

Process Heat – Overview

FACT SHEET



What is process heat?

Process heat is the energy used as heat mainly by the industrial and commercial sectors for industrial processes, manufacturing, and warming spaces. This is often in the form of steam, hot water or hot gases. Around half of New Zealand's process heat demand is met by burning coal or natural gas.¹



What is the process heat in New Zealand (PHiNZ) initiative?

PHiNZ is a joint initiative of the Ministry of Business, Innovation and Employment (MBIE) and the Energy Efficiency and Conservation Authority (EECA).

PHiNZ aims to work with industry and other stakeholders to improve the energy efficiency of supplying and using process heat, and increase the amount of renewable energy used to supply process heat.

Process heat overview

In 2016, the energy sector accounted for **39.8%**, or 31.3 million tonnes, of New Zealand's gross greenhouse gas (GHG) emissions.² Of this, supplying process heat accounted for around 8.3 million tonnes of carbon dioxide (CO₂) equivalent.³ As a result, process heat made up **28%** of all energy-related GHG emissions and is the second largest source of energy-related emissions behind transport.⁴

The process heat energy demand was 199 petajoules or around **35%** of total energy used in New Zealand in 2016. Around half of the process heat demand was met by burning coal or natural gas, the remaining demand was largely met by electricity, bioenergy⁵, using geothermal energy directly, and liquid fossil fuels (e.g. diesel).⁶

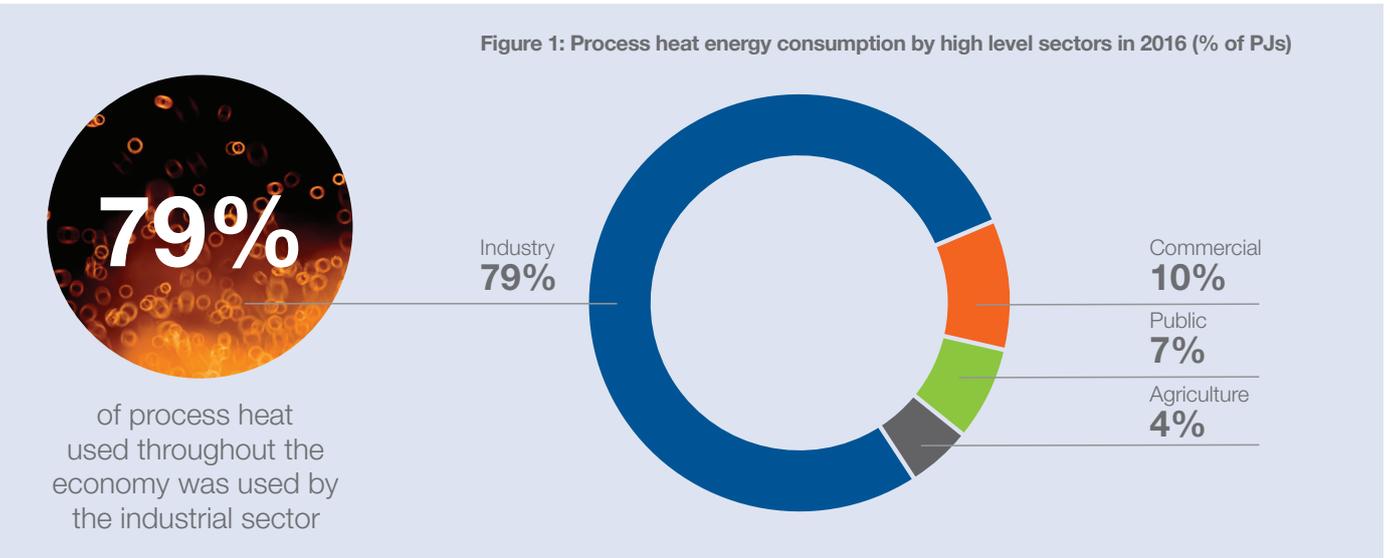
Key facts⁷

- Process heat accounted for **35%** of New Zealand's energy consumption.
- Around **55%** of process heat demand was supplied by burning fossil fuels, mainly coal or natural gas.
- Around **68%** of process heat was made using boiler systems.

Process heat was used throughout the economy⁸

- **79%** by the **industrial** sector – including sawmills, pulp and paper mills, and food processing plants (including dairy).
- **10%** by the **commercial** sector – mainly in shops and office buildings.
- **7%** by the **public** sector – schools, hospitals, prisons and public administration buildings.
- **4%** by the **agricultural** sector – mainly for indoor cropping (i.e. glass houses).

