EECA INSIGHTS

Energy End Use Database

Key insights and methodology

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Contents

Foreword 5

1 Introduction 6

2 High level insights – 2020 energy data 7

2.1 Stationary Energy 7

2.2 Industrial sectors 7

2.3 One of the unique attributes of the EEUD is its end use and technology breakdowns 8

2.4 Boiler Systems dominate technology use for stationary energy consumption 9

2.5 Key changes over time include sectors dipping in their energy consumption in 2020 10

3 Sector insights 11

3.1 Dairy Product Manufacturing accounts for 11% of all stationary energy use 11

3.2 Petrochemical Product Manufacturing accounts for 11% of all stationary energy use 12

4 Transport 13

4.1 Light Passenger Vehicles consume half of New Zealand's annual transport energy 13

4.2 Covid-19 had only a minor impact on transport energy use 13

5 Illustration of how energy is broken down 15

6 Stationary Energy Data Sources 17

7 Updating the EEUD – Stationary Energy Methodology 21

7.1 Modifier Data 22

7.2 Updating modifier data 23

7.3 Hypothetical illustration of sector values scaled and used for proprotions 24

7.4 Treatment of Stationary Energy values 26

8 Scaling – Stationary Energy 29

9 Summary of Assumptions - Stationary Energy 33

10 Glossary for the EEUD – Stationary Energy 34

10.1 Data in the EEUD is expressed in Terajoules (TJ) 34

10.2 Delivered Energy 34

10.3 ANZSIC 34

10.4 Fuel 34

10.5 Sectors 34

10.6 The sectors of the EEUD and their ANZSIC codes 35

11 Transport 38

11.1 Summary 38

11.2 Methodology 38

11.3 Sectoral Breakdown 39

12 Energy End Use Database visualisation tool 43
12.1 Main landing page 43
12.2 Data Explorer 46

Foreword

Understanding the relationship of energy use by sector is fundamental to accelerating the transition to a low emissions economy. Each year EECA spends time considering the past to develop a retrospective view of the previous year's energy use by sector, fuel type and technology use. The Energy End Use Database is updated annually by EECA and this year we are pleased to be launching a new interactive data visualisation tool to help people explore the relationship between energy and its end use by sector.

With 40% of New Zealand's greenhouse gas emissions coming from energy use, prioritising energy efficiency and renewable energy use is a key way to address the impacts of climate change. The Energy End Use Database provides a detailed breakdown of energy use by sector and end use technology and provides granular detail of the relationship between energy use and technologies.

The Energy End Use Database is the cornerstone open data tool that EECA produces each year to enable analysis of energy use across sectors and is one of the main data inputs for the New Zealand Energy Scenarios TIMES-NZ. The Energy End Use Database is freely available as open data for government, communities, business and industry to use to inform energy efficiency and decarbonisation initiatives.

Kate Kolich
Manager Evidence Insights and Innovation

EECA TE TARI TIAKI PŪNGAO
ENERGY EFFICIENCY & CONSERVATION AUTHORITY

1 Introduction

Energy End Use Database (EEUD) is a unique New Zealand data asset maintained by Energy Efficiency and Conservation Authority (EECA) enabling insights and analysis of energy use across sectors and technology by government, industry, and academia.

The EEUD provides annual estimates of how energy is used across the New Zealand economy. Delivered energy estimates are provided for fuel types, sectors, end uses and technologies. The current published data covers 2017, 2018, 2019 and 2020. The data is always released for the previous year soon after the MBIE Energy Balances are released.

Energy use estimates are derived using a 'top down' approach based on MBIE's annual high-level sector/fuel energy demand data and proportioned into further disaggregated sectors, end-use applications and technology values using 'bottom up' data held by EECA.

For clarity, the 'end use' values expressed in the EEUD represent how delivered energy is split between its uses in given sectors. The end use values do not represent end-use energy volumes after efficiencies and losses are accounted for.

The EEUD was initially created by EECA in 2007. EECA revised and improved the quality of the database in 2018. An improved dataset was released publicly in 2020 and was available through open data.

In November 2021 the updated dataset was released as an online data visualisation application showcasing the results with a user-friendly interactive interface. The data is also available as a downloadable spreadsheet of the entire dataset. The release in November 2021 includes an interactive data visualisation app in the following sectors: Residential, Industrial, Commercial, Agriculture Forestry and Fishing.

In April 2022, the transport data methodology was updated and now expresses an enhanced breakdown of technologies and transport modes. This update was based upon Waka Kotahi and Ministry of Transport data and has been reviewed by the Ministry of Transport. The updated data provides insights into Battery Electric Vehicles, passenger and freight rail, and heavy trucks.

For further information contact EECA Enquiries at info@EECA.govt.nz

2 High level insights – 2020 energy data

2.1 Stationary Energy

Stationary energy is energy use that is not energy used in transport. This includes uses such as process heat for manufacturing, space heating, water heating, lighting, refrigeration, pumping and electronics. Stationary energy is metric used in the insight graphs to follow.

2.2 Industrial sectors

Figure 1 shows the top 10 industrial sectors by stationary energy consumption. Petrochemical Manufacturing, Dairy Product Manufacturing, and the Primary Metals sectors are New Zealand's largest energy consuming industrial sectors making up 30% of total stationary energy consumption in New Zealand and 56% of stationary energy consumption in industry. Renewables primarily in the form of wood and geothermal are used significantly in the Wood, Pulp and Paper sectors.

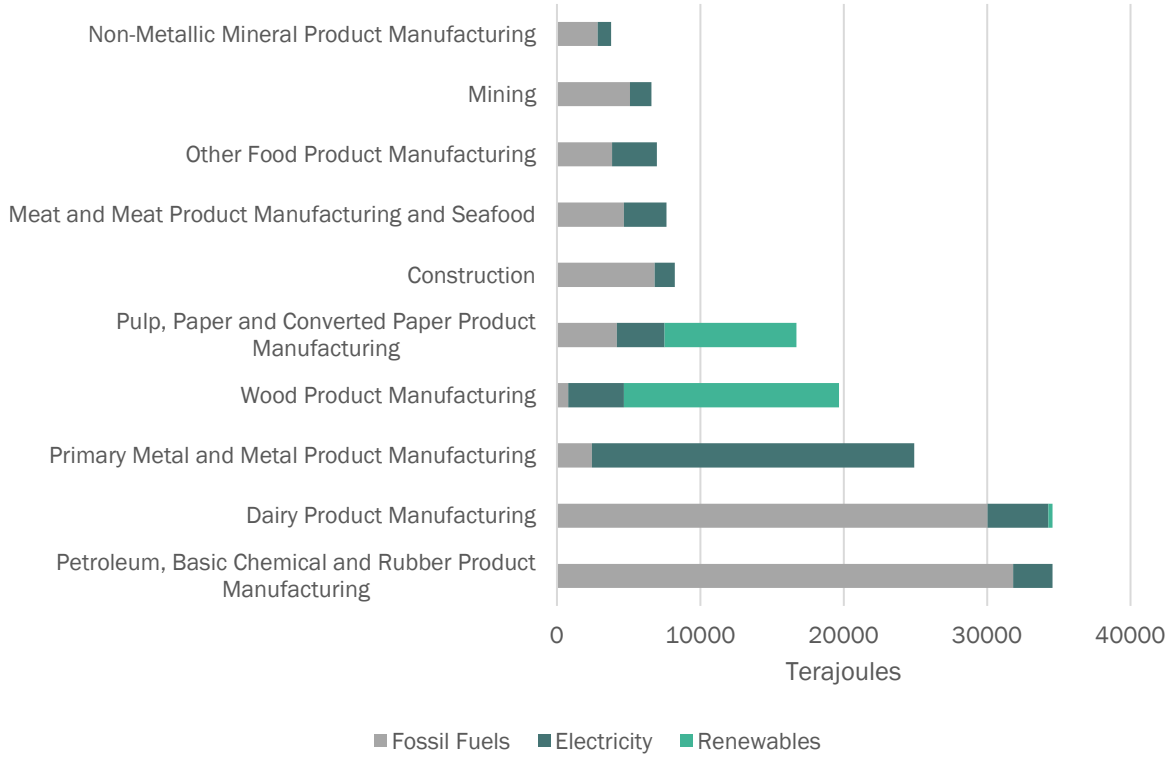


Figure 1: 2020 – Top 10 Industrial Sectors – Stationary Energy Consumption

2.3 One of the unique attributes of the EEUD is its end use and technology breakdowns

Figure 2 shows stationary energy consumption broken down by the top 10 end-use applications in New Zealand. High and intermediate temperature process heat requirements in manufacturing dominate making up 32% of total stationary energy consumption.

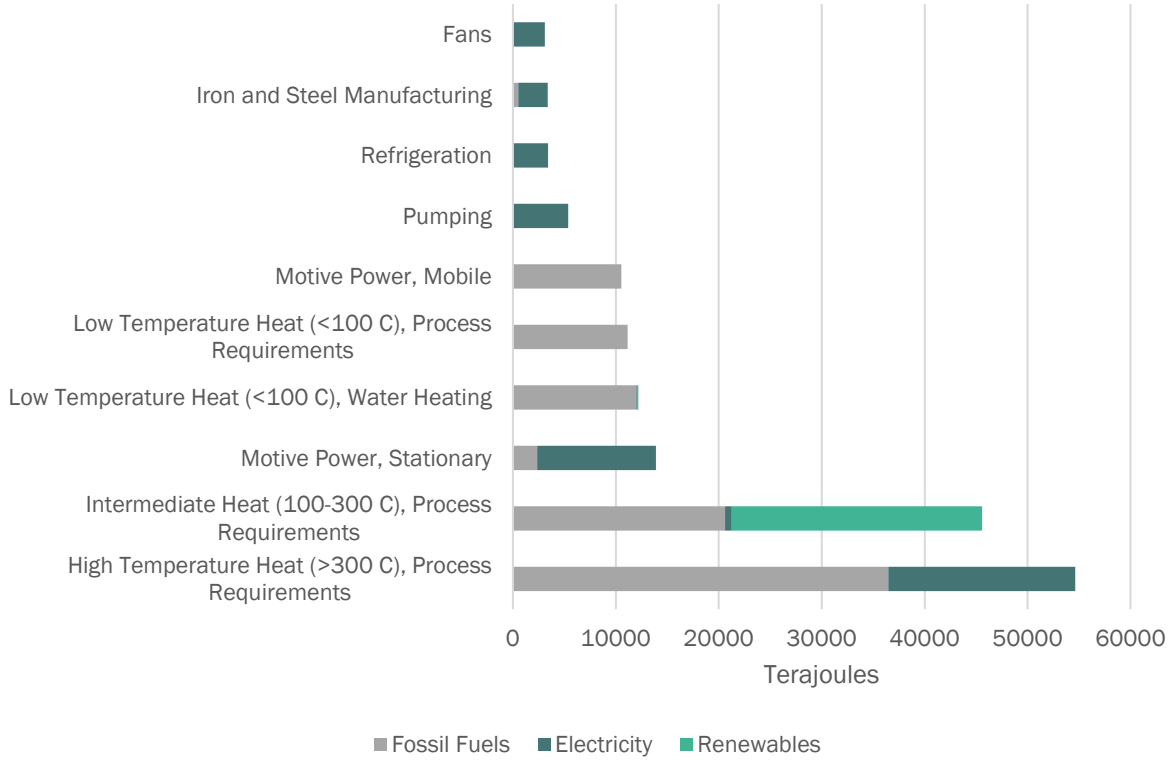


Figure 2: 2020 - Top 10 End Uses – Stationary Energy Consumption

2.4 Boiler Systems dominate technology use for stationary energy consumption

In terms of technology, boiler systems are the largest stationary energy consumer, making up 27% of total stationary energy usage.

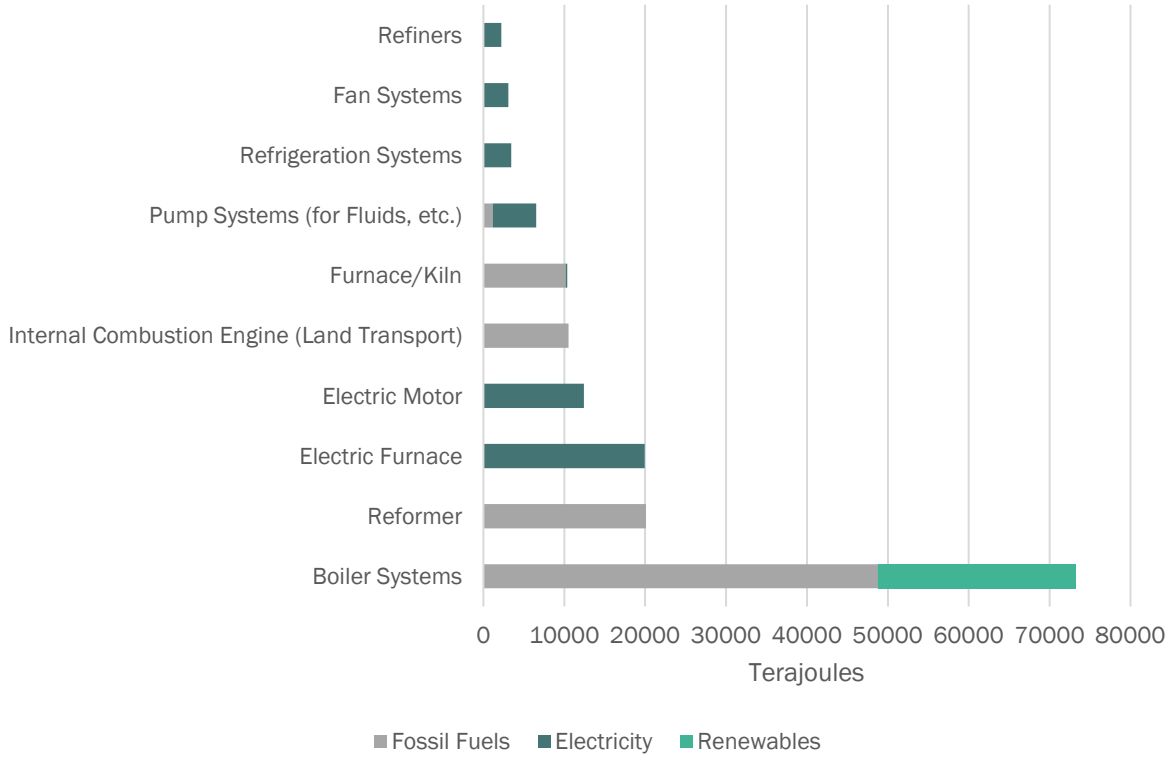


Figure 3: 2020 – Top 10 Technologies – Stationary Energy Consumption

2.5 Key changes over time include sectors dipping in their energy consumption in 2020

At the national level, energy consumption dipped in 2020. This was likely due to the April 2020 Covid lockdown. The 2020 dip is reflected in most business sectors and can be seen in the top 5 stationary energy consumption sectors in Figure 4 below. This is contrasted with the Residential sector, which has a slight increase (around 2%) from 2019 to 2020.

