



Greenhouse Gas Emissions Inventory Report

AUGUST 2023

Summary of Emissions

Purpose and limitations of this report

This report is a summary of Vector's greenhouse gas inventory. It is intended to inform readers about Vector's business strategy with respect to greenhouse gas emissions, but it is not earnings guidance nor financial advice for investors.

While Vector has taken all due care in preparing this report and has taken efforts to ensure that assumptions and input data have a reasonable basis and are coherent and robust (including basing them on modelling, public scientific information, market knowledge, government guidance, supplier information and reasonable/ expert opinions), assessments of greenhouse gas emissions are still a developing field. Modelling assumptions, emission factors and third-party data are expected to evolve as the discipline progresses.

To the greatest extent possible under NZ law, Vector expressly disclaims all liability for any direct, indirect or consequential loss or damage occasioned from the use or inability to use this report, whether directly or indirectly resulting from inaccuracies, defects, errors, omissions, out of date information or otherwise.

We recommend you seek independent advice before acting or relying on any information in this report.

2023 Reporting Suite

This GHG Emissions Inventory Report is published as part of a reporting suite, which also includes our Annual Report, and Taskforce on Climate-related Financial Disclosures Report. All three reports are available on vector.co.nz

In FY23, Vector's greenhouse gas emissions across scope 1, 2 and 3 amount to 1,620,321 tCO₂e. This is a 14.7% reduction from FY20, Vector's base year.

Table 1 summarises yearly emissions by scope, Table 2 shows total scope 1 and 2 emissions split by the gases stated in the Kyoto Protocol, and Table 3 breaks down emissions into scope and category.

Table 1: Emissions trend by scope in tCO₂e

Emissions category	FY20	FY21	FY22	FY23	Change from FY20 baseline
Total Scope 1, 2, 3	1,898,798	1,680,543	1,601,008	1,620,321	-14.7%
Scope 1	22,388	17,887	21,816	19,485	-13%
Scope 2*	33,148	34,449	39,486	42,810	29%
Scope 3	1,843,262	1,628,207	1,539,706	1,558,026	-15%

Table 2: Total FY23 emissions by greenhouse gas in tCO₂e[†]

Scope	CO ₂	CH ₄	N ₂ O	HFCs	SF ₆	Total tCO ₂ e
Total FY23	48,017	12,816	131	141	2,180	63,285
Scope 1	5,315	11,802	47	141	2,180	19,485
Scope 2 (location-based)	42,702	1,014	84	N/A	N/A	43,800

* Market-based method for electricity consumption. While location-based electricity emissions are also included in our inventory, the sums in tables 1 and 3 include only market-based emissions, as these form part of our science-aligned reduction target.

† PFCs and NF₃ are not listed here as they are not relevant to Vector activities.



Table 3: GHG inventory by scope and category in tCO₂e. FY23 emissions highlighted in green indicate a reduction since the baseline, whereas emissions in red show increases. Black indicates no change from base year, or no emissions calculated for FY20.

Emissions category	FY20	FY21	FY22	FY23
Total Scope 1, 2*, 3	1,898,798	1,680,543	1,601,008	1,620,321
Scope 1	22,338	17,887	21,816	19,485
Natural Gas Distribution Fugitive Emissions [‡]	16,368	12,074	14,493	11,908
SF ₆ Fugitive Emissions	426	592	1,859	2,180
Other Fugitive Emissions [§]	141	142	134	141
Stationary Combustion	3,558	2,971	3,348	3,183
Vehicle Fleet [§]	1,895	2,108	1,982	2,073
Scope 2*	33,148	34,449	39,486	42,810
Electricity Consumption (market-based) [§]	643	826	408	220
<i>Electricity Consumption (location-based)[§]</i>	<i>815</i>	<i>801</i>	<i>891</i>	<i>1,210</i>
Electricity Distribution Losses	32,505	33,622	39,078	42,590
Scope 3	1,843,262	1,628,207	1,539,706	1,558,026
C1: Purchased Goods & Services				
Upstream Purchased Natural Gas	227,569	170,442	136,821	152,290
Upstream Purchased LPG	46,555	47,609	52,806	58,140
Fuel Used by Field Service Providers [§]	6,475	6,822	6,456	7,235
Upstream Purchased Materials & Products	15,266	11,733	13,874	11,783
Upstream Purchased Other Goods & Services	75,939	71,465	75,080	79,559
C3: Fuel- and Energy-related Activities[§]	1,405	1,312	1,450	1,456
C4: Upstream Transportation	2,717	2,557	3,225	2,891
C5: Waste Generated in Operations	-	-	-	92
C6: Business Travel[§]	332	103	95	271
C7: Employee Commuting and WFH	-	-	-	933
C11: Use of Sold Products				
<i>Distributed Natural Gas AKL - Total</i>	<i>772,265</i>	<i>760,185</i>	<i>711,337</i>	<i>735,048</i>
Sold Natural Gas - AKL	151,603	115,578	57,149	66,376
Shipped Natural Gas - AKL	-	-	55,245	66,265
Other Distributed Natural Gas - AKL	620,662	644,607	598,943	602,407
Sold Natural Gas – non-AKL	562,567	381,871	231,127	223,568
Shipped Natural Gas – non-AKL	-	47,002	183,614	160,293
Sold LPG	131,385	126,245	122,904	123,542
C15: Investments				
Liquigas	87	89	108	105
Vector Metering [§]	700	771	809	821
Biogenic CO₂	162	134	150	138

[‡] A recalculation of FY22 was undertaken to add emissions from two leaks that occurred in June 2022, but were only documented as completed past the cut-off date for last year's GHG emissions inventory report. For details see Section 4.

[§] Recalculated FY20 – FY22 to remove emissions relating to Vector Metering after selling a 50% interest in the business. A 50% equity share of Vector Metering's scope 1 and 2 emissions is now included under scope 3. For details see Section 1 and Section 4.

^{||} Scope 3 categories that are newly included in FY23 reporting. Where emissions are material, these have been recalculated for FY20 - FY22 while immaterial categories are only included from FY23. For details see Section 4.

Summary of Emissions (continued)

Glossary of terms

Table 4: Definition and glossary of terms

Term	Description
AKL	Auckland
Carbon footprint	Vector's GHG emissions covered by the Kyoto Protocol, calculated in tonnes of carbon dioxide equivalent (tCO ₂ e).
CO₂	Carbon dioxide
DEFRA	Department of Environment, Food and Rural Affairs (UK)
EGF	Vector's Electricity distribution, Gas distribution and Fibre business
Emissions	GHG emissions
EPD	Environmental Product Declaration
EV	Electric vehicle
FSP	Field service provider
FY	Financial year
GHG	Greenhouse gas For the purposes of this report, GHGs are the seven gases listed in the Kyoto Protocol. These are currently: carbon dioxide (CO ₂), methane (CH ₄), nitrous oxide (N ₂ O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF ₆), and nitrogen trifluoride (NF ₃).
GHG Protocol	The Greenhouse Gas Protocol, a partnership between World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD). The GHG Protocol develops standards and guidance, such as the Corporate Standard and the Corporate Value Chain (scope 3) Standard, both used as guidance for this report.
GWP	Global warming potential, a measure of how much energy the emissions of 1 tonne of a greenhouse gas will absorb over a given period, relative to the emissions of 1 tonne of carbon dioxide (CO ₂).
GXP	Grid Exit Point
HVAC	Heating, ventilation, and air conditioning
ICP	Installation Control Point
IPCC (AR4/AR5)	Intergovernmental Panel on Climate Change (Fourth / Fifth Assessment Report)
LPG	Liquefied petroleum gas
MfE	Ministry for the Environment (NZ)
NZ	New Zealand
NZU	New Zealand Units
NZECS	New Zealand Energy Certificate Scheme
NZ ETS	New Zealand Emissions Trading Scheme
OGMP	Oil and Gas Methane Partnership
SBTi	Science Based Targets initiative
SELMA	Street Evaluation Laser Methane Assessment
SF₆	Sulphur hexafluoride
T&D	Transmission and distribution
tCO₂e	Tonnes of carbon dioxide equivalent
TCFD	Taskforce on Climate-related Financial Disclosures
TPD	Third-party damages
Vector	Vector Limited Group
WTT	Well-to-tank

Introduction

This report is for the Vector Limited Group ("Vector" or "the group"). The group comprises Vector Limited and its subsidiaries. Vector Limited is NZX listed and 75.1% owned by Entrust, a private community trust. A list of all subsidiaries can be found in [Appendix 1](#).

The purpose of this report is to transparently disclose Vector's greenhouse gas ("GHG") emissions: how they are quantified, how we're tracking towards our reduction targets and steps planned to further reduce GHG emissions ("emissions").

This GHG inventory report is for Vector for the year ended 30 June 2023. The inventory covered in this report is a complete and accurate quantification of the amount of GHG emissions that can be attributed to Vector's operations within the declared boundary and scope for the specified reporting period. Any exclusions from reporting are disclosed and justified.

This report has been prepared in accordance with the Greenhouse Gas Protocol: *A Corporate Accounting and Reporting Standard* [1] ("GHG Protocol Standard") and the Greenhouse Gas Protocol *Corporate Value Chain (Scope 3) Accounting and Reporting Standard* [2] ("GHG Protocol Value Chain Standard").

Statement of intent

Vector reports on its GHG emissions on an annual basis and has been calculating its carbon footprint since 2017.

Vector's GHG inventory has been calculated in accordance with the GHG Protocol Standard [1] and the GHG Protocol Value Chain Standard [2].

Its intended users are all interested stakeholders, including shareholders, investors, regulators, communities, employees, customers, and contractors.

This GHG inventory report has been reasonably assured by KPMG, see [Appendix 3](#).

Reporting period covered

This GHG inventory report covers Vector's financial year 1 July 2022 to 30 June 2023 ("FY23"). A summary of emissions can be found in both Vector's Annual Report 2023 and Taskforce on Climate-related Financial Disclosures (TCFD) Report 2023.

