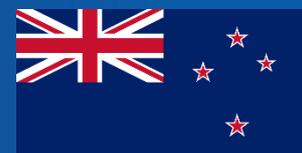


Country Reports

IEA Bioenergy: 10 2021



This report was prepared from the 2021 IEA World Energy Balances and Renewables Information, combined with data and information provided by the IEA Bioenergy Executive Committee and Task members¹. Reference is also made to FAOstat as well as data from national statistics. All individual country reports were reviewed by the national delegates to the IEA Bioenergy Executive Committee, who have approved the content. General background on the approach and definitions can be found in the central introductory report for all country reports.

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Contributions: Paul Bennett, Scion

HIGHLIGHTS

- Renewables make up 40% of *total energy supply* in New Zealand in 2019. The renewable energy share in *final energy consumption* is 31%², of which a quarter comes from biomass.
- Hydropower is dominant in electricity production, followed by geothermal power. The role of biomass-based electricity is marginal. Most bioenergy is used for heating purposes, particularly in industries.
- New Zealand has a high use of transport fuels per capita, which is still increasing. Particularly diesel consumption is going up, while gasoline is rather stable. The share of biofuels is currently at very low levels (0.1% of transport fuels) but is expected to increase in the coming years.
- New Zealand is a country with low population density and a relatively high forest area. The use of biomass/bioenergy is modest in relation to its domestic potential. Substantial progress is still possible to deploy bioenergy from solid biomass.
- Liquid biofuels and energy from MSW are underdeveloped at this stage and provide high deployment opportunities.
- The Climate Change Response (Zero Carbon) Amendment Act 2019 provides a framework by which New Zealand can develop and implement clear and stable climate change policies that 1)

¹ While data for 2020 are starting to become available at national level, it was decided to consider trends up to 2019 for good comparability and benchmarking between the different IEA Bioenergy member countries. Care should also be taken when using 2020 data for analysing trends as these data are distorted by the COVID19 Pandemic.

² More than half of renewable energy supply is from geothermal energy. Mind that geothermal power implies a large share of unused heat which is counted in total energy supply – the actual share of geothermal energy in final energy consumption is around 6%.

contribute to the global effort under the Paris Agreement to limit the global average temperature increase to 1.5° Celsius above pre-industrial levels and, 2) allow New Zealand to prepare for, and adapt to, the effects of climate change.

- In June 2021, The Climate Change Commission of New Zealand has issued its first advice to the Government. This includes recommendations for the first three carbon budgets, which work out to an average annual reduction, from a 2019 baseline, of 7% between 2022-2025, 20% between 2026-2030, and 35% between 2031-2035.
- During 2021, the Government has published three consultation documents on 1) Phasing out fossil fuels in process heat, 2) Transport Emissions: Pathways to Net Zero by 2050, and 3) Increasing the use of biofuels in transport: consultation paper on the Sustainable Biofuels Mandate

COUNTRY PROFILE

Population and land use

New Zealand is an island country in the southwestern Pacific Ocean. It has a total land area of 263 thousand km² and a population of 4.8 million people, which represents a very low population density of 18 persons per km².

New Zealand's climate is predominantly temperate maritime. 40% of the land area is agricultural land, dominated by permanent grasslands. 37% of the land area is forest land (of which one third is protected).

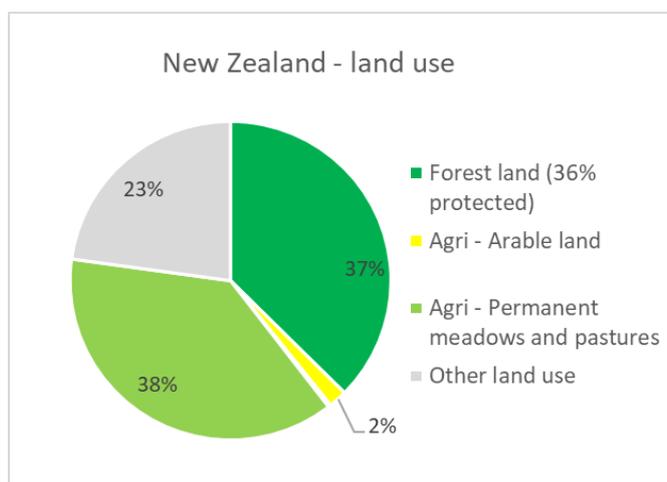


Figure 1: Land use in New Zealand (2018 figures - Source: FAOstat)

Final energy consumption

Overall final energy consumption in New Zealand (also including non-energy use of oil, natural gas, and coal in industry) equates 3.1 tonnes of oil equivalent (toe) per capita, which is somewhat above the average of IEA Bioenergy member countries. Energy use in industry and transport tends to be higher than in most other countries, while energy consumption in the residential sector and services is lower.