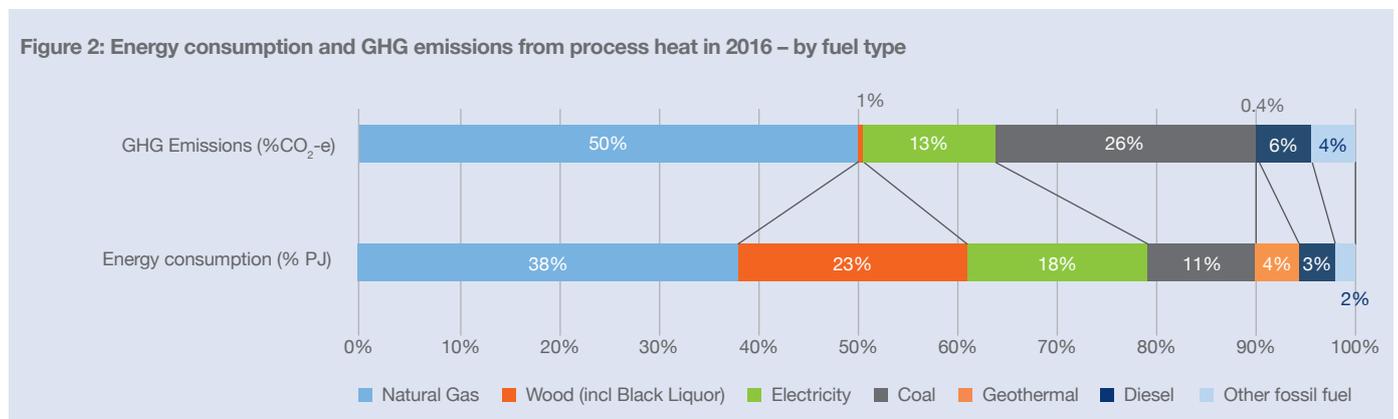
Figure 1: Process heat energy consumption by high level sectors in 2016 (% of PJs)



Process heat – what fuels were used and what were the resulting emissions?⁹

- Natural gas accounted for the largest proportion of fuel consumption at **38%**, and the largest levels of GHG emissions at **50%**.
- Coal accounted for **11%** of fuel consumption, and **26%** of GHG emissions. This ratio is due to coal holding the highest carbon content of any fossil fuel – and being more emissions intensive per unit of industrial output than any other source.
- Wood-derived fuels (including black liquor) accounted for **23%** of fuel consumption. Their collective GHG emissions were **1%**.

Figure 2: Energy consumption and GHG emissions from process heat in 2016 – by fuel type



Note 1: Percentages may not sum to 100% due to rounding.
 Note 2: The 'Other fossil fuels' group is made up of LPG, fuel oil, and petrol.
 Note 3: Energy-related GHG emissions are allocated in proportion to consumption based on MBIE's GHG emission factors.

Location and availability affect the choice of fuel type

Currently neither geothermal nor natural gas are available in the South Island. As a result, coal is used in the South Island for many operations of equivalent scale that are fuelled by geothermal or natural gas in the North Island.

Almost all bioenergy (wood and black liquor) is used in the wood, pulp and paper manufacturing sector, where residues from processing operations are used as fuel.

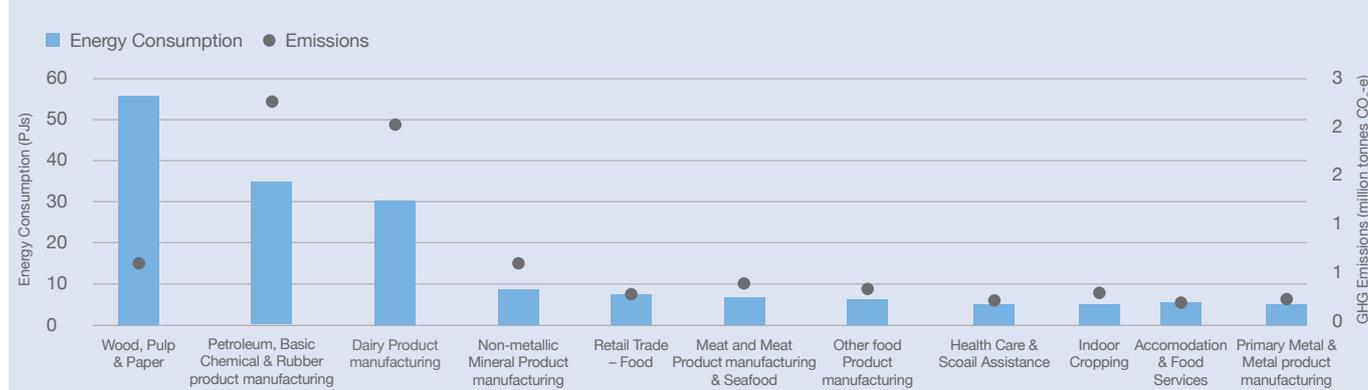
Other factors affecting the choice of energy source include:

