables LIC to meet its requirement under the Climate Leaders Coalition to make its greenhouse gas footprint publicly available.

[1] Scope 3 biogenic methane emissions from waste are compared to a 2019/20 base year as data capture improved and LIC is no longer using estimates based on container volume.

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Introduction

At LIC we recognise the importance of the preservation and restoration of the environment to ensure it is safeguarded for future generations. Our GHG inventory report aligns with our company strategy where environment and sustainability are foundational elements. This report guides our Senior Leadership Team with their decision-making relating to our environmental sustainability initiatives and transitioning to a low-carbon future.

At LIC we are committed to measuring our greenhouse gas footprint, having our data independently assured, and making our information publicly available. We also proactively support our staff and suppliers to reduce their carbon footprint.

This GHG inventory report contributes to our commitment to assessing our climate change risks and publicly disclosing them as a climate reporting entity (CRE).

The following report covers the period 1 June 2022 to 31 May 2023.

Statement of intent

This GHG inventory report contributes to part of LIC's commitments to assessing our climate change risks, gaining assurance of our GHG emissions, and publicly disclosing them as required by Aotearoa New Zealand Climate Standards as a CRE. The report forms part of our Sustainable Business Council (SBC) membership requirements to measure the carbon footprint of our New Zealand operations and report progress to the SBC, as well as our commitments as signatories of the Climate Leaders Coalition (CLC). The report guides the Senior Leadership Team in their decision-making relating to the corporation's environmental sustainability practices.

GHG inventory summary for 2022/23

LIC's total emissions for the 2022/23 reporting year were 14,680.70 tCO2-e, which was 4% higher than the 2021/22 reporting year total of 14,108.44 tCO2-e. Emissions were 12% lower than the base year total of 16,676.61 tCO2-e.[2]

[2] LIC attained further information for all reporting years relating to Scope 3 business travel in addition to carrying out recalculation of emissions using the New Zealand Government's latest emissions factors (at the time of assurance). LIC also recalculated its agricultural emissions based on data collated in Overseer.

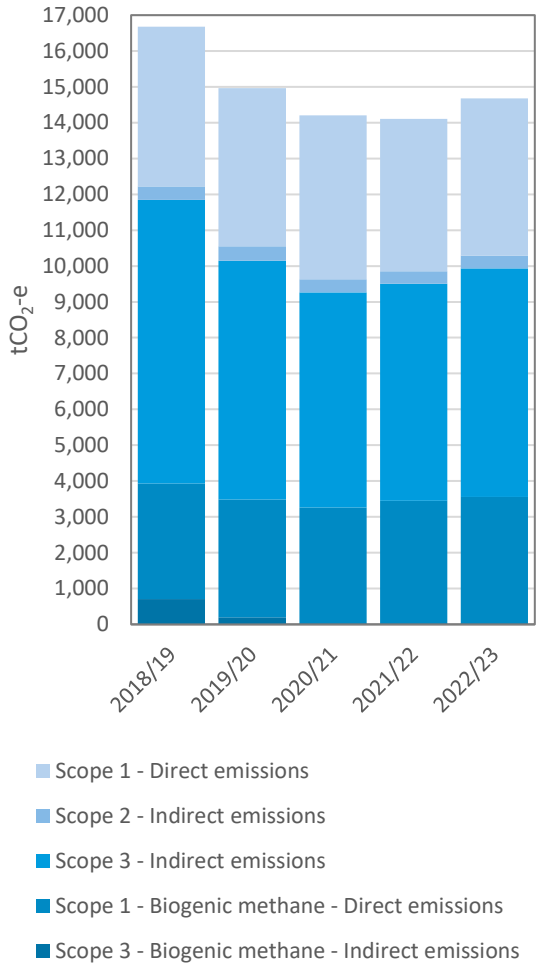

Figure 1: LIC total emission profile over time.

Scope 1 and Scope 2 non-biogenic emissions were reduced by 1.47% and 3.6% respectively from base year. Scope 3 emissions reduced by 19.46% (Table 1).[3]

Table 1: Total non-biogenic GHG emissions by scope.

	2018/19 tCO_2-e (base year)	2019/20 tCO_2-e	2020/21 tCO_2-e	2021/22 tCO2-e	2022/23 tCO2-e	tCO_2-e Variance of 2022/23 to 2018/19	tCO_2-e Variance of 2022/23 to 2021/22
Scope 1 direct emissions	4,452.02	4,414.04	4,575.55	4,258.91	4,386.60	-1.47% ▼	3.00% ▲
Scope 2 indirect emissions	377.09	401.39	368.47	345.87	363.50	-3.60% ▼	5.10% ▲
Scope 3 indirect emissions	7,914.71	6,662.51	5,996.13	6,059.26	6,374.44	-19.46% ▼	5.20% ▲
Total emissions	12,743.82	11,477.94	10,940.15	10,664.04	11,124.54	-12.71% ▼	4.32% ▲

[3] Excluding biogenic methane.

Total biogenic methane emissions for the period 2022/23 increased by 8.95% from the base year 2018/19 (Table 2). Overall biogenic methane emissions increased by 3.20% in comparison to the 2021/22 reporting year.

Table 2: Biogenic methane GHG emissions by scope.

Scope	2018/19 CH_4 (tCO_2-e)[4] base year	2019/20 CH_4 (tCO_2-e)	2020/21 CH_4 (tCO_2-e)	2021/22 CH_4 (tCO_2-e)	2022/23 CH_4 (tCO_2-e)	CH_4 (tCO_2-e) Variation of 2022/23 from 2018/19	CH_4 (tCO_2-e) Variation of 2022/23 from 2021/22
Scope 1 biogenic methane emissions	3,231.13	3,285.33	3,229.50	3,410.82	3,521.21	8.98%▲	3.24%▲
Scope 3 biogenic methane	12.22	9.54	10.38	13.23	12.53	2.55%▲	-5.28%▼
Total emissions	3,243.35	3,294.87	3,239.87	3,424.05	3,533.74	8.95%▲	3.20%▲

Following improvements to data capture for waste in the 2021/22 reporting year, LIC opted to assess biogenic methane derived from our landfilled waste using a 2019/20 base year. Biogenic methane emissions from waste were reduced by 88.26% from the new base year in the 2022/23 reporting year, however, increased by 10.12% when compared to the 2021/22 reporting year (Table 3).[5]

Table 3: Comparison of total biogenic methane emissions derived from the LIC waste stream to landfill.

Scope	2019/20 CH_4 (tCO_2-e) base year	2020/21 CH_4 (tCO_2-e)	2021/22 CH_4 (tCO_2-e)	2022/23 CH_4 (tCO_2-e)	CH_4 (tCO_2-e) Variation of 22/23 from base year	CH_4 (tCO_2-e) Variation of 22/23 from 21/22
Scope 3 biogenic methane - waste	191.02	23.29	20.36	22.42	-88.26%▼	10.12%▲

GHG emission source category results

38% of LIC emission source categories had a reduction for the 2022/23 reporting year from the base year (Table 4). Emissions from land freight had the greatest reduction of 72.31% from the base year. In comparison, the variance from 2022/23 to 2021/22 had overall reductions to only 23% of emission source categories, with land freight having the greatest reduction of 39.72% from the previous reporting year.

Table 4: Comparison of total GHG emissions by category for reporting periods.