Table 1: Distribution of the final consumption of energy carriers by sector in New Zealand (2019 figures - Source: IEA (2021) World Energy Balances and Renewables Information)

Final consumption energy carriers	Toe/capita (2019)	% of total	Median* (toe/capita)
Industry (energy use)	0.95	30%	0.67
Industry (non-energy use)	0.33	10%	0.21
Transport	1.13	36%	0.69
Residential	0.32	10%	0.57
Commercial & public services	0.26	8%	0.34
other	0.14	5%	
Total	3.14		2.34

* Median of the 25 member countries of IEA Bioenergy³

NATIONAL POLICY FRAMEWORK IN NEW ZEALAND

TARGETS AND STRATEGIES

The Climate Change Response (Zero Carbon) Amendment Act 2019 provides a framework by which New Zealand can develop and implement clear and stable climate change policies that:

- contribute to the global effort under the Paris Agreement to limit the global average temperature increase to 1.5° Celsius above pre-industrial levels
- allow New Zealand to prepare for, and adapt to, the effects of climate change.

The changes do four key things:

- set a new domestic greenhouse gas emissions reduction target for New Zealand to:
 - reduce net emissions of all greenhouse gases (except biogenic methane) to zero by 2050
 - reduce emissions of biogenic methane to 24–47% below 2017 levels by 2050, including to 10% below 2017 levels by 2030
- establish a system of emissions budgets to act as steppingstones towards the long-term target
- require the Government to develop and implement policies for climate change adaptation and mitigation
- establish a new, independent Climate Change Commission to provide expert advice and monitoring to help keep successive governments on track to meeting long-term goals

³ Comparative figures of the different IEA Bioenergy member countries are discussed in the central Countries' Report.

Table 2: Renewable energy and climate targets in New Zealand.

Sector	Share of renewables in gross final consumption per sector	GHG reduction target
Overall target		Net Zero emissions of all greenhouse gases (except biogenic methane) by 2050
Electricity	Labour party targets: 90% renewable by 2025 100% renewable by 2030	
Transport		DRAFT ⁴ - 3.5% CO ₂ reduction of emissions from transport by biofuels in 2025

A description of renewable energy and climate policies and measures in New Zealand is available at the IEA's Policies and Measures Database:

<https://www.iea.org/policies?qs=new%20ze&country=New%20zealand>

Specific policies related to renewable electricity, renewable heat and transport biofuels will be highlighted in the chapters about the role of bioenergy in different sectors.

THE CONTRIBUTION OF BIOENERGY IN NATIONAL ENERGY SUPPLY

TOTAL ENERGY SUPPLY

The total energy supply (TES) of New Zealand in 2019 amounted to 856 petajoule (PJ) with fossil fuels (oil, coal, gas) contributing around 60%. Oils products represent 33% (279 PJ), natural gas 20% (168 PJ) and coal 7.3% (63 PJ).

Renewable energy sources have a share of 40% or 346 PJ. The contribution of bioenergy (50 PJ) is much lower than hydropower (92 PJ) and particularly geothermal energy (196 PJ). Geothermal energy contributes to 23% of total energy supply, however, geothermal power includes an important share of unused waste heat which is counted in total energy supply; the contribution of geothermal energy in New Zealand's final energy consumption is limited to 6.3%.

⁴ Draft target in the consultation document *Increasing the use of Biofuels: Sustainable Biofuels Mandate in New Zealand*. The reduction is against the emissions that would have occurred if all fuels sold were fossil fuels.

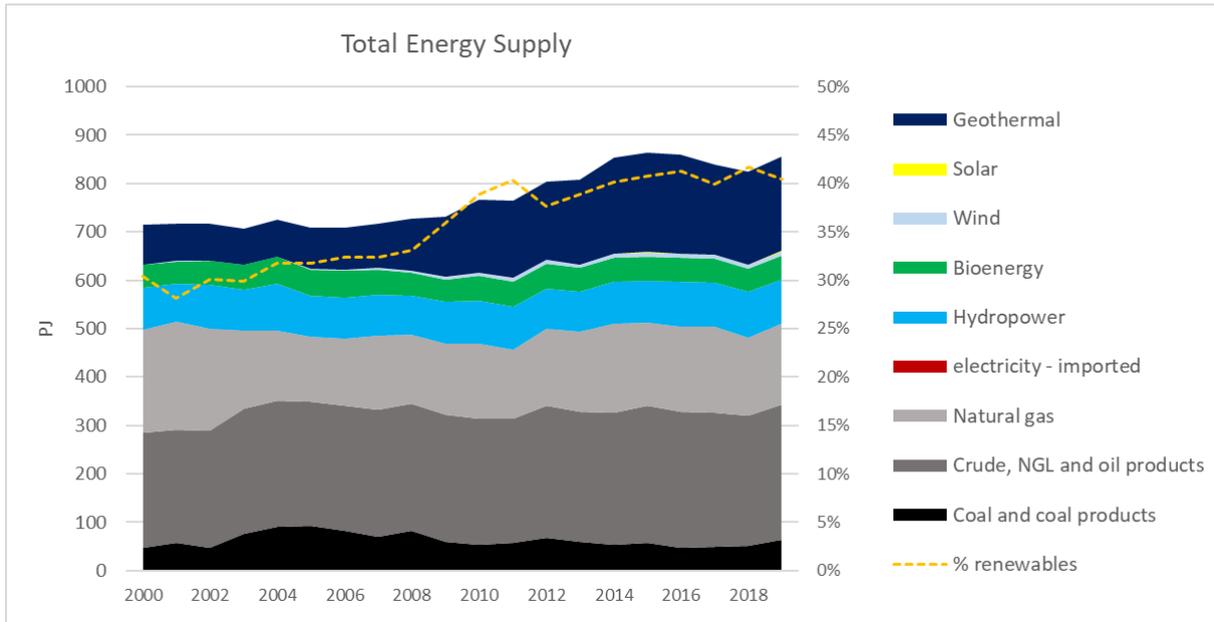
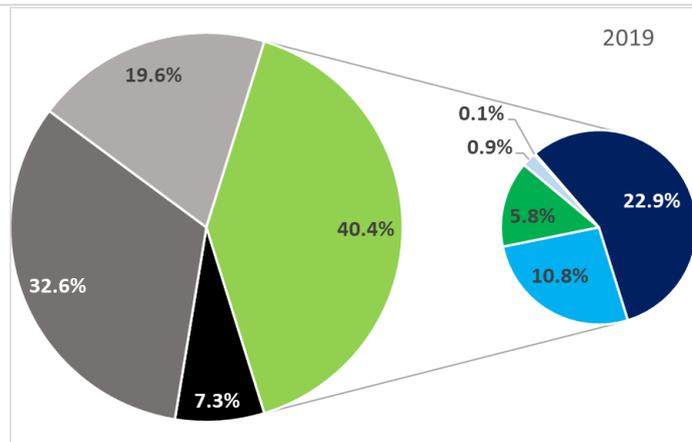


