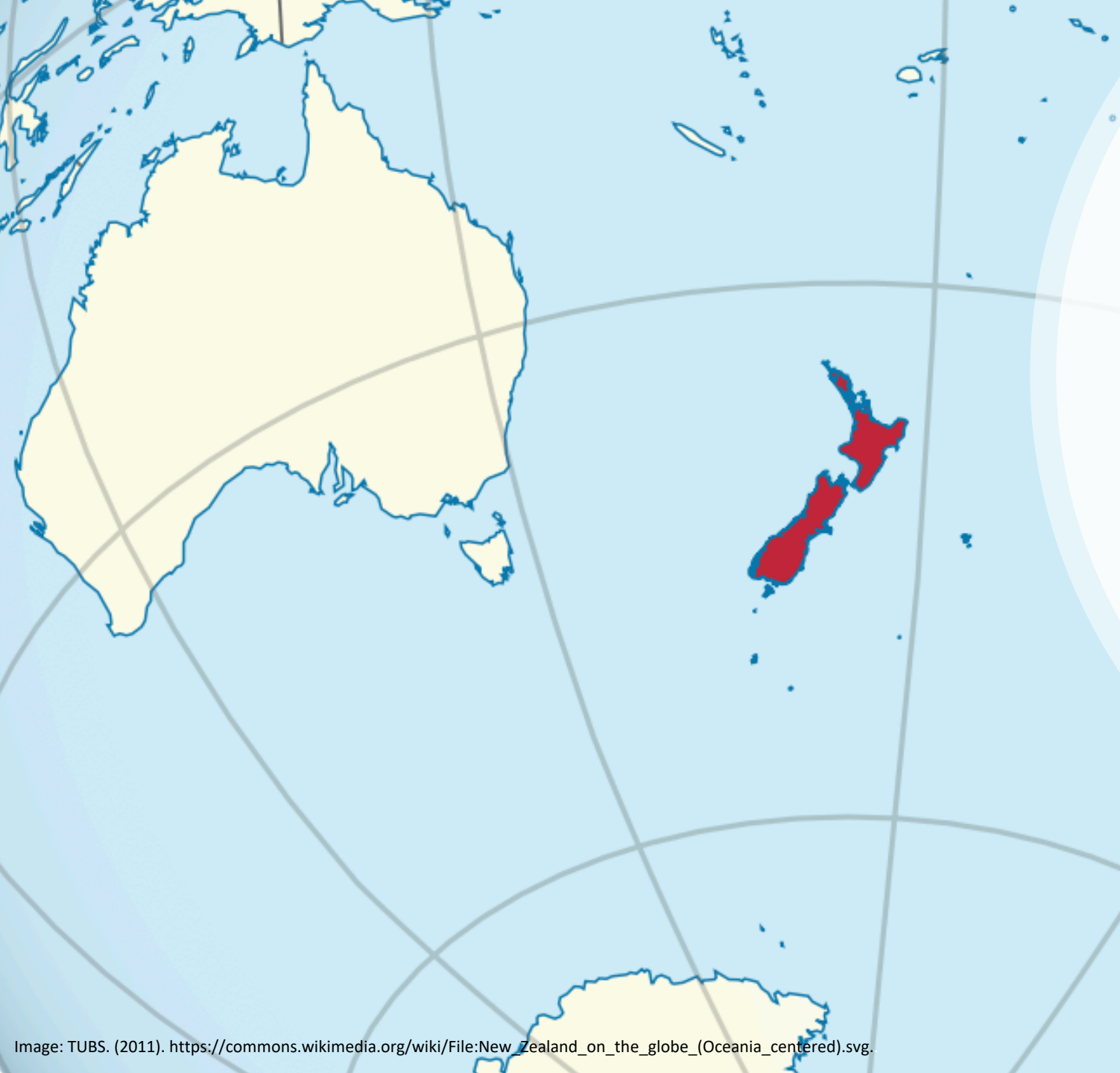
New Zealand's Energy Profile

Maggie Hensel

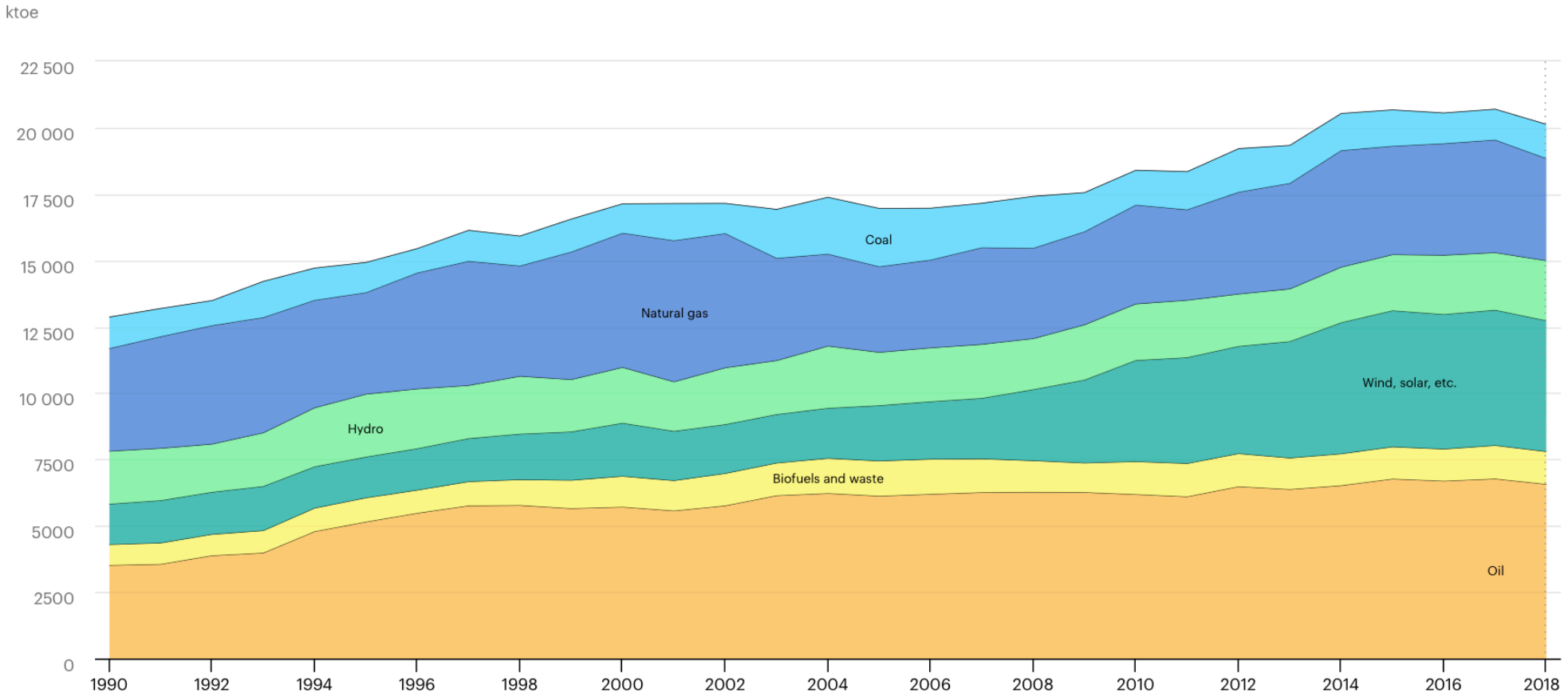
Image: Outside Online. (2020). https://www.outsideonline.com/2408674/new-zealand-south-island-travel-guide



About New Zealand

- Remote country
- Population - 4.8 million people
- Country is composed of mainly two islands
  - North Island (Two thirds of the population lives here)
  - South Island
- GDP per Capita - 41,945 current U.S dollars
- Per capita energy consumption is 8,700 KWh/year

Image: TUBS. (2011). https://commons.wikimedia.org/wiki/File:New_Zealand_on_the_globe_(Oceania_centered).svg.