	Emission source	tCO_2-e 2018/19 Base year	tCO_2-e 2019/20	tCO_2-e 2020/21	tCO_2-e 2021/22	tCO_2-e 2022/23	Variance from 2022/23 to 2018/19	Variance from 2022/23 to 2021/22
Scope 1	Transport fuel	3,324.05	3,201.71	3,376.53	3,051.57	3,082.90	-7.25%▼	1.03%▲
Scope 1	Stationary combustion	175.07	167.50	185.15	190.28	176.55	0.84%▲	-7.21%▼
Scope 1	Agricultural emissions	952.89	1,044.84	1,013.88	1,017.06	1,127.15	18.29%▲	10.82%▲

[4] Methane and nitrous oxide within this report are expressed in tCO2-e using the conversion factors of 25 and 298 respectively.

[5] LIC will consider using a 2020/21 base year moving forward, as it has been identified that processes have changed since 2019/20.

Scope 2	Electricity	377.09	401.39	368.47	345.87	363.50	-3.60%▼	5.10%▲
Scope 3	Domestic travel	259.46	208.50	182.68	71.45	275.12	6.03%▲	285.07%▲
Scope 3	International travel	1,200.91	883.63	8.55	18.29	482.84	-59.79%▼	2,540.4%▲
Scope 3	Electricity distributed T&D losses	38.61	40.49	33.82	31.75	33.37	-13.57%▼	5.10%▲
Scope 3	Freight land	60.28	60.02	22.79	27.69	16.69	-72.31%▼	-39.72%▼
Scope 3	Freight air	164.37	120.14	109.72	104.36	129.10	-21.46%▼	23.71%▲
Scope 3	Freight sea	4.26	2.03	3.03	2.28	2.38	-44.03%▼	4.54%▲
Scope 3	Natural Gas distributed T&D losses	10.49	8.71	5.59	5.76	5.03	-52.05%▼	-12.69%▼
Scope 3	Waste recycling	0.12	0.26	0.45	3.50	2.38	1,921.1%▲	-31.90%▼
Scope 3	Indirect travel emissions	6,173.85	5,337.14	5,628.01	5,792.44	5,426.13	-12.11%▼	-6.32%▼
Scope 3	Water supply	2.36	1.59	1.49	1.74	1.40	-40.91%▼	-19.92%▼

Biogenic methane emission sources saw an increase in Scope 1 agricultural emissions for the 2022/23 reporting year of 8.98% from the base year, with an increase also seen when comparing 2022/23 with the 2021/22 reporting year of 3.24%. Scope 1 wastewater treatment from LIC's Newstead site had a reduction of 4.41% from the base year but emissions increased by 2.08% compared to the 2021/22 reporting year (Table 5).

Scope 3 indirect biogenic methane from wastewater treatment from other sites increased by 13.6% from the base year but decreased by 9.68% when compared to the 2021/22 reporting year. Scope 3 indirect biogenic methane derived from waste was reduced by 88.3% from the base year because of improved data capture but increased by 10.1% from the 2021/22 reporting year. Further data improvements were made in the 2022/23 reporting year which required LIC to amend our 2019/20 data set.

Detailed data analysis in 2023 determined that a subset "bulk waste" emission source had been previously categorised as Scope 3 and was predominantly derived from sludge removal from one of LIC's processes to landfill, as a result, this has been re-categorised as Scope 3 biogenic methane. Furthermore, this emission source is no longer treated in the same manner and is now being processed through a wastewater treatment process and as such has reduced our Scope 3 biogenic methane emissions significantly. In the following reporting years, LIC will consider using the 2020/21 reporting period as the base year for Scope 3 biogenic methane waste.

Table 5: Comparison of total biogenic methane emissions by category for reporting periods.

	Emission source	CH_4 (tCO_2-e) 2018/19 Base year	CH_4 (tCO_2-e) 2019/20	CH_4 (tCO_2-e) 2020/21	CH_4 (tCO_2-e) 2021/22	CH_4 (tCO_2-e) 2022/23	Variance from 2022/23 to 2018/19	Variance from 2022/23 to 2021/22
Scope 1 Biogenic methane	Agricultural emissions - biogenic methane	3,229.49	3,283.89	3,227.91	3,409.29	3,519.65	8.98%▲	3.24%▲
Scope 1 Biogenic methane	Wastewater treatment	1.64	1.44	1.59	1.53	1.56	-4.41%▼	2.08%▲

Scope 3 Biogenic methane	Composting	1.77	0.08	0.08	0.08	0.66	-62.91%▼	697.92%▲
Scope 3 Biogenic methane	Wastewater treatment	10.45	9.45	10.30	13.15	11.88	13.64%▲	-9.68%▼
Scope 3 Biogenic methane - Waste only	Waste	689.44	191.02	23.29	20.36	22.42	-88.26%▼	10.12%▲

Organisational description and boundary

LIC is a farmer-owned co-operative and world leader in pasture-based dairy genetics and herd management.

LIC exist to deliver superior genetics and technological innovation to help its shareholders sustainably farm profitable animals.

LIC is headquartered in Hamilton, with over 30 sites across NZ, Australia, UK, and Ireland. With origins dating back to 1909, LIC has a long history of developing and delivering world-leading innovations for the dairy industry. This is even more relevant to farmers today given the rapid change the sector is undergoing.

The co-op is one of the sector's largest private investors in research and development (R&D). LIC's commitment to R&D and new product development continues today, in line with its strategy to deliver value for its farmer shareholders.

LIC shares are listed on the NZX. LIC shareholders must be dairy farmers in New Zealand, supply a New Zealand-based milk processor and buy a minimum number of qualifying products and services from LIC in any one year.

As a farmer-owned co-operative, all LIC's profit is returned to their shareholders in dividends, or reinvested into new solutions and R&D.

Following the methodology described in The Greenhouse Gas Protocol the organisational boundaries were set to include LIC New Zealand operations. LIC's international operations are excluded. The GHG protocol allows two distinct approaches to consolidate GHG emissions, equity share or control approaches (financial or operations). LIC has opted to disclose its GHG emissions using the operational control approach for the co-op's New Zealand operations.

Livestock Improvement Corporation Ltd. (LIC)

Offices and Laboratories

- Newstead, Hamilton, Waikato
- Riverlea Road, Hamilton, Waikato
- Palmerston Street, Awahuri, Manawatu
- Produce Place, Christchurch, Canterbury

International

- Australia
- Ireland
- United Kingdom

Farms

- Awahuri Farm, Awahuri, Manuwatu
- Feilding Farm, Feilding, Manawatu
- Innovation Farm, Rukuhia, Ohaupo
- Newstead Farm, Vailes and Centre, Waikato
- Tauwhare Farm, Tauwhare, Waikato

Depots

- Ashburton, Canterbury
- Bell Block, Taranaki
- Christchurch, Canterbury
- Gore, Southland
- Greymouth, West Coast
- Hawera, Taranaki
- Invercargill, Southland
- Morrinsville, Waikato
- Oamaru, North Otago
- Palmerston North, Manawatu
- Rolleston, Canterbury
- Te Awamutu, Waikato
- Te Hana, Northland
- Te Kauwhata, Waikato
- Te Puke, Bay of Plenty
- Tokoroa, Waikato
- Whakatane, Bay of Plenty
- Whangarei, Northland
- Winton, Southland

Inventory boundary

Emission source identification method and significance criteria

The GHG emissions sources included in this inventory were identified with reference to the methodology described in the GHG Protocol and ISO 14064-1:2018 standards as well as the Toitū Envirocare carbonreduce Programme Technical Requirements.

LIC identified sources and sinks via personal communications with relevant staff regarding their operations - for example, farm operational emissions sources, through vendors/suppliers directly supplying the information required to complete reporting - freight, fuel use, air travel, waste, water supply etc, and through review of operational expenditure records for energy supply and stationary combustion.