Figure 2: Total energy supply⁵ and the contribution of different energy sources in New Zealand, with distribution in 2019 (Source: IEA (2021) World Energy Balances and Renewables Information)



Overall TES has increased from 730 PJ to 850 PJ from 2009 to 2014 and had more or less stabilized since. There were some limited fluctuations in fossil fuels, but overall, they were rather stable in the past decade with oil products around 270 PJ, natural gas around 170 PJ, and coal around 60 PJ. There was a 6% increase in fossil fuels in 2019 which was largely because of a dry year and lower hydro generation being taken up by fossil fuel use. There was an increase of the share of renewable energy in total energy supply from 32% in 2007 to 40% in 2011 and this has more or less stabilized since. Hydropower and bioenergy were quite stable in the past decades around 90 PJ and 50 PJ respectively. There was an increase of geothermal energy supply between 2007 and 2014 from 90 to 200 PJ, which has stabilized since.

Figure 3 shows the evolution of the different types of bioenergy. As indicated, the overall share of bioenergy was fairly stable around 50 PJ. Solid biomass represents almost 90% of bioenergy supply, with some lower shares of biogas and charcoal (both around 3 PJ).

⁵ Total energy supply refers to the use of resources. In terms of the role in the energy system this distribution overestimates the role of resources producing electricity with a high share of unused waste heat (like geothermal electricity in New Zealand).

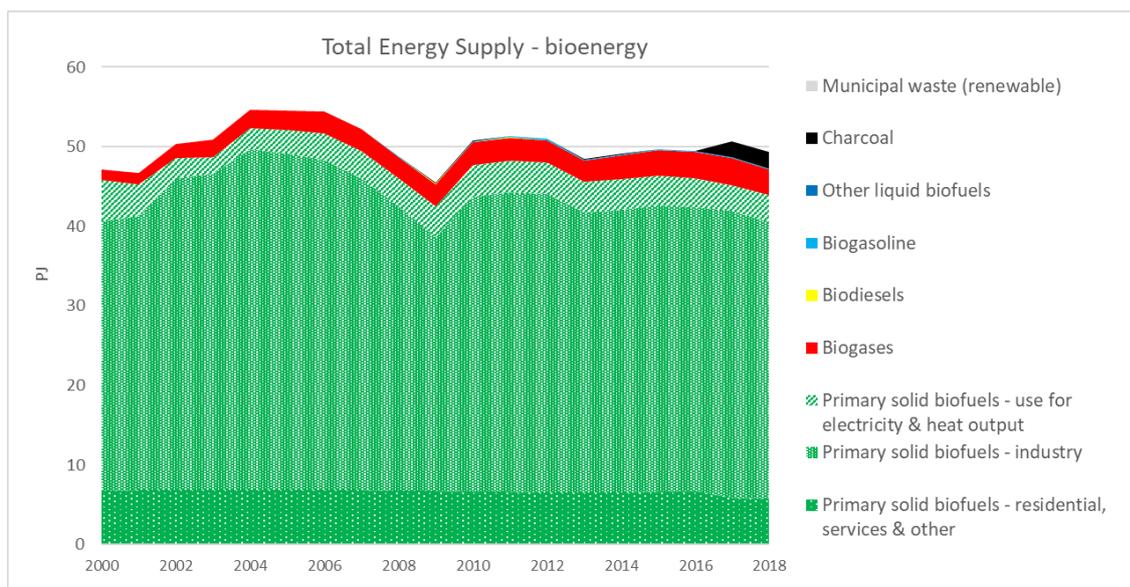


Figure 3: Development of total energy supply from bioenergy in New Zealand 2000 - 2019 (Source: IEA (2021) World Energy Balances and Renewables Information)