Variations: As SF₆ losses are calculated for the calendar year to align with New Zealand Emissions Trading Scheme ("NZ ETS") reporting requirements, SF₆ emissions refer to January – December 2022.

The purpose of this report is to transparently disclose Vector's GHG emissions: how they are quantified, how we're tracking towards our reduction target, and steps planned to further reduce GHG emissions.



Launch of New Zealand's first fully electric bus depot with the capacity to charge 20 - 30 buses each. Charging at this depot occurs within a 'dynamic operating envelope', where Vector forecasts optimal charging times each day and provides this through to the depot, reducing peak demand for a more affordable charging solution.

1. Organisational Boundaries

Description of Vector

Vector is an innovative New Zealand energy company which runs a portfolio of businesses delivering energy and communication services to more than 600,000 residential and commercial customers across New Zealand. Vector is creating a new energy future through its Symphony strategy which puts customers at the heart of the energy system.

The operations of the group are electricity and gas distribution, natural gas and LPG sales, telecommunications and new energy solutions. For further information visit www.vector.co.nz.

Organisational boundaries

Vector uses the operational control approach, as defined by the GHG Protocol Standard. This approach was chosen as it allows a focus on emissions over which the group has greatest control, and thereby can influence most with emission reduction measures.

For carbon accounting purposes, emissions are categorised into the business areas as outlined in Figure 1. A detailed list of all subsidiaries and shareholdings under Vector and their relevance for carbon accounting can be found in [Appendix 1](#).

Treatment of investments

In addition to these business areas, Vector has investments in a number of businesses that complement our network businesses and strengthen our capabilities in the energy services field. This subsection discusses the treatment of emissions from those businesses.

For carbon accounting purposes, Vector has set a threshold for equity investments of 20%, unless significant influence can be evidenced.

Vector Metering (50%)

Previously fully owned by Vector, Vector Metering manages around two million advanced electricity and gas meters across New Zealand and Australia. Vector Metering provides high resolution energy data services to enable new and innovative energy products that give customers large and small the ability to make smarter energy choices. Vector has sold a 50% interest in the business and in the process ceased to have operational control. Consequently, its emissions no longer form part of Vector's inventory, but we will account for a proportional share of Metering's scope 1 and 2 emissions under scope 3 - category 15.

Liquigas Limited (60.25%)

Liquigas is New Zealand's leading company for tolling, storage, and distribution of bulk LPG. It is not considered to be under Vector's operational control, because Vector does not have "full authority to introduce and implement its operating policies at the operation" (definition of operational control per the GHG Protocol Standard). As a result, Liquigas' scope 1 and 2 emissions are included under Vector's scope 3 - category 15 - Investments, with a 60.25% equity share.

mPrest Systems Limited (8.1%)

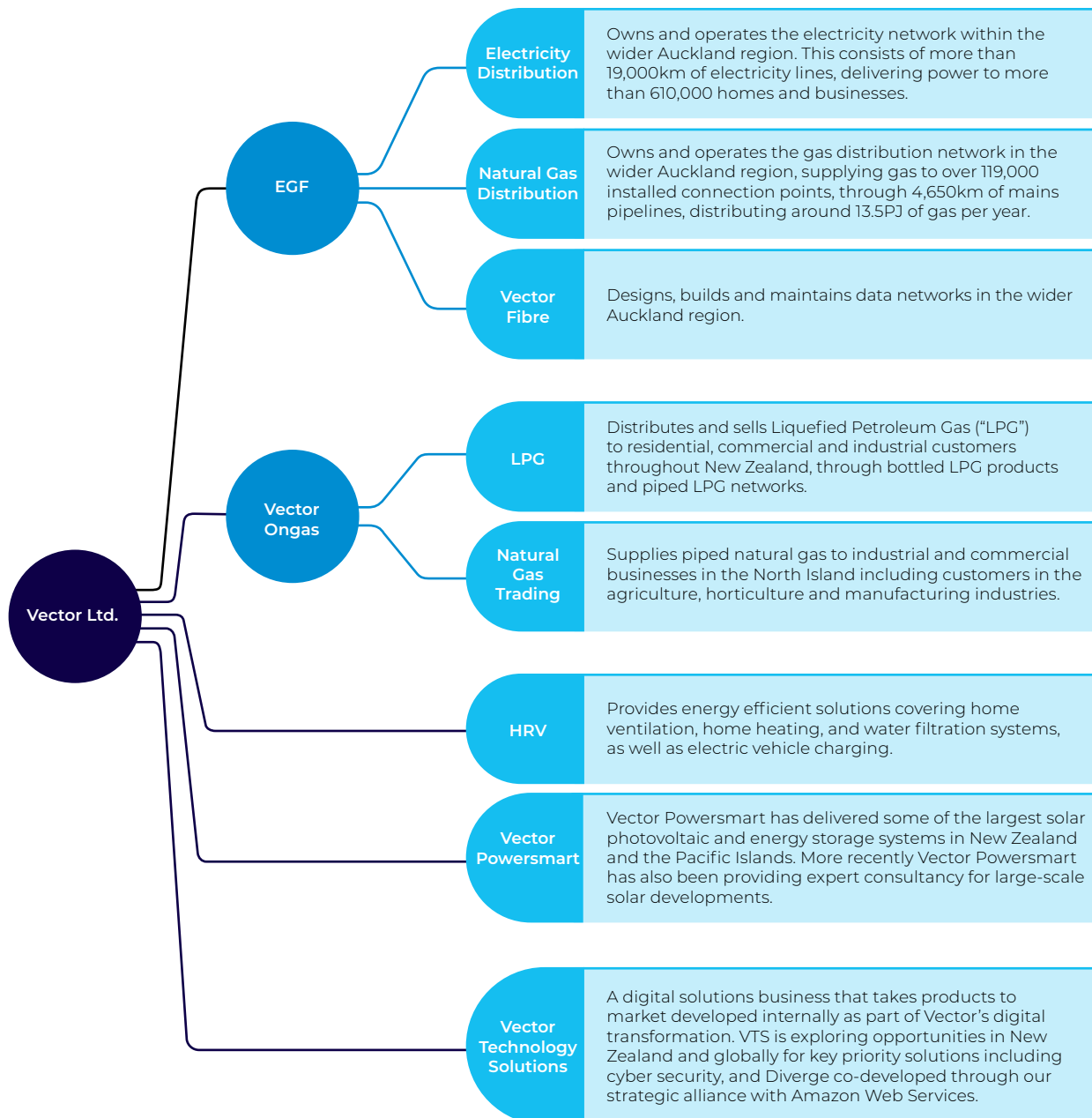
Vector holds an 8.1% shareholding in mPrest Systems (2003) Limited. The mPrest technology allows companies to better monitor, analyse, and control energy networks and connect traditional infrastructure like electricity lines and substations with new technology like solar and battery energy solutions.

Emissions from mPrest are excluded from Vector's carbon footprint due to Vector's share in mPrest sitting below the equity investment threshold of 20%.

Vector has investments in a number of businesses that complement our network businesses and strengthen our capabilities in the energy services field.



Figure 1: Vector businesses per organisational boundaries



2. Operational Boundaries

Operational boundaries

The GHG Protocol Standard splits emissions into three categories:

Scope 1 – Emissions Vector directly controls, such as vehicle fleet fuel combustion, diesel back-up generators, methane leaks, and SF₆ leaks.

Scope 2 – Vector’s consumption of purchased electricity, and electricity distribution losses along the network.

Scope 3 – All other indirect value chain emissions, such as customer energy consumption and supply chain emissions.

Scope 2 emissions include both Vector’s purchased electricity consumption (offices, electricity use in substations, and Vector’s network of free EV chargers) as well as electricity distribution losses that occur on Vector’s electricity network across Auckland.

The GHG Protocol Value Chain Standard splits scope 3 emissions into 15 categories. To gain a more comprehensive understanding of our emissions, in 2020 Vector commissioned an external review of its carbon accounting methodology. This included a scope 3 screening exercise to identify applicable and material categories and activities across Vector’s supply chain. 14 categories were determined as being applicable to Vector (all but category 10 – Processing of Sold Products), of which two were defined as material. The threshold at which a scope 3 category is considered as material is set to 1% of total scope 3 emissions.

During the screening process, emissions were calculated for eleven scope 3 categories, with emissions from the remaining three categories considered to be included in other categories of the inventory (2, 8) or to be zero (12). For the past three years, we chose to externally report only on emissions categories that are material (1, 11) or where data is deemed robust (3, 4, 6, 15). With additional work done to more accurately determine emissions from other sources, we will also report on emissions under categories 5 and 7 as well as emissions from all purchased products and services under category 1 going forward.

Included in other scope 3 categories:

Category 2 – Capital Goods: Included in category 1 as it was not possible to separate out new infrastructure construction from maintenance of existing infrastructure.

Category 8 – Upstream Leased Assets: Included in scope 1 & 2, as leased assets are expected to be under Vector’s operational control.

Excluded scope 3 categories:

Category 9 – Downstream Transportation and Distribution: Immaterial.

Category 12 – End-of-Life Treatment of Sold Products: Expected to be zero.

Category 13 – Downstream Leased Assets: Immaterial.

Category 14 – Franchises: Immaterial.

GHG emission source inclusions

Table 6 provides an overview of all emission sources included in Vector’s GHG inventory, including their data sources, calculation methods and an assessment of data quality and uncertainty.

For completeness, Vector is reporting on well-to-tank (“WTT”) emissions for fuel used by field service providers (“FSP”) under category 1 and 4 as well as on emissions from gas distributed via Vector’s gas network under category 11 (‘Other Distributed Natural Gas’). The latter one is optional under the GHG Protocol Standard, but required according to guidance from the Science Based Target initiative (“SBTI”).

As some gas sold or shipped by Natural Gas Trading is transported via Vector’s gas distribution network, these volumes are subtracted from the overall ‘Other Distributed Natural Gas’ amount to avoid double counting.