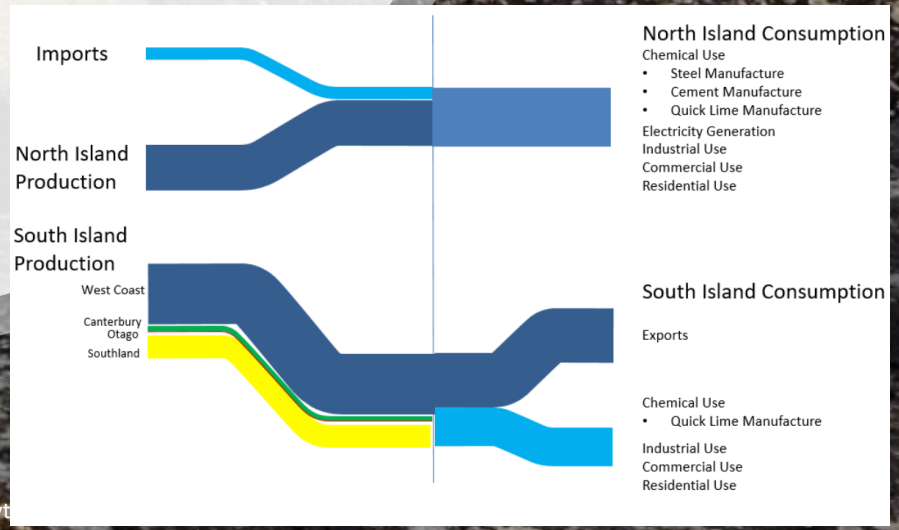
Energy Use

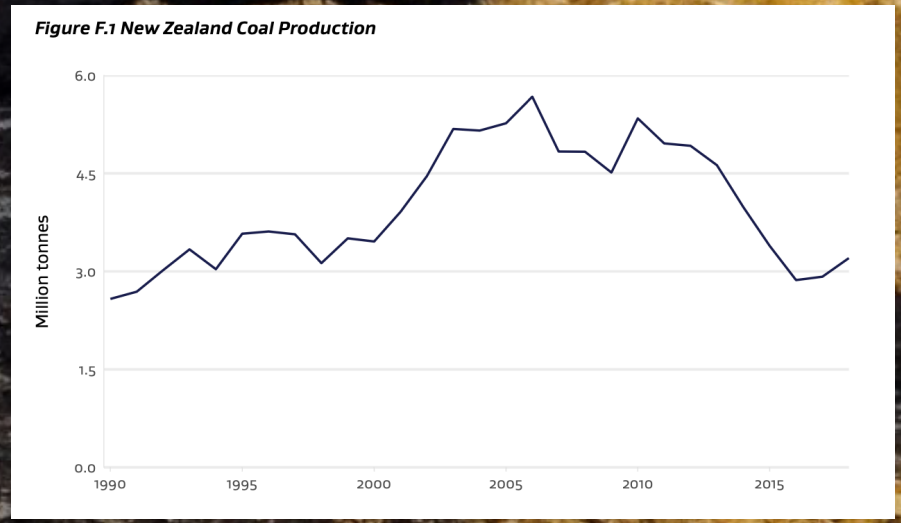
- Primary Energy Supply
  - 53% oil and natural gas
  - 10% coal
  - 40% renewables including geothermal, hydro and other (wind, solar and biogas)

Figure: IEA. (2017). *TPES*. https://www.iea.org/countries/new-zealand

Coal

- Over 16 billion tonnes (in ground)
- 80% Lignite
- Use of coal for electricity generation has been growing because of oil and gas shortages in 2017
- Mainly used for chemical use
- More cost-effective on the South Island (no online gas)





Figures: MBIE. (2019). *Energy in New Zealand 19.* www.mbie.govt
Image: Morris, Rod. (n.d). https://www.nzgeo.com/stories/the-black-and-the-green/?state=requireSubscription.

Overview of Taranaki Offshore and Onshore Oil and Gas Fields

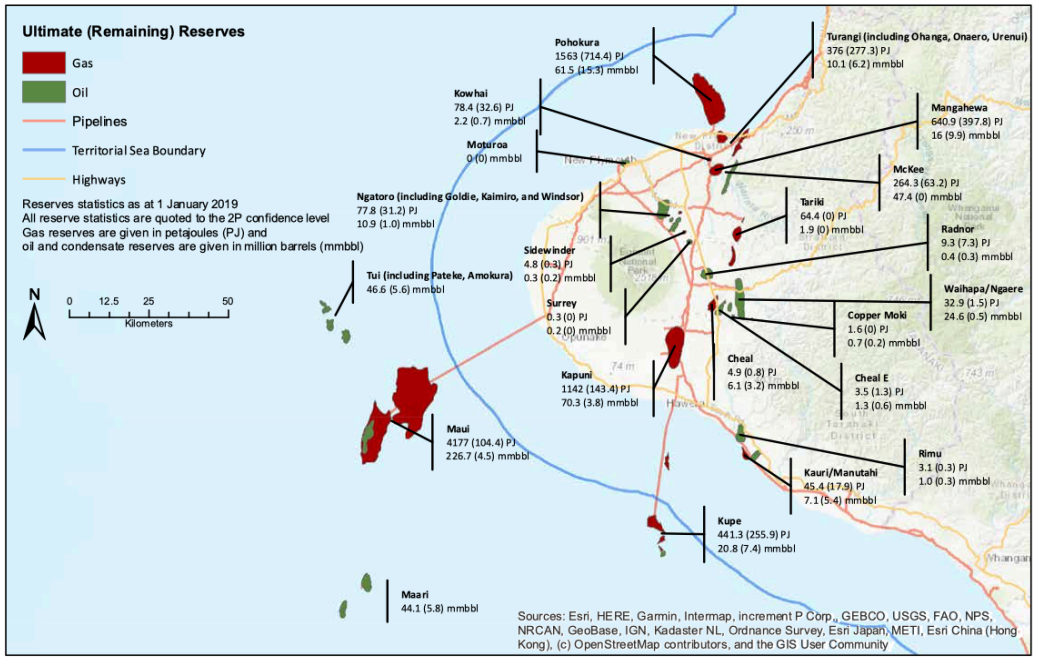
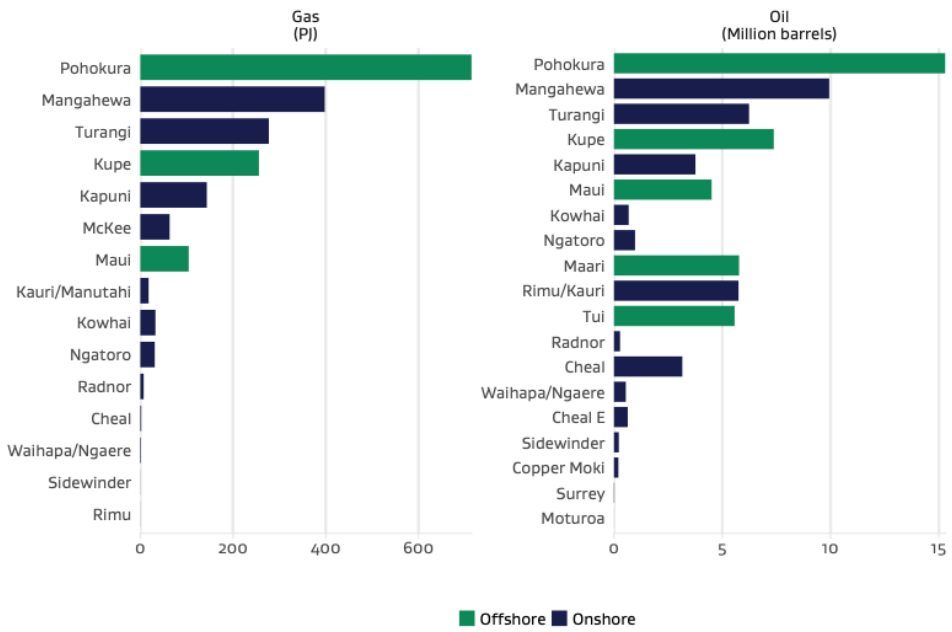