Evolution of the bioenergy carriers:

- Solid biofuels are mostly used in wood processing industries at a level of 35 PJ per year. The use of solid biofuels for residential applications is quite modest around 6 PJ. Some solid biomass (3-4 PJ) is also used for power production. Overall, these volumes are quite stable.
- Biogas saw an increase in the 2000s and has stabilized around 3 PJ in the past decade.
- Liquid biofuels are at very low levels at less than 0.5% of bioenergy.

Table 3 displays the 2019 total bioenergy supply values on a per capita basis. Compared to the other 24 member countries of IEA Bioenergy (expressed per capita), New Zealand ranks at the higher end for solid biofuels, in the middle for biogas and very low for liquid biofuels and renewable MSW.

Table 3: Total energy supply per capita in 2019 for different bioenergy carriers

	Supply per capita	Median IEA Bioenergy members
Bioenergy	10.4 GJ/cap	10.6
Solid biofuels	9.1 GJ/cap	7.0
Renewable MSW	0.0 GJ/cap	0.8
Biogas	0.7 GJ/cap	0.7
Liquid biofuels	0.0 GJ/cap	1.5

Source: IEA (2021) World Energy Balances and Renewables Information

Table 4 indicates the amounts of the different bioenergy carriers compared to some relevant reference points, namely the amount of forest in the country (for solid biomass), the amount of generated MSW (for renewable MSW used for energy), the amount of natural gas consumed in the country (for biogas) and the amount of fossil oil products consumed (for liquid biofuels).

Table 4: Comparison of the supply of different bioenergy carriers in 2019 to specific reference points

Compared to reference points			Median*
Bioenergy	5.8 %	of total energy supply	7.2 %
Solid biofuels	6.9 GJ/ha_forest	compared to the domestic hectares of forest land (excl. protected)	21.3 GJ/ha_forest
Renewable MSW	0.00 GJ/ton_MSW	compared to the total generated MSW in the country	1.4 GJ/ton_MSW
Biogas	0.020 GJ/GJ_NG	compared to natural gas supply	0.023 GJ/GJ_NG
Liquid biofuels	0.001 GJ/GJ_oil	compared to oil products supply	0.028 GJ/GJ_oil

Source: energy data from IEA (2021) *World Energy Balances and Renewables Information*; forest figures from FAOStat; waste figures from World Bank

* Median of the 25 member countries of IEA Bioenergy⁶

Specific comments in relation to the reference points:

- While the use of solid biomass for energy per capita is higher than most other IEA Bioenergy member countries, its use is quite low compared to the amount of forest land in New Zealand (less than 0.4 ton dry mass of wood per hectare⁷). Given the low current use, there might be considerable technical potential available.
- Liquid biofuels and energy production from (the renewable share of) MSW are very low, however further policy clarity on the long-term use on MSW is required.

⁶ Comparative figures of the different IEA Bioenergy member countries are discussed in the central Countries' Report.

⁷ Counted with a typical calorific value of wood (dry mass) of 19 GJ/ton_{dry mass}

ROLE OF BIOENERGY IN DIFFERENT SECTORS

OVERVIEW

The overall 2019 share of renewables in **final energy consumption** among electricity, transportation and heat sectors is 31%, with bioenergy making up 8% of the energy share (Table 5). Note that these figures are lower than the shares in total energy supply (where unused waste heat, e.g., in fossil power or geothermal power production, is also included).

Table 5: Role of bioenergy and renewable energy in electricity, transport energy and fuel/heat consumption in 2019

Sector	Share of bioenergy	Share of renewable energy	Overall consumption
Electricity ⁸	1.4%	81.8% (57.1% hydro)	45 TWh (161 PJ)
Transport energy (final consumption)	0.1%	0.3%	226 PJ
Overall fuel and heat consumption ⁹	21.8%	26.0%	198 PJ
TOTAL FINAL ENERGY CONSUMPTION	7.8%	31.4%	3402 PJ

Source: IEA (2021) World Energy Balances and Renewables Information

The following paragraphs will consider the evolutions in the different sectors.

ELECTRICITY

The power production in New Zealand is already largely renewable, with a dominating role of hydropower at a level of around 60% (26 TWh) and geothermal power at 18% (8 TWh) in 2019. The share of fossil fuels is around 18%, mostly natural gas (6 TWh) and some coal power (2 TWh). Wind produces 5% of power and biomass 1.5%.

⁸ Renewable electricity production compared to final consumption. Potential renewable shares of imported electricity are not included.

⁹ This includes final consumption of fuels and heat in industry, the residential sector, commercial and public services and agriculture/forestry. Transport fuels are excluded. Energy used for transformation and for own use of energy producing industries is also excluded.