Exclusions from GHG inventory

Table 5 shows scope 3 emissions sources that were excluded from reporting (in addition to the excluded categories listed previously), and the reasoning behind this.

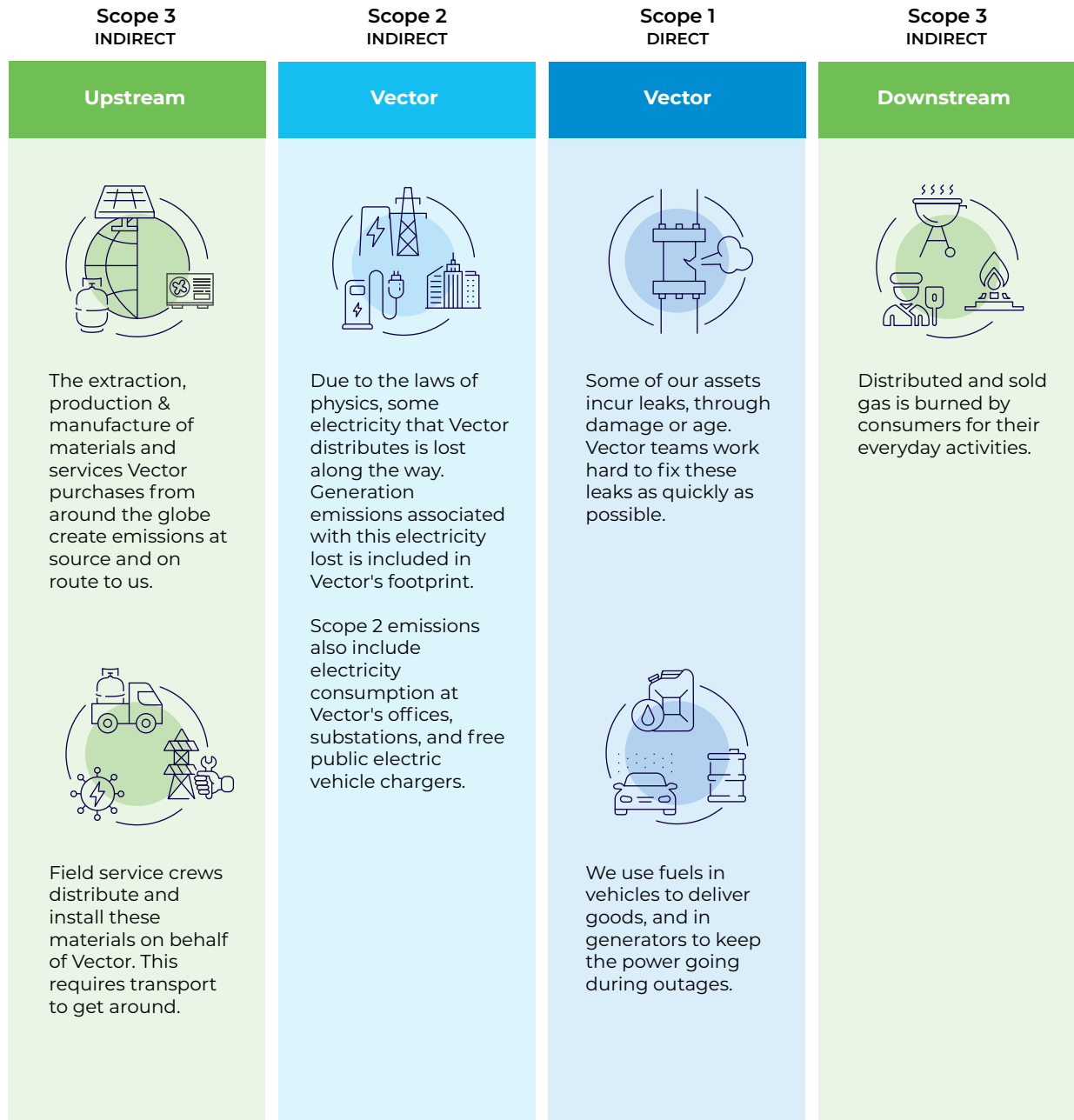
Other emissions – biogenic CO₂

Vector uses a 5% biodiesel blend in generators used by Vector Fibre and the electricity distribution network. In FY23, Vector’s combustion of biodiesel blend created 138 tonnes of biogenic emissions. This is a reduction of 15% from FY20.

Table 5: Excluded emission sources from reporting

Emissions category	Excluded emissions activity	Reasons for exclusion
C1 – Fuel Used by FSPs	Emissions from FSP fuel use where fuel amount is <1% of overall FSP fuel use	Emissions immaterial; data difficult to obtain
C4 – Upstream Transportation	Third-party transportation for upstream purchased materials and products covered under C1, and distribution services paid by Vector, other than where data on fuel use was available	Emissions immaterial; low data quality using spend- and distance-based methods
C11 – Use of Sold Product	Use of sold HVAC units	Likely immaterial; limited data availability

Figure 2: Key emission sources across Vector's value chain



2. Operational Boundaries (continued)

Newly included scope 3 emission sources

Category 1 – Purchased goods and services

In FY23, all business areas were tasked with starting to quantify emissions from materials and services purchased for their respective business activities. This saw them define key suppliers, or products that are likely to be material emissions sources in this scope 3 category, and engage with providers to source emissions from key purchased materials and products. All other purchases are quantified using the spend-based approach.

The combined results are published in this report. We have actively recalculated and included these emission sources from FY20 on, due to their materiality for Vector Group. More detail on the calculation methodology for this category is included in Section 3.

Category 5 – Waste Generated in Operations

This year's GHG inventory includes emissions from landfill waste across 30 of Vector's sites. Emissions from transporting waste materials is not included. The majority of obsolete items across Vector businesses are recycled, but if they do reach landfill they are mostly inert so do not produce methane emissions.

Category 7 – Employee Commuting

This year, all staff were asked to participate in a 'commute-to-work' survey. The answers from 406 staff members were used as a basis to calculate emissions from employee commuting and 'work-from-home'. The survey is intended to go out annually to track results over time.

As emissions from both category 5 and 7 are immaterial, they have not been recalculated for prior years.

In FY23, all business areas began starting to quantify emissions from materials and services purchased for their respective business activities.

Co-benefits

Supplier engagement

The steps taken to improve data quality of the three newly included emission sources had valuable co-benefits. In particular our work on calculating scope 3 - category 1 emissions increased conversations with suppliers on the topic of climate change and helped us understand which suppliers had set reduction targets themselves. Gaining access to supplier-specific emissions data is starting to be integrated into some supplier KPIs.

Staff engagement

Engaging all business areas ensured employees from across the business were given the chance to evolve their awareness and understanding around embodied emissions.

Additionally, feedback received via the commuting survey helped the company better understand staff preferences for travel and will support the development of a commuting strategy. This was particularly useful in the lead up to the move of Vector's head office, to a new six Green Star-rated building, which sees us supporting a more active travel to work culture to increase staff wellbeing.



Table 6: Emission calculation methods, data quality and sources

Reporting category	Emissions activity	Calculation method	Data source	GWP source	Data quality and uncertainty
SCOPE 1					
Natural Gas Distribution Fugitive Emissions	Fugitive natural gas across Vector's distribution network	See Section 3	FSP records; company records on asset database	MfE (2022) – IPCC AR4	Quality assured data on all leaks by asset and emissions category provided by FSP. Multiple estimates and assumptions made, as laid out in section 3, lead to medium uncertainty that Vector is continuing to improve. Vector's methodology has been reviewed by GNS Science, and assessed as OGMP 2.0 Level 3 or slightly above.
SF₆ Fugitive Emissions	SF ₆ leaks in switchgear	Top-up method	Gas recovery records; FSP SF ₆ cylinder records' log sheets; nameplate capacity amounts		Records on gas top-ups and recoveries provided by service providers. Multiple estimations, adjusted over time as data becomes available. Medium level of uncertainty that Vector is working on improving where possible.
Other Fugitive Emissions	LPG losses from venting, HVAC leaks (offices, substations, vehicle fleet), CO ₂	Top-up method for LPG and CO ₂ ; screening method for most HVAC; estimates for LPG and CO ₂	Service records; invoices; inventory lists		Some data on HVAC top ups available, but mostly annual averages for each inventory item used, as specified by MfE. LPG and CO ₂ use estimated – de minimis. High uncertainty, but emissions <1% of scope 1 so considered adequate.
Biodiesel Stationary Combustion	Biodiesel used in generators	Fuel-based method	Provider records		Records on litres of diesel used in generators supplied by lease provider monthly. Low uncertainty.
Diesel Stationary Combustion	Diesel used in forklifts and generators	Fuel-based method	Invoices		Records on diesel used in forklifts provided by supplier. Remaining diesel use estimated – de minimis. Overall low uncertainty.
LPG Stationary Combustion	LPG used in forklifts, flaring and vaporisers	Fuel-based method	Invoices		Internal invoices for forklift LPG use. LPG amount in vaporisers are estimates based on annual actual consumption, while re-valve flaring amounts are estimates based on standard capacity of the sites. Medium uncertainty that's considered adequate as <1% of scope 1.
Natural Gas Stationary Combustion	Water and space heating	Fuel-based method	Invoices		Usage data sourced from internal invoices. Low uncertainty.
Vehicle fleet	Fuel used in vehicle fleet	Fuel-based method	Fuel records by lease providers		Records on diesel and petrol use sourced from fuel card data. Low uncertainty.
SCOPE 2					
Electricity Consumption from Grid (market- and location based)	Electricity use at offices, substations, public EV chargers	Location-based method and market-based method, respectively	Invoices by retailers; NZECS certificate (market-based approach only)	MfE (2022) – IPCC AR4 (location-based) NZECS – IPCC AR4 (market-based)	Consumption data in kWh provided by retailers. Records on NZECS to calculate market-based approach provided by retailer. Moderate uncertainty from emission factors.
Electricity Distribution Losses	Electricity losses along the network	Location-based method	Transpower & distributed generators (ingoing); retailers (outgoing)	MfE (2022) – IPCC AR4	Metered data at Grid Exit Point (GXP) provided by Transpower and distributed generators. Data at Installation Control Points (ICP) level provided by retailers. Some estimations at year-end. Low uncertainty.

