

Primary Metal and Metal Product Manufacturing



FACT SHEET

What is process heat?

The Primary Metal and Metal Product Manufacturing sector uses process heat from a variety of fuels during smelting, conversion and metal-forming processes. Fuel plays a dual role during smelting: as a heating agent to maintain the high process temperatures necessary and as a reducing agent to convert metal oxides to metals. Fuels also manage temperatures of molten metals and heat solid metals for forming.

In 2016, total fuel consumption in the sector, including IPPU (see following page for definition) coal consumed at the steel mill was 44.3 PJ or **19%** of total energy consumed for process heat. Emissions from the sector make up **26%** of total process heat emissions.¹



What does the metals manufacturing sector produce?

New Zealand's Primary Metal and Metal Product Manufacturing sector is dominated by two operations:²

- The New Zealand Aluminium Smelter (NZAS). In 2017 the smelter produced 337,000 tonnes of aluminium metal products at its Tiwai Point facility near Bluff. The plant extracts aluminium from imported alumina (purified aluminium oxide).
- The New Zealand Steel (NZS) plant at Glenbrook. The plant uses a unique iron-smelting process to convert black iron sand from New Zealand's West Coast beaches into a variety of steel products. NZS's total output in 2017 was over 600,000 tonnes of steel products, including products from NZS's Pacific Steel rod and wire forming plant in Auckland.

There are a number of smaller companies engaged in activities such as galvanising, surface coating, can manufacturing and metal forming. The aggregate fuel consumption of these companies is very small compared with the two smelting plants above.

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Greenhouse gas emissions: from Energy and Industrial Processes.

Not all greenhouse gas (GHG) emissions emanating from carbon-based materials such as coal or natural gas are related to energy use. CO₂ is also produced as a result of chemical reactions.

According to the reporting guidelines of the Intergovernmental Panel on Climate Change such emissions fall under either “Energy” or “Industrial Processes and Product Use” (IPPU) classifications:

- **Energy:** emissions from fuels burnt to produce useful energy, including electricity generation. In this factsheet we report on the energy used to generate process heat, which is defined as energy primarily used for warming spaces and industrial processes. All electricity consumed in the Primary Metal and Metal Product Manufacturing sector falls within this classification.
- **IPPU:** emissions from industrial processes which chemically or physically transform materials. Coal is used in the steel making process as a reductant to chemically transform iron oxide ores into iron. A by-product of this process is carbon dioxide which is classified as an IPPU emission. In the manufacture of aluminium, carbon anodes are consumed during the electrolysis process producing carbon dioxide. These emissions also fall under the IPPU classification³.

How is the fuel used?

Aluminium manufacturing

- The NZAS plant’s core process is the electrolytic reduction of the alumina feedstock to produce aluminium metal. This smelting process requires very large quantities of electricity: it is estimated the plant consumes in the order of 18 PJ of electricity annually⁴, the very large majority for the electrolysis process and the remainder for non-heating uses.
- Carbon anodes are manufactured on-site in furnaces fired by heavy fuel oil. IPPU emissions from the consumption of the anodes were 540,000 tonnes of carbon dioxide in 2016⁵.

Steel making

- **Coal** for producing iron: iron metal is extracted from the West Coast iron-sand ore using Waikato and imported coal as a reductant. This takes place in a rotary kiln followed by treatment in electric-powered melters to complete the iron smelting process. This process consumes about 800,000 tonnes of coal per year⁶, the emissions from which fall in the IPPU classification⁷.
- **Electricity:** off-gases from the rotary kiln are burnt in cogeneration plants which generate about **70%** of the NZS plant’s electricity requirements. The plant consumes up to 1,100 GWh of electricity per year⁸, most of which is used in the iron melters and the steel-making furnace. The remainder is used for non-heating purposes.
- **Natural Gas:** Gas is used for heating ladles carrying molten iron and steel and heating steel slabs prior to rolling.



3.13
million tonnes
of carbon dioxide equivalent (CO₂-e)

The approximate volume of the Primary Metal and Metal Product Manufacturing sector’s GHG emissions in 2016.

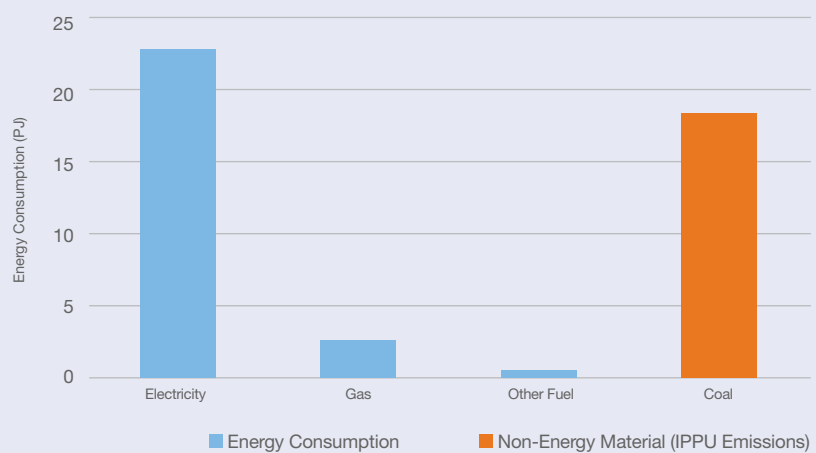
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What is the sector's process heat fuel demand?