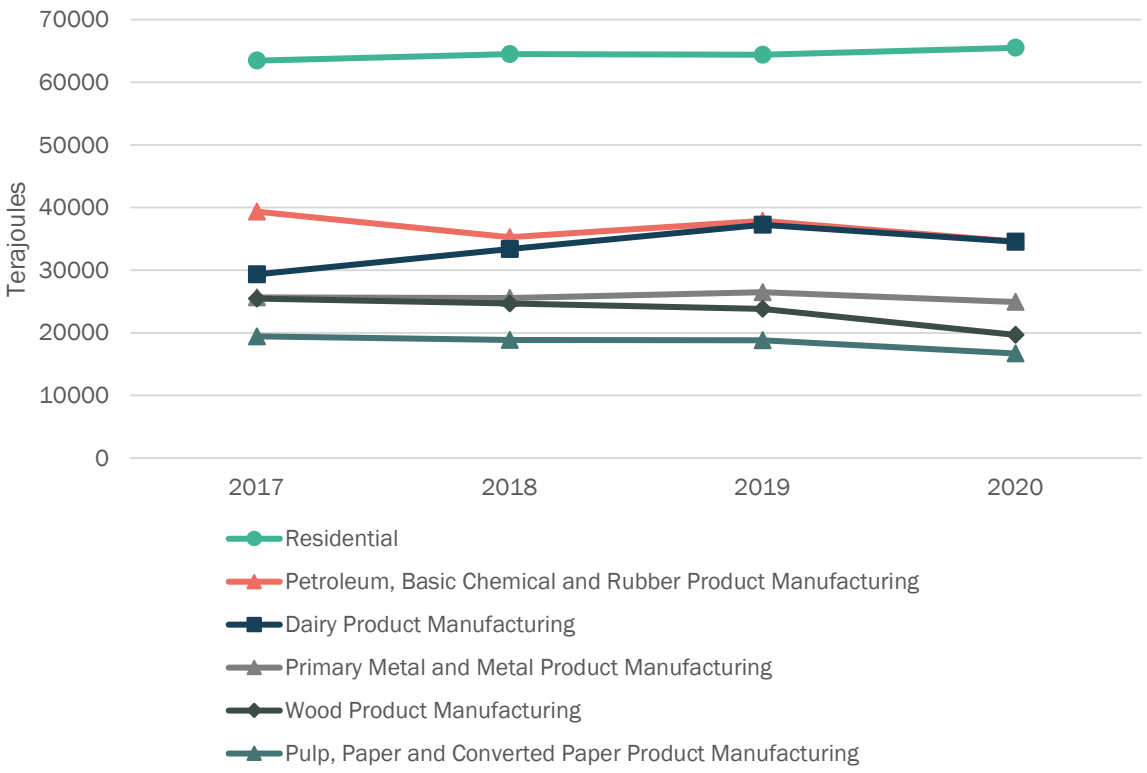


Figure 4: Top 5 Business Sectors and Residential Sector – Stationary Energy Consumption

3 Sector insights

3.1 Dairy Product Manufacturing accounts for 11% of all stationary energy use

The Dairy Product Manufacturing sector is one of the largest energy-using sectors in New Zealand, accounting for around 11% of all stationary energy use in 2020. In 2020 total consumption dipped slightly in line with most business sectors, likely due to the April 2020 Covid lockdown period. Coal and Natural Gas dominate the sectors' fuel profile accounting for 85% of total stationary energy in 2020. Process heat was the primary end-use application, accounting for 62% of total stationary energy used.

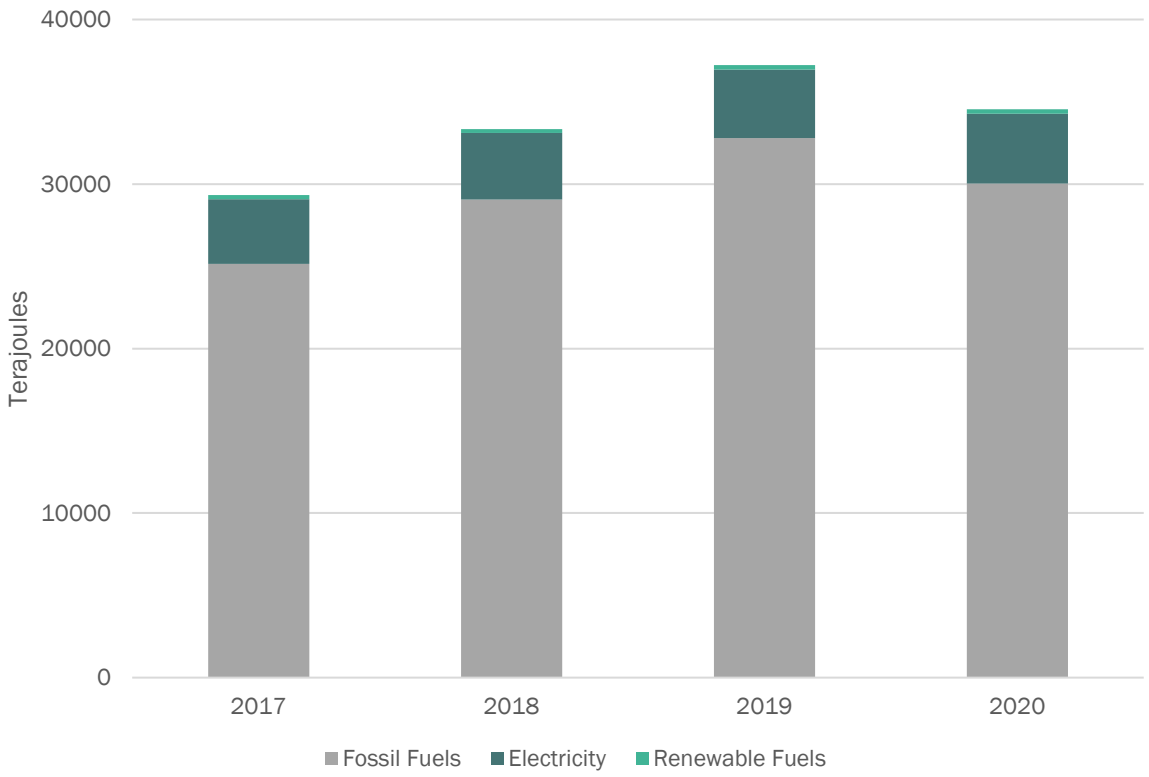


Figure 5: Dairy Product Manufacturing – Stationary Energy Consumption

3.2 Petrochemical Product Manufacturing accounts for 11% of all stationary energy use

The Petrochemical Product Manufacturing sector is another large energy-using sector in New Zealand. It accounted for around 11% of all stationary energy use in 2020. In 2018 energy consumption dipped due to outages which constrained production in the second half of the year. In 2020 consumption dipped again due to the April 2020 Covid lockdown period, global price reductions and gas supply reductions. Natural Gas dominates the sector's fuel profile accounting for 87% of total stationary energy in 2020. High-temperature process heat was the primary end-use application, accounting for 83% of total stationary energy used.

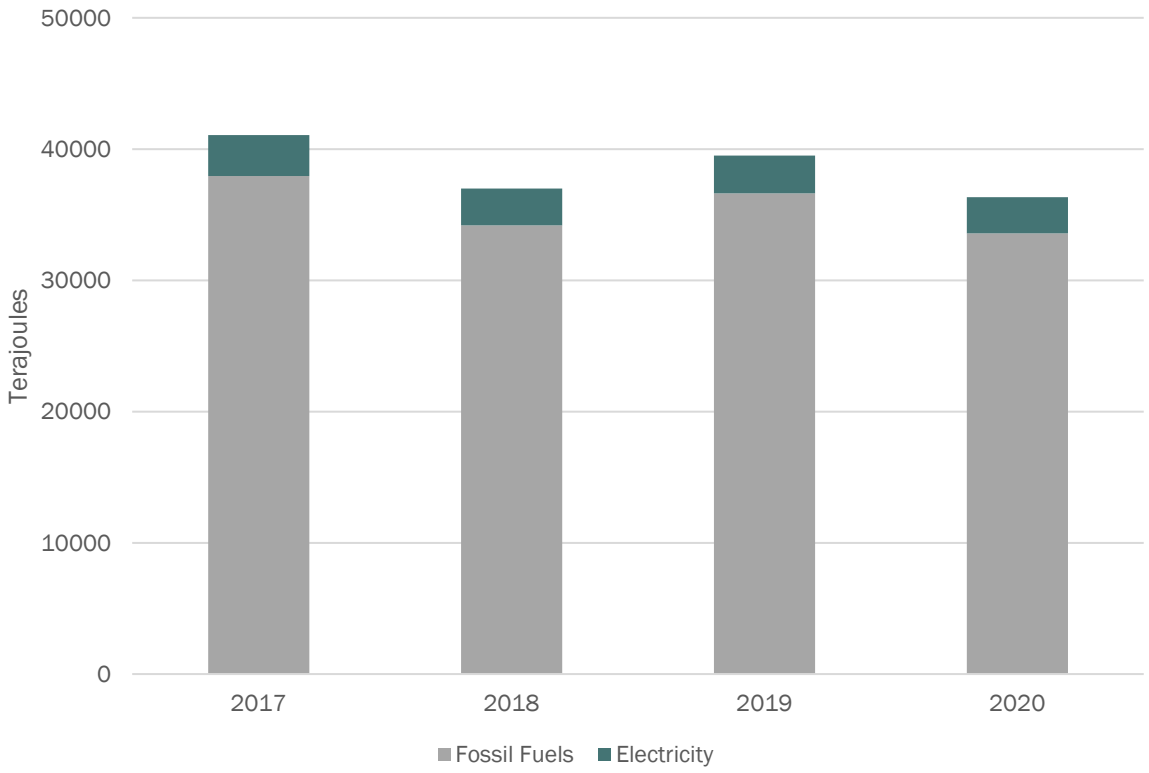


Figure 6: Petrochemical Product Manufacturing – Stationary Energy Consumption

Fossil fuel usage for energy continues to dominate key industrial sectors, and in New Zealand's overall energy profile in general. EECA is contributing to New Zealand's energy transition through its work programmes. The Government Investment in Decarbonising Industry (GIDI) Fund is one particularly relevant program in that it co-funds specific projects in industry across the country to fuel switch, or implement energy efficiency initiatives to reduce overall demand, at large manufacturing sites in numerous industrial sectors. The GIDI Fund has approved 39 projects to date, with $56 million and $85 million of government and applicant funding respectively, and 6.6 million tonnes of lifetime emission savings expected.

4 Transport

4.1 Light Passenger Vehicles consume half of New Zealand's annual transport energy

Light Passenger Vehicles (LPVs), such as cars and vans, dominate this sector, accounting for 50% of transport energy use. With more than double the annual energy use of the second largest category, Light Commercial Vehicles, the high number and usage of these LPVs puts them far ahead in this regard.

Also noteworthy is despite their growing prevalence, BEVs still contribute only a small amount of energy use in transport. While electricity usage in road transport doubled from 2017 – 2019, it still pales in comparison to petrol and diesel use. With BEVs now included in the EEUD, it will be possible to track this trend as the electrified fleet continues to grow.