2. Operational Boundaries (continued)

Table 6 (continued): Emission calculation methods, data quality and sources

Reporting category	Emissions activity	Calculation method	Data source	GWP source	Data quality and uncertainty	Emissions calculated using data provided by value chain partners ¹
SCOPE 3						
C1 - Upstream Purchased Natural Gas	Natural gas purchased	Hybrid method and average-data method	Invoices	MfE (2022) – IPCC AR4 NZA 2019 – IPCC AR5 (Kapuni-specific)	Records of gas purchases sourced from supplier invoices. Moderate uncertainty on emission factor for overall purchases as it uses national average rather than site specific data.	70%
C1 - Upstream Purchased LPG	LPG purchased	Hybrid method and average-data method	Cost of sales report		Records of LPG purchases based on supplier invoices. Moderate uncertainty on emission factor for overall purchases as it uses national average rather than site specific data.	77%
C1 - Fuel Used by FSPs	Fuel used by FSPs on behalf of Vector, incl. WTT	Hybrid method	Fuel data provided by FSPs	MfE (2022) – IPCC AR4 DEFRA (2023) – IPCC AR5	Petrol and diesel use on behalf of Vector shared by each FSP for relevant business areas, in litres. Some data on regular and premium petrol combined. Low uncertainty.	100%
C1 – Upstream Purchased Materials and Products	Key products purchased across Vector business areas	Supplier-specific and average-data method	Procurement or FSP data on quantities (by weight or length) of products purchased	EPDs – IPCC AR4 & AR5	Records on quantities sourced from internal systems. Where supplier-specific data was used, uncertainty is lowest. For average-data method, some estimations were made and secondary data is used, so uncertainty is relatively high. More details in section 3.	1%
C1 – Upstream Purchased Other Goods and Services	All remaining products and services purchased	Spend-based method	Procurement spend data	Eora MRIO 2017 – IPCC AR4	Spend by supplier sourced from internal procurement system, emission factor was assigned based on supplier's main business activity. High uncertainty. More details in section 3.	0%
C3 - Fuel- and Energy-Related Activities	T&D, upstream, and WTT emissions from the group's electricity and fuel use	Average-data method	Same invoice data as fuel and electricity use in scope 1 & 2	MfE (2022) – IPCC AR4 (T&D losses) DEFRA (2023) – IPCC AR5 (WTT fuels & electricity)	All data based on fuel data or electricity consumption data provided for scope 1 and 2. T&D emissions not calculated for electricity consumption in Auckland, as this is covered under scope 2 losses. Moderate uncertainty from emission factors.	0%

¹ Proportion of emissions calculated using calculation methods based on data obtained from suppliers or other value chain partners. Remaining emissions are calculated using internal or average data.

Table 6 (continued): Emission calculation methods, data quality and sources

Reporting category	Emissions activity	Calculation method	Data source	GWP source	Data quality and uncertainty	Emissions calculated using data provided by value chain partners ¹
SCOPE 3						
C4 - Upstream Transportation	Fuel used by LPG transport providers	Fuel-based method	Fuel data provided by transport providers	MfE (2022) – IPCC AR4 DEFRA (2023) – IPCC AR5	Records of petrol and diesel litres used per month by FSPs. Low uncertainty.	100%
C5 – Waste Generated in Operations	Waste sent to landfill from Vector offices and workshops / depots	Waste-type specific method	Waste contractor records	MfE (2022) – IPCC AR4	Weight per waste category by location provided by waste contractors. Some measurements use averages. Based on info provided by our waste contractors, it is assumed that all waste goes to landfills with gas recovery. Medium uncertainty that is considered adequate as <1% of scope 3.	0%
C6 - Business Travel	Air travel, hotels, rental cars, mileage claims, taxis	Distance-based method	Records provided by booking agents or internal expense management platform	MfE (2022) – IPCC AR4 (flights excl. radiative forcing)	Monthly travel details provided by booking agents on kms flown by class of travel, hotel nights by country, kms travelled by size of rental car. Taxi emissions estimated based on spend. Employee mileage emissions based on km and average petrol vehicle, using average from past three years. Medium uncertainty that is considered adequate as <1% of scope 3.	0%
C7 – Employee Commuting & WFH	Emissions from staff commutes to work and work-from-home	Distance-based method	Results from staff survey on commuting habits	MfE (2022) – IPCC AR4	Data gathered on travel modes, distance to work, and days in office via staff survey. Extrapolated for the full year assuming that travel habits are stable across the year. Some estimations and assumptions that lead to high uncertainty. Considered adequate as <1% of scope 3.	0%
C11 - Sold Natural Gas – Auckland	Natural gas sold via the Vector network, directly by Natural Gas Trading or via retailers	Direct use-phase method – fuel	Invoices to Auckland customers and retailers; downstream allocation reports	MfE (2022) – IPCC AR4	Quantities of gas sold directly to customers or retailers on the Auckland network. Retailer quantities derived from downstream allocation report. Calculation assumes all gas sold is combusted by consumers. Low uncertainty.	100%

¹ Proportion of emissions calculated using calculation methods based on data obtained from suppliers or other value chain partners. Remaining emissions are calculated using internal or average data.

2. Operational Boundaries (continued)

Table 6 (continued): Emission calculation methods, data quality and sources

Reporting category	Emissions activity	Calculation method	Data source	GWP source	Data quality and uncertainty	Emissions calculated using data provided by value chain partners ¹
SCOPE 3						
C11 - Shipped Natural Gas - Auckland	Natural gas transported via the Auckland network	Direct use-phase method – fuel	Invoices to Auckland customers	MfE (2022) – IPCC AR4	Quantities of gas transported to customers on the Auckland network. Calculation assumes all gas is combusted by consumers. Low uncertainty.	100%
C11 - Other Distributed Natural Gas	Gas distributed via Auckland network, excl. Natural Gas Trading amounts	Direct use-phase method – fuel	Firstgas Oatis system		Quantities of gas distributed via Auckland network, excluding quantities of gas shipped and sold on Auckland network via Natural Gas Trading. Calculation assumes all gas is combusted by consumers. Low uncertainty.	100%
C11 - Sold Natural Gas – non-Auckland	Natural gas sold outside of Auckland network	Direct use-phase method – fuel	Invoices to customers, retailers and wholesale buyers outside of Auckland; downstream allocation reports		Quantities of gas sold directly to customers not on the Auckland network. On wholesale buyers, an assumption is made that any gas sold is sold outside of Auckland network. Calculation assumes all gas sold is combusted by consumers. Low uncertainty	100%
C11 - Shipped Natural Gas – non-Auckland	Gas transported outside of Auckland network	Direct use-phase method – fuel	Invoices to customers outside of Auckland		Quantities of gas transported to customers not on the Auckland network. Calculation assumes all gas is combusted by consumers. Low uncertainty.	100%
C11 - Sold LPG	LPG sold	Direct use-phase method – fuel	Sales report		Quantities of LPG sold. An assumption is made that customers burn the full amount of LPG sold per bottle. Low uncertainty.	100%
C15 - Liquigas	60.25% of scope 1 and 2 emissions from Liquigas	Investment-specific method	Invoice based records provided by Liquigas	MfE (2022) – IPCC AR4	Actual energy consumption provided by Liquigas. Low uncertainty.	100%
C15 – Vector Metering	50% of scope 1 and 2 emissions from Vector Metering	Investment-specific method	Invoice and FSP based records provided by Vector Metering		Actual energy consumption provided by Vector Metering. Gas Metering Fugitive emissions based on multiple assumptions and estimates, which leads to medium uncertainty. Considered adequate.	100%

¹ Proportion of emissions calculated using calculation methods based on data obtained from suppliers or other value chain partners. Remaining emissions are calculated using internal or average data.

3. Data Collection and Quantification

Information management procedures

Vector uses an internal process guideline for GHG emissions accounting to ensure consistency in the preparation of its GHG inventory. This was developed following a screening of Vector's full value chain emissions, and setting the base year to FY20. The document outlines responsibilities, defines thresholds, calculation methods and recalculation policy, amongst other details that ensure conformance with the GHG Protocol Standards over time.

Vector uses the software solution BraveGen to collect data and calculate our carbon footprint. Activity data is gathered and uploaded either by Vector staff across all business areas, or directly by suppliers. All data is reviewed by the GHG accounting team before final upload onto the system. Emissions are calculated automatically within BraveGen by multiplying the provided activity data with each applicable emission factors. These factors are updated every year as required by Vector's GHG accounting team.

Prior to KPMG assurance, the inventory is analysed by the GHG accounting team for trends and missing data. Upon completed assurance, Vector's executive team and board are informed of changes in emissions over time. Both the internal GHG emissions accounting guide as well as our strategy to reach Vector's reduction target are reviewed and updated frequently.

Methodologies

Most of Vector's GHG emissions are calculated by multiplying activity data with appropriate emission factors. Examples of activity data include kiloWatt-hour (kWh) of electricity used, volume of fuel used, or giga-Joules (GJ) of gas sold. Most activity data is based on consumption data sourced from invoices provided by suppliers, or internal sales and purchase reports. An overview of sources used per category is included in Table 6.

Most emission factors used are sourced from the latest publications (at financial year end) by New Zealand's Ministry for the Environment ("MfE") [3] and the UK's Department of Environment, Food and Rural Affairs ("DEFRA") [4]. Exceptions are outlined below:

- The emission factor for additional processing at Kapuni for both Ogas LPG and Natural Gas Trading has been sourced from Table 10 of the latest version of the Climate Change (Stationary Energy and Industrial Processes) Amendment Regulations 2009 [5]. These additional emissions are to account for removal of extra CO₂ present at this gas field to meet the nationally required standard for natural gas. They are calculated by comparing the 'Kapuni' emission factor to the 'Kapuni LTS' one, and multiplying the difference by the GJ of natural gas purchased from the Kapuni gas field. For LPG purchases, the factor is first converted to kg of LPG.
- **Until March 2023**, market-based emissions from electricity consumption exclude kWh covered by renewable energy certificates.

