Industrial Use of Geothermal Energy in Kawerau

Tuwharetoa mai
Kawerau ki te Tai

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Kaipūkaha | Resource Engineer

Contents

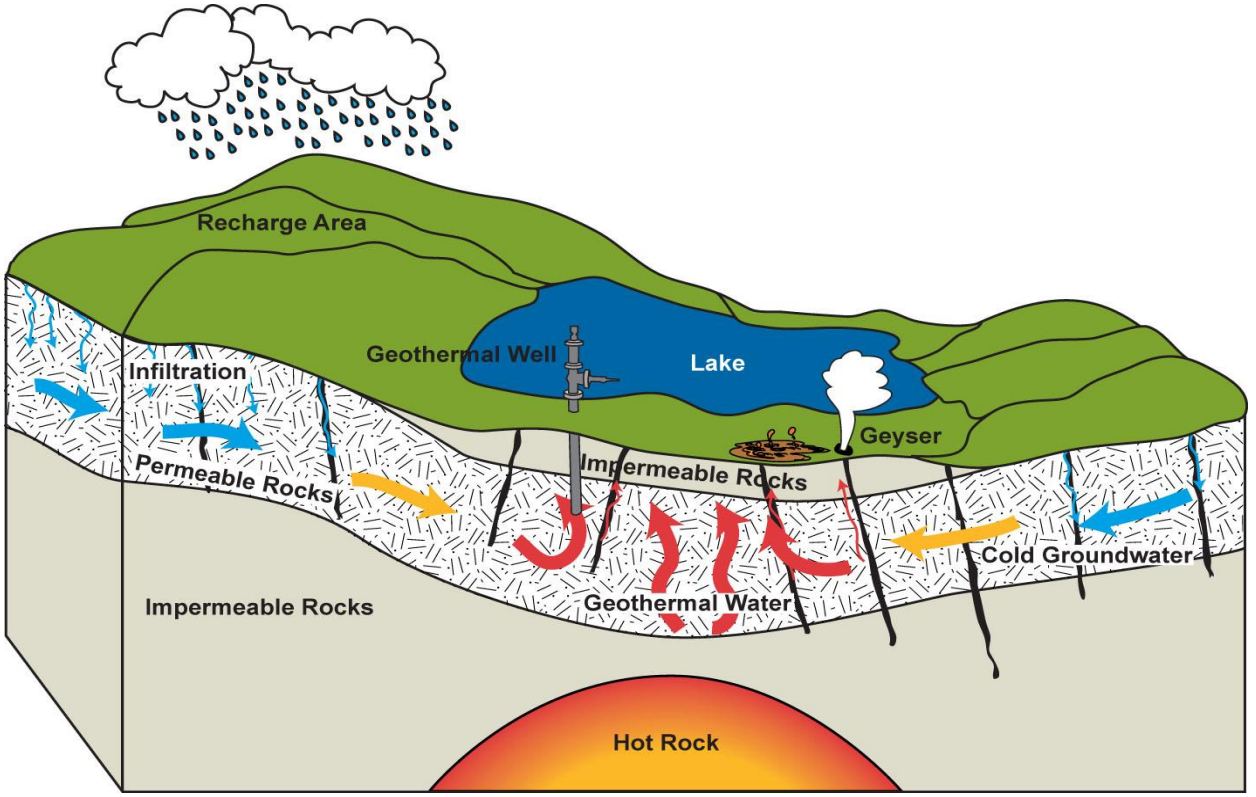
Geothermal System

Heat source

Permeable reservoir rocks – faults, fractures

Water source – natural convection as water is heated by heat source

“Cap” rock – limits the escape of hot water to surface



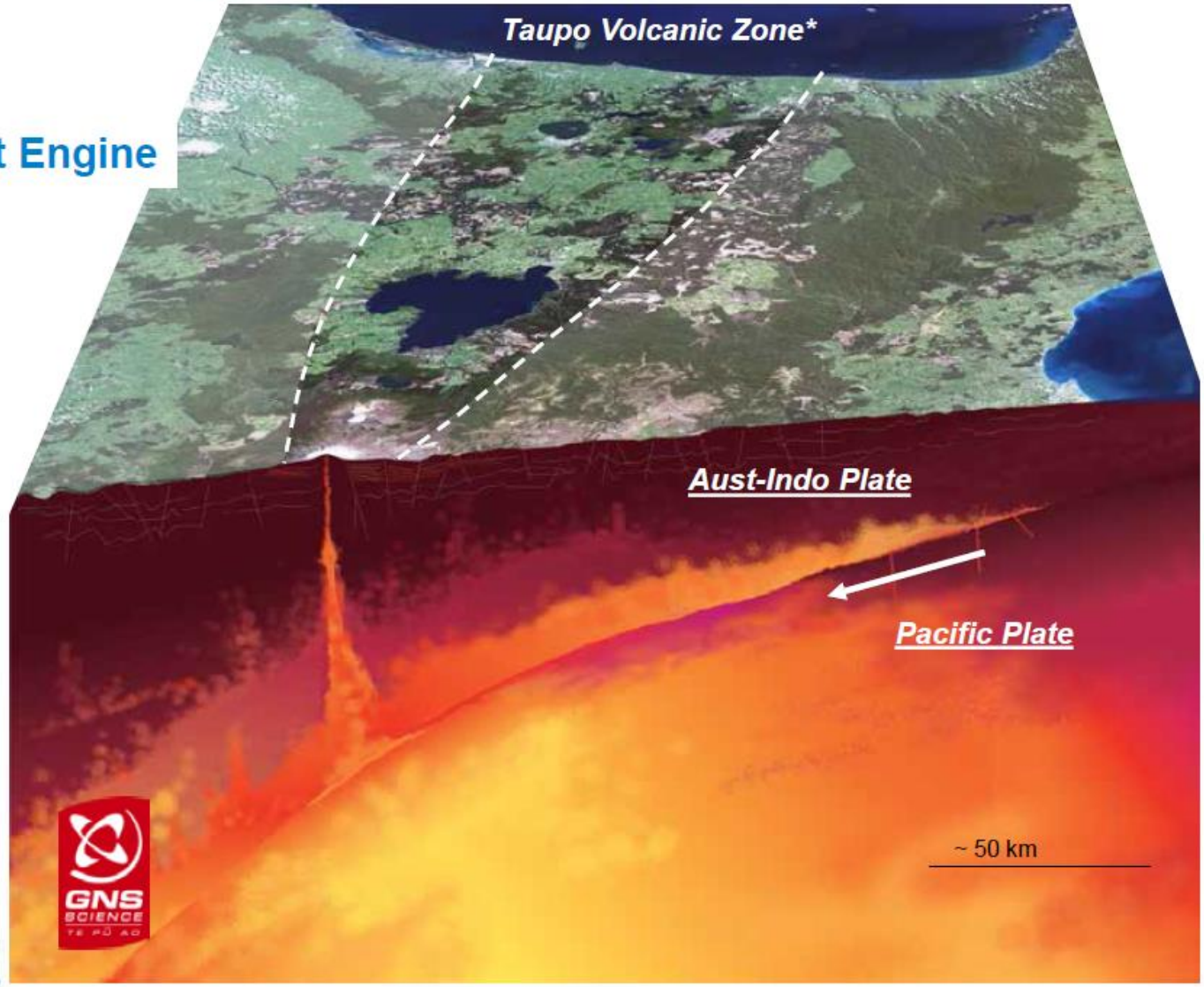
Geothermal wells – drilled into the reservoir to bring hot water out or return used geothermal water into the system (depth range from 100 to 3500m below ground)