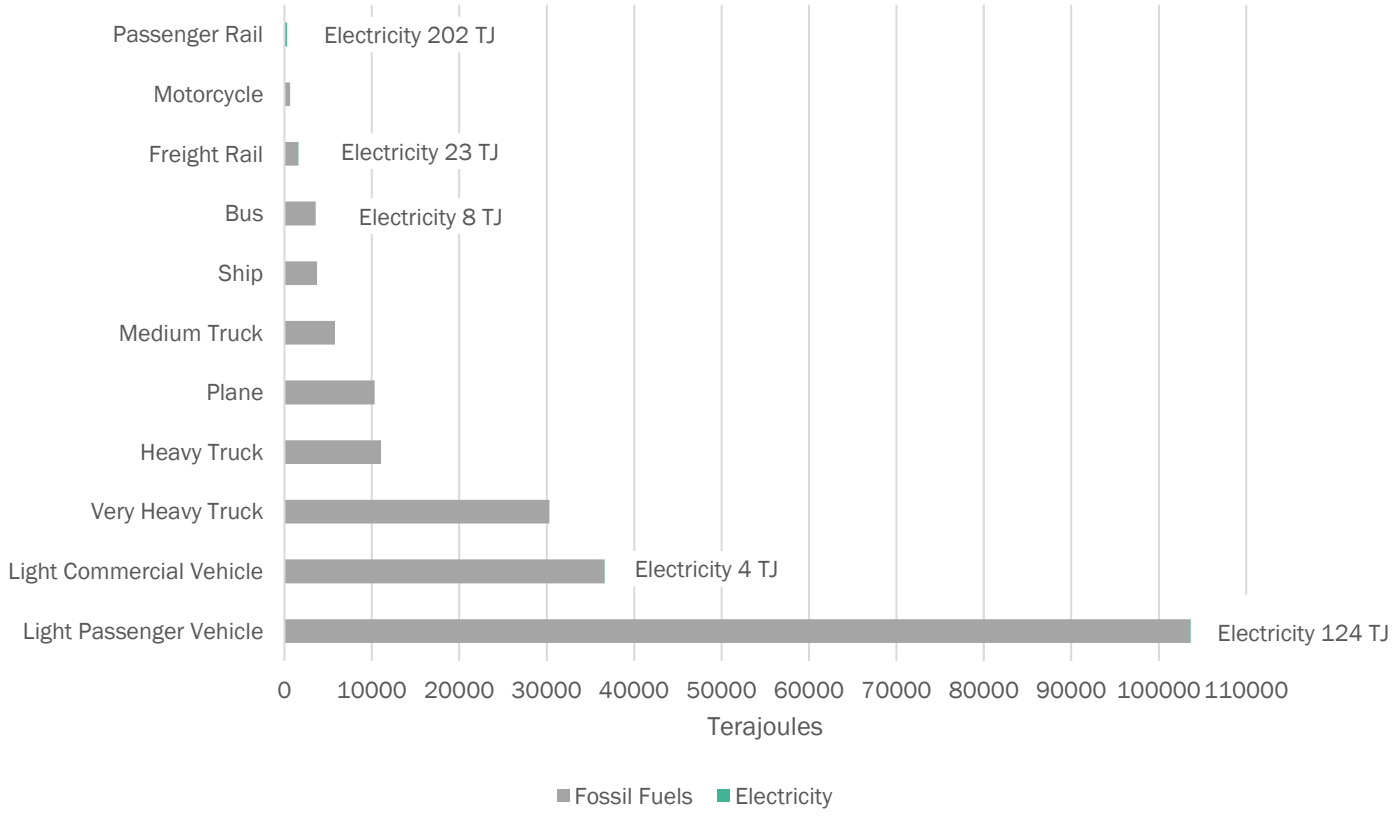


Figure 7: 2019 Transport Energy Consumption

4.2 Covid-19 had only a minor impact on transport energy use

While 2020 was a year of major disruption for the world, transport energy only showed a small decrease compared to previous years. As lockdowns hit, people were forced out of their vehicles, and even after

restrictions eased many moved to more frequent remote work. Many expected to see a significant downturn in transport energy use, however only a small drop eventuated.

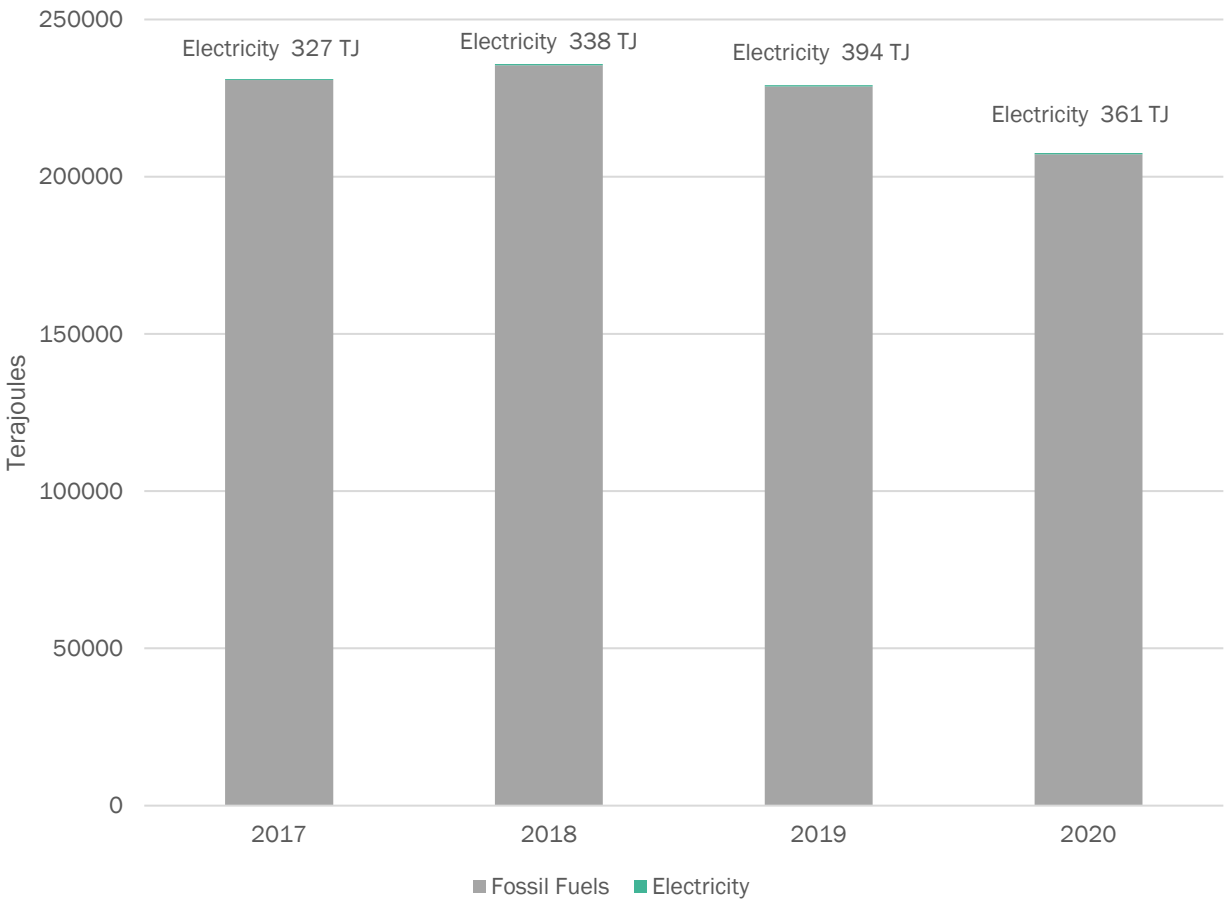
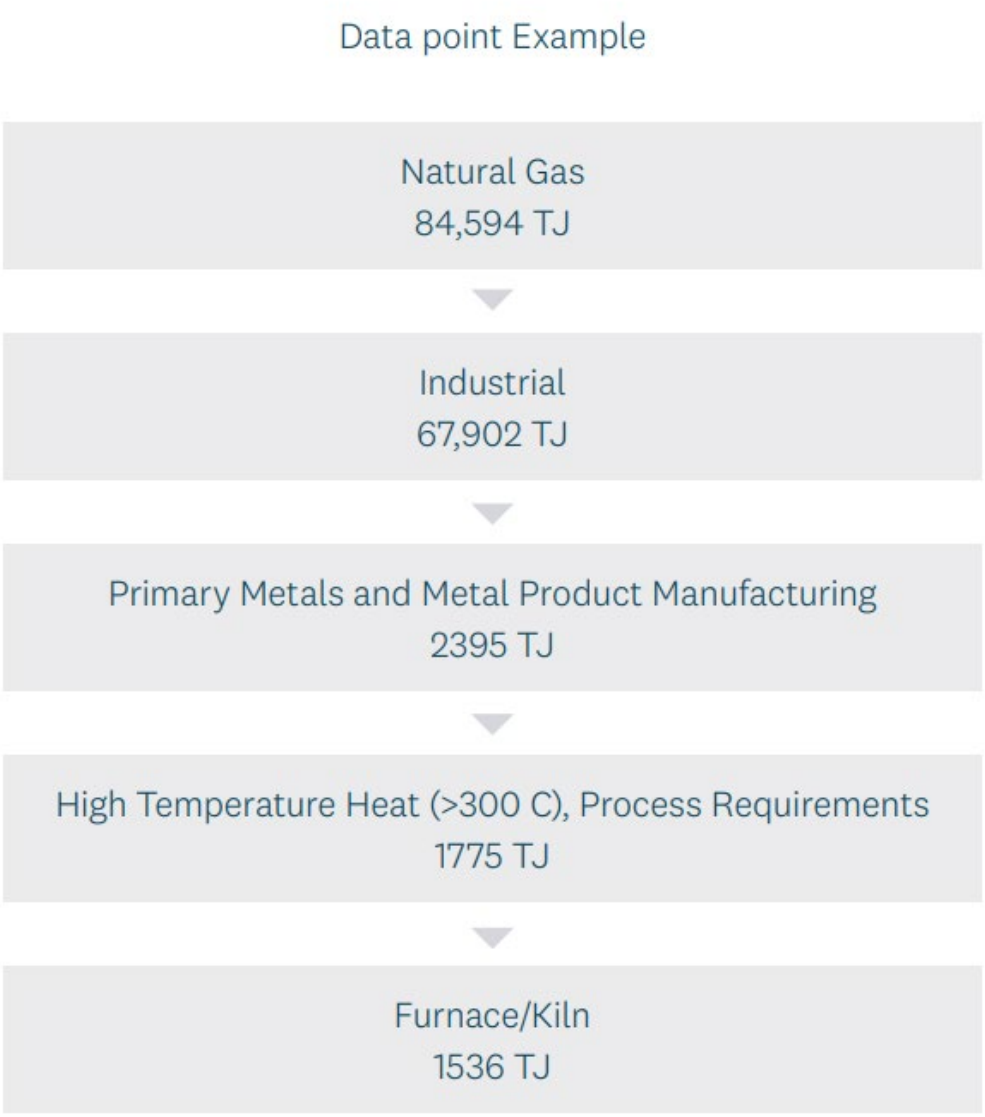


Figure 8: Transport Energy Consumption by year

5 Illustration of how energy is broken down

High Level Description	Detailed Description
 Fuel	Coal Electricity Natural Gas Other fuel breakdowns
 Sector	Commercial Industrial Residential Other sector breakdowns
 Subsector	Accommodation and Food Services Diary Product Manufacturing Other subsector breakdowns
 End Use	Low Temperature Heat (<100 C) Refrigeration Other end use breakdowns
 Technology	Boiler systems Lights Other technology breakdowns



- The example shows the total Natural Gas delivered energy in NZ in 2019, and how it is broken down into lower level estimates - by sector, subsector, end use and technology values.
- The final data point of 1536 TJ represents the Natural Gas used in Furnaces or Kilns, for High Temperature Heat (>300 C), Process Requirements, in the Primary Metals subsector, in the Industrial sector.

6 Stationary Energy Data Sources

The following data sources are used either as:

- Inputs – this is high level delivered energy values at the sector and fuel type level, which is then used to estimate final data points
- Modifiers – this data is used to produce more detailed splits[1] of inputs by subsector, end-use and technology.

Table 1: EEUD input data

Source	Fuel	Access location	Release date
Ministry of Business, Innovation and Employment (MBIE) Energy balances December Year End (DYE)	LPG Petrol Diesel Fuel Oil Aviation Fuel/Kerosene Geothermal Solar Biogas Wood	Ministry of Business, Innovation and Employment, Energy in New Zealand, webpage. https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-publications-and-technical-papers/energy-in-new-zealand/ Energy Balances Tables – Demand data	Annual as available
MBIE Coal statistics DYE	Coal (bituminous, sub-bituminous, lignite)	MBIE's Evidence and Insights Branch directly supplies data to EECA	Annual as available

[1] Splits are proportions of input values derived from other estimated values (i.e. modifiers).

MBIE Electricity demand data DYE	Electricity	MBIE's Evidence and Insights Branch directly supplies data to EECA	Annual as available
MBIE Natural Gas demand data DYE	Natural Gas	MBIE's Evidence and Insights Branch directly supplies data to EECA	Annual as available

Table 2: EEUD modifier data

Source	Fuel	Access location	Release date
MBIE Electricity retail data March Year End (MYE)	Electricity	MBIE's Evidence and Insights Branch	Annual as available
2019 DYE EEUD estimates: Used in 2020 EEUD build commissioned by EECA	Coal, Diesel, Electricity, Fuel Oil, Geothermal, LPG, Natural Gas, Petrol, Wood	EECA EECA reports commissioned in 2020 on the following sectors to provide a 2017-2019 data view of fuel, end use, and technology splits for the following sectors: Dairy Cattle Farming; Pulp, Paper and Converted Paper Product Manufacturing; Wood Product Manufacturing; Primary Metal and Metal Product Manufacturing; Petroleum, Basic Chemical and Rubber Product Manufacturing; Dairy Product Manufacturing; Meat and Meat Product Manufacturing and Seafood (EECA internally modelled data). The reports and modelling utilise company level data aggregated to form a whole sector estimate.	2019 estimated values
2007 MYE EEUD estimates: used in 2007 EEUD build commissioned by EECA2 Various sources (see footnote 3)	Aviation Fuel/Kerosene, Coal, Diesel, Electricity, Fuel Oil, Geothermal, LPG, Natural Gas, Petrol, Solar, Wood	EECA	2007 estimated values
Residential Baseline Study3	Electricity, Natural Gas, LPG, Wood	See footnote 2	August 2015
EECA product sales data modelling for the residential sector	Electricity, Natural Gas	EECA	Annual as available
2021 Report on Offroad Liquid Fuels	Petrol, Diesel	https://www.eeca.govt.nz/insights/eeca-insights/off-road-liquid-fuel-insights/	July 2021

[2] For information on 2007 data sources, contact EECA directly.