- **From April 2023**, most of Vector Group's consumed electricity is purchased from Ecotricity, a Toitū climate positive certified electricity retailer. Electricity consumed via Installation Control Points ("ICPs") included on the Ecotricity contract can be calculated as zero under market-based reporting.
- Emissions from FY23 electricity use not covered by certificates or purchased from Ecotricity are calculated using the Residual Supply Mix emission factor as disclosed by the New Zealand Energy Certificate System [6]. The residual factor is based on the production year period April – March (NZ financial year).
- The emission factor applied for LPG fugitive emissions has been sourced from the Intergovernmental Panel on Climate Change ("IPCC") Fourth Assessment Report [7] ("AR4"), aligned with MfE factors, for a 50:50 mix of Butane and Propane. Including these emissions is voluntary and counted as carbon dioxide (CO₂) in Table 2.

Emission factor sources and the underlying Assessment Report by the Intergovernmental Panel on Climate Change each source is based on (e.g. "IPCC AR4") for each scope and category are listed in Table 6.

All calculations in this report are expressed in total tonnes of carbon dioxide equivalent ("tCO₂e"). The time horizon in all cases is 100 years.

Fugitive emissions from gas distribution (S1) as well as emissions from 'upstream purchased materials and products' and 'upstream purchased other goods and services' (S3 – C1) are subject to more complex calculations that are described in the following two subsections.

3. Data Collection and Quantification (continued)

Gas distribution fugitive emissions

In FY21, Vector undertook a comprehensive study to model methane leaks on our gas network. The model created a fluid-dynamics based, quasi-digital twin of the network, which enabled us to identify and quantify methane leaks.

Vector has implemented the guidelines of the Technical Association of the European Gas Industry (Marcogaz [9]), which is largely derived from the Oil and Gas Methane Partnership methodology (OGMP 2.0 [10]) and found to be the most comprehensive and applicable to Vector's gas network. Marcogaz is currently in the process of integrating these guidelines into the CEN/ TC 234 European Technical Standard for Gas Infrastructure.

This quantification method requires Vector to split the gas network into groups of assets and corresponding categories of emissions that can be expected from these groups. The emission categories can be defined as:

Pipe permeation: Permeation of gas through the membrane material of the polyethylene pipes.

Leaks detected by systematic surveys: Found using Street Evaluation Laser Methane Assessment ("SELMA"), that are conducted on an annual basis.

District regulator stations: Operational emissions approximated using the American Petroleum Institute Compendium of Greenhouse Gas Emissions [11].

Third-party damages ("TPD")

Operational / maintenance emissions: Vented natural gas during commissioning, decommissioning, and asset maintenance.

Public reported escapes: Leaks detected by members of the public.

Valves and fittings: Additional leaks from seal failures of valves and fittings.

As it is not feasible to measure every variable, key assumptions are made. The following assumptions have a material impact on the overall data:

- Duration of leak when detected during systematic surveys: When a leak is found on a routine survey, there is no knowledge of when the leak started. However, we do know when the pipe was last surveyed, and, assuming a normal distribution, can state that on average the duration of a leak is half the time since the last survey. For example, Vector runs routine surveys annually. We can therefore approximate that the average leak duration is six months. This is in alignment with Marcogaz guidelines. From FY24, surveying will be increased to 6-monthly intervals, meaning the average leak duration drops to three months.
- Average size of leak found on routine survey: Most of the historical records of the detected leaks have been due to loose fittings. Vector has conducted several review sessions internally and across the industry and found that the most applicable assumption is in the RR630-HSE, UK standard. Within that, we take a conservative estimate of a hole size of 2mm².

- Average size of leaks found from third-party damages: Normalised across all third-party damages to 30mm, based on measured samples.
- Permeability of the ground: 6,700km of pipes run through various ground and geological formations. An estimation of soil permeability is made according to ISBN 0-486- 65675-6, and based on NZ soil map, however, further testing is planned to verify the assumptions.

GNS science recently conducted an independent review of this methodology. This included a review of the Marcogaz methodology that Vector is following in assessing emissions; a review of Vector's implementation of this methodology; an assessment of Vector's current level of reporting relative to the Marcogaz criteria and the underlying standards; as well as recommendations for future work that would improve Vector's emissions reporting and move Vector to a higher reporting level.

They key improvement opportunity identified is to obtain more specific, local emission factors, with GNS Science overall finding that Vector is currently operating at OGMP 2.0 Level 3 or slightly above. Level 5 is the highest possible level that also requires the use of site-level measurement to reconcile source and site level emission estimates.

Table 7: Breakdown of gas distribution fugitive emissions by category in tCO₂e

Emission source	FY20	FY21	FY22	FY23
Total	16,368	12,074	14,493	11,908
Pipe permeation	49	49	49	49
Leaks detected in systematic surveys	10,709	6,023	7,547	6,696
Operational / maintenance emissions	8	13	8	3
Third-party damages	4,199	4,685	5,582	3,890
Public reported escapes	20	15	19	19
District regulator stations (DRS) (maintenance and operation)	759	665	660	617
Valves and fittings	624	624	628	634



Upstream purchased materials and products

Methodologies to quantify emissions from purchased goods and services vary depending on what data is available from suppliers. Those identified as key suppliers for a specific business unit, either based on spend or the type and quantities of products purchased, were contacted to request supplier-specific emissions data.

Preference was given to data published in Environmental Product Declarations ("EPDs"), from which we extracted the GWP for the manufacturing / production phase (A1 – A3; fossil-specific where a breakdown was provided). Where supplier-specific EPDs weren't available, secondary emission factors from EPDs for comparable products or underlying raw materials have been used as proxy data.

Upstream purchased other goods and services

Emissions from all remaining purchases were quantified using the spend-based method. For FY23, this calculation covers around 30% of Vector's annual spend and more than 1,300 suppliers. It uses environmentally-extended input output (EEIO) emission factors, which estimate GHG emissions resulting from the production and upstream supply chain activities of different products in an economy. We used Eora MRIO 2017 scope 3 multipliers for New Zealand [12, 13] and adjusted them for inflation to the most recent quarter before the start of each financial year. Emission factors were assigned based on a supplier's main business activity.

We are intending to improve these calculations over time and further decrease the percentage of emissions calculated using the spend-based approach.

The approach we used for both sub-categories built on previous years' work completed with the support of thinkstep-anz, a trans-tasman sustainability firm.

Note that emissions from gas purchases as well as fuel used by FSP's have been calculated using supplier-specific data since FY20 and have been reported under scope 3 – category 1 in Vector's GHG emissions inventory since FY20.

4. GHG Emission Calculation and Results

Base year

Vector's base year for emissions reporting is FY20, 1 July 2019 to 30 June 2020. This was the first year that the GHG inventory included most material scope 3 emissions and forms the base year for Vector's science-aligned reduction target.

Changes to historic base year

Vector recalculates its historic base year emissions if the inventory is affected by changes that in aggregate total 5% of Vector's carbon footprint. These changes can be structural (e.g., acquisitions or divestments), changes in the way the inventory is calculated, or discovery of omissions or errors. Vector might decide to update the base year for changes below the threshold for other reasons such as consistency or clarity.

Multiple recalculations were required this year as laid out below:

- Due to the sale of a 50% interest in Vector Metering, emissions created by this business have been removed for all years since FY20. To stay consistent with the operational control approach, an

equity share of 50% of Vector Metering's scope 1 and 2 emissions is now included under scope 3 – category 15. For more information see Section 1.

- This year, we are including emissions from all purchased goods and services that were not already covered previously under scope 3 - category 1. As the newly added sources make up over 5% of Vector's carbon footprint, a recalculation of previous years' inventories was required to include these emissions from the base year on.

Additionally, we recalculated FY22 to include two leaks on the gas distribution network that occurred in June 2022 but were not processed in time for our FY22 disclosure. As this unexpected change to activity data sits above the significance threshold, last year's scope 1 has been recalculated to include emissions caused by those leaks, increasing Vector's direct emissions during FY22 by 3,040 tCO₂e.

For an overview of all recalculations, including those from previous years, see [Appendix 2](#).

FY23 results

In FY23, GHG emissions for Vector came to 1,620,321 tCO₂e. This is a reduction of 15% from our base year in FY20.

Scope 1

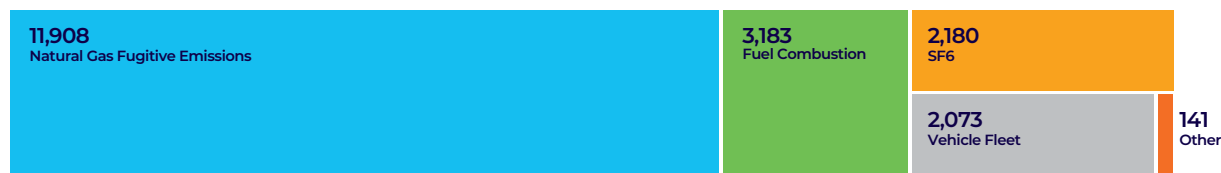
Vector's direct emissions in FY23 amount to 19,485 tCO₂e, a reduction from our base year by 13%. Explanations on the most notable changes in emissions across scope 1 follow.

Natural gas distribution fugitive emissions

Methane emissions have decreased significantly (27%) between FY20 and FY23 due to proactive pipeline surveying and other operational initiatives, e.g. reducing response time and flaring instead of venting. In FY23, we also re-initiated a proactive communications strategy in collaboration with other underground networks to reduce third-party damages, which had been increasing for the past three years. This has so far shown successful, with TPD emissions dropping below FY20 levels to 3,890 tCO₂e.