The significance of emissions sources within the organisational boundaries has been considered in the design of this inventory. No changes to the significance criteria have been made since this inventory was initially developed in the base year.

GHG emission source inclusions

LIC has elected to report on Scope 1 - Direct emissions, Scope 2, and Scope 3 – Indirect emissions, and Scope 1 direct biogenic methane emissions and Scope 3 indirect biogenic methane emissions. Table 6 outlines emissions sources and LIC's commitment to reporting on them.

Table 6: Emission sources inclusions.

GHG emissions Scope	GHG emissions source or sink subcategory	Overview of activity data and evidence	Explanation of uncertainties or assumptions around data and evidence	Use of default and average emissions factors
Scope 1	Stationary combustion	LPG stationary commercial, Natural Gas distributed commercial, Diesel stationary combustion	Assume that supplier invoices are correct (Trust power, Rock Gas, Genesis). Missing some data occasionally from emails/invoices misfiled. When that has occurred data average for the period is used for that month. Estimates of diesel fuel in the generators. We struggled to find reports on top-ups. Emails are saved to a file. Litres used are determined by generator size. LIC now 100% own these generators so they are no longer managed by an external company. The maintenance department tops them up but does not keep records. However, the top-up amounts are minimal annually and we require the generators to continue production if we lose power. They are not in continual use.	Some missing data where a monthly average was required to be used. We have projects currently in progress to eliminate the need to manually extract data from invoices.
Scope 1	Mobile combustion (incl. company owned or leased vehicles)	Diesel, Petrol premium, Petrol regular	Assume that Levno, Lease Plan and Toyota data are accurate. There is likely a margin of error when it comes to staff correctly entering in km, however, data is based on litres of fuel consumed. To the best of my knowledge fuel cards can only be used to purchase fuel and as such we have vast understanding of fuel litres purchased.	Averages were not used for this data set. It is complete.
Scope 1 – biogenic methane	Leakage of refrigerants	Wastewater for treatment plants (average)	Assume that water samples taken monthly by S3 are accurate and that the water meters are functioning correctly. The system is maintained regularly.	Averages were not used for this data set. It is complete.
Scope 1	Fertiliser use	Pre-calculated (tCO2-e) - Fertiliser - dissolution, pre-calculated (tCO2-e) - Fertiliser N2O	Farms data is determined using stocking rates, fertiliser applications, feed etc. Farmwise consultant enters data into Overseer. Human error when transferring data can lead to miscalculations. Peer review.	Averages were not used for this data set. It is complete.
Scope 1	Addition of livestock waste to soils	Pre-calculated (tCO2-e) - Effluent N2O, Pre-calculated (tCO2-e) - Excreta N2O, Pre-calculated (tCO2-e) - Indirect N2O emissions	Farms data is determined using stocking rates, fertiliser applications, feed etc. Farmwise consultant enters data into Overseer. Human error when transferring data can lead to miscalculations. Peer review.	Averages were not used for this data set. It is complete.
Scope 1 Biogenic methane	Addition of livestock waste to soils	Pre-calculated (tCO2-e) - Effluent Methane, Pre-calculated (tCO2-e) - Excreta methane	Farms data is determined using stocking rates, fertiliser applications, feed etc. Farmwise consultant enters data into Overseer. Human error when transferring data can lead to miscalculations. Peer review.	Averages were not used for this data set. It is complete.
Scope 1 Biogenic methane	Enteric fermentation	Pre-calculated (tCO2-e) - Enteric fermentation Methane	Farms data is determined using stocking rates, fertiliser applications, feed etc. Farmwise consultant enters data into Overseer. Human error when transferring data can lead to miscalculations. Peer review.	Averages were not used for this data set. It is complete.

GHG emissions Scope	GHG emissions source or sink subcategory	Overview of activity data and evidence	Explanation of uncertainties or assumptions around data and evidence	Use of default and average emissions factors
Overall assessment of uncertainty for Scope 1 emissions and removals			10%	Medium
Scope 2	Imported electricity	Electricity	Assume that supplier invoices (Contact, Mercury, Trust Power) are correct. Missing some data occasionally from emails/invoices misfiled. When that has occurred data average for the period is used for that month.	Some averages were used for this data set. It is largely complete.
Overall assessment of uncertainty for Scope 2 emissions and removals			11%	Medium
Scope 3	Business travel - Transport (non-company owned vehicles)	Freight (pre-verified tCO2-e), Staff vehicles (various sizes, ages, fuel types), Air travel domestic (average), Air travel domestic (large aircraft), Air travel long haul (business), Air travel long haul (econ), Air travel long haul (econ+), Air travel short haul (econ), Air travel short haul b/f class	Freight (pre-verified tCO2-e) data derived from NZ Post, Orbit World Travel Air travel - pkms used. Km data was used cross-referenced with employee km claims, where data was provided based on vehicle size, age, and fuel type. For all other data for those who did not answer the survey regarding their vehicle, the average emission factor was used based on km travelled by staff.	As staff awareness grows LIC hopes that more people take time to respond to the vehicle survey and accuracy can improve.
Scope 3	Upstream freight - Paid by the organisation	Freight Road all trucks (average), Freight Shipping container (average), Air travel domestic (large aircraft), Air travel domestic (medium aircraft), Air travel domestic (small aircraft)	Assume that data from suppliers are correct, (Kamar). Do not have exact addresses of where some of the freight is going so based on km distance from airport/seaport to airport/seaport.	Some data sets are difficult to obtain. LIC endeavours to obtain as close to accurate data as possible.
Scope 3	Downstream freight - Paid by the organisation	Freight Air travel Domestic (average), Freight Air travel long haul (average), Freight Air travel short haul (average), Freight Road all trucks (average), Freight Shipping container (average)	Assume that data from suppliers (AIRNZ, Cargo wise, Beacon) are correct. Do not have exact addresses of where some of the freight is going so based on km distance from airport/seaport to airport/seaport.	Some data sets are difficult to obtain. LIC endeavours to obtain as close to accurate data as possible.
Scope 3	Employee commuting	Staff vehicles (various size, age, fuel type)	Data based on staff survey regarding vehicle age, size, fuel used. All other data is calculated based on 2018 census data average of those travelling to Ruakura and FTE.	Once the 2023 census data is published, we will update this average distance travelled. As staff awareness grows, we hope that data will continue to improve.
Overall assessment of uncertainty for Scope 3 transport emissions and removals			20%	Medium
Scope 3 – biogenic methane	Disposal of solid waste - Landfilled	Composting, Waste landfilled LFGR Mixed waste, Waste landfilled No LFGR Mixed waste	Assume supplier data is correct (EnviroNZ).	No averages were used.
Scope 3	Disposal of solid waste - Not landfilled	Waste disposal recycling of Batteries, Waste disposal recycling of Glass, Waste disposal recycling of Paper	Battery recycling is based on the estimated weight (25kg) multiplied by the number of containers recycled per year by LIC. Assume supplier data is correct (Abilities, Polymer processing, Oji fibre solutions, EnviroNZ, Waste Management).	No averages were used.
Scope 3 – biogenic methane	Disposal of liquid waste - Not wastewater	Wastewater (industrial) dairy processing	Assume vendor invoices are accurate based on collection from tanks (Allens United, Prime Environmental).	No averages were used.
Scope 3 – biogenic methane	Disposal of liquid waste - Wastewater	Wastewater for treatment plants (average)	Assume vendor invoices are accurate based on collection from tanks and council meter readings. (Allens United, Prime Environmental, Local	No averages were used.