Electric heating (direct or through heat pumps) is not included in these figures as this is not separately reported.

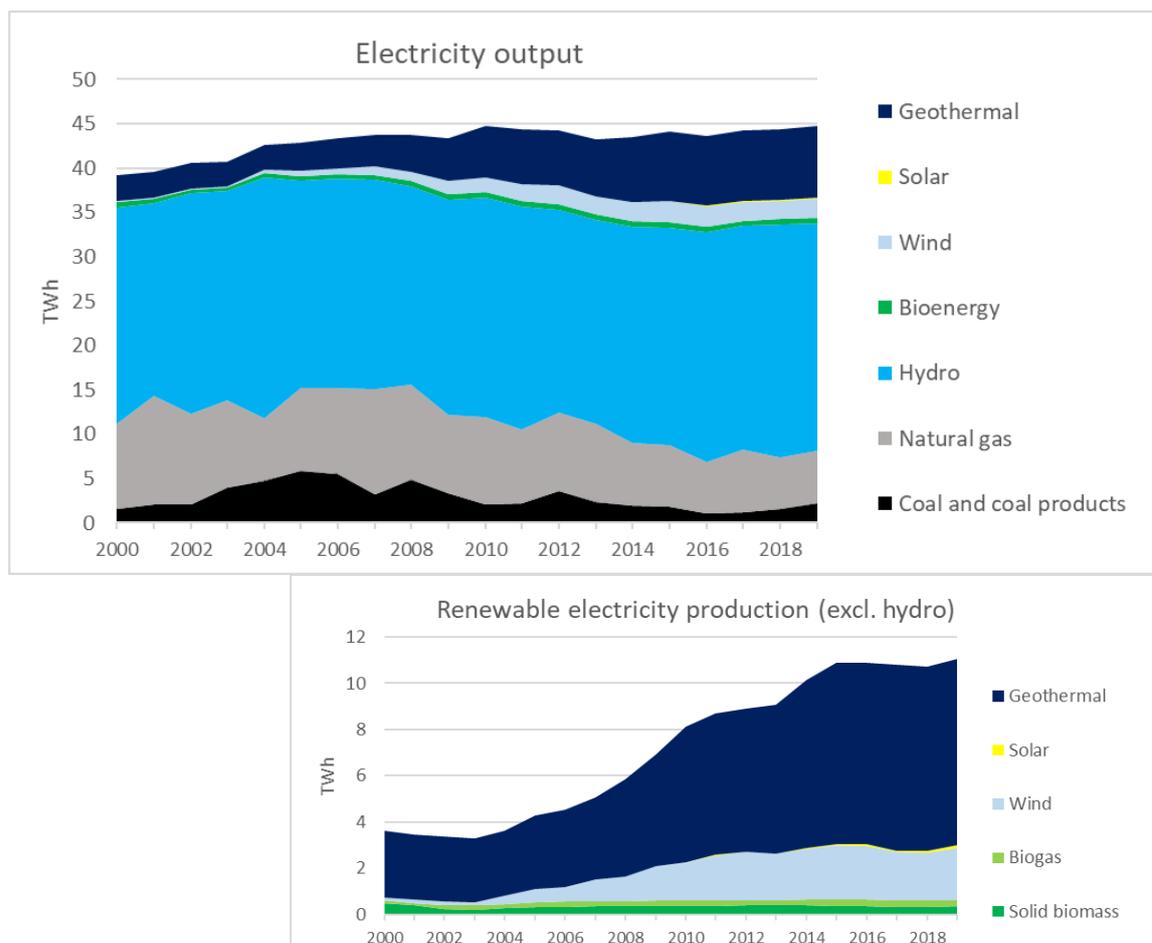


Figure 4: Evolution of the electricity mix in New Zealand 2000 - 2019 (Source: IEA (2021) World Energy Balances and Renewables Information)

The level of hydropower has been quite stable in the past decades, while geothermal power increased from 3 PJ in the early 2000s up to 8 TWh recently, with the main growth between 2007 and 2015. Wind has increased up to 2 TWh in the 2000s but has stabilized since 2011. Bioenergy has been very stable around 0.5 TWh in the past decades. There is a small fraction of solar power representing 0.3% of power production.

Policy framework

There has been no specific legislation to accelerate bioenergy for power production. The New Zealand Battery Project has been set up to address the lack of dry year storage in the electricity system, and it is considering the challenges of moving to an increasingly renewable electricity system, while maintaining affordability and security of supply. The Battery Project will consider a range of possible solutions, including bioenergy.

HEAT/FUEL

Figure 5 shows the role of different fuels/energy carriers for providing heat in different sectors (industry, residential sector, commercial and public services and other). Fuel use by energy producing industries for transformation and for own use is excluded. Mind that electric heating (direct or through heat pumps) is not included in these figures as this is not separately reported in the IEA database.