[3] The Residential Baseline Study (August 2015) is a report on energy use in the Australian and New Zealand Residential Sectors. It provides comprehensive annual energy consumption estimates by product type using actuals up to 2014 and forecasts to 2030. The data is currently being updated by EnergyConsult with a new publication planned for 2021. See the following links for report details:
Residential Baseline Study Energy Consult Report PDF link
Residential Baseline Study Energy Consult Technical Appendix PDF link (methodology paper)
Residential Baseline Study data tables

commissioned by EECA. Data used for the Dairy Cattle Farming sector and the non-Dairy Agriculture sector			
Statistics New Zealand's (Stats NZ) Energy Use Survey (EUS) values	Diesel, Petrol	Stats NZ https://www.stats.govt.nz/insights?filters=New%20Zealand%20energy%20use%2CInformation%20releases Stats NZ Infoshare table reference: EUS004AA	2016, 2017, 2018 data; (Final survey completed 2018)
Waka Kotahi New Zealand Transport Agency (NZTA)	Petrol	Waka Kotahi NZTA	Annual as available

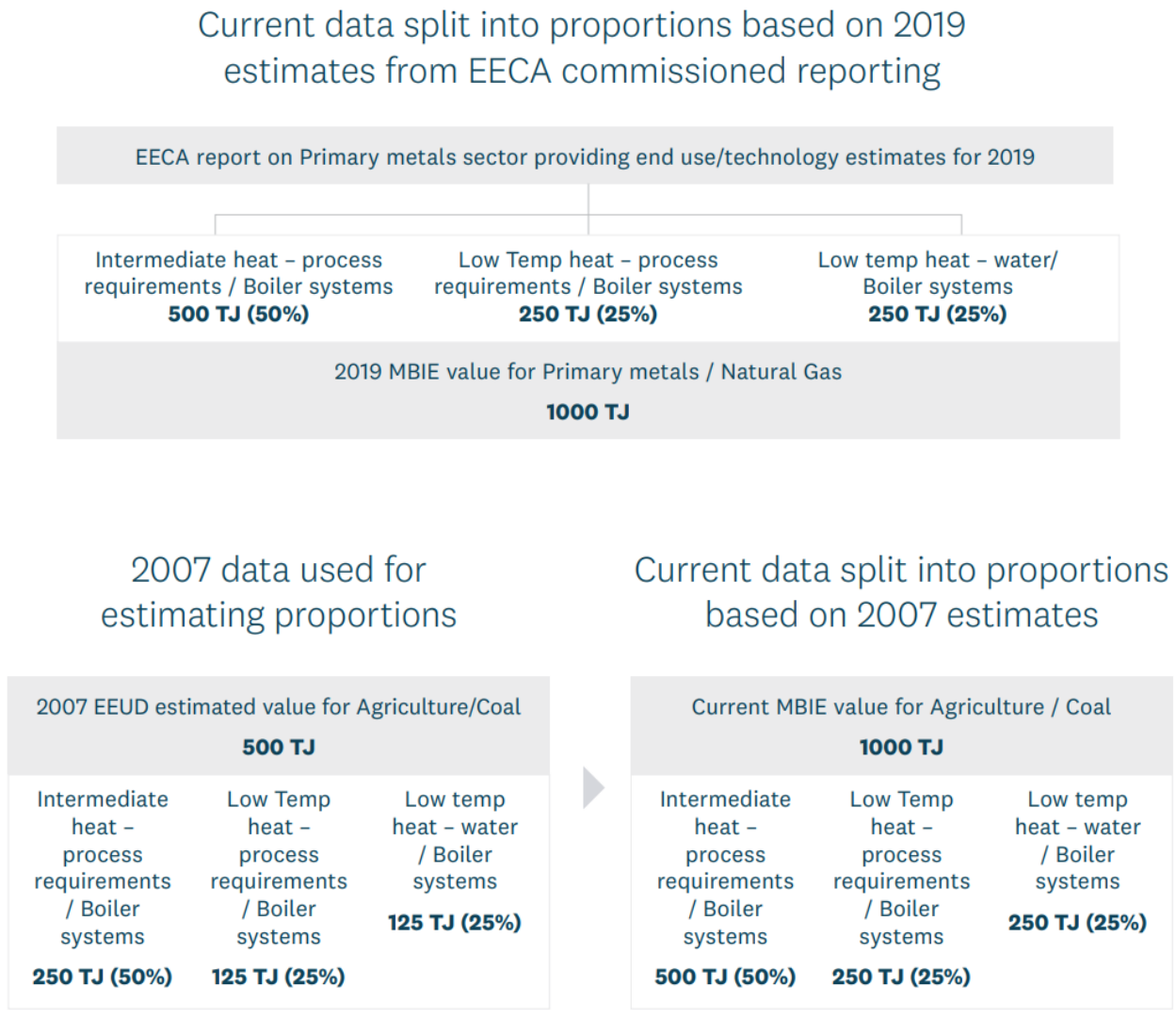
7 Updating the EEUD – Stationary Energy Methodology

The EEUD is updated annually after the release of MBIE's Energy in New Zealand publication, usually around August/September. The update includes a refresh of previous years' data, as input and modifier series may have undergone refreshes since being applied to the EEUD in previous years.

The general method for estimating delivered energy by end use and technology is to split the latest year energy values from MBIE at a sector/fuel level into smaller, more detailed energy values at an end use and technology level.

The split method uses the latest information collected by EECA on given sectors (see Table 2), and also estimates from EECA's 2007 EEUD database. This information is 'low level', and is used to derive proportions to split out the 'high level' delivered energy values from MBIE into 'low level'.

This general method is illustrated below.



Primary inputs are sector and fuel energy consumption values. The sector and fuel level values are split into subsector values and end use/technology values.

In the hypothetical example, the current value for the Agriculture sector and Coal fuel type shown as 1,000 (TJ) for simplicity, is disaggregated into end-uses as follows:

a. For this sector/fuel combination, 2007 EEUD values provide the end uses and technology proportions. In this case of the total 500 TJ:
    i. Intermediate Heat – Process Requirements (end-use) and Boiler systems (technology) is 250 TJ, or 50%
    ii. Low Temperature heat – Process Requirements (end-use) and Boiler systems (technology) is 125 TJ, or 25%
    iii. Low Temperature heat – Water (end-use) and Boiler systems (technology) is 125 TJ, or 25%
b. The current value of 1000 TJ for Agriculture/Coal is then split into these combinations of end-use and technologies using the proportions calculated using 2007 values.[4] For example, the current value for:
    i. Intermediate Heat – Process Requirements (end-use) and Boiler systems (technology) is 50% of 1000 TJ, or 500 TJ
    ii. Low Temperature heat – Process Requirements (end-use) and Boiler systems (technology) is 25% of 1000 TJ, or 250 TJ
    iii. Low Temperature heat – Water (end-use) and Boiler systems (technology) is 25% of 1000 TJ, or 250 TJ.

7.1 Modifier Data

The EEUD uses certain data items to split high-level MBIE consumption values into more detailed values. These data items are called 'Modifier data'. Specific modifier data used are listed below:

a. Specific sector estimates for 2019 of fuel/end ususe/technologystimates from reports commissioned by EECA in 2020 and internal modelling conducted in 2020. The data these estimates are based on is largely company level energy use data derived from direct sub sub-meteringthe course of energy audits.
b. March year-end (MYE) electricity retail data from MBIE. This provides greater subsector detail than MBIE's electricity DYE estimates. For example, the DYE estimate for the Food Processing sector can be split into three subsectors using MYE retail data – these are Meat Products, Dairy Products and Other Food Products.

[4] All modifier values that are not of the latest year are scaled to represent and estimation for the latest year – see the Updating Modifier Data section.

c. NZTA Fuel excise duty data on off-road use of petrol. This data is used to split out estimates for non-transport use of petrol across sectors.

d. Statistics New Zealand Energy Use Survey[5]. This provides greater detail for Petrol and Diesel end-use. It is used to:

    iv. derive subsector proportions – for example, MBIE's Petrol value for the Commercial sector can be split into subsectors such as Accommodation and food services, Arts and recreation services, Financial and insurance services and others.

    v. derive diesel off-road usage.

e. 2007 EEUD values. This data is used to estimate sector values if no other more recent sector indicators are available.

7.2 Updating modifier data

Some modifier data used is not from the latest year – it is historical data. For instance, Stats NZ EUS data and 2007 EEUD values were measured historically, covering 2016 to 2018 and 2007 respectively. As this data is used to estimate values for the latest year of the EEUD, each data point must be scaled to the latest year using a select scalar specific to its sector. See the Scaling section for complete details. 6.3 provides an illustration of how scaled values are used to derive proportions.

[5] The survey ran most recently from 2016 to 2018 (but has been discontinued). It collected statistics detailing the energy used by the New Zealand economy. Businesses provided information on how much energy they use. Individual data was aggregated to give published data at industry and national level for different energy types.

7.3 Hypothetical illustration of sector values scaled and used for proportions

2007 data
Commercial / Electricity
Total Value = 1300 TJ

2007 data scaled to latest estimate
Commercial / Electricity
Total Value = 2500 TJ

Step 1:
Scale 2007 EEUD data by sector GDP change

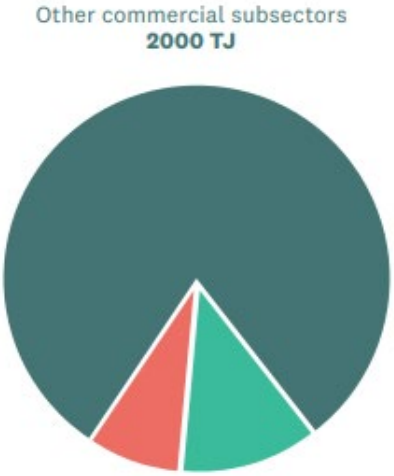
$$\text{GDP Change} = \frac{\text{(GDP Latest Year)}}{\text{(GDP Base Year (2007))}}$$

Hypothetical Example: Accommodation & Food Services GDP change from 2007 to 2018 = $100million to $200 million.

$$\text{GDP Change} = \frac{\$200\text{m}}{\$100\text{m}} = 2.00$$

Data scaled by GDP change = 150 TJ x 2.00 = 300 TJ

2007 data scaled to latest estimate
Commercial / Electricity
Total Value = 2500 TJ



Proportions applied to MBIE data
Commercial / Electricity
Total Value = 5000 TJ

Step 2:
Calculate proportions using scaled 2007 data and apply to new data

$$\text{Proportion} = \frac{(\text{Accommodation \& Food Services (TJ)})}{(\text{Total Commerce (TJ)})}$$

Hypothetical Example: Accommodation & Food services proportion based on 2007 scaled estimates applied to latest Commercial/Electricity value of 5000 TJ.

$$\text{Proportion} = \frac{(300\ \text{TJ})}{(2500\ \text{TJ})} = 0.12$$

Proportion applied to latest data = 0.12 x 5000 TJ = 600 TJ

Table 3: How modifier data is used to provide proportions to MBIE values

Data type	How is this data used	Example
2017-2019 sector data from commissioned reports or EECA internal modelling	Data is used to estimate fuel type, end use and technology splits for given sectors	Primary Metal and Metal Product Manufacturing sector report provides estimates for all fuels used in the sector, broken down by end use and technology. These estimates are used to provide proportions to split out MBIE's published Primary Metals sector demand estimates
MBIE electricity MYE retail data	Data is used to estimate (DYE) sectors to greater subsector detail.	The MBIE DYE estimate for the Food Processing sector is split into three sub-sectors using MBIE MYE retail data. These subsectors are: • Meats and meat products • Dairy products • Other food products, beverages and tobacco
NZTA Fuel Excise Duty Petrol data for off-road use	Data is used to estimate sector splits for off-road petrol use.	The NZTA data provides breakdowns of off-road petrol usage for nine sectors under the commercial sector group (e.g. Transport, postal and warehousing; Building cleaning, pest control and other support services). These breakdowns flow through to end-use/technology splits for commercial group susub-sectors This data is superior to using Stats NZ EUS data for ofoff-roadetrol estimates.
Residential Baseline Study	Data is used to estimate residential energy use by end-use/technology	The MBIE Residential electricity value can be proportioned into electricity usages such as lighting, cooking and entertainment technologies
EECA product sales data modelling for the residential sector	Data is used to estimate residential energy use by end-use / technology	The MBIE Residential electricity value can be proportioned into electricity usages such as heating and refrigeration technologies (i.e. technologies that EECA regulates and collects product sales data on)
2007 EEUD values	This data is used to estimate sector proportions, and end use and technology proportions.	The MBIE value for Commercial / Natural gas is split into 34 values across 13 sectors based on the 2007 EEUD. An example is the Retail Trade – food sector, which has three end use/technology values: • Intermediate Heat (100-300 C), Cooking / Cooking Ovens • Low Temperature Heat (<100 C), Space Heating / Burner (Direct Heat) • Low Temperature Heat (<100 C), Water Heating / Hot Water Cylinder

7.4 Treatment of Stationary Energy values [6]

For stationary energy values, the input data is from MBIE. The MBIE values are provided by sector and fuel.