Reservoir temperature range – up to 370°C

Source: Bay of Plenty Regional Council (www.boprc.govt.nz) and New Zealand Geothermal Association (NZGA)

Taupo Volcanic Zone

Amazing Heat Engine



New Zealand Geothermal Association

Source: New Zealand Geothermal Association (NZGA)

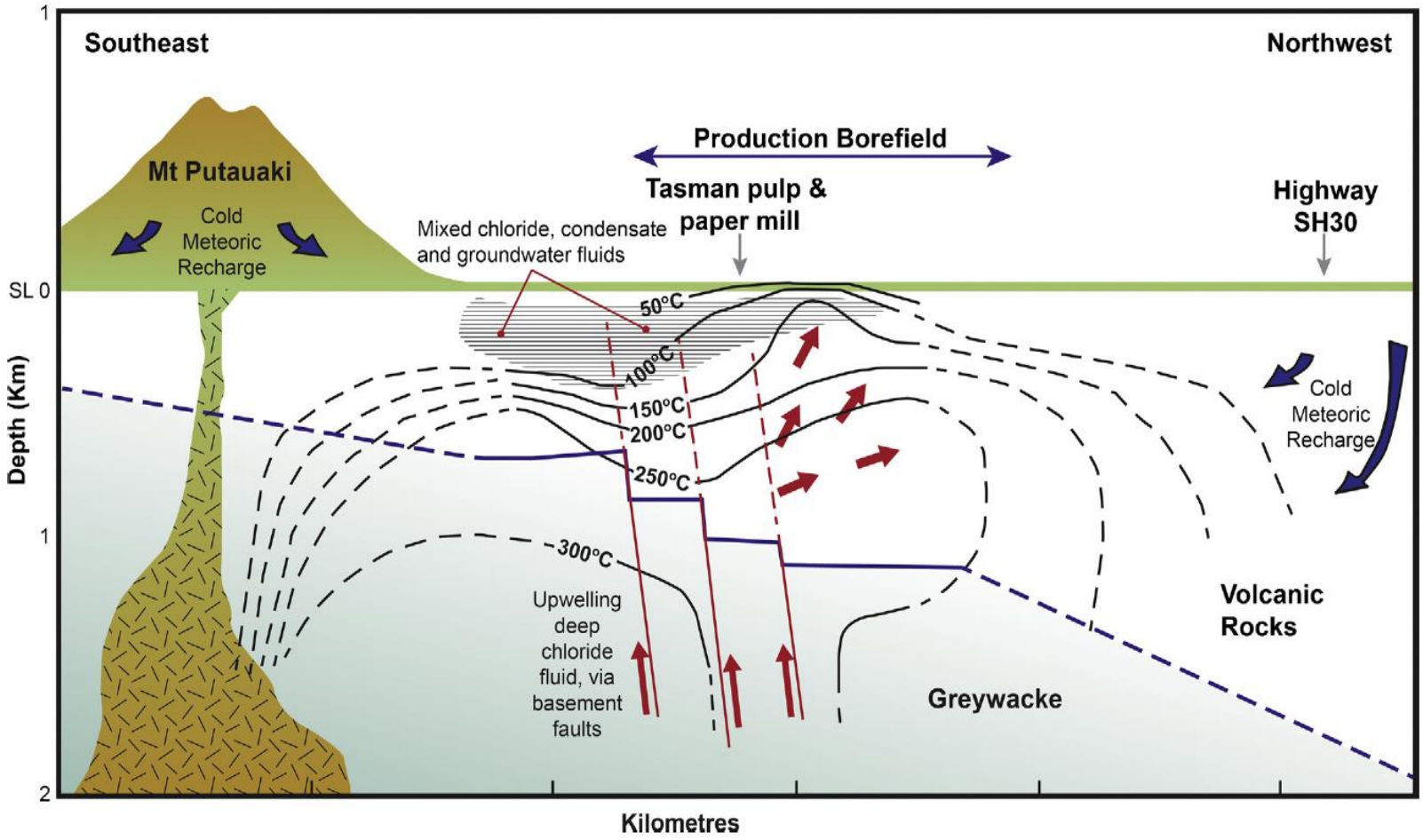
Geothermal Direct Heat Use

Using geothermal energy (heat) in thermal processes, avoiding inherent losses associated with conversion to electricity.