GHG emissions Scope	GHG emissions source or sink subcategory	Overview of activity data and evidence	Explanation of uncertainties or assumptions around data and evidence	Use of default and average emissions factors
			Council, S3) Some estimates are required based on per-capita information.	
Scope 3	Transmission of energy (T&D losses)	Electricity distributed T&D losses, Natural Gas distributed T&D losses	Assume that supplier invoices are correct. (Contact, Trust Power, Mercury). Missing some data occasionally from emails/invoices misfiled. When that has occurred data average for the period is used for that month.	Some averages were used for this data set. It is largely complete.
Scope 3	Recycling process	Recycling - Commingled	Assume supplier data is correct (EnviroNZ, Waste Management).	No averages were used.
Overall assessment of uncertainty for Scope 3 emissions and removals			9%	Medium

GHG emission source exclusions

LIC recognise that a small proportion of its GHG emission sources contribute to total inventory with many individual GHG emissions contributing to less than 1% per emission source category. When collated, these emission sources have totalled less than 2% of total GHG emissions inventory and as such LIC have deemed them *de minimis*. Table 7 outlines the GHG emission source exclusions and justifications.

Table 7: GHG emission sources excluded from LIC inventory.

Scope	GHG emission source	Reason for exclusion
Scope 1	Biofuels and biomass	LIC does not use biofuels or biomass
Scope 1	LPG gas BBQ bottles	LIC has a few 9kg LPG BBQ cylinders on site. These are excluded from the inventory as they are likely to be deemed *de minimis*.
Scope 1	Fugitive emissions from refrigeration, air-conditioning units, and vehicle air-conditioning units	Data was difficult to quantify, LIC used the screening method in 2019/20 and determined that R-gases are likely *de minimis* and have been excluded. LIC will look to include this information in further reporting years once data improves.
Scope 3	Indirect business-related emission factors (emissions associated with employees working from home)	LIC has determined that this information will be difficult to quantify due to seasonal fluctuations and a mix of staff working from home and on-site across all business units. New workstation setups will potentially provide LIC with the information required and will look to include this information in the future.
Scope 3	Accommodation	Determined to be *de minimis*. From previously generated reports accommodation was determined to be *de minimis* and as such has been excluded. Data is available and could be added to the report however it is likely insignificant to the larger emissions profile.
Scope 3	Public transport and taxi travel	LIC has excluded public transport and taxi travel as it is difficult to obtain data.
All emission scopes	Livestock Improvement Corporation Limited - International	LIC excluded International Site data from the GHG inventory report as it was not a requirement under the commitments made to the CLC or SBC. In future reports, LIC will assess if this information will be required to be included and conduct significance screening.

Liabilities

GHG stocks held on-site

Refrigerants and fuels may be stored on-site, but their accidental leakage or release could result in a large increase in emissions for that period. Refrigerants such as HFCs, PFCs and SF6 are GHGs with high global warming potentials, so material volumes of these or fuel are reported as potential liabilities.

Table 8: Total storage as of year-end with potential GHG emissions liabilities.

GHG gas stock held	Quantity	Unit	Potential liability (tCO_2e)
Diesel	8,990.00	litres	24.22
Diesel stationary combustion	980.00	litres	2.62
LPG stationary commercial	90.00	kilograms	0.27
Petrol	4,175.00	litres	10.25
Total potential liability			37.36

Methodology

This GHG inventory was prepared in alignment with The Greenhouse Gas Protocol standard guidance (GHG-Protocol, 2015), ISO 14064-1:2018 – Greenhouse gases – Part 1 and Measuring Emissions: A Guide for Organisations (NZGovt, 2022).

LIC used Toitū Envirocare emanage and Toitū Envirocare My Farms software in conjunction with OverseerFM to calculate GHG emissions. LIC managed data using Microsoft Excel.

Significant emission sources 2022/23

LIC's top emission sources are derived from Scope 1 direct emissions - diesel use, Scope 1 biogenic methane - enteric fermentation, and Scope 3 indirect emissions - staff commuting.

The activities that relate to the most significant emission sources are indirect transport emissions from staff commuting to, from, and for work. Emissions produced by on-farm activities are derived from livestock, fertiliser use and feed, and emissions generated by the diesel used in fleet vehicles to deliver LIC's products and services.

Scope 1 – Direct emissions

Transport fuel represents a large proportion of LIC's total Scope 1 emissions with diesel contributing to 59% of emissions and petrol contributing 11%. Diesel emissions were reduced by 6.5% from the base year and regular petrol emissions by 14%. Transport fuel emission reductions are related to replacing many of LIC's combustion engine fleet vehicles with EVs and PHEVs. Further reductions year-on-year are expected as LIC continue to replace existing combustion engine vehicles (Figure 2).

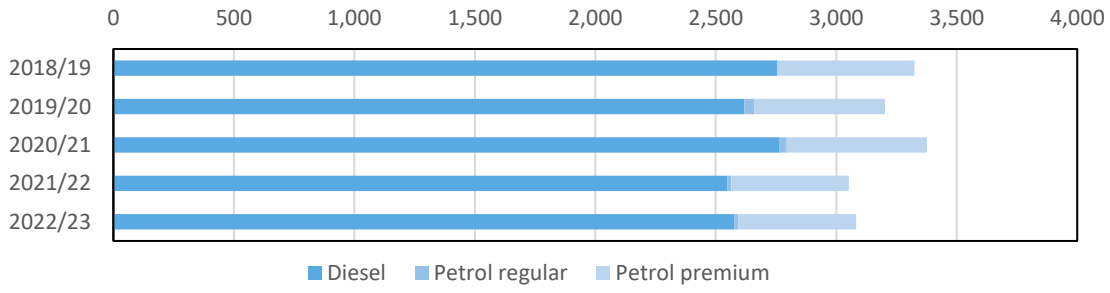

Figure 2: Transport fuel emissions base year to 2022/23 reporting year.

Agricultural N_2O emissions reported as CO_2 contributed to 22% of LIC's total Scope 1 emissions. In the 2022/23 reporting year, the co-op's agricultural emissions increased by 18.3% from the base year and increased by 10.8% from the 2021/22 reporting year (Figure 3). The increases are a result of increased animal numbers on-farm and in research trials.

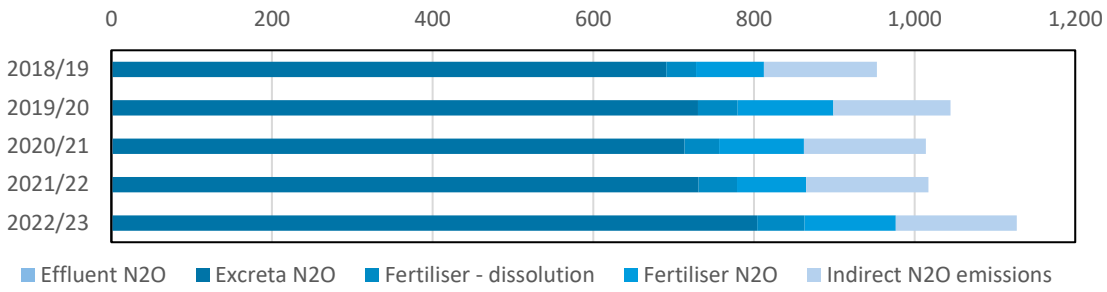

Figure 3: Top agricultural N2O emissions from the base year to the current reporting year.

Stationary combustion emissions from reticulated LPG and natural gas contributed to 4% of LIC's total Scope 1 GHG emissions in 2022/23 increasing by 0.84% from the base year but reduced by 7.2% from the 2021/22 reporting year (Figure 4).