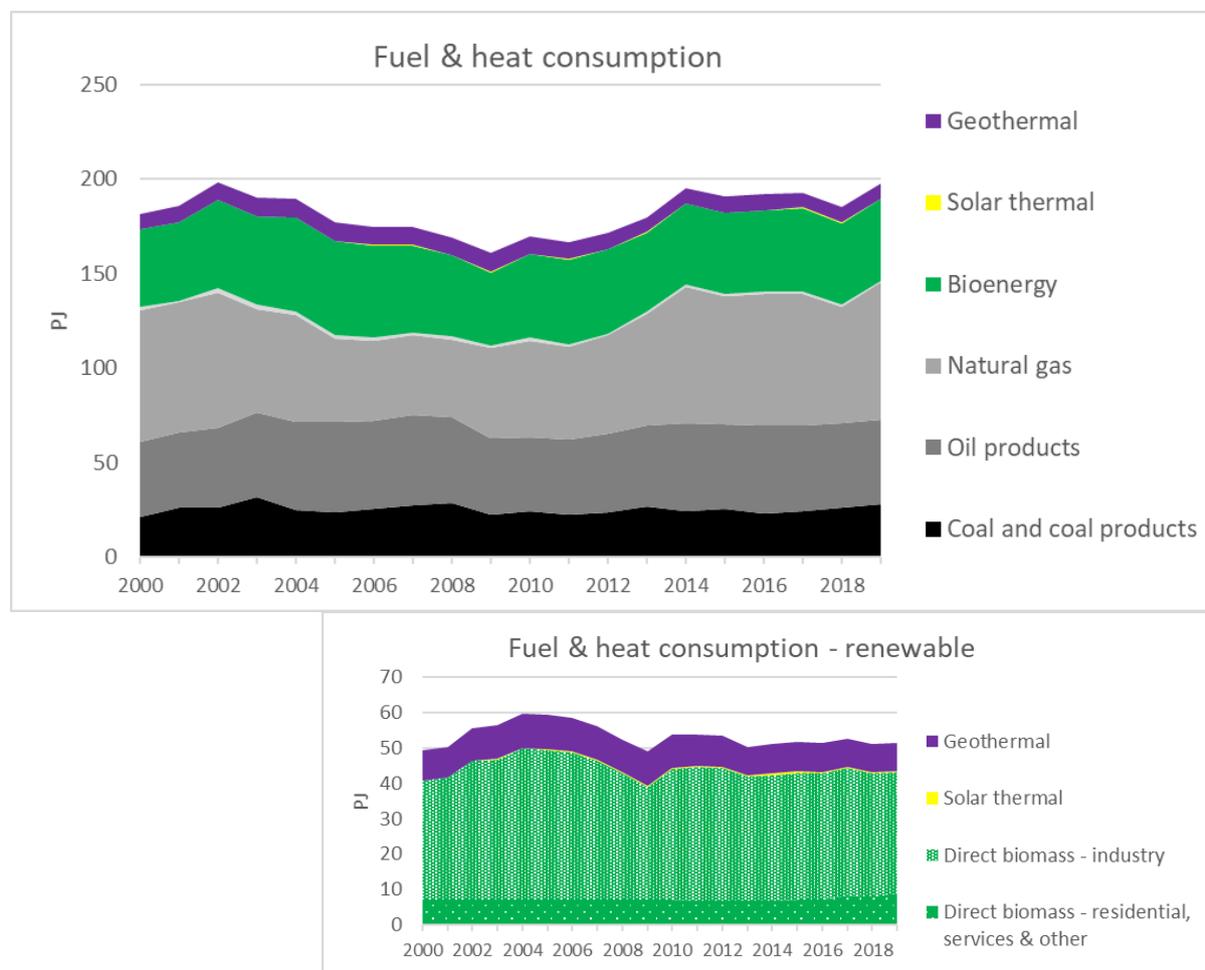


Figure 5: Evolution of fuel and heat consumption in New Zealand 2000 - 2019 (Source: IEA (2021) World Energy Balances and Renewables Information)

The overall consumption of fuel/heat fluctuated between 170 and 200 PJ in the past decades. The provision of heat is still dominated by fossil fuels (73%) in 2019, with natural gas being the main energy source (37%), followed by oil products (23%) and coal power (14%). Bioenergy represents 22% of heat production, which is mostly in industries. 4% of heat is provided by geothermal energy.

There is no reporting of heat sales in New Zealand.

Policy framework

The main relevant policy instruments behind the evolutions of renewable heat are:

- April 2021 Consultation Document – Phasing out fossil fuels in process heat. The intent is:
 - No new coal-fired boilers for low and medium temperature heat
 - Phasing out coal in existing sites by 2037 for low and medium temperature heat process heat requirements
 - Require all other sites to have a emissions reductions plan for uptake of best practices and transition from fossil fuels

In addition to the price signal set by the NZ ETS, there is work already underway to reduce industrial emissions from low to medium temperature process heat, including:

- a range of Energy Efficiency and Conservation Authority (EECA) programmes for businesses, which received increased funding in Budget 2021
- implementing the Government Investment in Decarbonising Industry (GIDI) fund
- developing National Direction on Industrial Greenhouse Gas Emissions under the RMA

The Government is developing an Industry Transformation Plan for the Forestry and Wood Processing sector. Key objectives of the plan are to increase value-add wood processing and support the production of low emissions wood products and bioenergy. The plan will make recommendations on ways to improve certainty of supply of wood biomass, the role of government in managing and accelerating the development of the bioenergy market in New Zealand and attract investment in primary processing and the production of biofuels.