Figure E.1 Overview of Taranaki offshore and onshore oil and gas fields

Figure E.2 Remaining gas and oil 2P reserves as at 1 January 2019



Oil and Natural Gas

- Main oil field – Taranaki on the North Island
- In 2018 NZ decided to stop new oil exploration efforts
- The focus is now on current reserves
- 2P reserves mean the oil that can be accessed given the current technology

Figures: MBIE. (2019). *Energy in New Zealand 19.* www.mbie.govt.nz/info-services/ sectors-industries/energy/energy- data-modelling/publications/.

Oil

- Exports most of their oil because it is high quality and they do not have the capacity to refine it
- Imports crude oil from the Middle East, Asia, and Russia

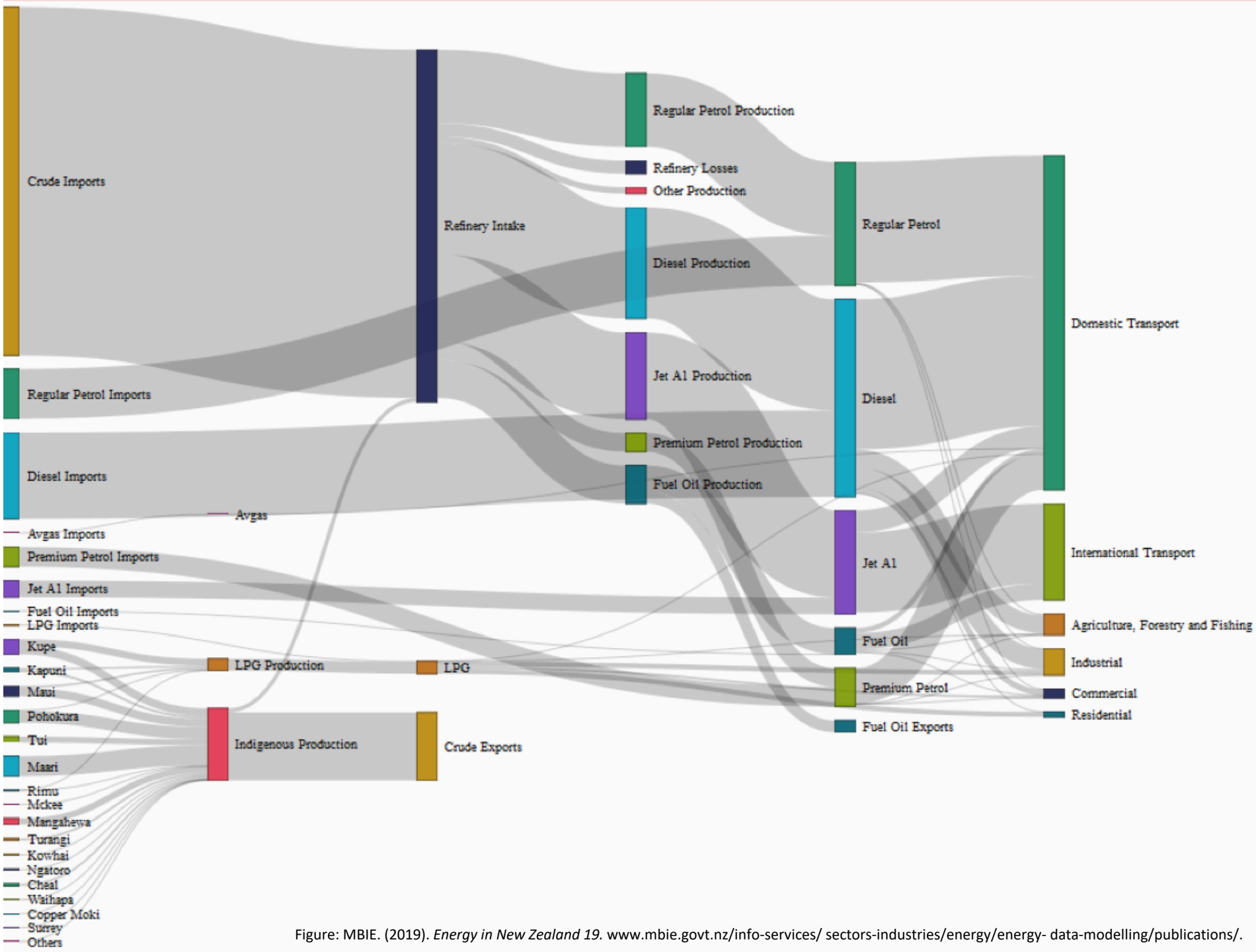


Figure: MBIE. (2019). *Energy in New Zealand 19.* www.mbie.govt.nz/info-services/ sectors-industries/energy/energy- data-modelling/publications/.

Natural Gas

- The north island mainly uses gas
- Price competitive with coal
- 40% of New Zealand's natural gas is produced by Pohokura oil field