Examples of Geothermal Direct Heat Uses in New Zealand

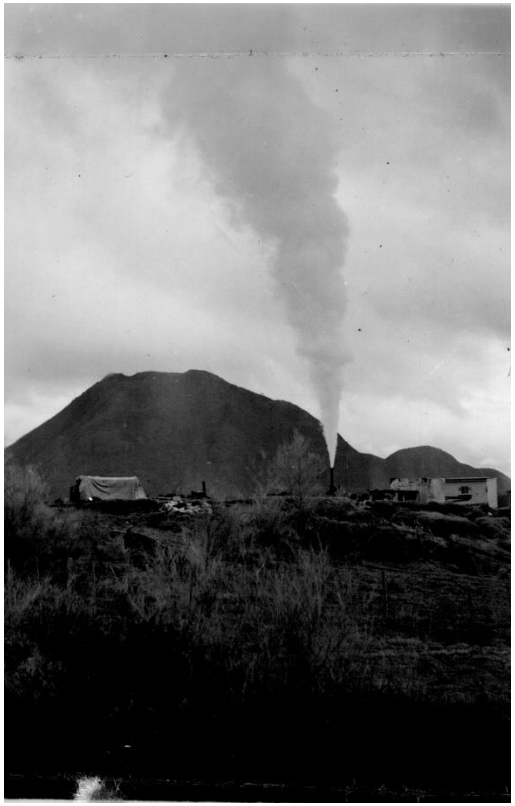
- Clean steam production for various industrial plants – pulp and paper, dairy
- Timber drying in kilns
- Glasshouse heating – horticulture
- Aquaculture
- Honey processing
- Space heating – hotels and hospital
- Pool heating, bathing, tourism

Kawerau Geothermal System



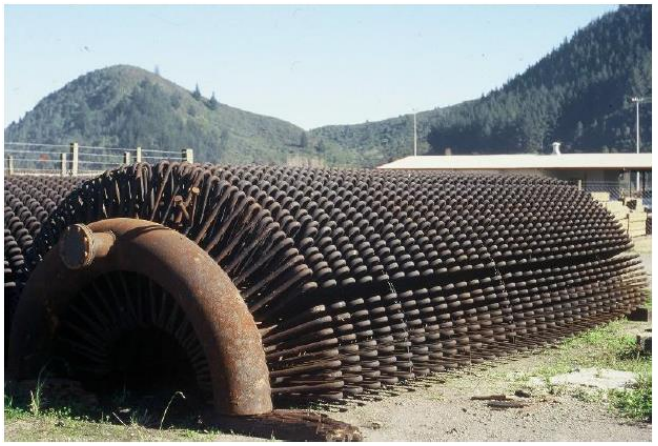
Source: S.D. Milicich et al. (2014) Geothermics 51 344-350
Source: S.D. Milicich et al. (2016) Geothermics 59 252-265

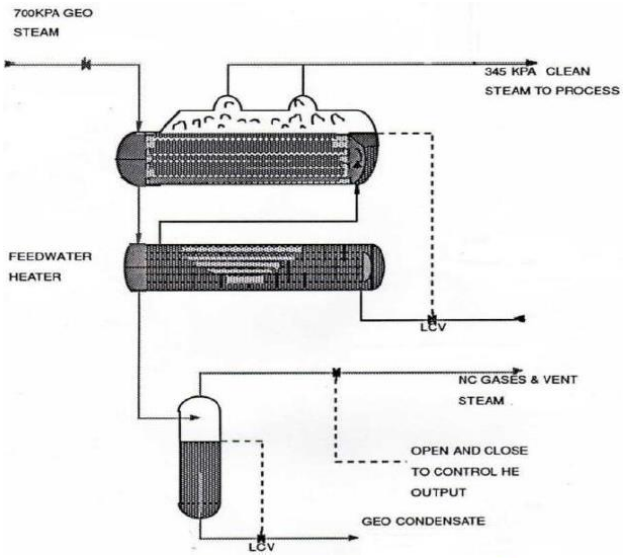
Geothermal Direct Heat Use



Ref: WA-38718-F. Alexander Turnbull Library, Wellington, New Zealand. /records/23524535; Ministry of Works