Figure 3: Vector GHG emissions inventory FY23, scope 1 & 2 only

SCOPE 1



SCOPE 2



Diesel use in generators

With the switch from diesel generators to mobile transformers on planned asset replacements we can this year see a drop in emissions from fuel used in generators, both compared to last year (8%) and even more significantly from Vector's base year (15%). This is despite other factors driving up the need for generation overall, e.g., increased capital works as well as catching up on maintenance that was postponed during Covid.

SF₆ emissions

SF₆ emissions increased again this year, by 17% from the year before. This was driven by multiple leaks particularly in two sub transmission switchboards. Delays in the delivery of replacement parts hindered Vector's ability to expedite permanent repairs, however, key repairs were completed in late 2022.

To mitigate this risk in the future, Vector has enacted a proactive stock management plan by purchasing additional spare components so that leaks can be repaired as they happen. We are also keeping a close eye on developments in the market for non-SF₆ switchgear to reduce the risk of leaks long-term.

Scope 2

Scope 2 emissions are split into emissions from Vector's own consumption of electricity from the grid, and emissions from distribution losses across Vector's network.

Despite a slight decrease in electricity distribution losses in FY23, related emissions have increased. This is due to a significantly higher emissions factor used for this year's calculation, based on 2020 data, which was the latest available factor for 'purchased electricity' by MfE at the time our calculations closed for the financial year. It is worth noting that MfE have since published an updated guidance that promises more up-to-date emission factors for purchased electricity going forward.

Market-based emissions from the group's own consumption of electricity dropped this year, as Vector now purchases most electricity through Ecotricity, a Toitū climate positive certified retailer. This allows us to calculate zero emissions under market-based reporting from April, for all applicable ICPs.

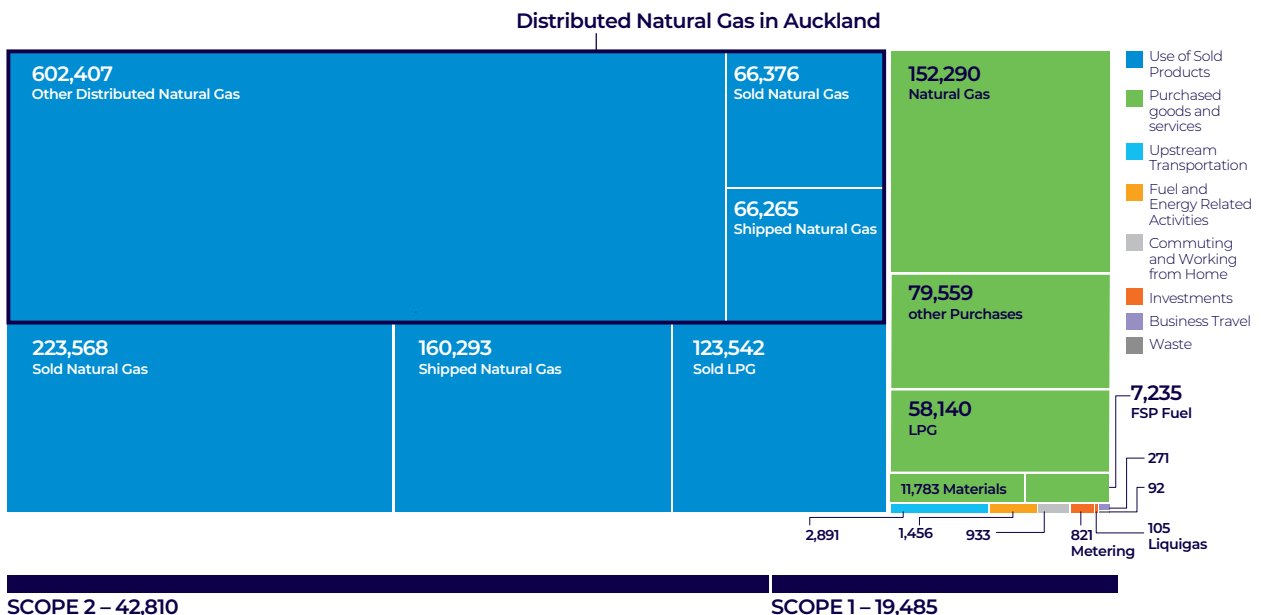
Overall electricity use, and therefore location-based emissions from electricity, has increased, due to a higher uptake of Vector's free public EV charging infrastructure across Auckland.

Scope 3

Value chain emissions have seen a slight increase from FY22 (1%), however, are sitting at an overall 15% reduction from our base year. Key changes can be observed in the natural gas distributed via Vector's network, which had dropped over the past three years but saw a small increase in FY23. In the long-term, however, we expect natural gas consumption, and therefore emissions, to drop further. Emissions from purchased gas have seen the highest decrease since FY20, mainly due to a shift from selling natural gas to managing the shipment of gas for customers across NZ via Vector's Natural Gas Trading business.

The most noticeable contributor to an increase in emissions across scope 3 are LPG purchases from Kapuni, which have increased steadily over the year. As we're accounting for additional emissions for purchases from Kapuni due to the high levels of CO₂ in gas extracted from this field, this consequently has led to an increase in emissions. The newly included emission source of 'upstream other purchased goods and services' has also risen over the years, which amongst other things can be explained with the increase in maintenance and capital works on Vector's networks requiring more product purchases.

Figure 4: Vector GHG emissions inventory FY23



4. GHG Emission Calculation and Results (continued)



Reducing fugitive emissions on Vector's gas network

Gas leaks on our network are a major contributor to Vector's greenhouse gas emissions. Since 2016 our partner, Omexom, has been using a gas leak detection system known as SELMA (Street Evaluating Laser Methane Assessment) to find leaks.

The equipment is fitted to a ute and detects minor gas leaks by simply driving down the street at normal speed. Featuring two independent detectors, SELMA detects leaks from both the front bumper intake system and the rooftop camera. A precision gas analyser on the front bumper uses a number

of small plastic tubes to sample air in the immediate vicinity, while a remote laser on the roof scans for leaks within a 150-meter radius. Air drawn in via the front bumper detector is filtered between two reflecting mirrors to analyse the sample. When a gas leak is detected, an alarm is activated and GPS technology marks the exact location so it can be relayed to the reactive maintenance team for immediate investigation.

Proactive pipeline surveying like this not only improves the overall performance of our gas network, but it also ensures the safety of the public and environment.

In 2021, we increased survey frequency from two yearly to yearly. This has to date reduced annual emissions in this category by 37%, or 4,013 tCO₂e, compared to our 2020 baseline. In 2024, we intend to further increase pipeline surveys to six-monthly, which will enable us to find leaks even faster and reduce reported faults. This important initiative reduces gas emission while improving safety, and will help us move one step closer to meeting our science-aligned reduction target of 53.5% by 2030.





Replacing diesel generators with mobile transformers

Another successful decarbonisation initiative tackles the issue of network maintenance. The Auckland region's line network spans over 19,000km, which is similar to the distance between New Zealand and the UK. Regular network maintenance ensures the safe, reliable, and resilient supply of electricity to our customers.

Some of our network maintenance requires diesel generators to ensure the power stays on for customers while we do the work. Generators are not only expensive to set up and run, there's also emissions, street-level pollution, and loud noise to consider.

Together with our field service providers, Vector has started using mobile transformers to supply power instead. This works by temporarily routing the area's power supply through the mobile transformer, instead of isolating the section from the distribution network and supplying power by diesel generation. When we're finished, we connect the area back up again, switch the connections over and disconnect the mobile transformer before taking it away.

Since our first trials in 2022, this initiative has helped to avoid an estimated 1,611 tCO₂e (scope 1 and 3 combined) across 41 sites.

The change in process has also reduced stress for staff working on-site, reduced complaints from nearby residents as there is less noise and pollution, all while also reducing cost.

Although we can't use mobile transformers for all maintenance projects, we intend to use this approach as part of our standard planning practice where possible and are sharing this knowledge with other electricity companies as part of our carbon handprint.



5. GHG Emission Reductions

Science-aligned target

Vector is targeting a reduction of absolute scope 1 & 2 GHG emissions (excluding electricity distribution losses) of 53.5% by FY30, from a FY20 base year. The target is aligned with Science Based Target initiative methodology and consistent with reductions required to keep global warming to 1.5C. Biogenic emissions are included in Vector's reduction target. The target uses market-based emissions for electricity consumption.

In addition, Vector has committed to having net carbon zero operational emissions (scope 1 and 2 excluding electricity distribution losses) by 2030.

A recalculation of the target is triggered by a recalculation of scope 1 and 2 base year emissions.

As of FY23, Vector has achieved a 14.5% reduction towards this target.