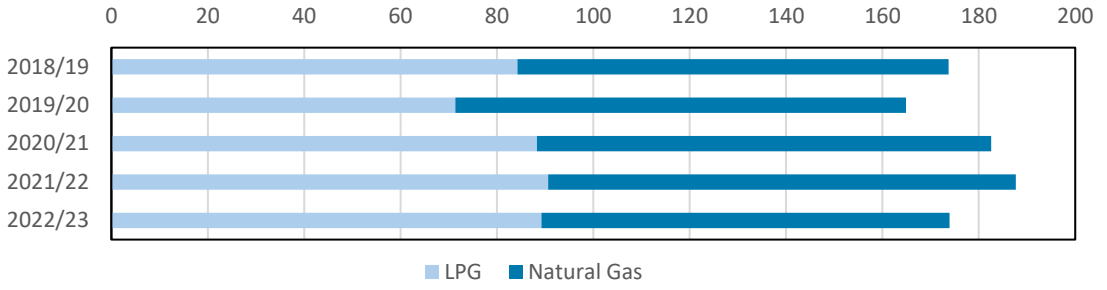

Figure 4: Scope 1 Stationary combustion emissions from the base year to the current reporting year.

Scope 2 – Indirect emissions

Electricity consumption makes up 100% of LIC's Scope 2 emissions. In the 2022/23 reporting year, emissions were reduced by 18.3% from the base year and by 5.1% from the 2021/22 reporting year (Figure 5). Emission factor changes to energy saw LIC's energy emission profile change significantly from previous reports.

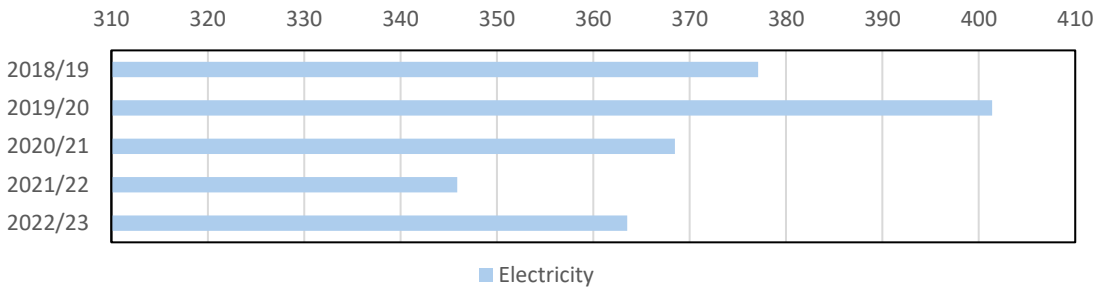

Figure 5: Scope 2 indirect electricity emissions, base year to the current reporting year.

Scope 3 – Indirect emissions

Staff commuting (64% of Scope 3) and Business travel (~21%) are the most substantial Scope 3 emission sources (Figure 6). Emissions associated with staff commuting were reduced by 13.7% when compared to the base year and by 8.11% from 2021/22. Decreases in both staff commuting and

business-related travel are related to improved data capture, reducing the need to use averages and estimations.

LIC flight emissions are still tracking below the base year figures, however, when compared to 2021/22 International Flight data increased significantly. In the 2022/23 reporting year LIC was able to reconnect with our international operations in the UK, Ireland, and Australia. We were also able to re-engage with key stakeholders abroad, including our work with the Ethiopian Government to assist in the design and development of livestock information systems to improve informed policy and planning decision-making. It is envisaged that this information will have the ability to inform climate and environmental decision-making and mitigations in the longer term.

Waste emissions from our recycling increased significantly in the reporting period from base year. The increase can be viewed as a positive as LIC divert recyclable materials from being landfilled. While these emissions are largely *de minimis*, they have been included in the inventory as they provide LIC with assurance that our waste reduction initiatives are making a concerted difference. Recycling emissions will be expected to rise in the coming years as we continue to improve our waste management practices.

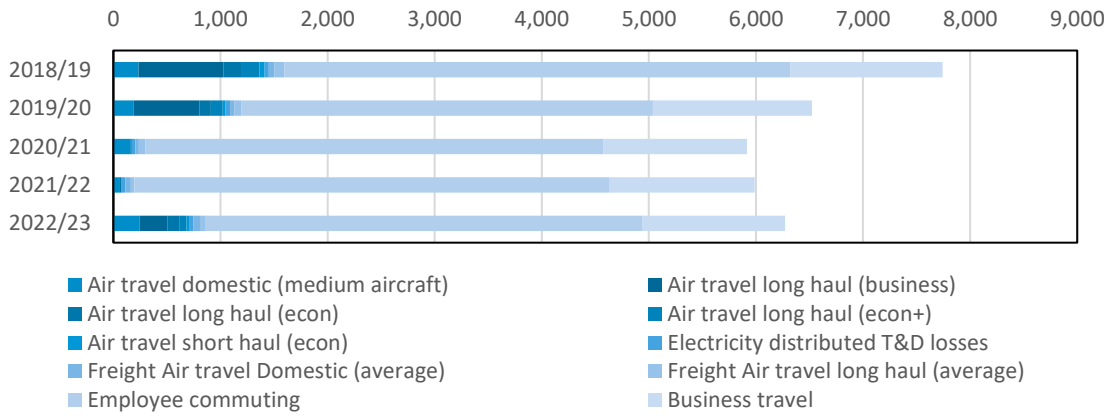

Figure 6: Scope 3 indirect travel emissions, base year to the current reporting year.

Scope 1 and Scope 3 – Biogenic methane emissions

LIC's top contributor to biogenic methane emissions is derived from livestock. LIC's total agricultural biogenic methane equates to 99.96% of Scope 1 biogenic methane emissions. Wastewater treatment is as such *de minimis* at 0.04% of Scope 1 biogenic emissions. Agricultural emissions increased by 8.9% when compared to the base year and increased by 3.2% when compared to the 2021/22 reporting year. Wastewater treatment was reduced by 4.4% from the base year and increased by 2% when compared to the 2021/22 reporting year.

Scope 3 biogenic methane is derived from indirect wastewater treatment (34%) and biogenic waste (66%). Wastewater treatment emissions increased by 13.6% when compared to the base year and decreased by 9.7% when compared to the 2021/22 reporting year. As mentioned previously, LIC's waste emissions were reduced by 88.3% from the 2019/20 base year because of improved data capture. Waste emissions increased by 10% from the 2021/22 reporting year. Moving forward the base year for waste will be the 19/20 reporting year (Figure 7).

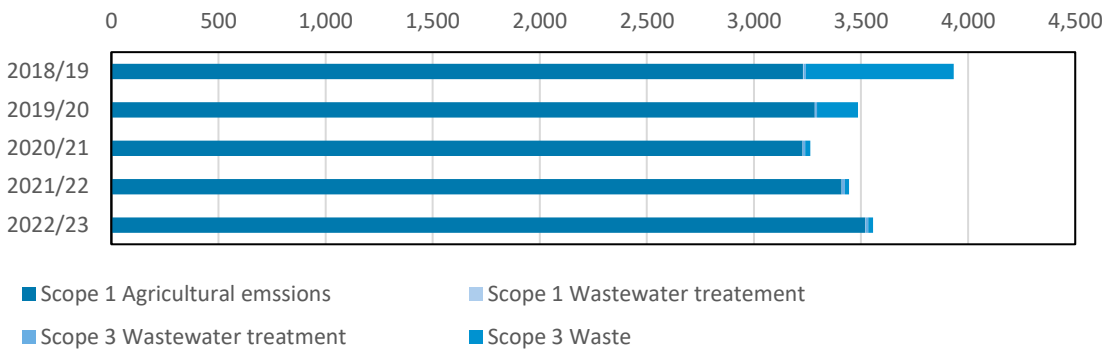

Figure 7: Combined Scope 1 and 3 biogenic methane emissions from the base year to the current reporting year.