Geothermal Direct Heat Use



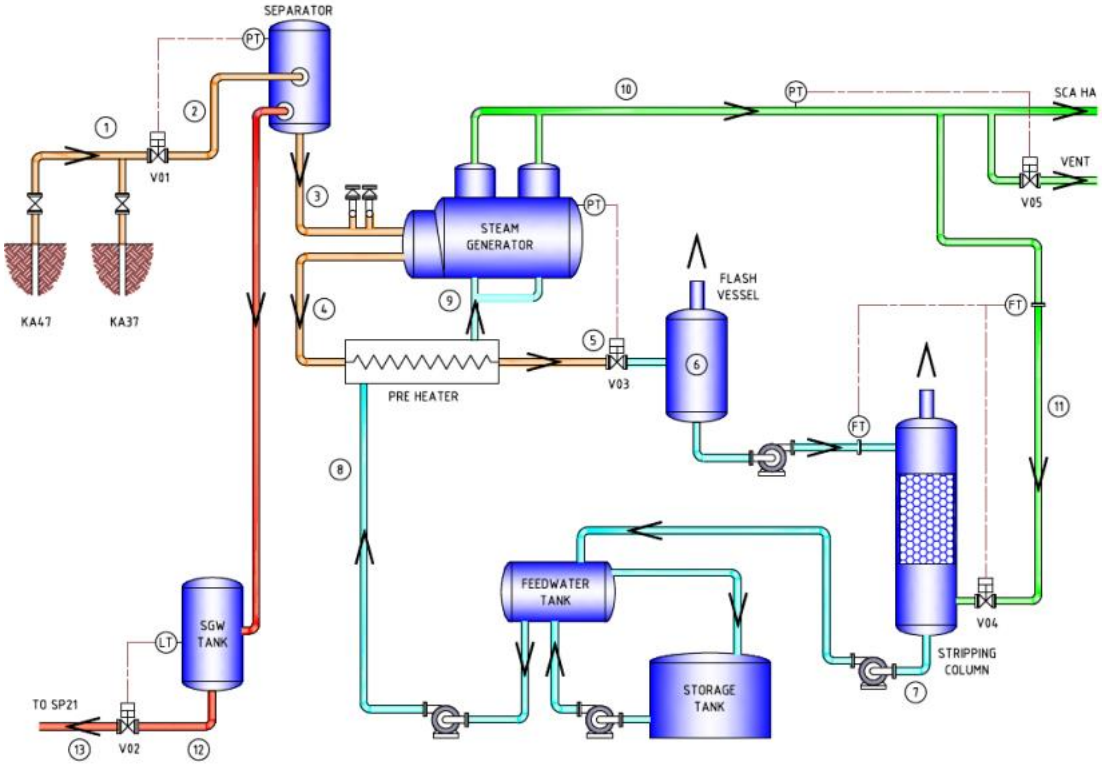


Steam supplied to the Tasman Pulp and Paper mill

Operations include heat exchangers, driers and internal power generation

Ref: A. Bloomer (1998, 2011), photos on the right courtesy of Joe Hotson

Geothermal Direct Use



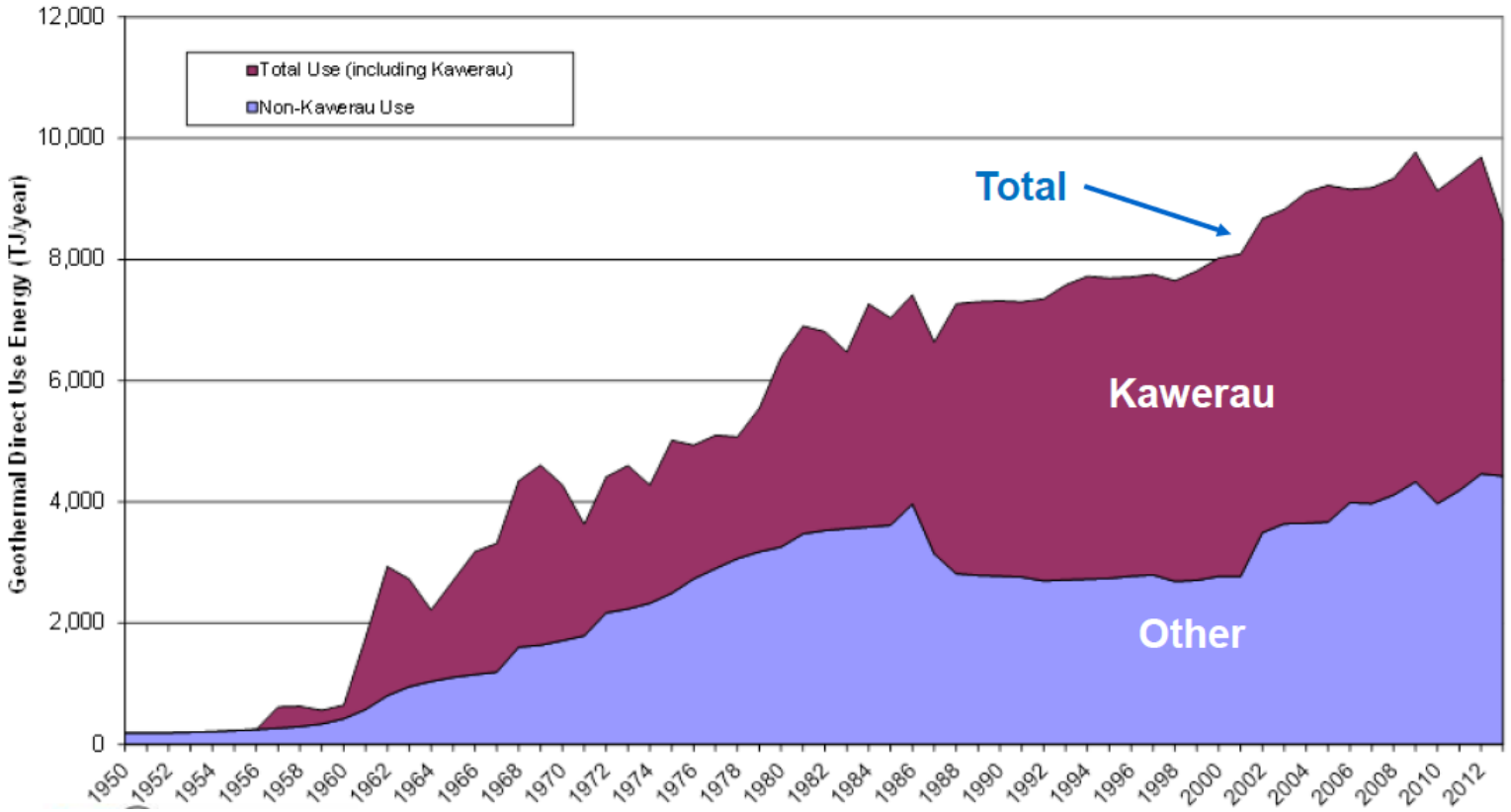
High-pressure clean steam plant

Supplies 16 barg clean steam to tissue manufacturing (hygiene products)

Feed water from geothermal steam condensate

Ref: Dobbie Engineers (2014)