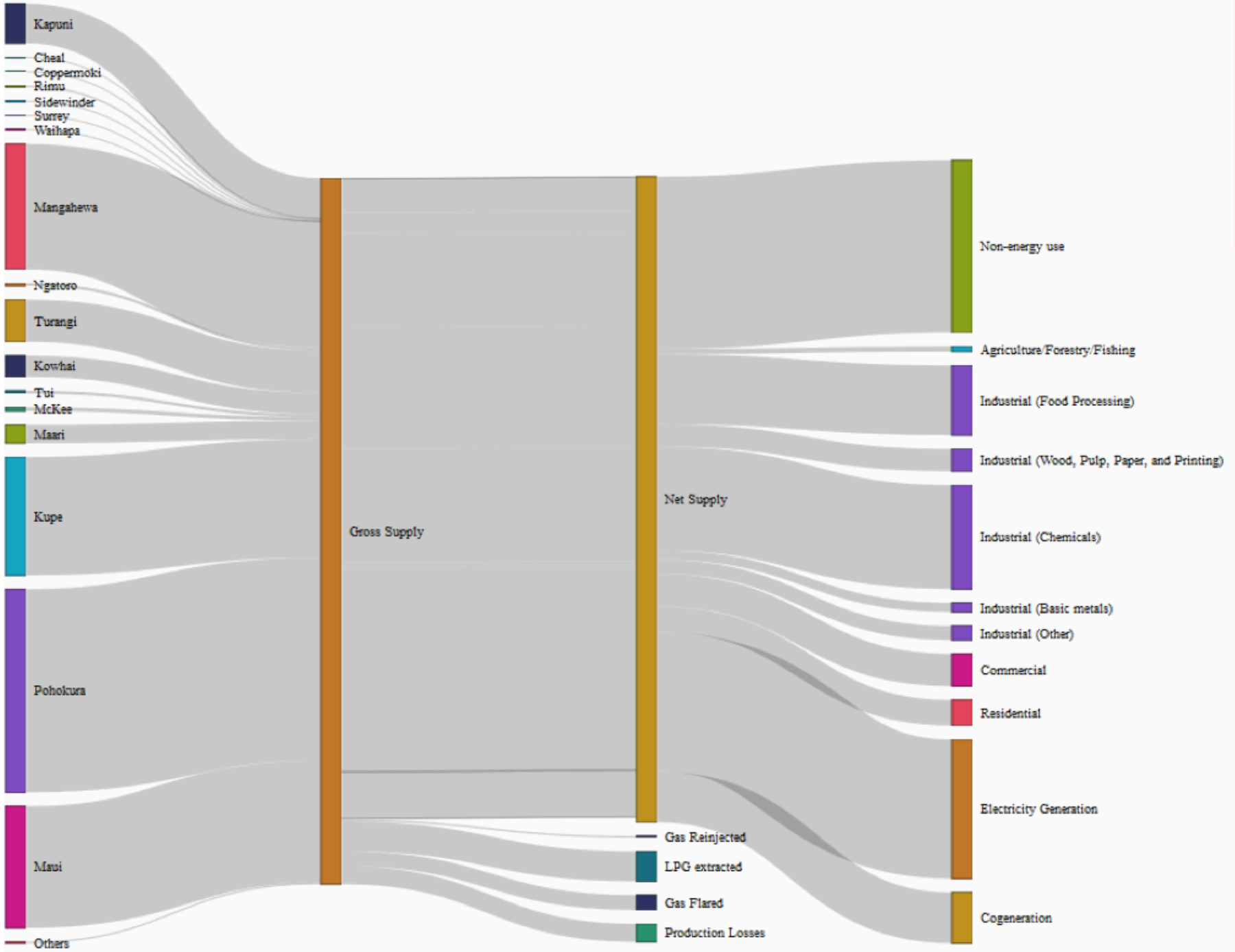


Figure: MBIE. (2019). *Energy in New Zealand 19.* www.mbie.govt.nz/info-services/ sectors-industries/energy/energy- data-modelling/publications/.

Renewables

- 40% of the primary energy consumed is from renewables
- 84% of the electricity is from renewable sources
- Hydro and geothermal are the main sources of renewable energy
- Wind makes up only 5%

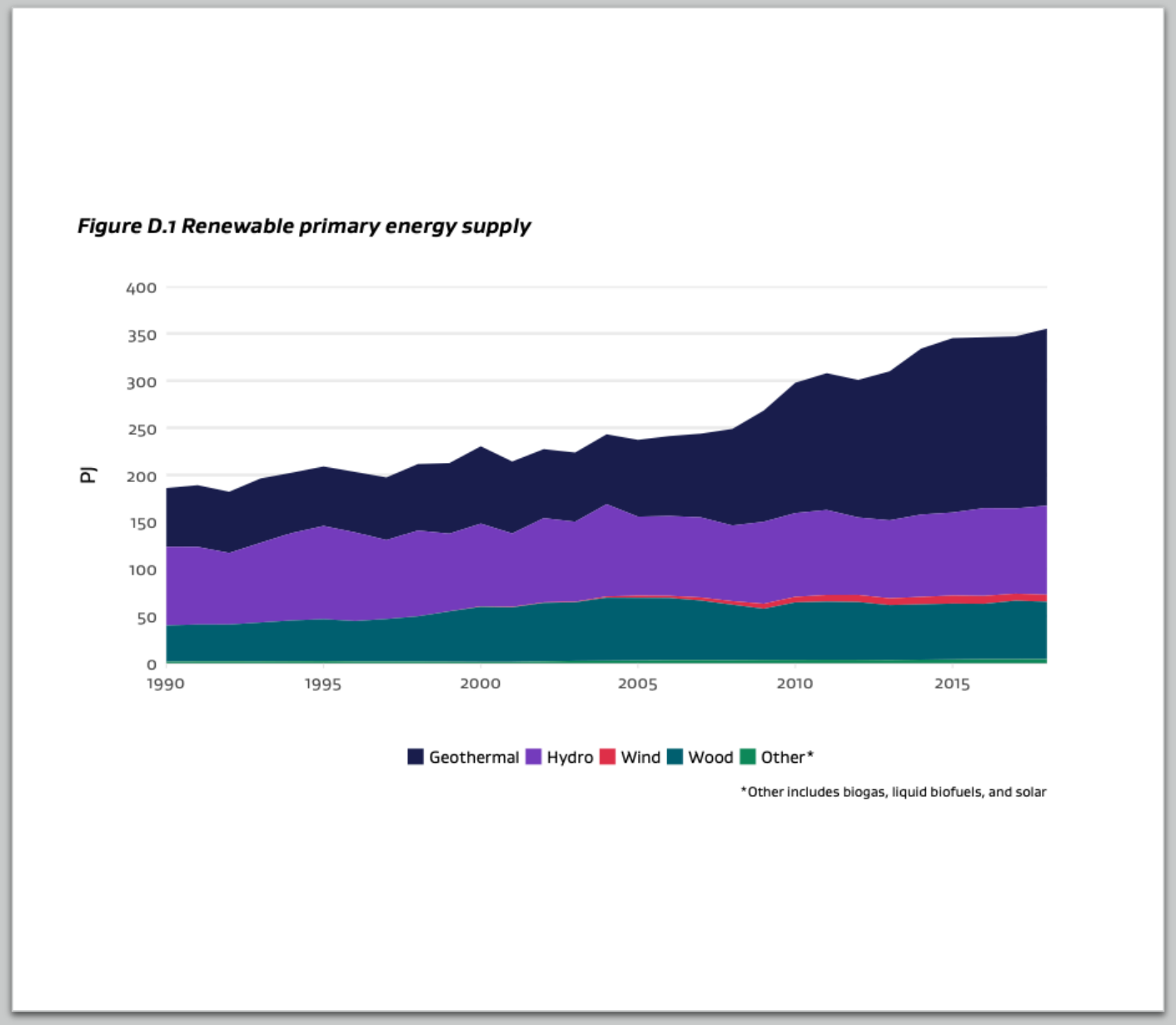


Figure: MBIE. (2019). *Energy in New Zealand 19.* www.mbie.govt.nz/info-services/ sectors-industries/energy/energy- data-modelling/publications/.

Hydro

- 26,027 GWh generated in 2018
- Hydro alone makes up over half of NZ electricity supply
- Over 100 hydro sites, the two main power stations are Upper Waitaki Scheme (848 MW) and Manapouri (800MW)
- Downside – limited storage capacity (4,000GWh)
- Not much capacity to expand

Image: Bloomberg, Simon. (n.d). https://www.nzgeo.com/stories/waitaki-water-of-tears-river-of-power/?state=requireSubscription.