Influence over significant emission source activities - overview

LIC is always striving to find ways to improve the way they work. The co-op has influence over several of its emission sources and tries and reduce carbon footprint from work activities.

LIC, in association with CRV and NZAGRC, is currently working on a research project which measures the methane emissions expelled from young dairy breeding bulls. Daughters bred from these bulls will also be measured in future to determine the significance of selecting lower-emitting animals and understand if there are adverse effects between animals with different levels of emissions. This research will be critical to understanding the potential to measure and select dairy sires with lower emissions in the future.

LIC works together with Ravensdown to ensure the fertiliser input used on the co-op's owned farms is monitored through a regular fertiliser schedule. By conducting regular soil testing LIC ensures the correct amount of nutrients is used to provide sufficient pasture growth for grazing animals.

In terms of emissions derived from fleet vehicles, LIC ensures that vehicles are kept well-maintained and procures vehicles that generate fewer emissions. Through education of staff and monitoring their driving through systems like EROAD, LIC can see where improvements are required. LIC's procurement team also keeps up to date on technological advances in electric vehicles and is systematically replacing fleet vehicles with EVs when able.

By raising awareness about the impacts of climate change and providing education and guidance to staff, LIC has some influence over the generation of emissions. This awareness, guidance and education will potentially help staff make informed choices about how they can reduce their carbon footprint, including the option to work from home.

Emission reduction targets and progress against the plan

LIC has set emission reduction targets based on science using the SBTi methodologies and the NZ Government, Climate Change Response (Zero Carbon) Amendment Act 2019 [6], to limit the temperature increase to 1.5°C of pre-industrial levels to reach the co-op's goal of:

- 46.2% reduction of Scope 1 and 2 emissions* by 2030 (against the 2018/19 base year)
- 28.88% reduction of Scope 3 emissions* by 2030 (against the 2018/19 base year)
- 10% reduction of biogenic methane by 2030 (against 2018/19 base year)

*Excluding biogenic methane

Table 9: LIC performance against targets.

Target name	Baseline period	Target date	Type of target (intensity or absolute)	Current performance (tCO_2e)	Current performance (%)	Reduction target for 22/23 (%)	Reduction target 22/23 (tCO2e)
Scope 1 – Direct emissions	2018/19	2030	Absolute	4,386.60	-1.47%	-16.80%	3,704.08
Scope 2 – Indirect emissions	2018/19	2030	Absolute	363.50	-3.60%	-16.80%	313.74
Scope 3 – Indirect emissions	2018/19	2030	Absolute	6,374.16	-19.46%	-10.50%	7,083.67
Scope 1 – Biogenic methane - Direct emissions	2018/19	2030	Absolute	3,521.21	8.98%	-3.64%	3,113.63
Scope 3 – Biogenic methane	2018/19	2030	Absolute	8.24	-32.58%	-3.64%	11.78
Scope 3 – Biogenic methane (Waste only)	2019/20*	2030	Absolute	19.90	-89.58%	-2.73%	185.81

*Data improvements to waste data collection. Now calculating from 2019/20 reporting year.

In the 2022/23 reporting year, LIC has reduced Scope 1 emissions by 1.47% against the 2018/19 base year. This reduction result is less than the projected 16.8% reduction required for the reporting year to meet the co-op's 2030 target of 46.2% Scope 1 reduction (Figure 8).

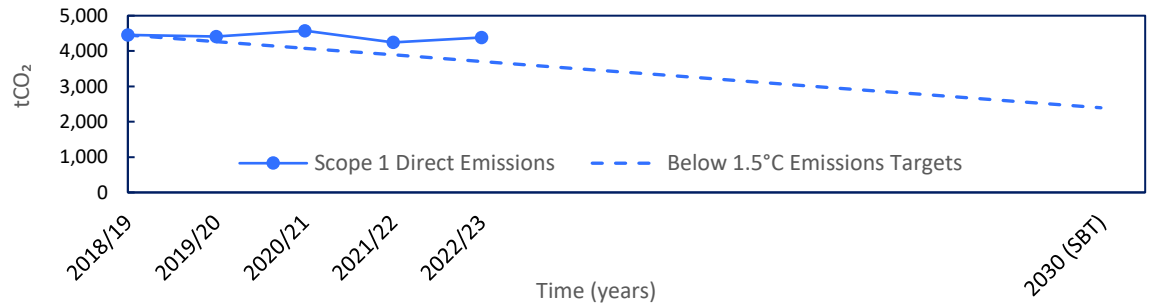

Figure 8: LIC Scope 1 emissions in comparison to 2030 science-based target.

LIC's Scope 2 emissions were reduced by 3.6% from the 2018/19 base year. This result is less than the expected target of the 16.8% reduction required for the reporting year to meet the co-op's 2030 target of 46.2% Scope 2 reduction (Figure 9).

[6] Part 1B Emission Reduction, Subpart 1 – 2050 target, 5Q Target for 2050 1(b)(i)

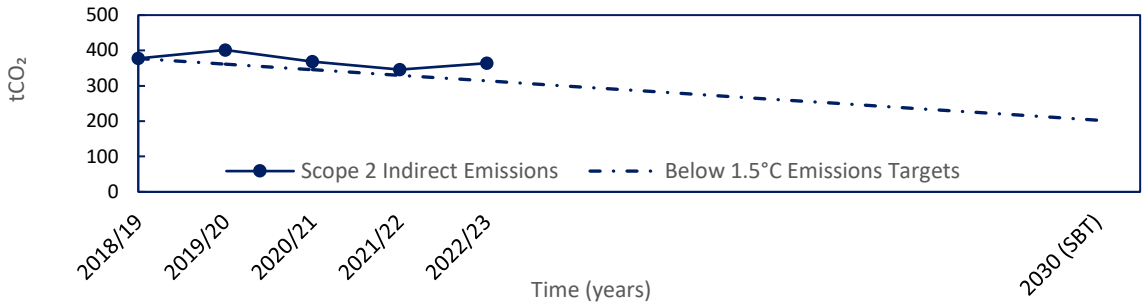

Figure 9: LIC Scope 2 emissions in comparison to 2030 science-based target.

LIC's Scope 3 emissions were reduced by 19.5% from the 2018/19 base year. This result exceeded the expected target of 10.5% required to be on track to meet the co-op's 2030 reduction target of 28.9% (Figure 10).

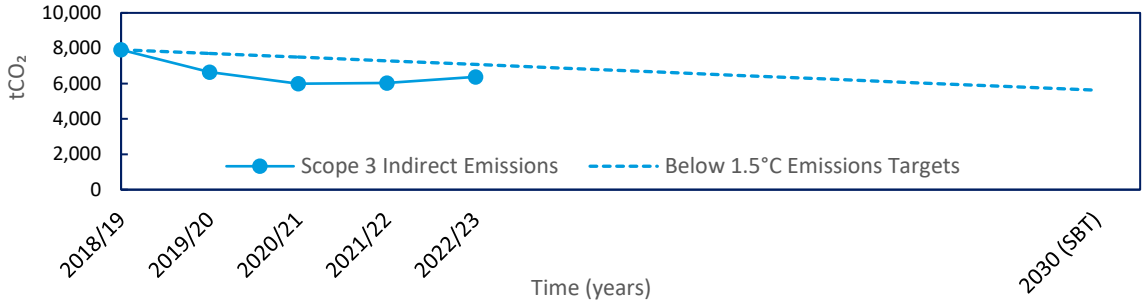

Figure 10: LIC Scope 3 emissions in comparison to projected emission reduction 2030 science-based target.