Geothermal Direct Heat Use



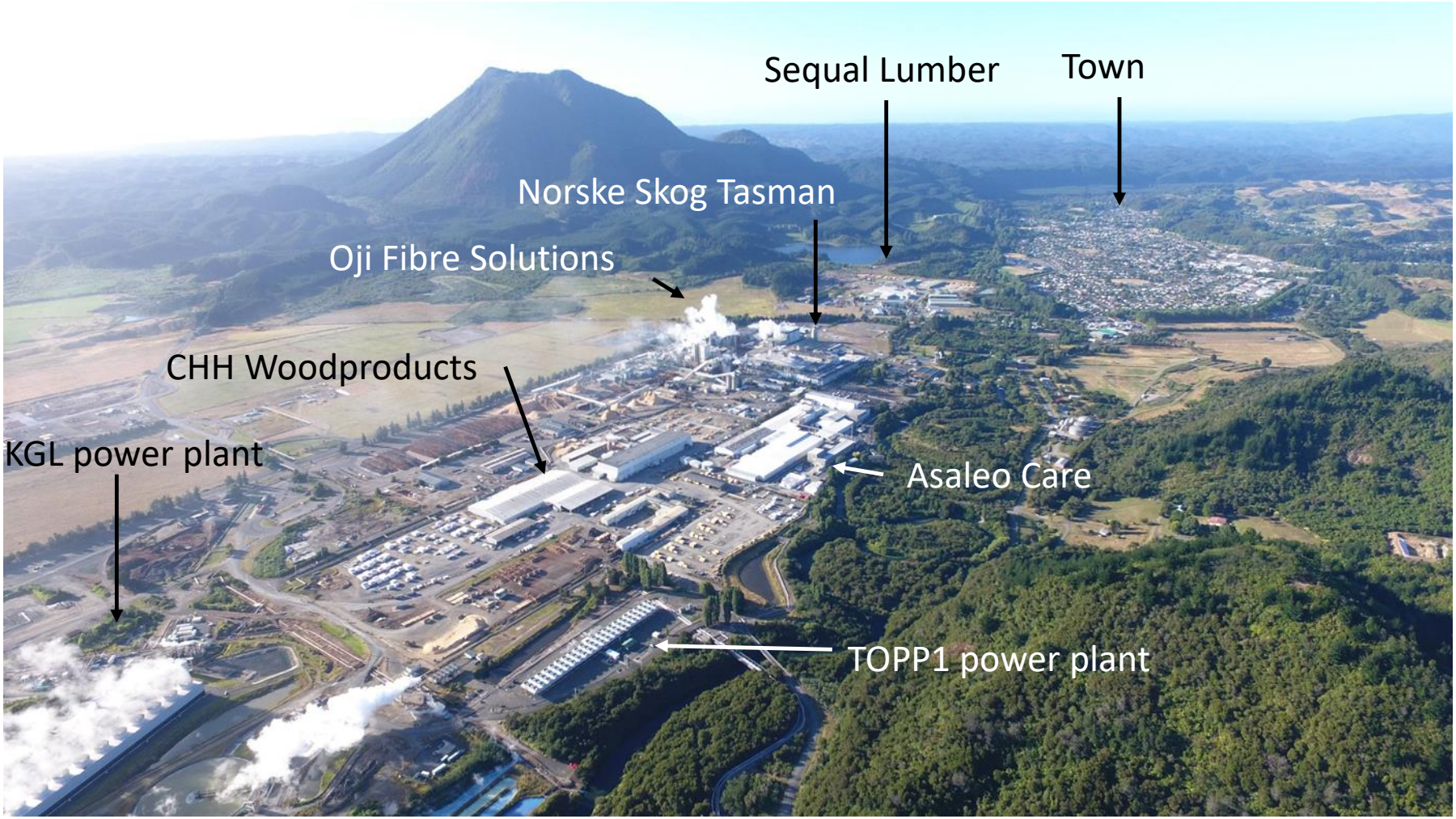
Geothermal direct heat use has been gradually increasing in New Zealand