The predominance of the smelting processes in the sector is clearly illustrated in Figure 1 by the high consumption of electricity in aluminium production and coal in steel production. The latter is shown separately as a non-energy material, with emissions falling in the IPPU classification.

Total electricity consumption in the sector was 22.9 PJ in 2016, with the aluminium smelter estimated to use about 80% of this energy. 2.4 PJ of natural gas was used in the steel making and forming activities in the North Island during the same period. A smaller quantity of other fuels are used, including heavy fuel oil for anode manufacture.

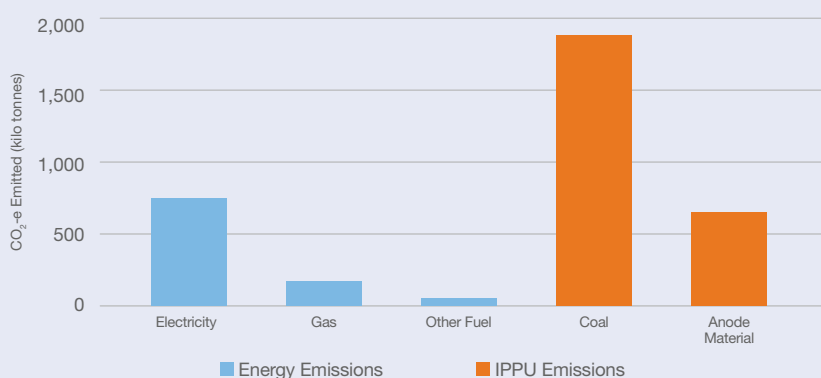
Figure 1. Primary Metal and Metal Product Manufacturing Fuel Consumption, 2016^{9 10}



What are the sector's greenhouse gas emissions?

A similar pattern is shown in Figure 2 for greenhouse gas emissions which also includes carbon dioxide emissions from the anodes at the aluminium smelter¹¹. Total emissions from all sources was 3.13 million tonnes of CO₂-e in 2016.

Figure 2. Primary Metal and Metal Product Manufacturing GHG Emissions, 2016^{12 13}



Emissions from electricity consumption are calculated assuming the national average emission factor for electricity generation. On this basis electricity emissions make up **21%** of emissions from total process heat emissions for the primary metal manufacturing sector. Those coming from non-energy IPPU sources contribute **74%** of total sector emissions.

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Sources

1. EECA 2016 Energy End Use Database (2018);
New Zealand Greenhouse Gas Inventory 1990-2016 Ministry for the Environment (2018);
www.nzsteel.co.nz/sustainability/natural-resources-and-energy/;
Note: Fuel consumption and greenhouse gas emissions for this sector are greater than those expressed in the [Process Heat – Current State Factsheet](#) in this series.
This is because New Zealand Aluminium Smelter and New Zealand Steel Industrial Processes and Product Use (IPPU)-related data are included to provide a richer picture of the sector. The total energy consumption for the sector in 2016 is broken down below:
7.6 PJ (as shown in the [Process Heat – Current State factsheet](#)).
18.2 PJ (electricity used in aluminium manufacturing).
18.5 PJ (IPPU Coal).
Total greenhouse gas emissions for the sector in 2016 are broken down below:
302.8 kt CO₂-e (as shown in the [Process Heat – Current State factsheet](#)).
524.5 kt CO₂-e (electricity used in aluminium manufacturing).
2300.2 kt CO₂-e (IPPU coal/anode material).
2. New Zealand Aluminium Smelter: 2017-18 Sustainability Development Report.
www.nzsteel.co.nz/sustainability/natural-resources-and-energy/
3. New Zealand Greenhouse Gas Inventory 1990-2016 Ministry for the Environment (2018).
4. Derived from New Zealand Aluminium Smelter: 2017-18 Sustainability Development Report.
During this period, the New Zealand Aluminium Smelter “used 572 MW of electricity, equivalent to 704,000 average kiwi households every year”.
5. New Zealand Greenhouse Gas Inventory 1990-2016 Ministry for the Environment (2018).
6. www.nzsteel.co.nz/sustainability/natural-resources-and-energy/
7. New Zealand Greenhouse Gas Inventory 1990-2016 Ministry for the Environment (2018).
The carbon in the coal ultimately is vented to the atmosphere as carbon dioxide after the rotary kiln off-gases are burnt in the cogeneration plants.
8. www.nzsteel.co.nz/sustainability/natural-resources-and-energy/
9. EECA 2016 Energy End Use Database (2018).
www.eeca.govt.nz/resources-and-tools/tools/energy-end-use-database/
10. Non-energy: derived from the New Zealand Greenhouse Gas Inventory 1990-2016 Ministry for the Environment (2018).
11. New Zealand Greenhouse Gas Inventory 1990-2016 Ministry for the Environment (2018).
Emissions from anodes include 48.7 kt CO₂-e IPPU emissions due to perfluorocarbons released during the electrolysis process at the aluminium smelter.
12. EECA 2016 Energy End Use Database (2018).
13. Non-energy: derived from the New Zealand Greenhouse Gas Inventory 1990-2016 Ministry for the Environment (2018).



You can find out more about Process Heat in New Zealand (PHiNZ) on the Ministry of Business, Innovation & Employment (MBIE) website - www.mbie.govt.nz/PHiNZ

For more information on PHiNZ please contact us at energymarkets@mbie.govt.nz