LIC's Scope 1 biogenic methane emissions increased by 8.89%. The co-op's projected reduction target of 3.64% was not met and improvements will need to be made in the coming years to meet the overall reduction target of 10% by 2030 (Figure 11).

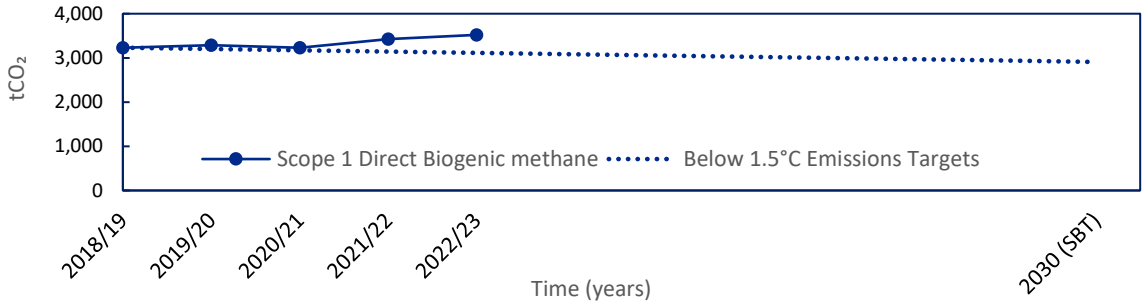

Figure 11: LIC Scope 1 biogenic methane emissions in comparison to projected emission reduction 2030 science-based target.

LIC's Scope 3 biogenic methane indirect emissions (excluding waste) increased by 2.55% from the 2018/19 base year. The co-op's projected reduction target of 3.64% was not met and improvements will need to be made in the coming years to meet the overall reduction target of 10% by 2030 (Figure 12).

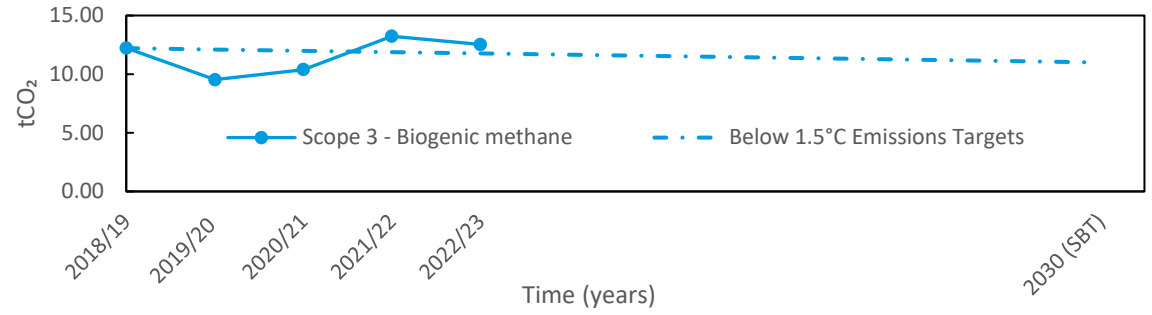

Figure 12: LIC Scope 3 biogenic methane emissions in comparison to projected emission reduction 2030 science-based target.

LIC's Scope 3 biogenic methane indirect waste emissions decreased by 88.3% from the 2019/20 base year. The co-op's projected reduction target of 3.64% was exceeded and consideration needs to be taken regarding LIC using a 2020/21 base year moving forward (Figure 13).

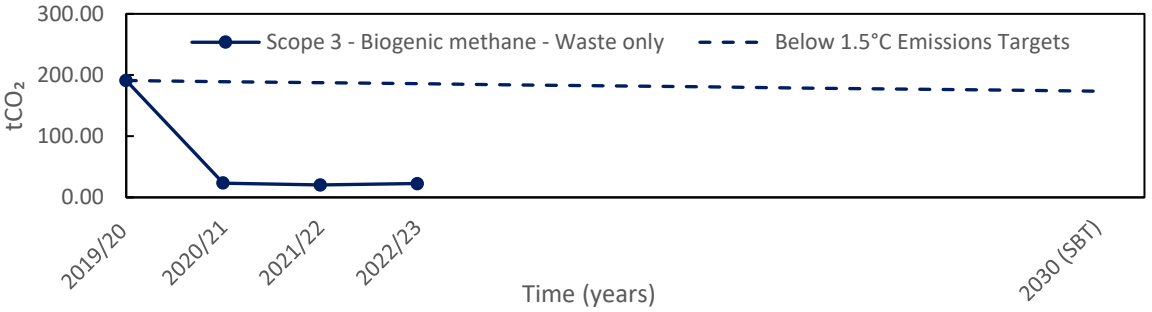

Figure 13: LIC Scope 3 biogenic methane emissions (excluding the base year) in comparison to projected emission reduction 2030 science-based target.

Emission reduction projects and data improvements

To achieve LIC's reduction targets, specific projects have been identified to achieve the targets as detailed in Table 10.

Table 10: Projects to improve data and reduce emissions.

Objective	Project	Responsibility	Completion date	Potential co-benefits	Potential unintended consequences	Actions to minimise unintended consequence
Reduce energy emissions - Newstead head office	Install solar panels at Newstead	Elliott Winthrop, Procurement Co-ordinator, Joel Bowden, General Manager Customers, Lightforce	30/11/2023	Raising awareness with staff of renewable energy sources and LIC playing its part in reducing emissions.	None anticipated	n/a
Reduce energy emissions - Newstead head office	Finalise energy emission reduction pathway	Chad Harland, Senior Scientist, Adrea Noyes - Environmental Advisor	31/09/2023	Further energy emission reductions	None anticipated	n/a

Objective	Project	Responsibility	Completion date	Potential co-benefits	Potential unintended consequences	Actions to minimise unintended consequence
Reduce energy emissions - Newstead head office	Complete energy audit at Newstead	Adrea Noyes - Environmental Advisor	31/01/2024	Further energy emission reductions and projects.	None anticipated	n/a
Improve data capture for Scope 3 staff commuting and business travel emissions	Improve survey questions for the next reporting year	Adrea Noyes - Environmental Advisor, Hannah Blackburn - AB Operations Office Manager	1/10/2023	Reduced emissions through improved reporting and data capture.	None anticipated	n/a
Improve data capture for Scope 3 staff commuting and business travel emissions	Develop a survey for Field assists to improve data capture.	Adrea Noyes - Environmental Advisor, Devon Samuel, Commercial Projects Manager - Operations	31/01/2024	Reduced emissions through improved reporting and data capture.	None anticipated	n/a
Continue transport fuel use emission reductions	Replace 30 vehicles to reduce emissions. 50% full EV replacement target. SUV options are provided.	Elliott Winthrop, Procurement Co-ordinator	31/05/2024	Reduced fuel use from improved technology and efficiency. Raise awareness to people provided fleet vehicles regarding their carbon footprint.	Increase of energy use emissions.	Solar panel installation at Newstead.
Reduce methane emissions	Dairy farm - install eco-pond	Phil McKinnon – Farms Manager	31/10/2023	Reduced methane emissions from treating the effluent pond. Reduced e-coli through treatment. Reduced odours	None anticipated	n/a
Reduced use of artificial fertilisers	Whole farm soil testing	Phil McKinnon – Farms Manager/Sarah Death Ravensdown	30/11/2023	Targeted fertiliser applications on a paddock basis will enable LIC to only apply necessary fertiliser to each paddock. Likely reduce fertiliser cost & waste	None anticipated	n/a
Reduced fuel emissions	Farm EVs - purchase electric ATV - Awahuri	Procurement	31/05/2024	Staff awareness	Increase of energy use emissions.	Further investigation into solar panel installation at Awahuri.