Kawerau geothermal direct heat use is the largest industrial use in the world

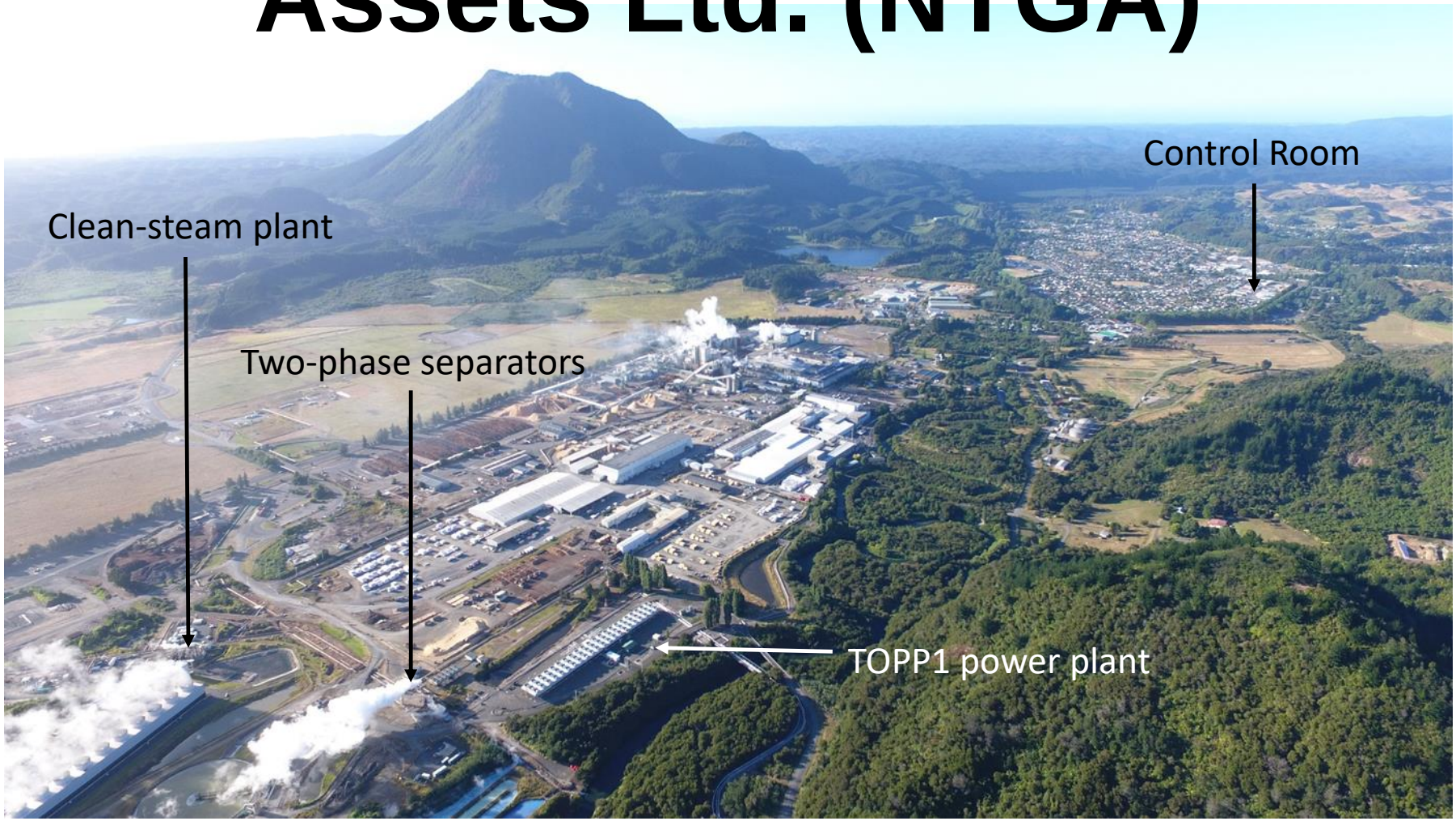
Ref: New Zealand Geothermal Association (NZGA)

Kawerau Industrial Complex

Kawerau Geothermal Energy



Ngāti Tūwharetoa Geothermal Assets Ltd. (NTGA)



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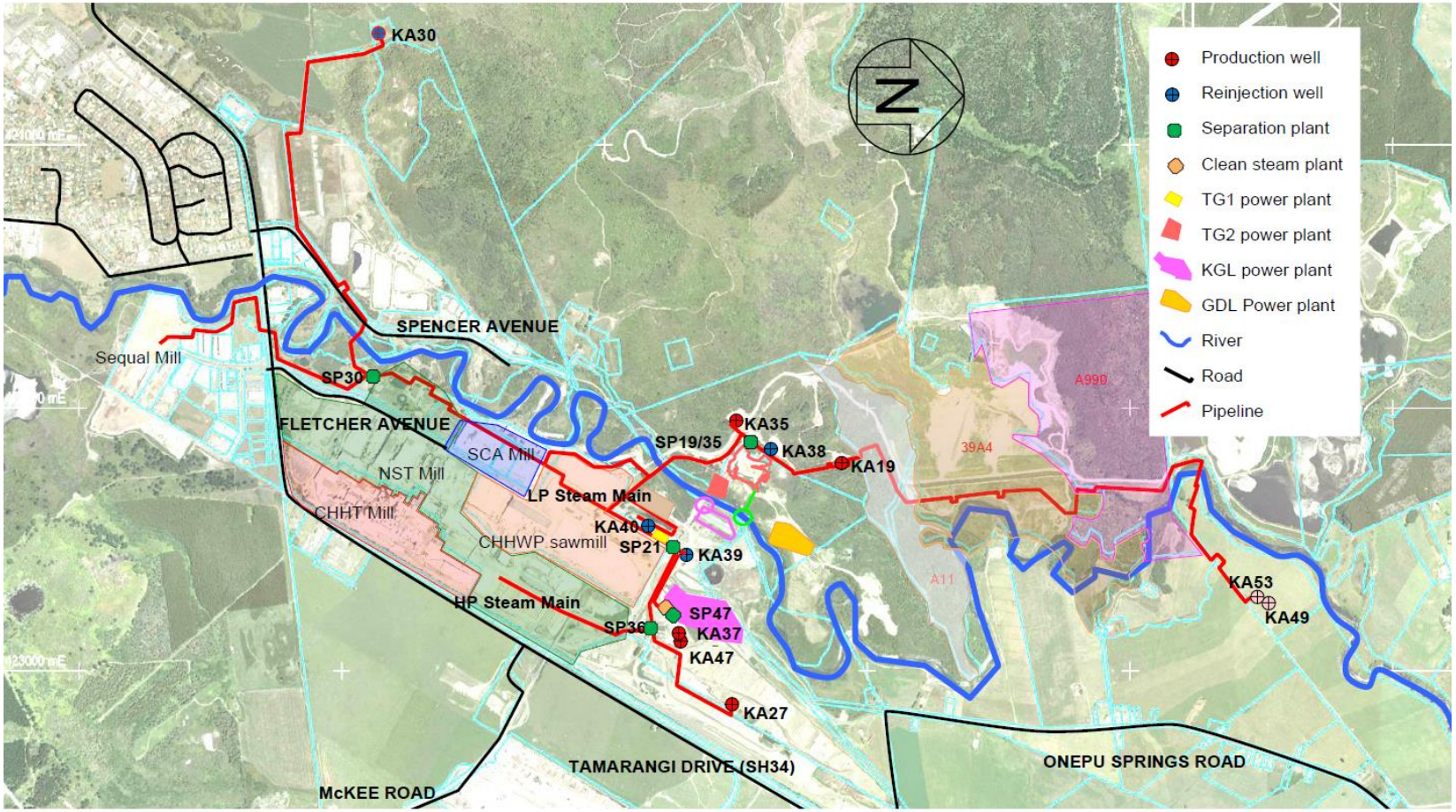