TRANSPORT

Figure 6 shows an overview of the energy used in transport in New Zealand, split up by different fuels/energy carriers.

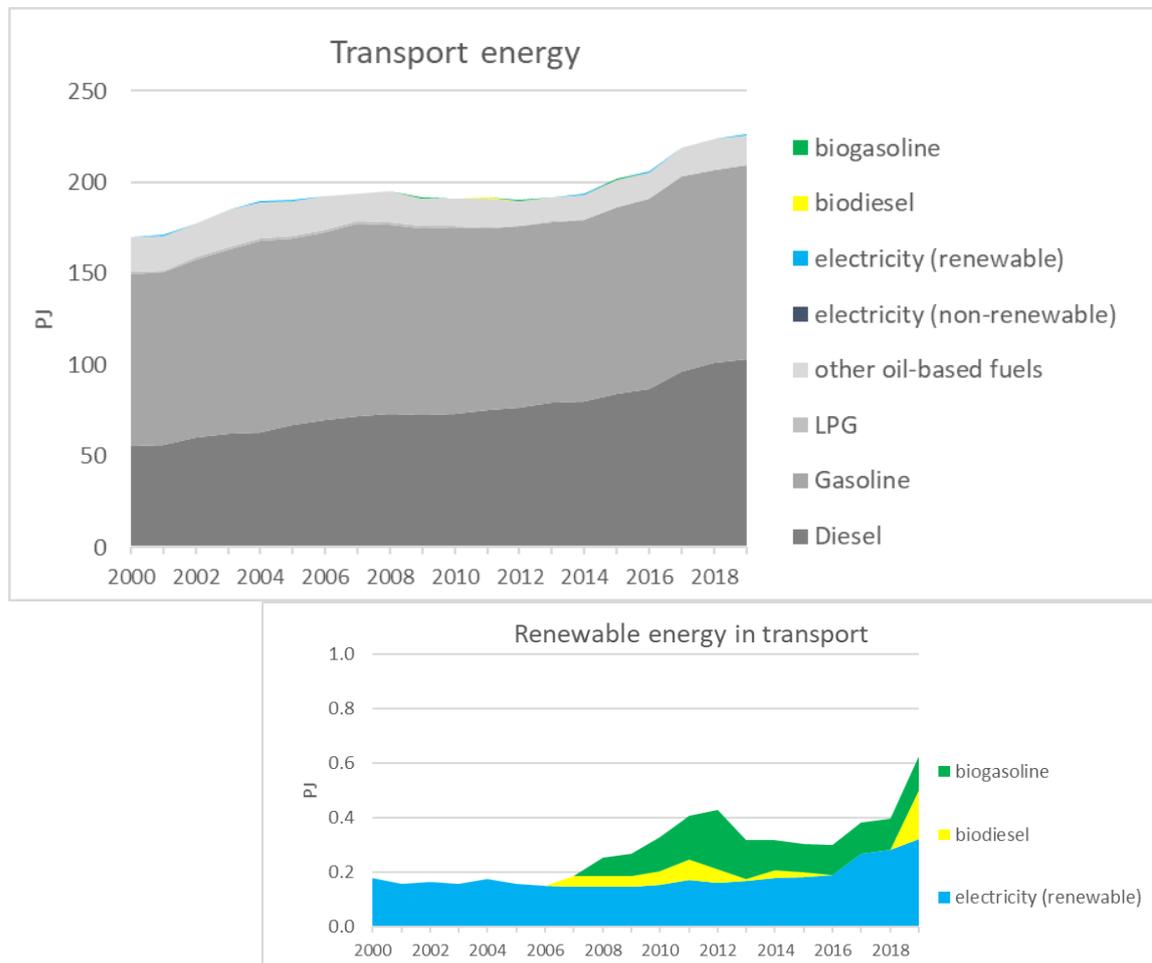


Figure 6: Evolution of transport fuels in New Zealand 2000 - 2019 (Source: IEA (2021) World Energy Balances and Renewables Information)

After a stabilisation between 2004 and 2014, overall transport energy use has been steadily increasing in the past 5 years. Gasoline was the dominant fuel, but the consumption of diesel fuel is increasing and has now reached similar levels as gasoline, both at 46% of transport fuel consumption. Mind also the share of 'other oil-based fuels' at 7% of transport energy which represents aviation fuel for domestic flights.

There has been a very limited uptake of biofuels, with levels around 0.1% of transport fuel consumption.

Electricity in transport is at very low level (0.2% of total transport energy). The use of electricity in road vehicles is still marginal in 2019 (0.06% of total transport energy use) but this level may increase in the coming years.