The EEUD then provides further sub sector breakdowns, and end use/technology breakdowns.

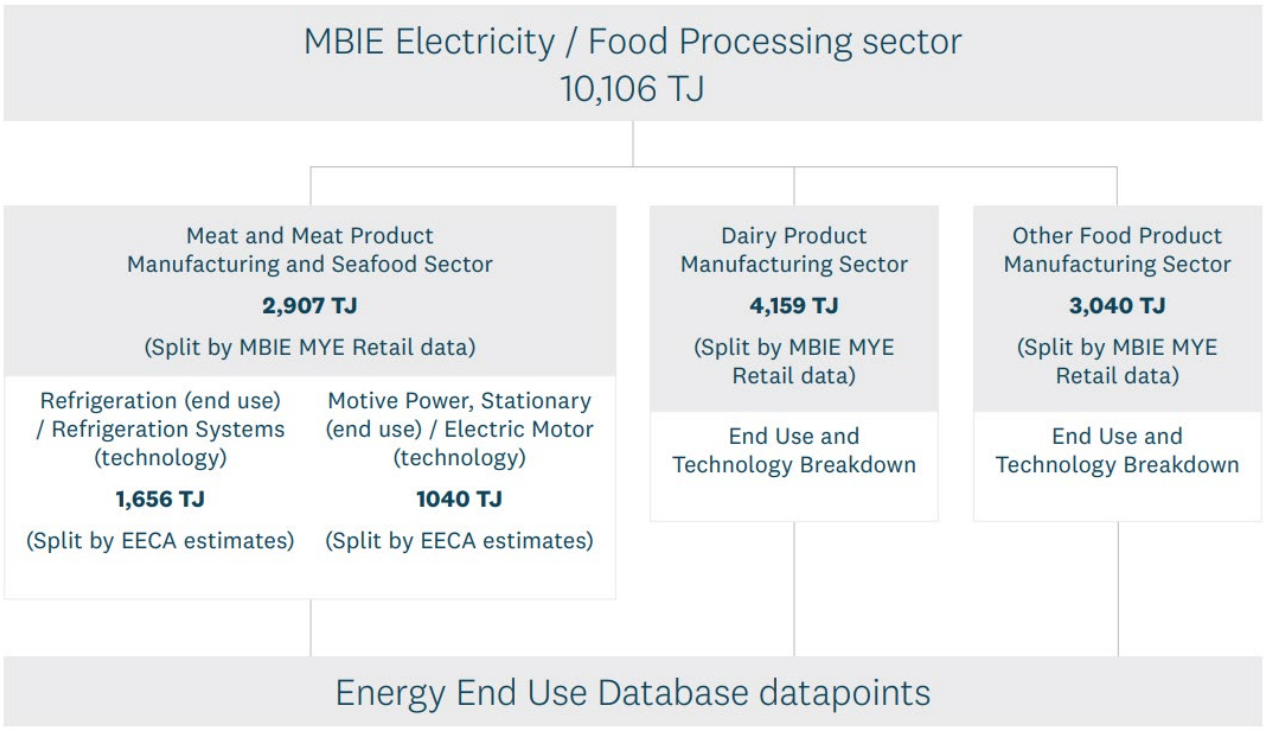
Table 4: Treatment of Stationary energy values

Sector group	Fuel type	Input source	Split 1	Split 2
Dairy Cattle Farming; Pulp, Paper and Converted Paper Product Manufacturing; Wood Product Manufacturing; Primary Metal and Metal Product Manufacturing; Petroleum, Basic Chemical and Rubber Product Manufacturing; Dairy Product Manufacturing; Meat and Meat Product Manufacturing and Seafood	Electricity, Natural Gas, Coal, LPG, Av. Fuel/Kerosene Fuel Oil[7] Wood[8] Geothermal[9]	MBIE DYE	Reports and EECA internal modelling used for estimates of end use/technology (For Electricity, MBIE sector proportions for are split first, then end use/technology estimates are derived)	
All remaining sectors except Residential	Electricity, Natural Gas, Coal	MBIE DYE	MBIE sector proportions	2007 estimates of end use/technology
	LPG, Fuel Oil Av. Fuel/Kerosene, Wood, Geothermal, Biogas	MBIE DYE	2007 estimates of subsector/end use/technology	
All sectors except Residential	Petrol	MBIE DYE	NZTA Fuel Excise Duty proportions	2007 estimates of end use/technology
All sectors except Residential	Diesel	MBIE DYE	Stats EUS sector and end use proportions	2007 estimates of end use/technology
Residential	Electricity, Natural Gas, LPG, Wood	MBIE DYE	Residential Baseline Study; EECA residential product sales data modelling	
Residential	Coal, Diesel, Petrol, Geothermal	MBIE DYE	2007 estimates of end use/technology	

[7] Fuel Oil data from the Petroleum, Basic Chemical and Rubber Product Manufacturing, Dairy Product Manufacturing, Pulp, Paper and Converted Paper Product Manufacturing, and Wood Product Manufacturing sectors is used to allocate MBIE's Industrial-Unallocated/Fuel Oil demand estimate.

[8] Wood data for the Pulp, Paper and Converted Paper Product Manufacturing and Wood Product Manufacturing sectors is used to allocate MBIE's Wood, Pulp and Paper sector demand estimate.

[9] Geothermal data for the Pulp, Paper and Converted Paper Product Manufacturing and Wood Product Manufacturing sectors is used to allocate MBIE's Industrial-Unallocated/Geothermal demand estimate.


MBIE Electricity / Food Processing sector
10,106 TJ
Meat and Meat Product Manufacturing and Seafood Sector
2,907 TJ
(Split by MBIE MYE Retail data)
Refrigeration (end use) / Refrigeration Systems (technology)
1,656 TJ
(Split by EECA estimates)
Motive Power, Stationary (end use) / Electric Motor (technology)
1040 TJ
(Split by EECA estimates)
Dairy Product Manufacturing Sector
4,159 TJ
(Split by MBIE MYE Retail data)
End Use and Technology Breakdown
Other Food Product Manufacturing Sector
3,040 TJ
(Split by MBIE MYE Retail data)
End Use and Technology Breakdown
Energy End Use Database datapoints

8 Scaling – Stationary Energy

Data values that are not measured for the latest year are scaled to the latest year to ensure a greater level of estimation accuracy. The 2007 EEUD estimates and Stats NZ EUS estimates are scaled from their respective base year as shown in Table 6.

Table 6: Scaled data items by sector

Data item	Sector group	ANZSIC 06	Base year
2007 estimates	Agriculture/Industry/Commerce/Residential	A - S	March 2007
Stats NZ EUS values	Primary	A - B	March 2016
Stats NZ EUS values	Industrial and Trade	C – G, I	March 2017
Stats NZ EUS values	Services	H, J - S	March 2018

Table 7 lists the EEUD sectors and what scalar is used.

Three types of scalar are currently used:

a. GDP,
b. Population estimates, and
c. Herd stock (number of cows).

GDP is sourced from Stats NZ infoshare - Table SNE065AA.[10] The table provides quarterly GDP volumes by ANZSIC industry groups. Base year volumes are determined as the sum of four quarters from March (or Q2) - e.g. March 2007 is Q2, Q3, Q4 2006 and Q1 2007.

Population estimates are from Stats NZ infoshare - Table DPE058AA.[11] The table provides estimated resident population by age and sex – annual December estimate. Mean year ended (annual – December) are used.

Herd stock (number of cows) is updated from DairyNZ's annual publication New Zealand Dairy Statistics 2018/19, Table 2.2 – 'Total cows'.[12]

[10] This table is a quarterly GDP series, chain volume, actual, expressed in 2009/10 prices, by ANZSIC06 industry groups. The table is updated quarterly and values can be adjusted between quarters.

[11] This table is updated annually in November. The November edition is used as our population scalar. The values used are the 'Mean year ended' values.

[12] https://www.dairynz.co.nz/publications/dairy-industry/ This count is specifically of all cows lactating for that season, and therefore most likely to be utilised for energy consumption processes (milking). This is a preferred measure to Stats NZ data which only provides a total cattle count, irrespective of lactation.

EEUD sectors are mapped to the GDP results of industry sectors using ANZSIC06.[13]

Table 7: Sectors by ANZSIC code, base year, and scalar type

2007 estimates by sector	ANZSIC 06	Base year	Scalar
Indoor Cropping	A0111, A0114, A0122	MYE 2007	GDP
Non-Dairy Agriculture	A0112-A0113, A0115, A0121, A0123, A013-A015, A017-A019, A02, A05	MYE 2007	GDP
Dairy Cattle Farming	A016	DYE 2019	Herd stock (number of cows)
Forestry and Logging	A03	MYE 2007	GDP
Fishing, Hunting and Trapping	A04	MYE 2007	GDP
Mining	B	MYE 2007	GDP
Meat and Meat Product Manufacturing and Seafood	C111-C112	DYE 2019	GDP
Dairy Product Manufacturing	C113	DYE 2019	GDP
Other Food Product Manufacturing	C114-C119, C12	MYE 2007	GDP
Textile, Leather, Clothing and Footwear Manufacturing	C13	MYE 2007	GDP
Wood Product Manufacturing	C14	DYE 2019	GDP
Pulp, Paper and Converted Paper Product Manufacturing	C15	DYE 2019	GDP
Printing	C16	MYE 2007	GDP
Petroleum, Basic Chemical and Rubber Product Manufacturing	C17-C19	DYE 2019	GDP
Non-Metallic Mineral Product Manufacturing	C20	MYE 2007	GDP
Primary Metal and Metal Product Manufacturing	C21	DYE 2019	GDP
Fabricated Metal Product, Transport Equipment, Machinery and Equipment Manufacturing	C22-C24	MYE 2007	GDP
Furniture and Other Manufacturing	C25	MYE 2007	GDP
Electricity, Gas, Water and Waste Services	D	MYE 2007	GDP
Construction	E	MYE 2007	GDP
Wholesale and Retail Trade - Non Food	F33, F34, F35, F37, F38 & G39, G40, G42, G43	MYE 2007	GDP
Wholesale Trade - Food	F36	MYE 2007	GDP
Retail Trade - Food	G41	MYE 2007	GDP
Accommodation and Food Services	H	MYE 2007	GDP

[13] ANZSIC06 is the Australian and New Zealand Standard Industrial Classification index of Australia and New Zealand industries. It is used as a mapping mechanism between the EEUD subsector structure, and other data sources (MBIE data, GDP). http://archive.stats.govt.nz/methods/classifications-and-standards/classification-related-stats-standards/industrial-classification.aspx

Transport, Postal and Warehousing	I46-I51	MYE 2007	GDP
Transport, Postal and Warehousing (Commercial - Non-Transport)	I52, I53	MYE 2007	GDP
Information Media and Telecommunications	J	MYE 2007	GDP
Financing, Insurance, Real Estate and Business Services	K, L, M, N72	MYE 2007	GDP
Building Cleaning, Pest Control and Other Support Services	N73	MYE 2007	GDP
Public Administration and Safety	O751, O752, O754, O755, O77	MYE 2007	GDP
Local Government Administration	O753	MYE 2007	GDP
Defence	O76	MYE 2007	GDP
Education and Training: Pre-School, Primary and Secondary	P80	MYE 2007	GDP
Education and Training: Tertiary Education and Other Education	P81-P82	MYE 2007	GDP
Health Care and Social Assistance	Q	MYE 2007	GDP
Arts, Recreational and Other Services	R, S	MYE 2007	GDP
Residential	-	MYE 2007	Population

The table below lists sectors as they are reported in Stats EUS data and their relevant scalar. Stats EUS sectors are mapped to the EEUD sectors based on ANZSIC[14] codes.

[14] See Glossary for explanation of ANZSIC

Table 8: Stats NZ EUS data by sector and scalar

Stats NZ EUS values sector group	Stats NZ EUS values by sector	ANZSIC 06	Base Year	Scalar
Primary	Agriculture	A01	MYE 2016	GDP
Primary	Aquaculture	A02	MYE 2016	GDP
Primary	Forestry and Logging	A03	MYE 2016	GDP
Primary	Fishing	A04	MYE 2016	GDP
Primary	Services to agriculture, forestry, and fishing	A05	MYE 2016	GDP
Primary	Mining	B	MYE 2016	GDP
Industrial and Trade	Manufacturing	C	MYE 2017	GDP
Industrial and Trade	Electricity, gas, water, and waste services	D	MYE 2017	GDP
Industrial and Trade	Construction	E	MYE 2017	GDP
Industrial and Trade	Wholesale trade	F	MYE 2017	GDP
Industrial and Trade	Retail trade	G	MYE 2017	GDP
Services	Accommodation and food services	H	MYE 2018	GDP
Industrial and Trade	Transport, postal, and warehousing	I	MYE 2017	GDP
Services	Information, media, and telecommunications	J	MYE 2018	GDP
Services	Financial and insurance services	K	MYE 2018	GDP
Services	Rental, hiring, and real estate services	L	MYE 2018	GDP
Services	Professional, scientific, and technical services	M	MYE 2018	GDP
Services	Administrative and support services	N	MYE 2018	GDP
Services	Public administration and safety	O	MYE 2018	GDP
Services	Education and training	P	MYE 2018	GDP
Services	Health care and social assistance	Q	MYE 2018	GDP
Services	Arts and recreation services	R	MYE 2018	GDP
Services	Other services	S	MYE 2018	GDP

Please contact EECA for more information on scaling, and details on the exact GDP series used for each sector group.