Exclusion of electricity distribution losses from our targets

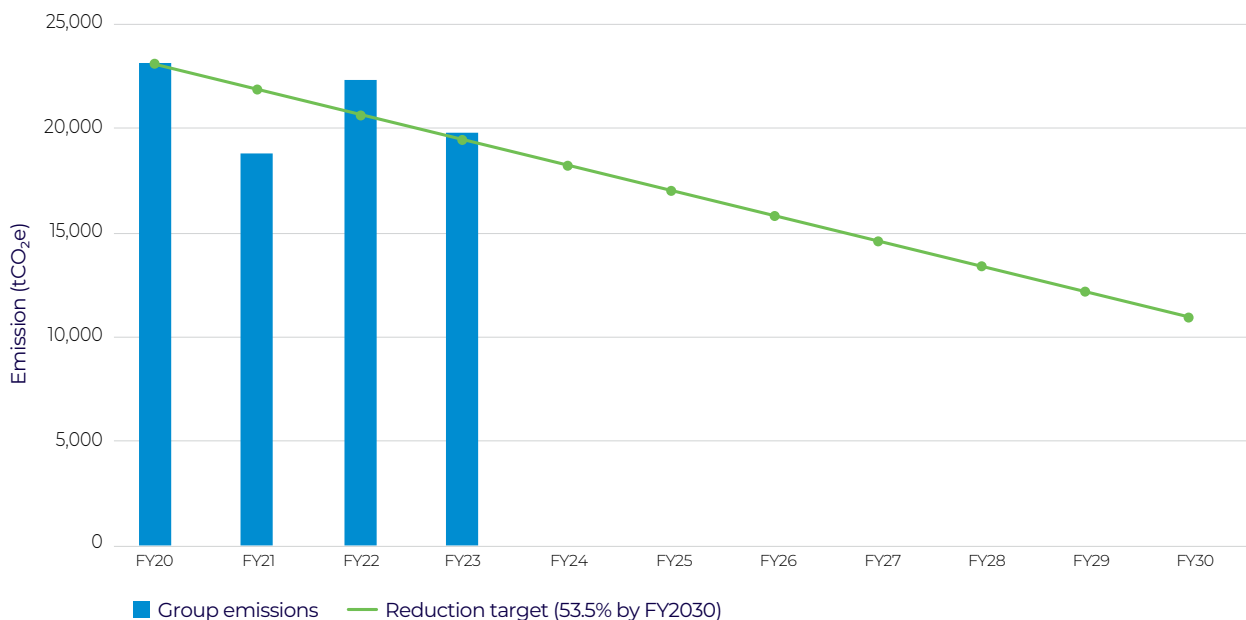
Although electricity distribution losses account for almost 59% of overall scope 1 and 2 emissions (based on FY20 data), they are excluded from Vector's science-aligned target. This is because the reduction of electricity loss emissions is often achieved internationally by reducing the emission intensity of generation assets. However, in New Zealand, transmission and distribution companies do not generate electricity due to regulatory limitations. This means that actions to reduce distribution losses is out of the operational scope for transmission and distribution companies. In addition, as electrification is a key component in New Zealand's emissions reduction plan, networks are expected to grow, and with it the overall electricity conveyed. Therefore Vector, along with other electricity distribution businesses and Transpower, have excluded electricity losses from their emission reduction targets.

Additional information

Under the New Zealand Emissions Trading Scheme (NZ ETS), Vector is obligated to surrender New Zealand Units (NZUs) for emissions related to fugitive SF₆.

NZ ETS reporting is by calendar year, whilst Vector GHG emissions reporting is by financial year (1 July - 30 June). For the 2022 calendar year, Vector surrendered NZUs to the value of 2,179 tCO₂e related to fugitive SF₆ gases.

Figure 5: Annual progress towards Vector's science-aligned reduction target



Emission reduction initiatives

In FY22, we developed a carbon abatement cost curve to help achieve our reduction target (scope 1 and 2 excluding electricity distribution losses). This important work identifies the financial impact of potential carbon reduction activity across scope 1 and 2 emissions, using a carbon cost of \$140 per tCO₂e as a comparative “do nothing” cost. \$140 was chosen to align with Climate Change Commission recommendations to Government [14].

Through this work, we identified emissions that could be reduced while saving money for the group (those with negative abatement cost), others that were close to cost neutral (those with bars close to \$0/tCO₂e/year), with the balance assessed as being more complex to abate given the availability of current alternatives. The curve was updated in FY23 to include newly identified initiatives, reflect cost changes, highlight completed projects, and exclude Vector Metering.

The updated graphic also highlights some key challenges that Vector faces in reducing certain emission sources. For example, transitioning to electric trucks is a key initiative to achieve a 2030 decarbonisation target, and yet is highly dependent on the availability of suitable heavy electric vehicles in the

New Zealand market. An overview of abatement limitations currently identified is summarised in Table 8. Abatement initiatives which are not planned or have issues are highlighted via a red dot in the abatement curve graphic (Figure 6).

The most noticeable changes from last year’s abatement curve and status updates on key initiatives are as follows:

- **In progress:** Third-party damages to pipelines are a significant contributor to Vector’s gas distribution fugitive emissions. In FY23, we implemented a proactive communications strategy to reduce this risk. Multiple social media campaigns as well as a public safety awareness video in partnership with BeforeUDig are just some of the actions taken so far that can be attributed to the noticeable reduction in emissions we have seen this year.

As this emissions source will always remain largely out of our control and it is difficult to relate costs to carbon abated, we have decided not to add a relevant bar to our abatement curve. Instead, a placeholder indicates how much of Vector’s base year footprint comes from third-party damages, and we will continue our efforts to reduce emissions in this category.

- **In planning:** After successfully increasing the gas pipeline survey frequency from 2-yearly to annually to identify and suppress gas leaks faster, a further change is on the horizon. From 2024, Vector will start 6-monthly surveying, with an additional surveying system already on order. This is expected to lead to another drop in emissions by more than 2,000 tCO₂e.
- **Standard business practice:** In FY23, the use of mobile transformers in place of diesel generators has become business as usual for planned asset replacement and major capital works. 21 projects, affecting 41 sites, have now been completed using this solution, avoiding an estimated 1,300 tCO₂e of direct emissions all while saving costs, reducing noise and pollution, and improving health & safety. We are now investigating expanding this programme to maintenance work where feasible, and developing an overhead line version.

We expect this curve to continue to change annually as new technologies reach the market, new business innovations are trialled, and the costs of the abatement strategies change.



5. GHG Emission Reductions (continued)

Figure 6: Vector's marginal carbon cost abatement curve. The x-axis corresponds to Vector's total annual emissions. Each bar details a carbon abating initiative where the thickness of the bar indicates the carbon abated. The y-axis represents the cost, with negative values indicating cost-savings. Initiatives are ordered left to right, from the most cost-saving to the most expensive.

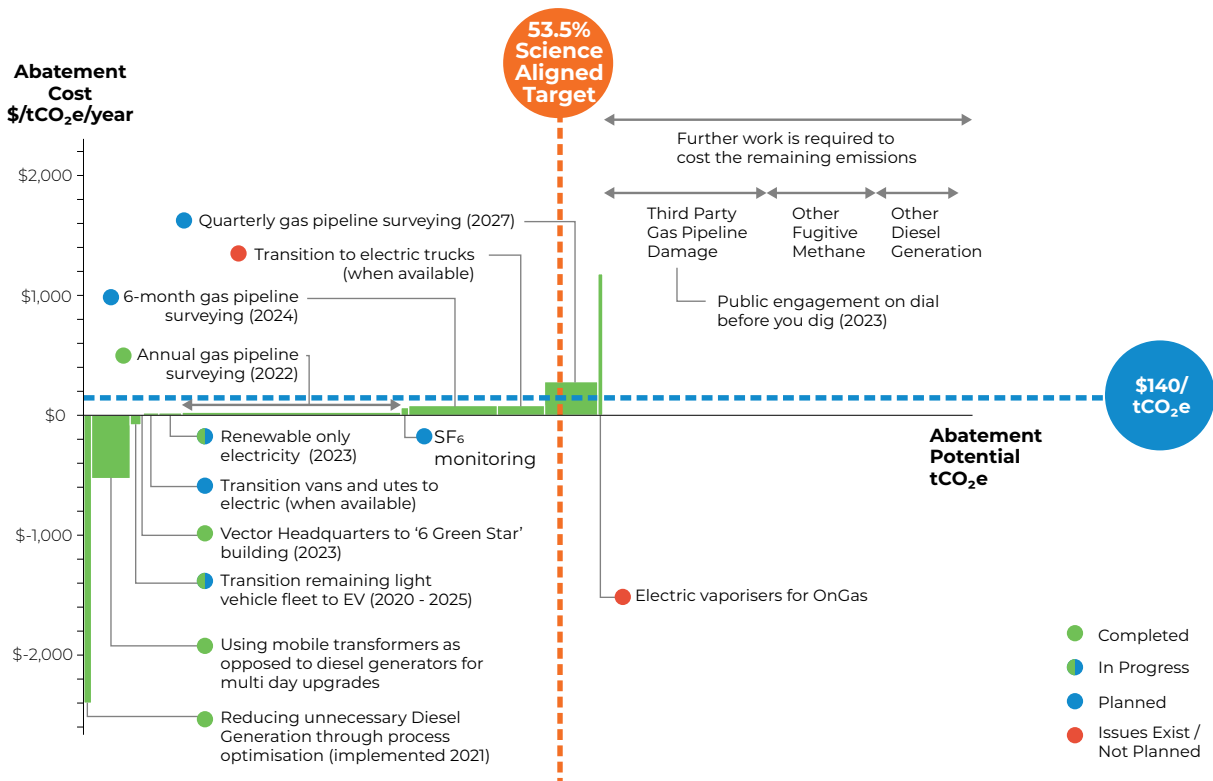


Table 8: Identified carbon abatement risks

Carbon Abatement Risk	Description
Dependency on electric truck manufacturers for heavy vehicle fleet decarbonisation	Vector Ogas LPG has a fleet of 86 trucks. Currently, there is no suitable heavy vehicle available to decarbonise these. Whilst Vector trialled a pre-production electric truck in 2022, its range is not sufficient to transition the remaining fleet. We expect market ready trucks with adequate range to enter the international market before 2030, however there is no guarantee that they will be available in New Zealand in time.
Damage to high pressure pipelines	Damage to Vector's high pressure gas pipelines can release significant quantities of CO ₂ e. For example, two leaks detected in FY22 released 3,040 tCO ₂ e from those two incidents alone. Whilst Vector can reduce emissions over time on average, these high volatility events can cause a sudden spike in emissions for that reporting year. In addition, there is a risk that emissions from third-party damages remain high or even increase, with limited influence from Vector's side.
Long-term SF₆ assets on Vector network	Many Vector SF ₆ assets have a lifetime beyond 2030. It is not possible to replace all these assets before reaching FY30, and leaks are largely unpredictable. While we have installed monitoring devices that alert us of leaks quickly, there is still a risk that leaks could increase and keep reoccurring. SF ₆ has an emission factor of 22,800 times that of CO ₂ , so even small leaks of SF ₆ can have material global warming impacts.