NTGA Operations

Geothermal energy supply infrastructure:

7 in-service production wells – enthalpy from 1000 - 1200 kJ/kg, WHP from 10 – 35 barg

4 two-phase separators – required in liquid-dominated geothermal systems

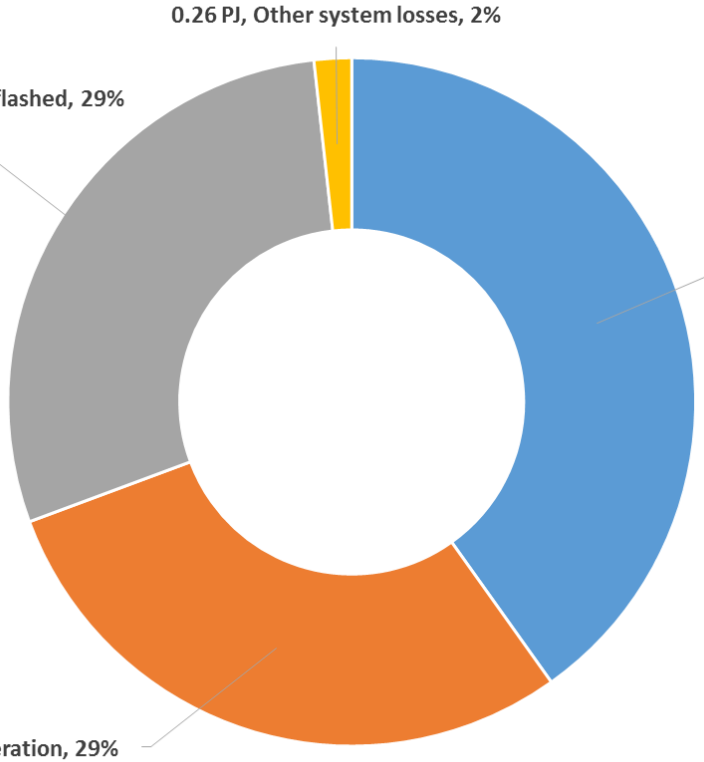
1 high-pressure clean steam plant – for food-grade, hygiene products processing

5 reinjection wells – 3 wells at less than 300m, 2 wells at 2500m depth

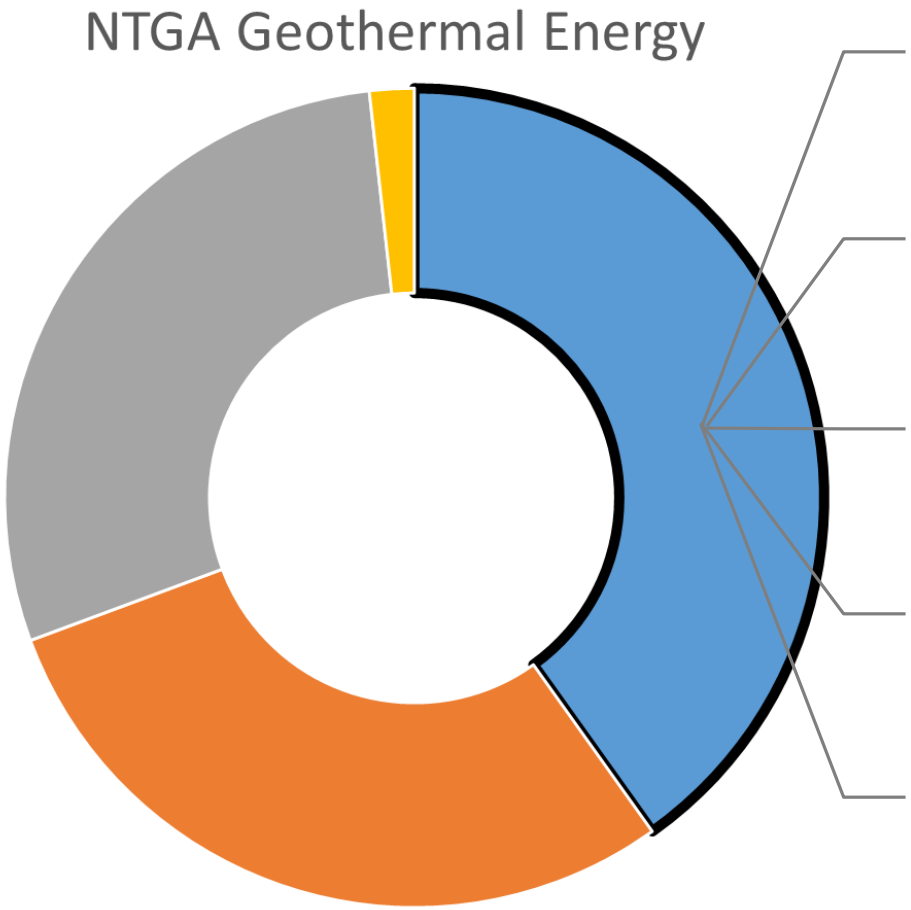
Pipelines – two-phase, steam, hot water, steam condensate

NTGA Operations

NTGA Geothermal Energy for 2017



NTGA Direct Heat Use



39% reduction in GHG emissions for Asaleo Care

16% renewable energy in Oji Fibre solutions total energy requirement

60+ years of renewable steam supply to Norske Skog Tasman

Increased value from kiln-dried timber for Sequal Lumber

Supports sustainable timber drying at CHH Woodproducts

Direct Heat Challenges

Different requirements versus available geothermal fluid at wellhead

- Direct geothermal vs clean steam
- Different operations require different pressures and temperatures
- Steam demand quantities for individual customers are relatively small compared with output from a good well → a need to cluster together