Policy framework

The main relevant policy instruments behind the evolutions in biofuels are:

- In 2008, the Government introduced a biofuels sales obligation, which would require suppliers of petrol or diesel in New Zealand to also supply a minimum proportion of biofuels. The biofuel proportion was initially 0.5 percent of a liable supplier's petrol and diesel sales, rising to 2.5 percent over four years. However, it was repealed shortly after the General Election in 2008. Between 2009 and 2012, the Government implemented a biodiesel grants scheme.
- Since then, the main policy incentives for biofuels remaining in New Zealand are the New Zealand Emissions Trading Scheme (ETS), the excise tax exemption for bioethanol and some R&D support to research institutions, such as Scion. The ETS zero-rates the biofuel component of transport fuels, but the current carbon price translates to only around 9 cents per litre for diesel, and 7.8 cents for petrol. The petrol excise duty is 70.024 cents per litre, which translates to a tax advantage of 7 cents per litre for 10% bioethanol blend (E10) over petrol.
- National Land Transport Fund also provides an incentive of NZ\$0.69/litre incentive for the bioethanol fraction of gasoline/ethanol blends.
- To help New Zealand move towards net zero emissions by 2050, the New Zealand Government is now proposing to implement a sustainable biofuels mandate, which would require liable fuel suppliers to reduce the emissions of the liquid fossil fuels they supply in New Zealand by a set percentage each year.
- The Government is also investigating the potential for the production in New Zealand of Biocrude, Advanced Liquid Biofuels and Solid Biofuels made from woody biomass as part of the Forestry and Wood Processing Transformation Plan.

RESEARCH FOCUS RELATED TO BIOENERGY

The New Zealand Government provides substantial funding through various funds, including: Catalyst, Endeavour, Envirolink, The Partnership Scheme, Innovative Partnerships, National Science Challenge, PreSeed Accelerator Fund, Commercialisation Partner Network, Strategic Science Investment Fund, RSI: Talent and Science Promotion, Advanced Energy technology Platform, Callaghan Innovation's R&D grants and Sustainable Food and Fibre Futures.

Scion, a New Zealand Crown Research Institute, has a bioenergy research programme funded by the NZ Strategic Science Investment Fund, contestable and commercial funding. Sustainable bioenergy and biofuels produced from forestry, other biomass and industrial side streams will increase New Zealand's energy security, reduce greenhouse gas emissions and advance the development of biorefining and industrial symbiosis.

Scion's bioenergy research programme focusses on:

- Wood-based (lignocellulosic) replacements for transport biofuels and industrial energy, both of which currently use large amounts of non-renewable resources.
- Identifying, adopting, and adapting the best international technologies, ensuring they are cost-effective, risk is managed, a good "fit" to New Zealand, and building the capability for large scale uptake and deployment.

Biofuel research at **University of Canterbury** includes:

- Characterising liquid biofuel feedstock resources including woody biomass; biomass from agriculture sector; biosolid wastes; algae; purpose grown crops
- Development of biomass conversion technologies and feasibility studies; biomass gasification and liquid biofuel synthesis (Fischer-Tropsch); biomass pyrolysis/liquefaction and biooil upgrading; fermentation of cellulose for bioethanol; biorefinery; catalysis technologies for biofuel synthesis and purification
- Biofuel analysis
- Sustainability analysis of the biofuel processing chain
- Strategic analysis of complex energy and environmental systems

RECENT MAJOR BIOENERGY DEVELOPMENTS

There are no confirmed new investments in biofuels production in NZ yet, even though the announcements of the biofuels mandate proposal and the potential closure of NZ's only oil refinery have generated some interest. The upfront capital cost of building a biorefinery remains a major barrier. Some bioenergy projects funded by the GIDI Fund can be found here: [Summaries of approved projects for Government Investment in Decarbonising Industry \(GIDI\) Fund | Gen Less](#)

LINKS TO SOURCES OF INFORMATION

Climate Change Response (Zero Carbon) Amendment Act 2019: <https://environment.govt.nz/acts-and-regulations/acts/climate-change-response-amendment-act-2019/>

Sustainable Biofuels Mandate consultation: <https://www.mbie.govt.nz/have-your-say/increasing-the-use-of-sustainable-biofuels-in-aotearoa-new-zealand>

Industry Transformation Plan for the Forestry and Wood Processing sector:
<https://www.beehive.govt.nz/sites/default/files/2021-04/Future%20of%20Forestry%20Booklet.pdf>

Phasing out fossil fuels in process heat: national direction on industrial greenhouse gas emissions consultation document - <https://environment.govt.nz/publications/phasing-out-fossil-fuels-process-heat-consultation-document/>

Summaries of approved projects for Government Investment in Decarbonising Industry (GIDI) Fund | Gen Less: <https://genless.govt.nz/running-a-business/co-funding-and-support/business-co-funding-and-support-programmes/government-investment-in-decarbonising-industry-gidi-fund/summaries-of-approved-projects/>