9 Summary of Assumptions - Stationary Energy[15]

EECA have made the following assumptions in estimating energy end use in the EEUD

The input or modifier data is an accurate base representation of the New Zealand energy demand picture at the date of publication for the input/modifier data.

The scalars used provide an accurate representation of the change in delivered energy usage over time for each sector.

The following sectors have modifier estimates for DYE 2019 based on company level data and/or research using publicly available information to build a sector level data picture. The data may not cover all organisations in a given sector, but at least 80% market share is covered. This is assumed to provide an accurate data representation for the following sectors:

a. Dairy Cattle Farming
b. Dairy Product Manufacturing
c. Meat and Meat Product Manufacturing and Seafood
d. Pulp, Paper and Converted Paper Product Manufacturing
e. Wood Product Manufacturing
f. Petroleum, Basic Chemical and Rubber Product Manufacturing
g. Primary Metal and Metal Product Manufacturing

For sectors that are reliant on 2007 EEUD data, the database does not account for overall changes in how energy is used in those sectors since 2007. The current model assumes that energy use is aligned with its relevant scalar. EECA is the continually developing accurate sector energy profiles which will improve this.

[15] The summary of assumptions here is broad and at a high level. The assumptions pertaining to specific data points are complex. Contact EECA directly for queries around detailed assumptions at the data point level.

10 Glossary for the EEUD – Stationary Energy

10.1 Data in the EEUD is expressed in Terajoules (TJ)

10.2 Delivered Energy

Delivered energy is the heat content of the energy type (petrol, coal, wood, etc.) delivered to the location (home, building, business) where it is used. It is measured in TJ. One TJ has the same energy content as 28,490 litres of petrol.

10.3 ANZSIC

ANZSIC is the Australian and New Zealand Standard Industrial Classification. For more information visit http://archive.stats.govt.nz/methods/classifications-and-standards/classification-related-stats-standards/industrial-classification.aspx

10.4 Fuel

Fuel includes:

- Coal
- Petrol
- Diesel
- Fuel oil
- Aviation fuel/kerosene
- LPG
- Natural gas
- Electricity
- Geothermal
- Solar
- Biogas
- Wood

10.5 Sectors

The definition used for sectors is based on the Australian New Zealand Standard Industrial

Classification (ANZSIC) 2006. The sectors of the EEUD are tabled below

10.6 The sectors of the EEUD and their ANZSIC codes

Sector Group	Sector	ANZSIC 06
Agriculture, Forestry and Fishing	Indoor Cropping	A0111, A0114, A0122
	Non-Dairy Agriculture	A0112-A0113, A0115, A0121, A0123, A013-A015, A017-A019, A02, A05
	Dairy Cattle Farming	A016
	Forestry and Logging	A03
	Fishing, Hunting and Trapping	A04
Industrial	Mining	B
	Meat and Meat Product Manufacturing and Seafood	C111-C112
	Dairy Product Manufacturing	C113
	Other Food Product Manufacturing	C114-C119, C12
	Textile, Leather, Clothing and Footwear Manufacturing	C13
	Wood Product Manufacturing	C14
	Pulp, Paper and Converted Paper Product Manufacturing	C15
	Printing	C16
	Petroleum, Basic Chemical and Rubber Product Manufacturing	C17-C19
	Non-Metallic Mineral Product Manufacturing	C20
	Primary Metal and Metal Product Manufacturing	C21
	Fabricated Metal Product, Transport Equipment, Machinery and Equipment Manufacturing	C22-C24
	Furniture and Other Manufacturing	C25
	Electricity, Gas, Water and Waste Services	D
	Construction	E
Commercial	Wholesale and Retail Trade - Non Food	F33, F34, F35, F37, F38 & G39, G40, G42, G43
	Wholesale Trade - Food	F36
	Retail Trade - Food	G41
	Accommodation and Food Services	H
	Transport, Postal and Warehousing (Commercial - Non-Transport)	I52, I53
	Information Media and Telecommunications	J
	Financing, Insurance, Real Estate and Business Services	K, L, M, N72
	Building Cleaning, Pest Control and Other Support Services	N73
	Public Administration and Safety	O
	Central Government Administration	O751
	Local Government Administration	O753
	Defence	O76

	Education and Training: Pre-School, Primary and Secondary	P80
	Education and Training: Tertiary Education and Other Education	P81-P82
	Health Care and Social Assistance	Q
	Arts, Recreational and Other Services	R, S
Residential	Household	-
Transport	Transport, Postal and Warehousing	I46-I51

10.6.1 End Uses and Technologies

End uses	Technologies
Iron and Steel Manufacturing	Electric Furnace Electric Motor Furnace/Kiln
High Temperature Heat (>300 Degrees C), Process Requirements16	Boiler Systems Reformer (Petroleum, Basic Chemical and Rubber Product Manufacturing only) Electric Furnace Furnace/Kiln Industrial Ovens Resistance Heater
Intermediate Heat (100-300 Degrees C), Process Requirements	Boiler Systems Burner (Direct Heat) Furnace/Kiln Industrial Ovens Resistance Heater
Low Temperature Heat (<100 Degrees C), Process Requirements	Boiler Systems Burner (Direct Heat) Furnace/Kiln Heat Pump (for Heating) Resistance Heater
Intermediate Heat (100-300 Degrees C), Cooking	Cooking Appliances (Residential only) 17 Cooking Elements Cooking Ovens
Low Temperature Heat (<100 Degrees C), Space Heating	Boiler Systems Burner (Direct Heat) Heat Pump (for Heating) Open Fire (Residential only) Open Fire, with Wetback (Residential only) Resistance Heater
Low Temperature Heat (<100 Degrees C), Water Heating	Boiler Systems Burner, with Wetback (Residential only) Gas Water Heater (Residential only)

[16] Heat for *Process Requirements* is heat energy requirements for agriculture, industrial and commercial processing operations e.g., the heat requirements of processes in the iron and steel, cement, kilning, chemical, food, paper, textile industries where elevated temperatures are required.

[17] This includes cooktops, ovens, uprights, microwaves, other kitchen appliances.

	Heat Pump (for Heating) Hot Water Cylinder Open Fire, with Wetback (Residential only) Resistance Heater
Motive Power, Mobile	Internal Combustion (Domestic Use) Internal Combustion Engine (Land Transport) Internal Combustion Engine (Sea Transport)
Motive Power, Stationary	Electric Motor Stationary Engine
Compressed Air	Air Compressors (Pulp, Paper and Converted Paper Product Manufacturing, and Wood Product Manufacturing sectors only)
Fans	Fan Systems (Pulp, Paper and Converted Paper Product Manufacturing, and Wood Product Manufacturing sectors only)
Refiners	Refiners (Pulp, Paper and Converted Paper Product Manufacturing, and Wood Product Manufacturing sectors only)
Pumping	Pump Systems (for Fluids, etc.)
Irrigation	Irrigation (Dairy Cattle Farming only)
Refrigeration	Refrigeration Systems
Lighting	Lights LED (Residential only) Incandescence (Residential only) 18 Fluorescent (Residential only) 19
Low Temperature Heat (< 100 C), Dishwashers	Dishwashers (Residential only)
Low Temperature Heat (<100 C), Clothes Drying	Clothes Dryer (Residential only)
Low Temperature Heat (<100 C), Clothes Washing	Clothes Washers (Residential only)
Space Cooling	Heat Pump (for Cooling)
Electronics and Other Electrical Uses20	Electronics IT and Entertainment (Residential only) 21

[18] Combination of Mains Voltage Incandescent, Mains Voltage Halogen and Extra Low Voltage Halogen lights.

[19] Combination of Linear fluorescents and Compact fluorescent lights.

[20] Electronics and Other Electrical Uses includes e.g., television sets, home entertainments, computers, microwaves, vacuum cleaners and mixers, etc.

[21] This includes Televisions, computers (desktop and laptop), desktop monitors, home entertainment audio equipment, game consoles, video players and media recorders, wireless/wired network devices, set-top box (free to air and subscription), miscellaneous IT equipment.

11 Transport

11.1 Summary

An interim update was completed in April 2022 to revise the Transport sector in the EEUD. During the 2020 review the Transport data and structure was deemed to be needing review, as stakeholder discussions revealed that it was not being used.

Issues included:

- the transport mode data provided was considered outdated and not reflective of the current picture,
- electric vehicles were not considered,
- groupings were very simplistic and mode breakdown was very limited.

In this update, ANZSIC based splits have been removed from EEUD Transport data as stakeholders indicated this was not useful for their purpose and with the ANSIC splits being based on data from 2007, it was seen as not being robust enough to be carried over. Instead, technology splits have been used, breaking categories such as Light Passenger Vehicles into Internal Combustion Engines, Hybrids, Plug-In Hybrids and Battery Electric Vehicles. As the update of low-emissions technologies are key to EECA's role, having a better understanding of their fuel use allows better decisions to be made.

In previous versions, Heavy Vehicles were collected into a category simply known as Freight. This has been enhanced to split freight energy use between Medium, Heavy and Very Heavy trucks, taking into consideration both the vehicles themselves and the trailers they may be towing.

The structure has also been designed to align with EECA's TIMES-NZ model, which uses the EEUD as a key input. By reconfiguring the transport data, it will allow for greater utilisation of the EEUD for future updates to TIMES-NZ.

11.2 Methodology

Key inputs:

- Energy Balance Tables – maintained by MBIE. These model the total use of energy by fuel type for high level sectors[22].
- Motor Vehicle Register (MVR) – maintained by Waka Kotahi (NZTA). This is a log of all road vehicles registered in New Zealand, and contains information such as make, model, fuel type and weight[23].
- Annual Fleet Statistics - maintained by Te Manatū Waka Ministry of Transport (MoT). These are a record of previous years fleet composition, distances travelled and fuel use[24].

[22]https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-statistics/energy-balances/
[23]https://www.nzta.govt.nz/vehicles/how-the-motor-vehicle-register-affects-you/motor-vehicle-registrations-dashboard-and-open-data/
[24] https://www.transport.govt.nz/statistics-and-insights/fleet-statistics/sheet/vehicle-fleet

- Vehicle Fleet Emissions Model (VFEM) – maintained by MoT. This is a projection of the future fleet composition and fuel use[25].
- Vehicle Emissions Prediction Model (VEPM) – maintained by Waka Kotahi. This model is primarily used for air quality assessments, predicting the emissions from vehicles out to 2050[26].
- New Zealand Energy Scenarios TIMES-NZ 2.0 (TIMES-NZ) – maintained by the Energy Efficiency and Conservation Authority (EECA). An integrated energy systems model that generates least-cost pathways through to 2050[27].

Determining Fuel Use:

- Fuel use of each vehicle class and fuel type was calculated using annual vehicle kilometers travelled (vkt) multiplied by a fuel efficiency factor. For example:
    - In 2019 motorcycles travelled 420 million km,
      A fuel efficiency factor of 0.0017 Petajoules of petrol per million km was applied (from the VFEM),
      420 * 0.0017 = 0.714 PJ
- Most vkt figures were from MoT's annual fleet statistics, and efficiencies from MoT's VFEM. Due to some differences in modelling these figures do not exactly match the MBIE balance tables. As the EEUD is used to break down these balance tables, the total fuel use figures derived for each class by this process were used as proportions, to then split the Energy Balance table's total transport fuel consumption by fuel type.
- To get historic vehicle registrations for 2017 – 2019, NZTA manually generated copies of the MVR from 31 December of each year. Future iterations will be able to use publicly published versions as they are released.
- For figures derived from the MVR, a python script was used to classify each vehicle into the relevant category.

11.3 Sectoral Breakdown

Light Vehicles:

- Sector split into Light Passenger Vehicles (LPV) such as cars and SUVs, and Light Commercial Vehicles (LCV) such as utes, vans and light trucks.
- Technologies available for these are Internal Combustion Engine (ICE), Hybrid (HEV), Plug-in Hybrid (PHEV) and Battery Electric (BEV).
- HEVs were considered to be vehicles with electric motors and a battery used to harvest energy but cannot be charged from an external source of electricity.

[25]https://www.transport.govt.nz/assets/Uploads/Data/Transport-outlook-updated/Vehicle-Fleet-Emissions-Model-Documentation-20190719.pdf
[26]https://www.nzta.govt.nz/roads-and-rail/highways-information-portal/technical-disciplines/air-quality-climate/planning-and-assessment/vehicle-emissions-prediction-model/
[27] https://www.eeca.govt.nz/insights/new-zealand-energy-scenarios-times-nz/

- Total LPV and LCV vkt were from MoT, by fuel type. These figures were split into technologies using proportions from the MVR, with the same annual travel distance assumed for each technology.
- PHEVs are assumed to have 60% of their vkt powered by electricity, with the remaining 40% by petrol. Hybrid LPV efficiencies are used to determine petrol use, and EV LPV for electricity.
- LPG fuel split using the MVR, using a count of the number of LPG vehicles in each class, VFEM efficiencies, and the average VKT from petrol vehicles used.
- Not all LCV technologies have values associated with them due to a lack of data, however they were added to allow for future releases to report these once data is available.