Geothermal

- Abundant geothermal resources (Taupo and Kawerau regions)
- 20% of electricity supply– estimated 1000MW more
- Expansion is very likely – low cost for new generation
- Benefits - tourism, mining, direct heat, and electricity generation

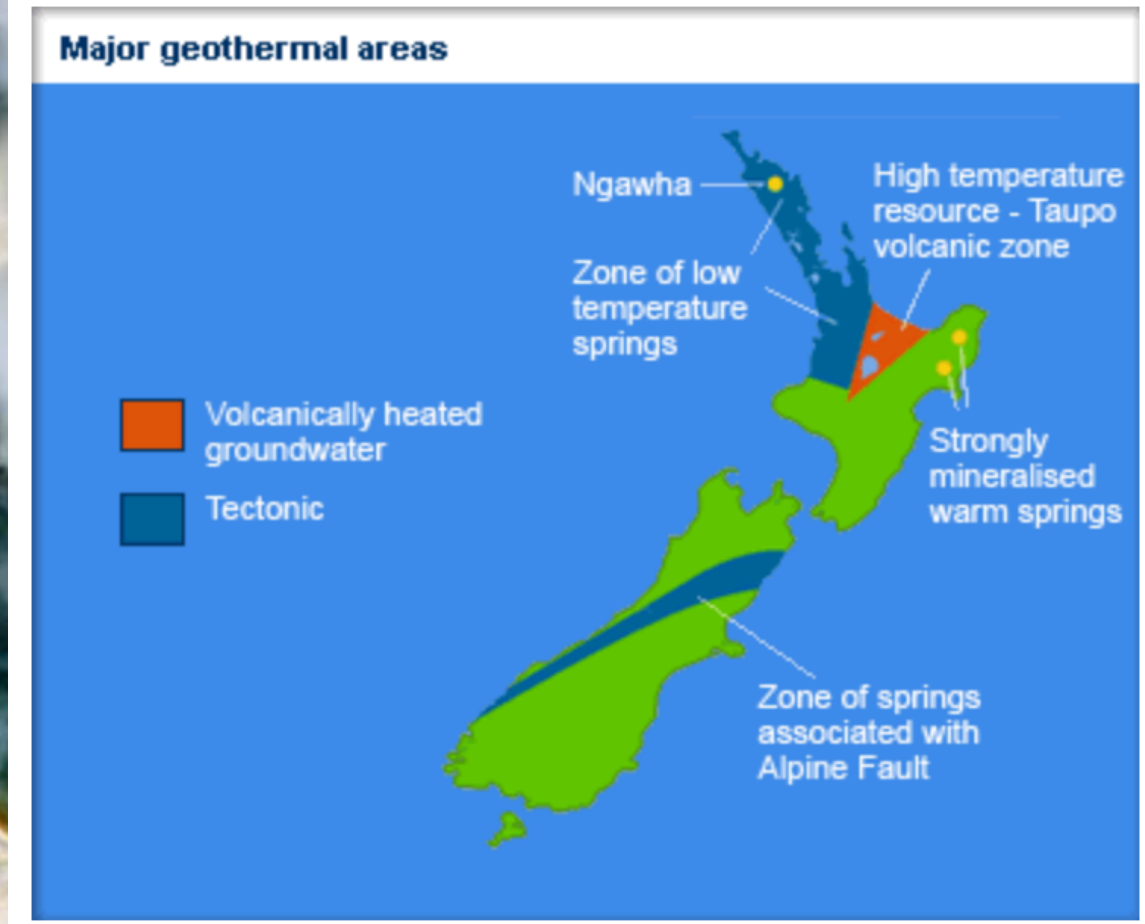
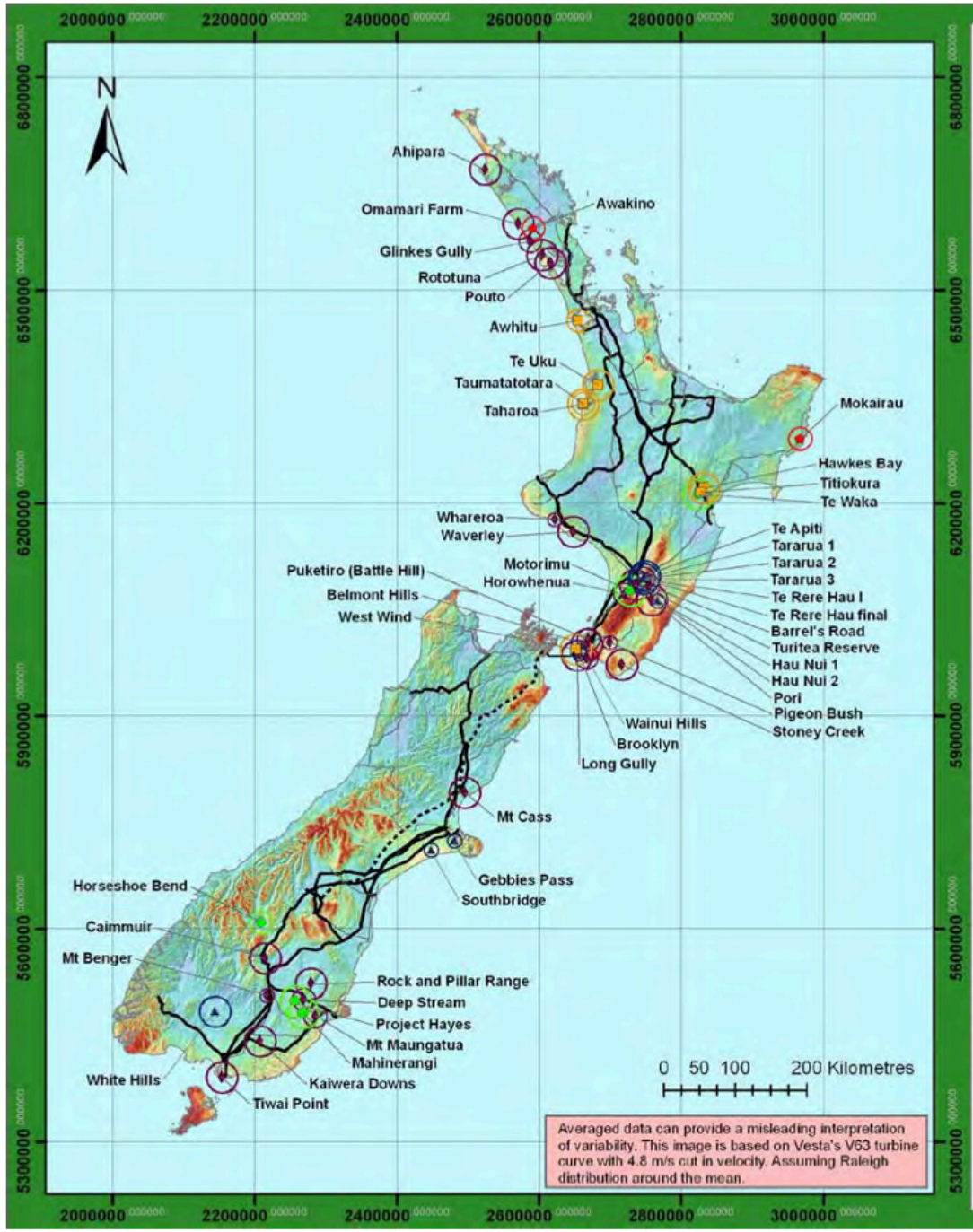


Figure 1: Geothermal Energy Resources in New Zealand. (n.d). https://www.geni.org/globalenergy/library/renewable-energy-resources/world/oceania/geo-oceania/geo-newzealand.shtml
Figure 2: MBIE. (2019). Energy in New Zealand 19. www.mbie.govt.nz/info-services/ sectors-industries/energy/energy- data-modelling/publications/.
Image: Carol Stewart, 'Geothermal energy - Effects on the environment', Te Ara - the Encyclopedia of New Zealand, http://www.TeAra.govt.nz/en/photograph/5440/champagne-pool.