LIC has identified emissions that may pose a liability risk in the Liabilities section. To mitigate any adverse effects Table 11 outlines actions taken to prevent any GHG emission losses and liabilities.

Liability source	Actions to prevent emissions	Responsibility	Completion date
Farm diesel tanks	Regular servicing and preventing damage to units	Site Manager	Ongoing
Farm petrol tanks	Regular servicing and preventing damage to units	Site Manager	Ongoing
Diesel generators	Regular servicing and preventing damage to units	Site Manager	Ongoing
LPG cylinders for water heating at Vailes	Regular servicing and preventing damage to units	RockGas	Ongoing

Staff engagement

LIC staff are made aware of the organisations' emissions reduction commitments through our internal website 'The Shed' which has dedicated pages to highlight our environmental impacts, as well as annual knowledge-share sessions where our emissions results are shared with staff in an interactive in-person and online presentation. LIC sends out companywide communications regarding its annual reports and has developed an environmental training module which was completed at the end of 2022.

LIC has formed an Environment and Sustainability Management Committee comprised of staff from across the business who have had one-to-one training with the Environmental Advisor to develop LIC's Environmental Aspects Register and are setting targets and objects to monitor, remedy and mitigate any adverse effects from LIC operations. Committee members help drive initiatives to reduce LIC's impact under the four pillars – emission reductions, environmental impact, staff and supplier engagement. The committee members provide updates to their teams and organise companywide events to help raise awareness on how our staff can make reductions to their own environmental impacts and carbon footprint.

LIC has implemented recycling schemes for staff to recycle e-waste, batteries, soft plastics, and polystyrene from home to reduce their waste emission from hard-to-recycle products.

In February of 2023, the LIC Environment Team ran a survey of all LIC staff based in New Zealand to gauge their understanding of the work that LIC is doing in the environment and sustainability space, how they think LIC is doing, and what they would like to see LIC do in the environment and sustainability space. The survey highlighted areas of improvement and will help shape the next three-year planning cycle.

GHG information management and monitoring procedures

Information management

LIC's GHG emissions are calculated annually and compared against the base year (2018/19). Procedures detailing methods for, but not limited to data collection, data entry, GHG calculations, and record-keeping are used to prepare the co-op's annual report. The procedures are reviewed on an annual basis to ensure LIC is using the most up-to-date methodology.

Base year recalculation

LIC may in the future be required to recalculate its base year as a result of historical data uncovered, improvements in data gathering, changes to the reporting boundaries, and changes to calculation methods or other contributing factors. As such the base year is to be reviewed and recalculated and the next GHG inventory report will include an explanation of any changes.

Historical recalculations

Historical recalculations have been conducted in the 2022/23 reporting year. During June and July LIC had reporting years 2019/20, 2020/21, 2021/22, and the current reporting year 2022/23 audited and assured by Toitū, minor data errors were found and amended. Further to the audit findings, historical data for Scope 3 business travel was added to each reporting year. Following assurance, the inventories will be closed, and any additional data will only be added to the next reporting year. LIC's emissions profile will likely increase as the full value chain is explored in the coming year and significance is determined.

Verification of GHG inventory

LIC has had this GHG inventory assessed and verified by Toitū Envirocare. The assurance report and LIC's carbonreduce certification can be found on our website.

References

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Appendix 1
Scope definitions

Scope 1 – Direct GHG emission sources
Direct emissions are generated by sources owned or controlled by the company. For example, emissions are derived from the combustion of fuel in vehicles, stationary combustion fuels (generator diesel or piped natural gas), refrigerant use (air conditioning units) or agriculture.

Scope 1 – Biogenic methane
Scope 1 biogenic methane emissions are generated from enteric fermentation, manure and wastewater treatment (WWT). Enteric fermentation emissions are based solely on the methane produced by animals whilst the manure and WWT emissions are divided into methane and nitrous oxide. Methane derived from manure management and WWT are included in Scope 1 biogenic methane emissions, and the nitrous oxide derived from manure is included in Scope 1 direct GHG emissions.

Scope 2 – Indirect GHG emission sources
Indirect emissions are derived from the generation of purchased energy such as steam, heat, or electricity that is used by the company.

Scope 3 – Other GHG indirect emission sources including Scope 3 biogenic methane
Other indirect emissions are derived from the activities that are carried out by the company but from sources not controlled by the company. For example, indirect emissions from travel such as air travel, freight transport, refrigerant use from chilled transport or air conditioning, and passenger-owned vehicles used by AB staff. Other indirect GHG emissions from products the company uses such as water supply and wastewater treatment, transmission and distribution losses, materials and waste (NZGovt, 2022).Appendix 2

Calculating LIC Agricultural emissions

Scope:
LIC have scoped its agricultural emissions as the emissions which come from the farms and animals owned by LIC in New Zealand.

In 2022 this includes:

1. Innovation Farm, dairy farm, Ngahinapouri, Waikato
2. Newstead Bull Farm, Newstead, Waikato
3. Chudleigh Bull Farm, Tauwhare, Waikato
4. Awahuri Bull Farm, Awahuri, Manawatu
5. Feilding Farm, Feilding, Manawatu
6. All animals grazing on LIC-owned farms regardless of ownership
7. External grazing arrangements for:
    a. Innovation Farm dairy cattle
    b. Breeding scheme cattle
    c. Research cattle

It specifically excludes:

1. All animals not owned by LIC (except for a small number of animals grazing on LIC-owned farms)
2. Animals owned by other parties are used for:
    a. periodic contracted mating arrangements,
    b. used for semen collection at third-party semen collection centres,
    c. used for embryo collection at third-party locations,
    d. phenotype data capture,
    e. research measurements.
3. Animals are not in New Zealand.

For LIC-owned farms:

LIC have created OverseerFM files for each of the LIC-owned farms to calculate agricultural emissions. These emissions are predominantly from animals and fertiliser products. It includes direct emissions of enteric methane, indirect emissions from faeces, urine and effluent applied to soils; and direct and indirect emissions from fertiliser and lime products applied.

For external grazing arrangements:

For LIC-owned animals which are not grazing on LIC farms, there has been an estimation of their methane and nitrous oxide emissions directly associated with these animals. It is estimated that this accounts for 80-90% of the total greenhouse gas emissions associated with these animals.

The classes of animals included in this section are:

1. Innovation Farm Cattle:
    a. Wintering off dry cows
2. Breeding Scheme Animals
    a. Short Gestation Length (SGL) breeding scheme animals
    b. KiwiPrime breeding scheme animals
    c. Slick breeding scheme animals
3. Research animals
    a. KiwiPrime Benchmark project animals (from Spring 2021)

These grazing arrangements are contractually based and LIC do not have access to any other emissions associated with the properties these animals graze on regarding other livestock, fertiliser and farm practices. Other emissions associated with these animals have not been assessed.

These emissions have been estimated by using feed intake requirements per animal over the periods they are subject to external grazing arrangements and multiplied by emissions factors for both methane and nitrous oxide.