Heavy Vehicles:

- Split into four categories: Buses, Medium Trucks, Heavy Trucks, and Very Heavy Trucks.
- Bus vkt was from MoT, with efficiencies from each fuel type from MoT's VFEM.
- The Heavy and Very Heavy split was added to get a more granular understanding of truck use in New Zealand and assist as a data input into TIMES-NZ. The Very Heavy category is to capture large vehicles that carry bulky and/or heavy loads and are likely to have a greater average vkt per vehicle due to their use in road freight.
- NZTA's VEPM 6.2 update[28] was used to refine heavy/very heavy vkt. This update used road user charge (RUC) data to estimate the proportion of truck vkt undertaken while towing trailers.
- Both Gross Vehicle Mass (GVM) and Gross Combination Mass (GCM) were considered to determine the categories. GVM itself does not consider the weight of the trailer or trailers being towed by a vehicle, which many Heavy and Very Heavy trucks are doing so. Understanding how these vehicles tow was considered core to this update.
- The below splits were used to define the truck categories:
    - Rigid trucks (those not towing a trailer):
        - Under 10t GVM - Medium
        - 10 -30t GVM – Heavy
        - Over 30t GVM – Very Heavy
    - Articulated trucks (those towing trailers):
        - 14t – 40t GCM – Heavy
        - Over 40t GCM – Very Heavy

[28] https://www.nzta.govt.nz/assets/Highways-Information-Portal/Technical-disciplines/Air-and-climate/Planning-and-assessment/Vehicle-emissions-prediction-model/VEPM-6.2-technical-report-2021.pdf

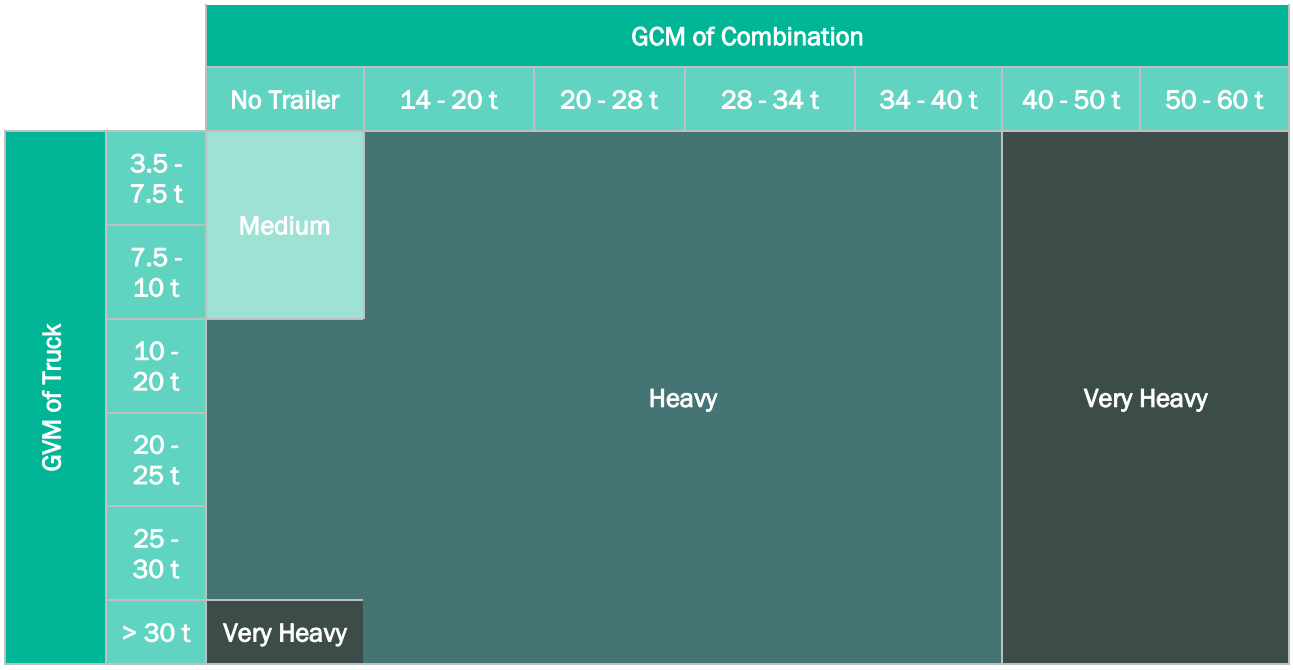


Figure 9: Heavy Vehicle Class Breakdown

- VEPM splits were applied to determine the proportion of total truck travel that each category undertakes, which were then applied to the vkt reported by MoT for each year.
- Fuel efficiency of Medium trucks from VFEM.
- To reflect the difference in fuel use between Heavy and Very Heavy trucks, manual efficiencies were applied for these categories. These were derived from EECA internal data – approx. 45 L/100km for Heavy, 56 L/100km for Very Heavy.
- All petrol truck vkt are assigned to medium trucks.
- All Heavy and Very Heavy trucks treated as diesel.
- BEV Trucks were not modelled due to a lack of data around travel distances. These will be added in a future update.

Motorcycles:

- All motorcycles were considered petrol as only small numbers were found to be alternatively fuelled. BEV motorcycles were not modelled due to their small number of registrations and lack of data around their use, these will be added in a future update.

Rail:

- Energy use provided by Kiwirail. This is split into diesel and electricity, as well as passenger and freight.

Air:

- All transport aviation fuel/kerosene is allocated to air travel as per MBIE oil tables. Only domestic aviation is considered.

Sea:

- All transport fuel oil is allocated to domestic navigation as per MBIE oil tables.

11.4 Technology Groups and Technologies

Technology Group	Technologies
Light Passenger Vehicle	Internal Combustion Engine Conventional Hybrid Vehicle Plug-in Hybrid Vehicle Battery Electric Vehicle
Light Commercial Vehicle	Internal Combustion Engine Conventional Hybrid Vehicle Plug-in Hybrid Vehicle Battery Electric Vehicle
Motorcycle	Internal Combustion Engine Battery Electric Vehicle
Medium Truck	Internal Combustion Engine Battery Electric Vehicle
Heavy Truck	Internal Combustion Engine Battery Electric Vehicle
Very Heavy Truck	Internal Combustion Engine Battery Electric Vehicle
Bus	Internal Combustion Engine Battery Electric Vehicle
Freight Rail	Internal Combustion Engine Electric Motor
Passenger Rail	Internal Combustion Engine Electric Motor
Plane	Plane
Ship	Ship

12 Energy End Use Database visualisation tool

This section provides an overview of the Energy End Use Database online application: an interactive tool that enables exploration of the EEUD data. This can be freely accessed on the EECA website here.

12.1 Main landing page

The main page of the Energy End Use Database shows how energy is used at the New Zealand national level in the interactive Sankey chart. This can be toggled between Fuel to End Use, and Fuel to Sector to End Use.

Each of the charts[29] are available for download as an image or as an open dataset and available to use under a creative commons licence.

[29] Sankey only available as image.

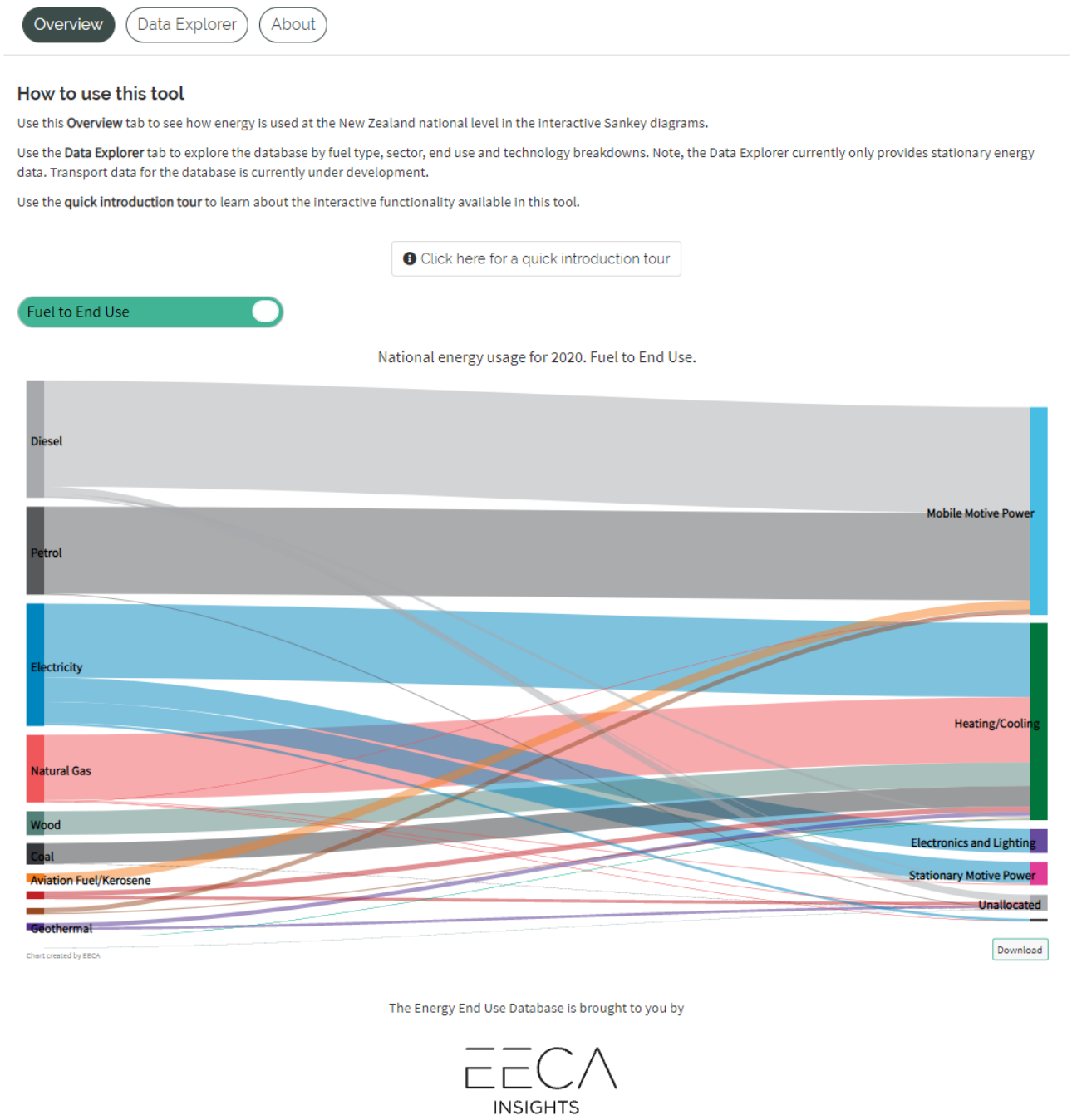


Figure 10: Main landing page with a Sankey for national energy usage from Fuel to End Use

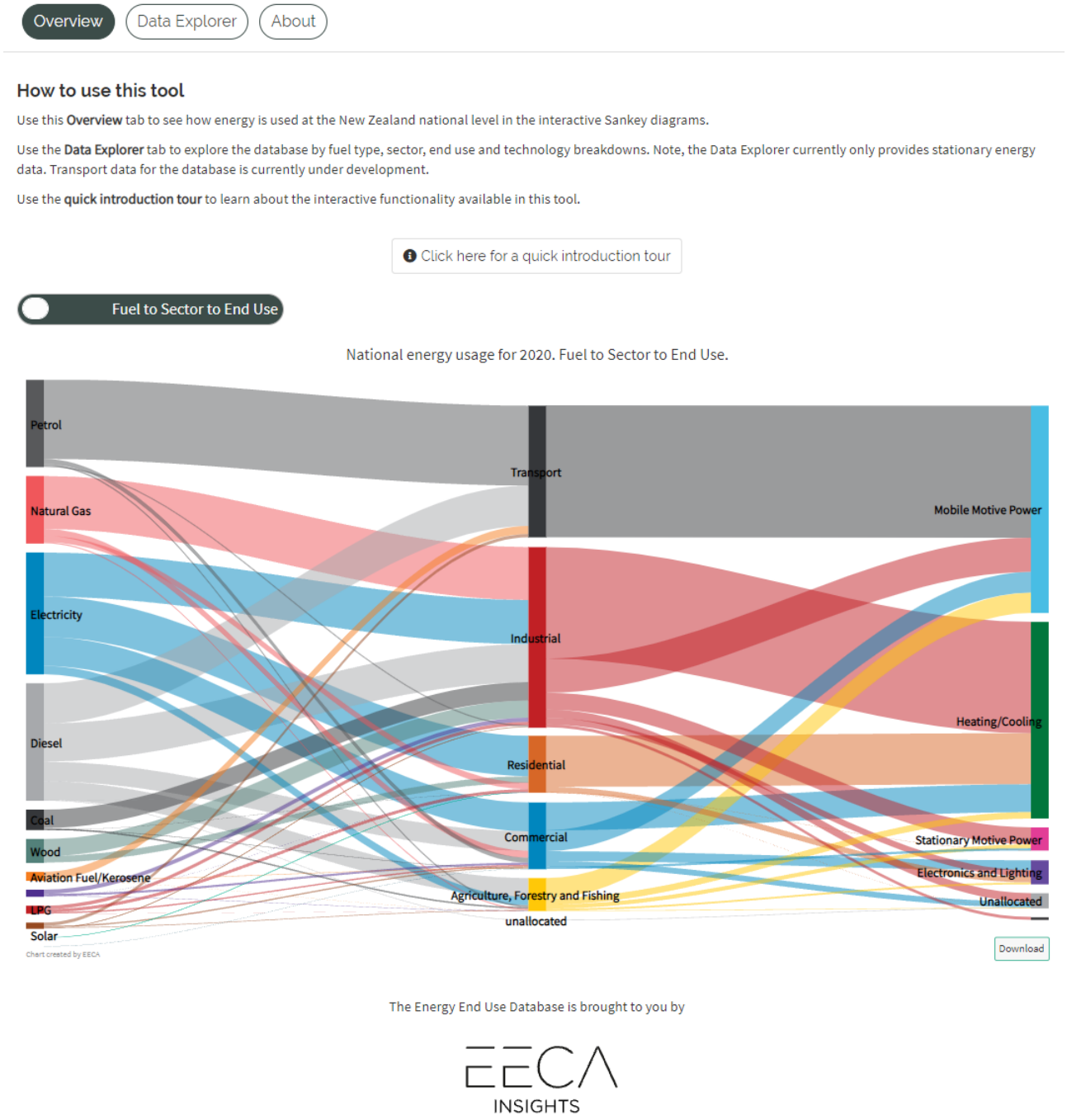


Figure 11: A Sankey showing national energy usage for 2020 from fuel to sector to end use.