Wind

- Provides 2,047 GWh of energy which makes up 5% of the total electricity supply
- NZ currently has 19 wind farms (490 turbines) with a capacity of 690 MW
- Investing over 500 million dollars into two large wind turbine projects that will increase generation by over a third

Image: New Zealand Wind Energy Association. (n.d). http://www.windenergy.org.nz



Potential Wind Power Density

Power density W/m²

- > 9.00
- 7.51 - 9.00 (Tier 0)
- 6.01 - 7.50 (Tier 1)
- 4.51 - 6.00 (Tier 2)
- 3.01 - 4.50 (Tier 3)
- 2.01 - 3.00
- 1.01 - 2.00
- < 1.01

Wind turbine sites

Installation capacity (MW)

- < 10
- 10 - 50
- 50 - 1000

Wind turbine sites status

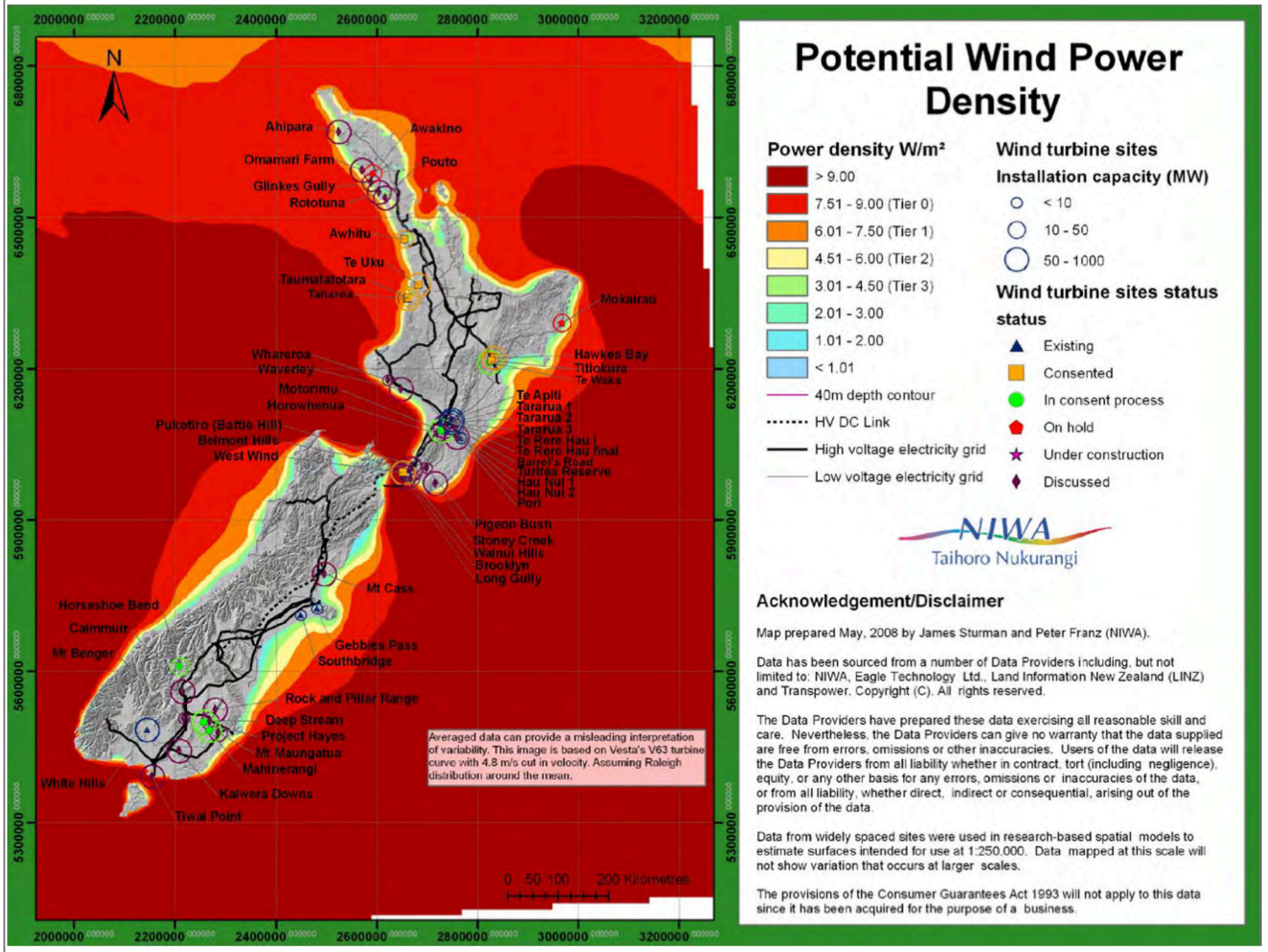
- Existing
- Consented
- In consent process
- On hold
- Under construction
- Discussed
- HV DC Link
- High voltage electricity grid
- Low voltage electricity grid

NIWA
Taihoro Nukurangi

Acknowledgement/Disclaimer

Map prepared March, 2008 by Andrew Tait, Rilke de Vos and James Sturman (NIWA).

Data from widely spaced sites were used in research-based spatial models to estimate surfaces intended for use at 1:250,000. Data mapped at this scale will not show variation that occurs at larger scales.



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- 2.01 - 3.00
- 1.01 - 2.00
- < 1.01
- 40m depth contour
- HV DC Link
- High voltage electricity grid
- Low voltage electricity grid

Wind turbine sites

Installation capacity (MW)

- < 10
- 10 - 50
- 50 - 1000

Wind turbine sites status

status

- Existing
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NIWA
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Map prepared May, 2008 by James Sturman and Peter Franz (NIWA).

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Solar

- Generating 84 MW
- Mostly residential use
- Marsden Point Oil refinery is planning to install a solar farm – when complete it will be the largest solar farm in NZ
- NZ government advises people to invest in an electric car instead of solar panels