Utilisation factor is generally lower than power generations

- Direct use customers generally have lower utilisation factors (70 to 90%) than electricity (95%)

Asset management

- Operating a highly interconnected network of pipelines
- Adapting surface infrastructure to geothermal reservoir changes – fluid enthalpy and geochemistry changes
- Managing corrosion and scale deposition in wells and surface facilities

New Possibilities

10.7 PJ of consented energy take

4.3 PJ of energy for cascade use

Kawerau Dairy clean steam supply

Particle board manufacture

Dried sawdust pallets

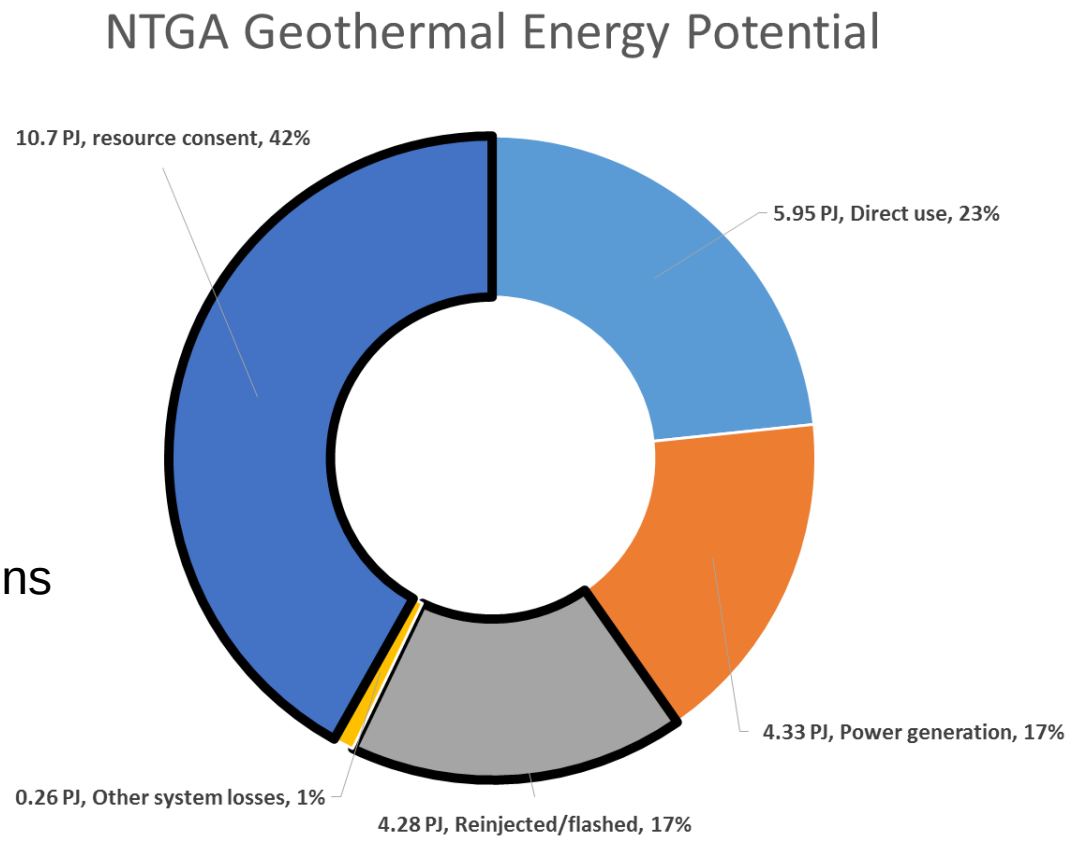
Increased supply to Oji Fibre solutions

Horticulture/aquaculture

Tourism

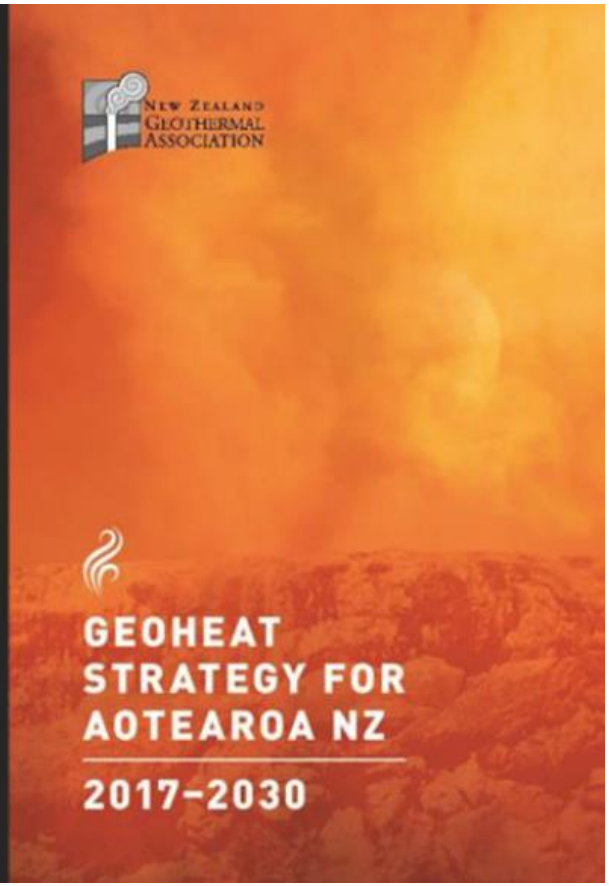
Power generation

Cascade uses



New Possibilities

- The GEOHEAT Strategy seeks to unlock untapped potential, capitalising on interest in renewable geothermal energy, assisting to coordinate efforts and resources of industry and government, to drive increased interest and direct geothermal utilisation.
- Implementing the GEOHEAT Strategy will assist in meeting New Zealand's energy needs and strategic energy targets, contribute to economic and social development, and further New Zealand's commitment to increased renewable and clean energy use.



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Kia ora!