- The temperatures required for the process – some fuels are not capable of supplying the high temperatures required by industrial processes
- The relative cost of different fuels
- The requirement to store on-site. Wood and coal, for example, need to be stored on-site while natural gas is supplied to the site as required.

Process heat use is concentrated in industry

- The sector that used the most energy was **wood, pulp and paper manufacturing**. However, this sector had relatively low GHG emissions due to mainly using low-emission fuels such as bioenergy (wood and black liquor). The sector still used fossil fuels for co-firing boilers, supplementary heating of pulp flash dryers, and heating up drying kilns.
- Two sectors that had high energy use and high emissions were:
 - **Petroleum, basic chemicals and rubber product manufacturing**
 - **Dairy manufacturing**
- The **petroleum, basic chemicals and rubber product manufacturing** sector was the largest user of natural gas. This and the **primary metal and metal products** sectors had a small number of large sites, with the use of heat tending to be tightly integrated to the process.
- The **dairy manufacturing** sector accounted for around **68%** of energy use in food manufacturing.¹⁰ It was the largest user of coal for process heat, which is a high-emitting fuel source.

Figure 3: Energy consumption and emissions from process heat in 2016 – Largest consuming¹¹



Note: the sectors shown accounted for 88% of all process heat energy consumption. 24 further sectors accounted for the remaining 12% which amounted to total consumption of around 25 PJ in 2016.

Processes can have significantly different scale and temperature requirements

The specific requirements and nature of the processes determines how the heat can be supplied and used.

Temperature requirements can be classified as low, medium or high:

Category	Temperature requirements	Uses	Examples
Low	Less than 100°C	Water heating Space heating	Sanitisation of equipment in the food processing sector
Medium	Between 100 and 300°C	Industrial processes	Drying wood products Drying food products, such as milk powder
High	Greater than 300°C	Industrial processes	Oil refining Melting metals Chemical manufacturing

These differ both within and across sectors:

- The majority of processes in food manufacturing use hot water and relatively low temperature steam. The highest temperature required for food processing is around 200°C for drying milk powder.
- A small-scale food processor needing only hot water (less than 100°C) may have a peak heating load of less than 0.1 MW. In contrast, steel making requires temperatures in excess of 1000°C, with a heating load consistently above 100 MW.

About 68% of process heat is generated in boiler systems

Most of process heat is generated in boilers (68%), which are used in all sectors of the economy. Despite their economic life span of 15 to 20 years, boilers are often in use for much longer periods of time (between 20 and 40 years).

For certain industrial applications where high temperatures are required, direct heating in ovens, furnaces and kilns are used.

Some sites (notably in the dairy manufacturing and wood, pulp and paper manufacturing sectors) use heat from cogeneration or combined heat and power (CHP) facilities. This is where electricity and heat are produced simultaneously.



15-20 years

the economic lifespan of boilers used in all sectors of the economy

Sources

- ¹ EECA Energy Use Database (EEUD) 2016 data (released in 2018) (<https://www.eeca.govt.nz/resources-and-tools/tools/energy-end-use-database/>).
- ² Ministry for the Environment (2018), New Zealand's Greenhouse Gas Inventory 1990–2016.
- ³ The 8.5 million tonnes does not include industrial processes and product use (IPPU) emissions, which were 4.853 million tonnes in 2016 (Ministry for the Environment (2018), New Zealand's Greenhouse Gas Inventory 1990-2016).
- ⁴ EECA EEUD 2016 data (2018).
- ⁵ Bioenergy refers to woody biomass and black liquor which is from processing wood.
- ⁶ EECA EEUD 2016 data (2018).
- ⁷ EECA EEUD 2016 data (2018).
- ⁸ (including Figure 1): EECA EEUD 2016 data (2018).
- ⁹ (including Figure 2): EECA EEUD 2016 data (2018).
- ¹⁰ 'Food manufacturing' covers three sectors: dairy product manufacturing; meat and meat product manufacturing and seafood; and other food product manufacturing.
- ¹¹ (including Figure 3): EECA EEUD 2016 data (2018).



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

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