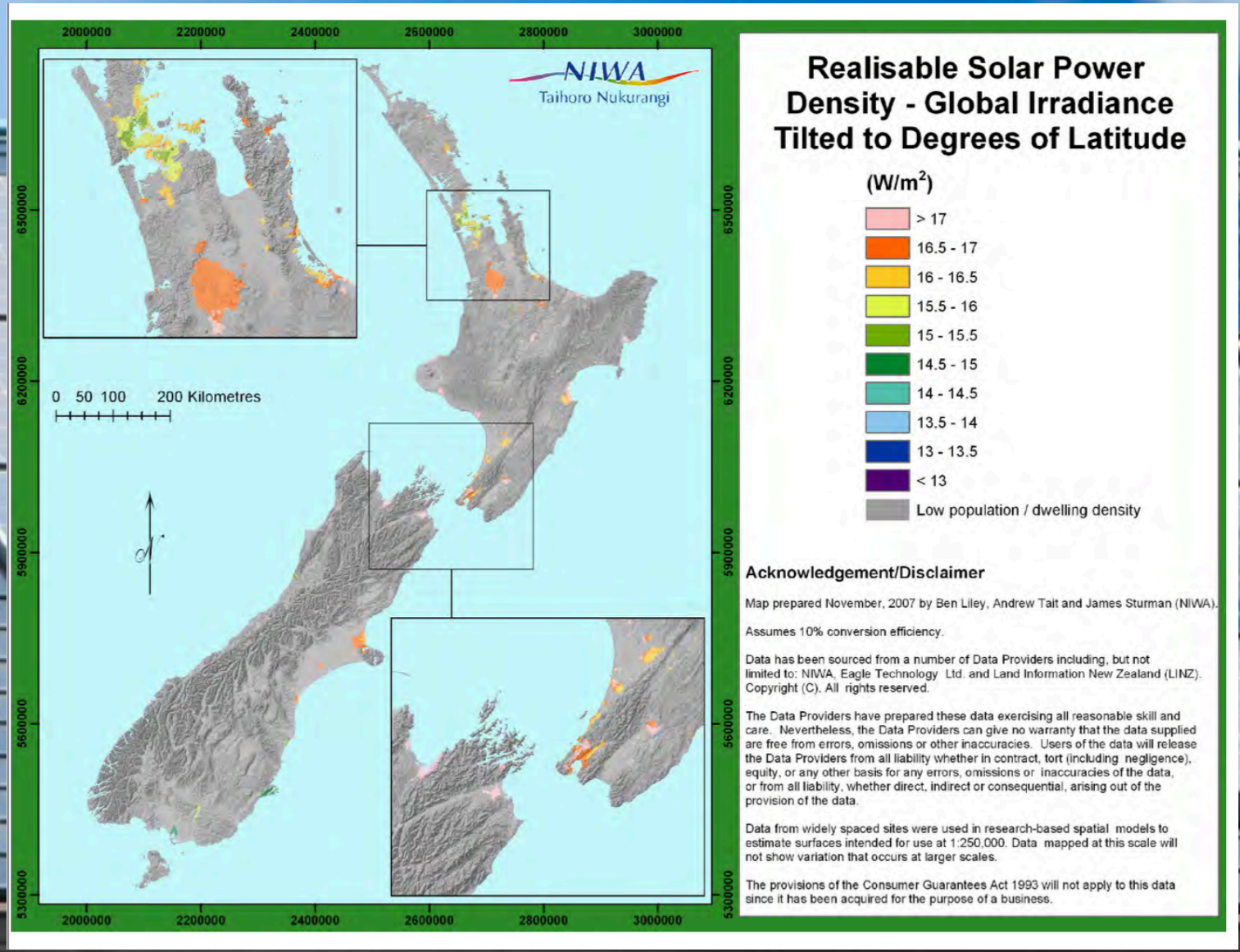


Image: HVR Solar. (2018). https://www.stuff.co.nz/life-style/homed/how-to/102435422/a-beginners-guide-to-solar-power

Biomass

- Woody (94.6%)
- Black liquor (by-product of wood)
- Biogas (5.2%)
- Liquid Biofuels (0.2%)
  - Bioethanol
  - Biodiesel
- NZ has plans to expand biomass using all land classes
  - Canola Seed
  - Energy Crops
  - Forests and Forest Residues

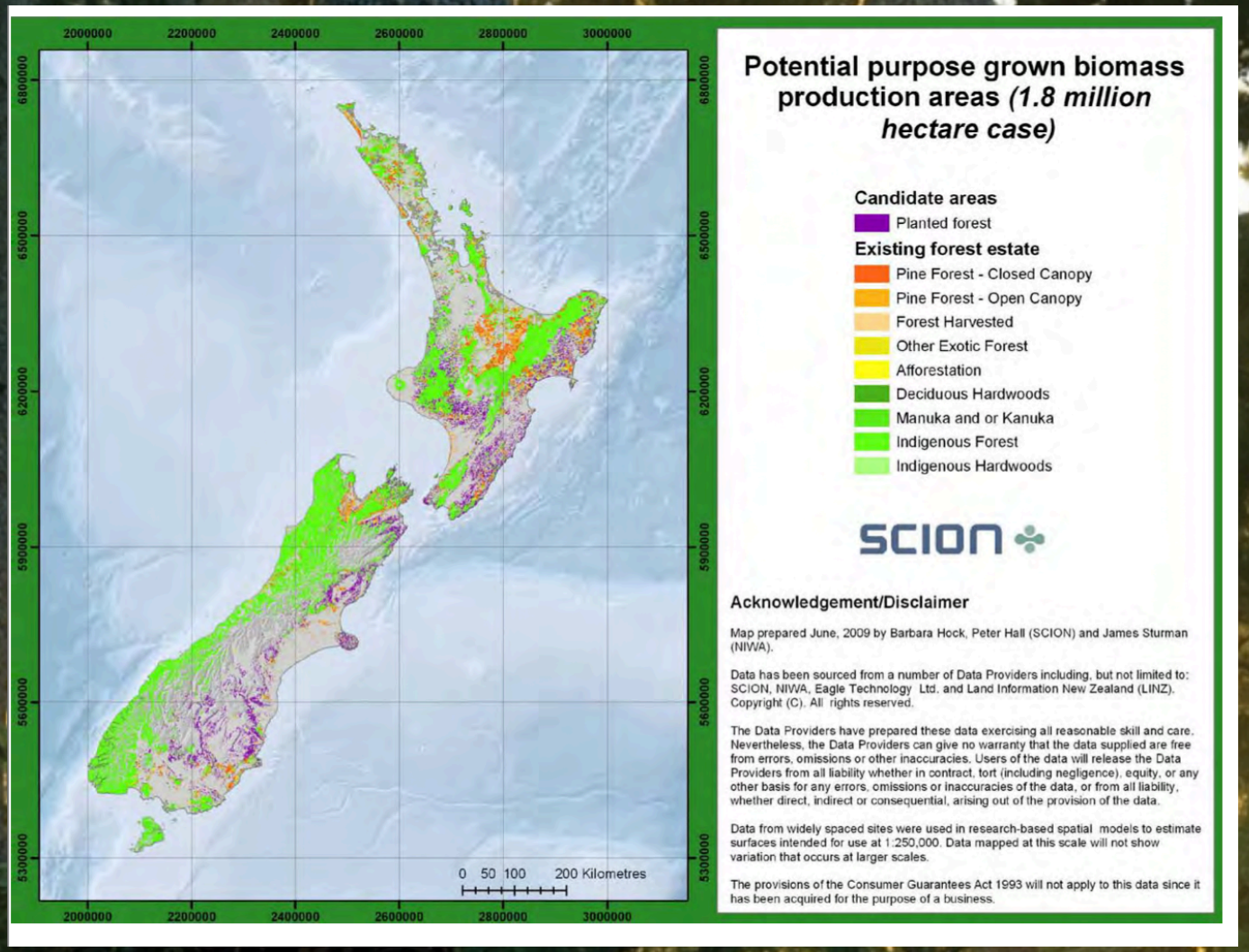


Image: Wood Energy. (2020). Residual biomass fuel projections for New Zealand. https://www.usewoodfuel.org.nz/resource/residual-biomass-fuel-projections-for-nz

Marine

- Between 2007 – 2011 funding was offered to increase marine energy projects
- Plans to install 200 turbines in the Kaipara Harbor was put on hold in 2013
- There was some installed capacity, but net generation was zero
- Marine energy is expensive which will probably prevent it from expanding in NZ