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Appendix

Appendix 1: Vector subsidiaries

#	Wholly owned and joint operations	Treatment for GHG emissions calculation	Interest held	Principal activity	Vector Org structure name	Holding company name
1	Vector Ltd	Operational control approach (100% for Vector's scope 1,2,3)	100%	Parent company	Corporate; Electricity & Natural Gas Distribution	N/A
2	NGC Holdings Ltd	No emissions from operations	100%	Holding Company	N/A - Holding Company	Vector Ltd
3	Vector MeterCo Ltd	No emissions from operations	50%	Holding Company	N/A	NGC Holdings Ltd
4	Vector Gas Trading Ltd	Operational control approach (100% for Vector's scope 1,2,3)	100%	Natural Gas Trading and Processing	Vector Ongas - Natural Gas Trading	NGC Holdings Ltd
5	Liquigas	No operational control. Proportional (60.25%) scope 1 & 2 emissions accounted for under scope 3 - category 15	60.25%	Bulk LPG Storage, Distribution and Management	N/A	NGC Holdings Ltd
6	On Gas Ltd	Operational control approach (100% for Vector's scope 1,2,3)	100%	LPG Sales and Distribution	Vector Ongas - LPG	NGC Holdings Ltd
7	Vector Communications Ltd	Operational control approach (100% for Vector's scope 1,2,3)	100%	Telecommunications	Vector Fibre	Vector Ltd
8	Vector Energy Solutions Ltd	No emissions from operations	100%	Holding Company	N/A - Holding Company	Vector Ltd
9	Powersmart NZ Ltd	Operational control approach (100% for Vector's scope 1,2,3)	100%	Energy Solutions Services	Vector Powersmart	Vector Energy Solutions Ltd
10	E-Co Products Group Ltd	No emissions from operations	100%	Holding Company	N/A - Holding Company	Vector Energy Solutions Ltd
11	Cristal Air International Ltd	Operational control approach (100% for Vector's scope 1,2,3)	100%	Ventilation, Heating and Water Systems Sales and Assembly	HRV	E-Co Products Group Ltd
12	Vector Technology Solutions Ltd	Operational control approach (100% for Vector's scope 1,2,3)	100%	Technology Services	Vector Technology Solutions Ltd.	Vector Ltd
13	Vector Advanced Metering Assets (Australia) Ltd	Non-trading subsidiary	100%	Metering Services	N/A	NGC Holdings Ltd
14	NZ HoldCo Limited and its subsidiaries	No operational control. Proportional (50%) scope 1 & 2 emissions accounted for under scope 3 - category 15	50%	Metering Services NZ	N/A	Vector MeterCo Limited
15	VM AU HoldCo PTA Limited and its subsidiaries	No operational control. Proportional (50%) scope 1 & 2 emissions accounted for under scope 3 - category 15	50%	Metering Services AUS	N/A	Vector MeterCo Limited

Appendix 1 (continued): Vector subsidiaries

#	Wholly owned and joint operations	Treatment for GHG emissions calculation	Interest held	Principal activity	Vector Org structure name	Holding company name
16	Vector Energy Solutions (Australia) Pty Ltd	No emissions from operations	100%	Energy Solution Services	N/A	Vector Ltd
17	VPS Pacific	Non-trading subsidiary	100%	Energy Solution Services	Vector Powersmart	Vector Powersmart
18	mPrest	Below equity investment threshold. Emissions not accounted for	8%		N/A	Vector Ltd
19	Vector ESPS Trustee Ltd	No emissions from operations	100%	Trustee Company	N/A - Trustee Company	Vector Ltd
20	Vector Auckland Property Ltd	No emissions from operations	100%	Assets Holding Company	N/A - Holding Company	Vector Ltd
21	Vector Northern Property Ltd	No emissions from operations	100%	Assets Holding Company	N/A - Holding Company	Vector Ltd

Appendix 2: Summary of GHG emissions inventory recalculations across years.

Recalculation description	Resulting change in inventory	Year of reported change	Scope(s) and year(s) affected
Structural change: Divestment of Treescape shares	Recalculation of scope 3 - category 15: investments. Voluntary recalculation for clarity.	FY22	Scope 3 – category 15 FY20: -3,069 tCO ₂ e FY21: -2,956 tCO ₂ e
Structural change: Sale of a 50% interest in Vector Metering, with loss of operational control	Removing Vector Metering emissions from scope 1, 2, 3, and adding proportional scope 1 and 2 emissions in relation to the joint venture to scope 3 - category 15.	FY23	Removal of Metering emissions across scope 1, 2, 3: FY20: -5,017 tCO ₂ e FY21: -5,099 tCO ₂ e FY22: -4,824 tCO ₂ e 50% of Metering's scope 1, 2 moved to scope 3 – category 15: FY20: +700 tCO ₂ e FY21: +771 tCO ₂ e FY22: +809 tCO ₂ e
Improvement of data quality and data availability for material emission source	Inclusion of additional purchased goods & services emissions to scope 3 - category 1	FY23	Scope 3 – category 1 FY20: +91,205 tCO ₂ e FY21: +83,199 tCO ₂ e FY22: +88,953 tCO ₂ e
Quantification of leaks identified subsequent to year-end	Update to gas fugitive emissions to include data quantified after financial year-end FY22	FY23	Scope 1 FY22: +3,040 tCO ₂ e

Independent Reasonable Assurance Report Vector Limited

Opinion

Our reasonable assurance opinion has been formed on the basis of the matters outlined in this report.

In our opinion, in all material respects, the Greenhouse Gas Statement, comprising the Emissions Inventory has been prepared in accordance with Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard, and Greenhouse Gas Protocol: Corporate Value Chain (Scope 3) Accounting and Reporting Standard (together the 'criteria') for the period 1 July 2022 to 30 June 2023.

Information subject to assurance

We have performed an engagement to provide reasonable assurance in relation to Vector Limited and its subsidiaries' (the 'Group') GHG Statement for the period 1 July 2022 to 30 June 2023.

Criteria

The criteria used as the basis of reporting include the Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard, and Greenhouse Gas Protocol: Corporate Value Chain (Scope 3) Accounting and Reporting Standard published by the World Resources Institute and World Business Council for Sustainable Development. As a result, this report may not be suitable for another purpose.

Standards we followed

We conducted our reasonable assurance engagement in accordance with International Standard on Assurance Engagements (New Zealand) 3000 (Revised) *Assurance Engagements other than audits or reviews of historical financial information* and International Standard on Assurance Engagements (New Zealand) 3410 *Assurance Engagements on Greenhouse Gas Statements* ('ISAE (NZ) 3410') issued by the New Zealand Auditing and Assurance Standards Board. We believe that the evidence we have obtained is sufficient and appropriate to provide a basis for our opinion. In accordance with those standards we have:

- assessed the suitability of the circumstances of the Group's use of the criteria as the basis for preparation of the GHG Statement;
- used our professional judgement to assess the risks of material misstatement and plan and perform the engagement to obtain reasonable assurance that the GHG Statement is free from material misstatement, whether due to fraud or error;
- considered relevant internal controls when designing our assurance procedures, however we do not express an opinion on the effectiveness of these controls;
- evaluated the appropriateness of quantification methods and reporting policies used, and the reasonableness of estimates made by the Group;
- evaluated the overall presentation of the GHG Statement; and
- ensured that the engagement team possesses the appropriate knowledge, skills and professional competencies.

How to interpret reasonable assurance and material misstatement

Reasonable assurance is a high level of assurance, but is not a guarantee that it will always detect a material misstatement when it exists.

Misstatements, including omissions, within the GHG Statement are considered material if, individually or in the aggregate, they could reasonably be expected to influence the relevant decisions of the intended users taken on the basis of the GHG Statement.

Use of this assurance Report

Our report is made solely for the Group. Our assurance work has been undertaken so that we might state to Vector Limited those matters we are required to state to them in the assurance report and for no other purpose. No other third party is intended to receive our report.

Our report should not be regarded as suitable to be used or relied on by any third parties other than the Directors of Vector Limited ("Recipients") for any purpose or in any context. Any other party who obtains access to our report or a copy thereof and chooses to rely on our report (or any part thereof) will do so at its own risk.

Our report is released to the Recipients on the basis that it shall not be copied, referred to or disclosed, in whole or in part, without our prior written consent.

To the fullest extent permitted by law, none of KPMG, any entities directly or indirectly controlled by KPMG, or any of their respective members of employees accept or assume no responsibility and deny all liability to any party other than Vector Limited for our work, for this independent reasonable assurance report, and/or for the opinions we have reached.

Management's responsibility for the GHG Statement

The Management of Vector Limited are responsible for the preparation of the GHG Statement in accordance with the criteria. This responsibility includes such internal control as the Management determine is necessary to enable the preparation of the GHG Statement that is free from material misstatement whether due to fraud or error.

As noted in the GHG Statement Table 6 of page 11, GHG quantification is subject to inherent uncertainty because of incomplete scientific knowledge used to determine emission factors and the values needed to combine emissions of different gases.

Our responsibility

Our responsibility is to express an opinion to the directors on whether the GHG Statement is, in all material respects, prepared in accordance with the criteria.

Our independence and quality control

We have complied with the independence and other ethical requirements of Professional and Ethical Standard 1 International Code of Ethics for Assurance Practitioners (Including International Independence Standards) (New Zealand) issued by the New Zealand Auditing and Assurance Standards Board, which is founded on fundamental principles of integrity, objectivity, professional competence and due care, confidentiality and professional behaviour.

The firm applies Professional and Ethical Standard 3 (Amended) and accordingly maintains a comprehensive system of quality control including documented policies and procedures regarding compliance with ethical requirements, professional standards and applicable legal and regulatory requirements.

Our firm has also provided financial audit, regulatory assurance, other assurance and compliance services in relation to R&D tax credits to the Group. Subject to certain restrictions, partners and employees of our firm may also deal with the Group on normal terms within the ordinary course of trading activities of the business of the Group. These matters have not impaired our independence as assurance providers of the Group for this engagement. The firm has no other relationship with, or interest in, the Group.

KPMG

KPMG
Auckland

24 August 2023