12.2 Data Explorer

The Data Explorer page visualises the data in three different ways.

Users can select sectors of interest to explore in the sector buttons at the top, between All Sectors, Residential, Industrial, Commercial and Agriculture, Foresty and Fishing. The year can also be selected from 2017-2020. The left and right nodes can be changed to either: fuel, fuel group, technology, technology group, end use, end use group, sector and sector group.

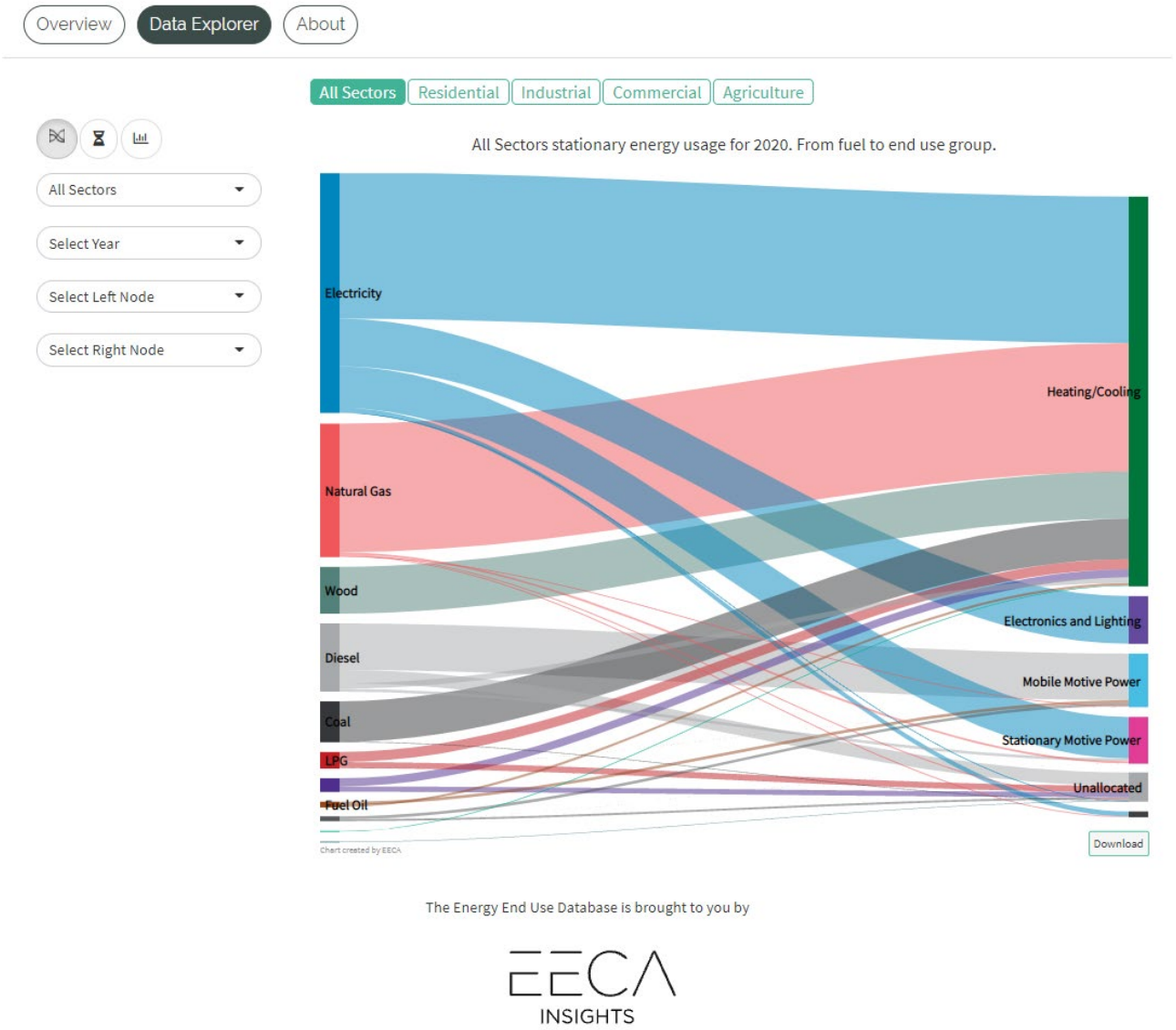


Figure 12.: A Sankey showing all sector stationary energy usage for 2020, from fuel to end use group.

This stacked bar chart shows comparisons between years. It also has selectable sectors, and can be stacked by either fuel, fuel group, technology, technology group, end use, end use group, sector and sector group.

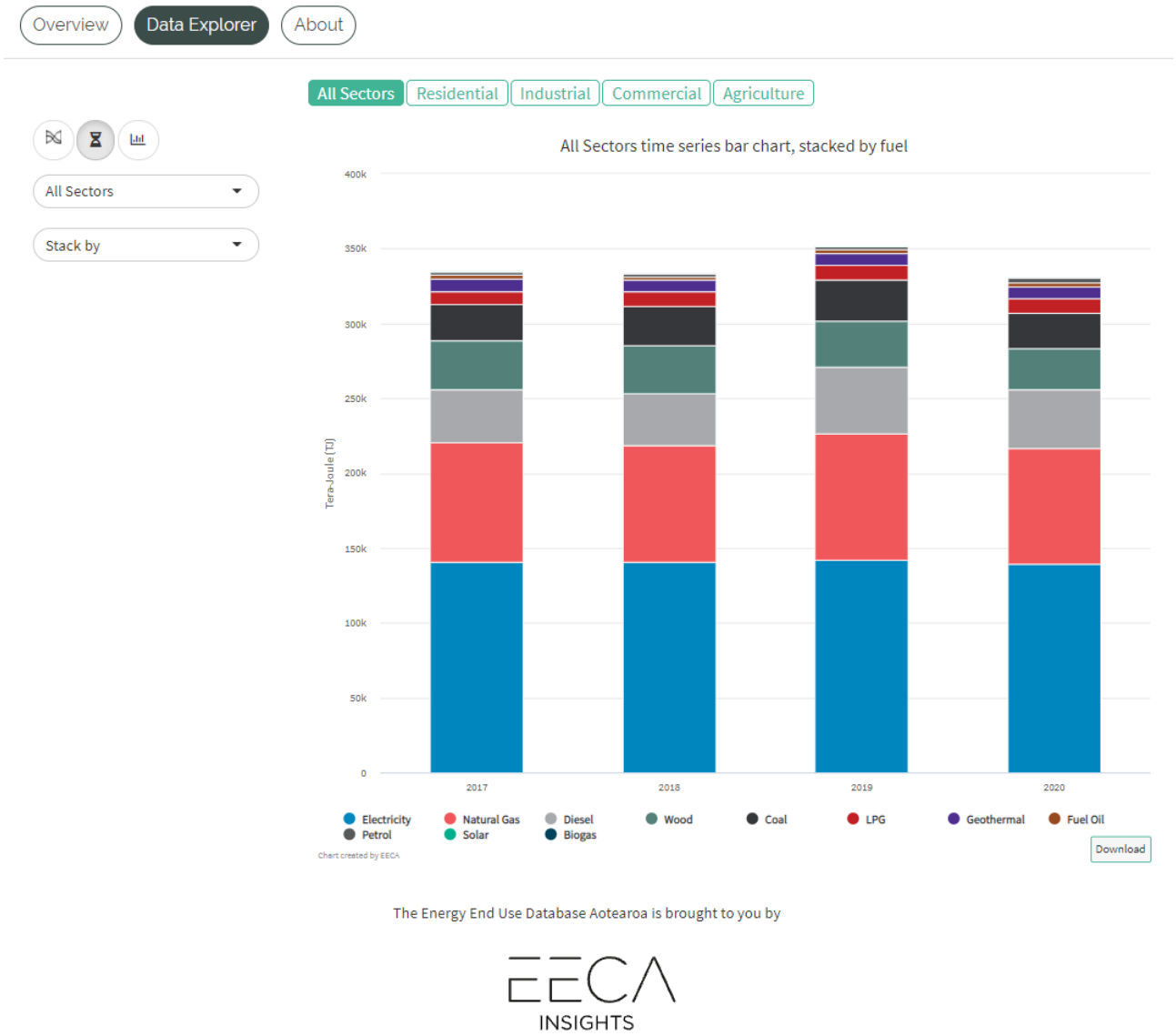


Figure 13: A bar chart showing the energy, per terajoule, consumed for all sectors, for the years 2017-2020, stacked by fuel.

The last stacked bar graphalso has selectable sectors, and has selectable years between 2017-2020. It can be stacked by either fuel, fuel group, technology, technology group, end use, end use group, sector and sector group. The X-Axis can also be either fuel, fuel group, technology, technology group, end use, end use group, sector and sector group.

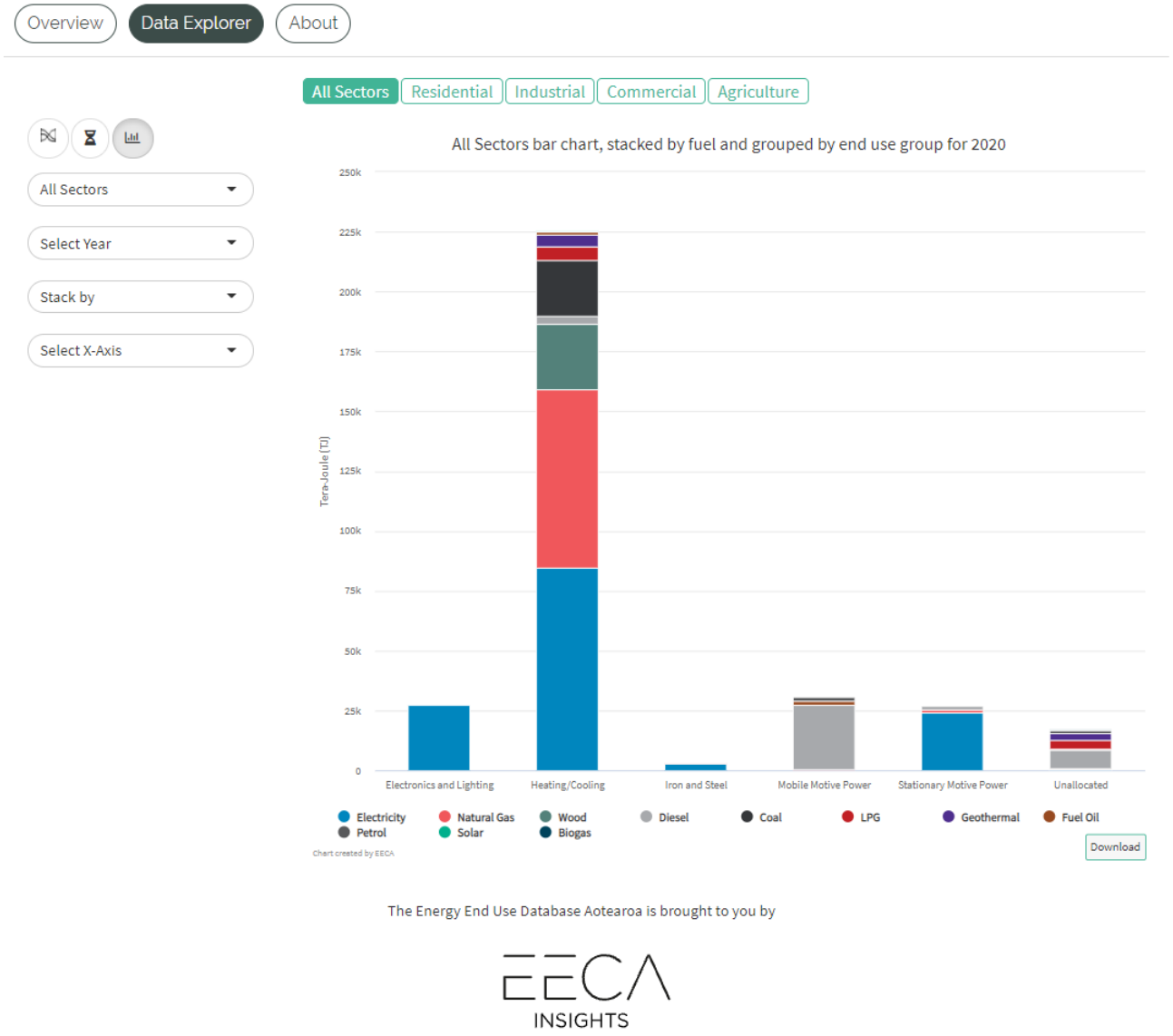


Figure 14: A bar chart showing the energy, per terajoule, consumed for all sectors, for the years 2020, stacked by fuel and grouped by end use group.