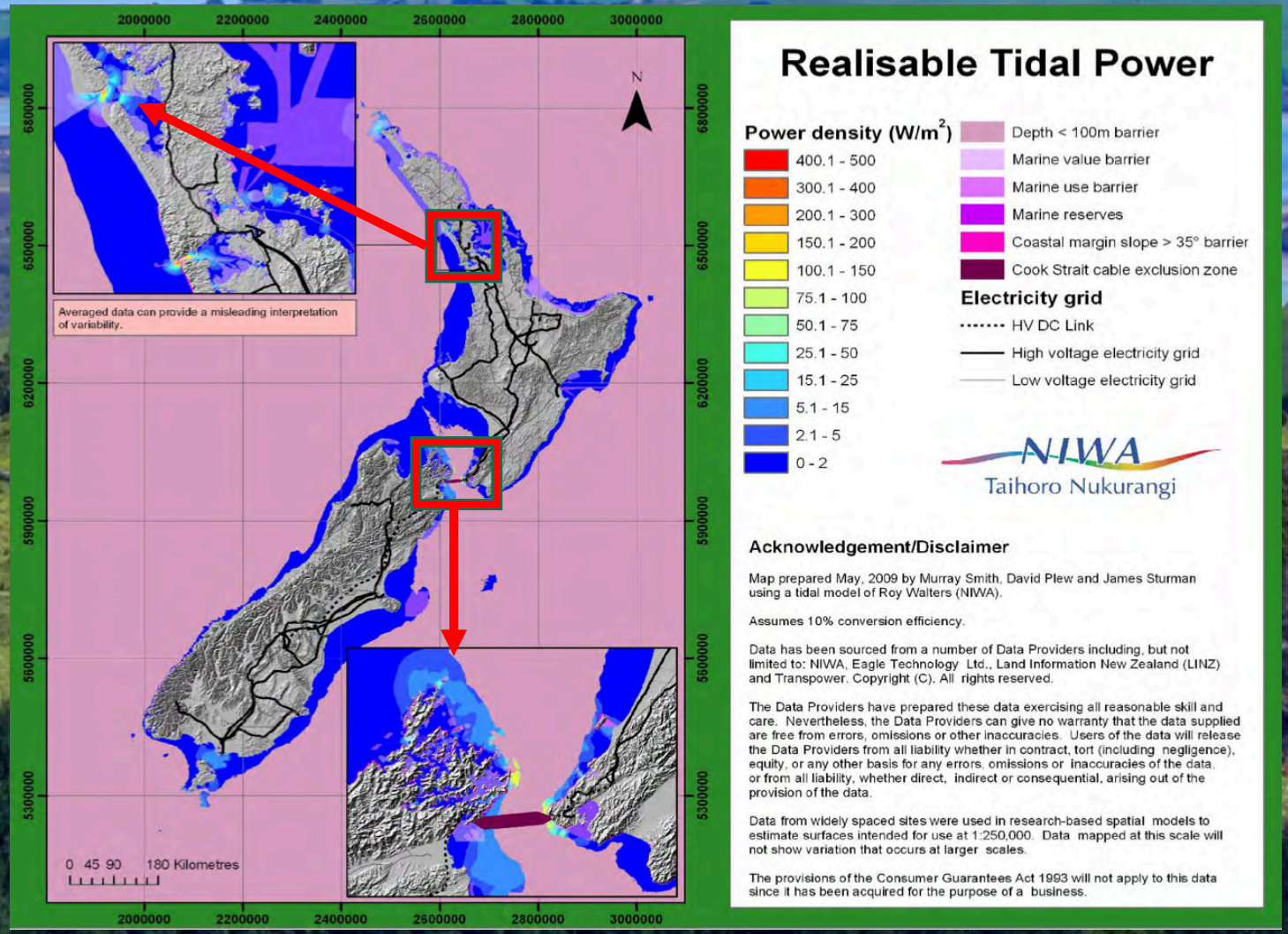


Image: NZ Places. https://nzplaces.nz/place/kaipara-harbour

Nuclear

- No plans to include nuclear energy
- Little public support
- Zero research reactors
- No large uranium deposits

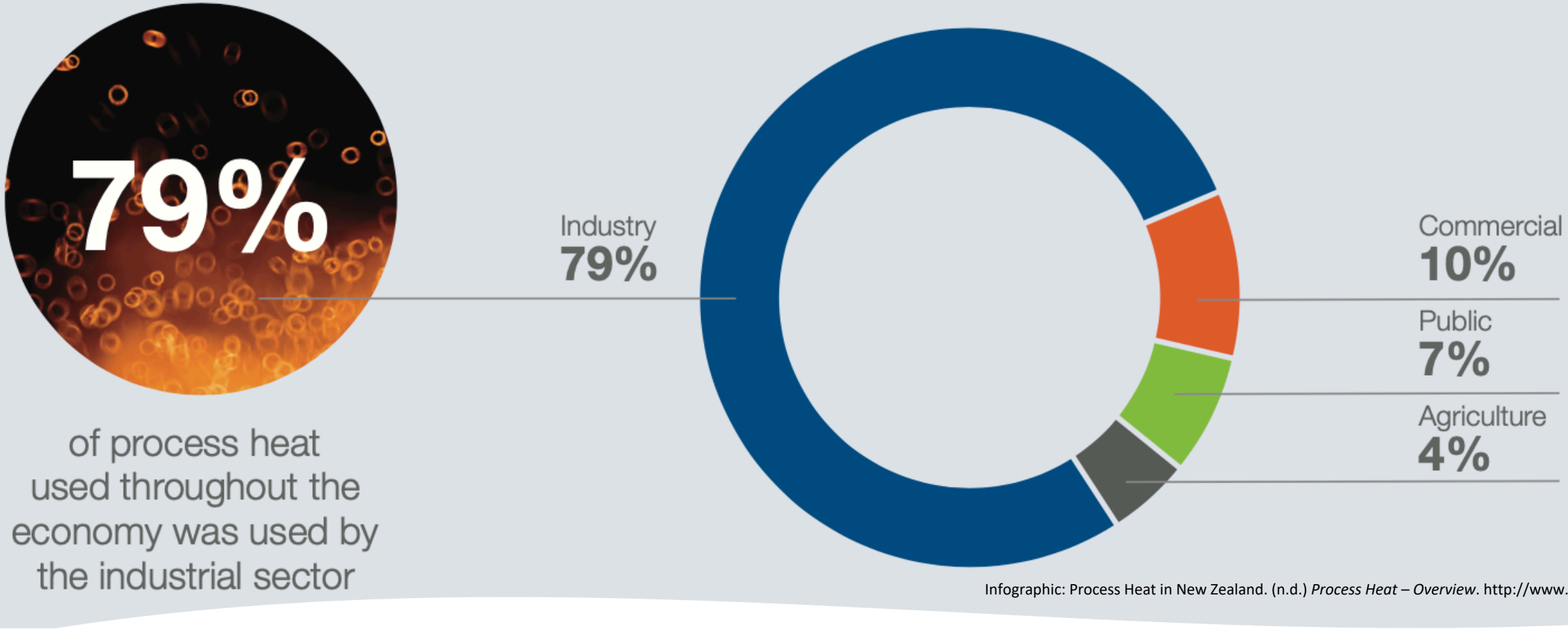
Image: Volrab, Vaclav. (n.d.). https://www.123rf.com/photo_62593094_nuclear-power-plant-with-wind-turbines-and-electricity-pylon-in-the-sunset-energy-resources-concept-.html

New Zealand's Renewable Energy strategy

Process Heat

Efficient and low emissions transport

Innovative and efficient use of electricity



Infographic: Process Heat in New Zealand. (n.d.) *Process Heat – Overview*. http://www.mbie.govt.nz/PHiNZ.

Process Heat

- Goal - to decrease process heat by 1% per year between 2017 - 2022
- Contributes 9% to total greenhouse gas emissions
- 60% is generated from coal and natural gas

Efficient and low emissions transport

- Goal - for EVs to make up 2% of the fleet by 2021
- Current transportation system relies heavily on fossil fuels
- Government is incentivizing this transition

Image: AT Metro Service Delivery. (2018). Auckland Transport: Low Emission Bus Roadmap 2018. https://at.govt.nz/media/1980070/low-emissions-bus-roadmap-dec-2018.pdf.

Innovative and efficient use of electricity

- Goal – to supply 90% of electricity from renewable sources
- While electricity demand per household has been decreasing, it is predicted to increase with the transition over to Evs
- Policies focus on emission reduction, energy efficiency, and expanding renewable energy sources

Image: MBIE. (2017). Unlocking Our Energy Productivity and Renewable Potential. https://www.mbie.govt.nz/assets/346278aab2/nzeecs-2017-2022.pdf.

Figure: MBIE. (2020). Energy Strategies for New Zealand. https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-strategies-for-new-zealand/.

New Zealand's Potential Additional Renewable Capacity

GENERATION TYPE	Existing Capacity (MW)	Potential Capacity (MW)
Wind	700	10000
Geothermal	1000	1200
Hydro	5500	1000
Solar	50	2500

Table: New Zealand Government. (2018). *A Vision for Hydrogen in New Zealand.* ISBN 978 1 99 000415 5.

Future

- Expand wind and geothermal
- Consider marine energy
- Role of hydrogen

Resources

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