

## Geothermal Down-Bore Heat Exchanger Project – New Zealand

### SUMMARY

**Project Description:** Harnessing Geo-thermal energy at YHA Rotorua

**Project Type:** Geothermal

**National Association:** YHA New Zealand

**Project Location:** YHA Rotorua

**Estimation of number of reduced tonnes of CO2 per year:** The project will save at least **38 tonnes** of CO<sub>2</sub>-e per year, representing a reduction of approximately **30% of the total carbon footprint** for the hostel per year.

**Total Funds Requested:** £ 25,000

**Total Project Cost:** £ 28,500

**Annual £ saves and ROI (return of investment):** £4,750 per year

**Extra Benefits:** The savings realised from installation of the down-bore heat exchanger would be reinvested to support YHA's commitment to reduction of its carbon emissions. A prime candidate for re-investment is YHA Auckland International. This is because this hostel emits 15.56 tonnes CO<sub>2</sub>e per year as a result of natural gas consumption for production of potable hot water. We believe that with some investment this can be significantly reduced. A proposal to install hot water heat pumps in this hostel would therefore be instigated.

### Why should this project be funded ahead of others?

YHA New Zealand proposes to install a geothermal down-bore heat exchanger in its YHA Rotorua hostel. This hostel produces a significant amount of YHA's total carbon emissions because it currently uses natural gas and electricity for its energy requirements. There is a unique opportunity to significantly reduce these emissions by using geothermal activity, of which there is plenty in the geothermally active city of Rotorua. Located right on the hostel site is a geothermal bore from which YHA has permission to remove heat. A heat exchanger would be installed down the bore to heat the potable hot water supply for the hostel.

The savings achieved from YHA Rotorua would then be invested in the YHA Auckland International hostel to install hot water heat pumps to replace the current and inefficient natural gas powered system for production of potable hot water.

YHA New Zealand has a long-standing commitment to environmental sustainability and acting as a catalyst for change for its members and guests. Funding a project such as this will support YHA's goal to be an exemplar for environmental sustainability both within New Zealand and in the HI community. Most importantly YHA's members and guests will learn more about the use of renewable geothermal energy when they stay at YHA Rotorua.





**Help YHA New Zealand harness its boiling pools of geo-thermal energy that are currently underground below the YHA Rotorua hostel. Guests will learn more about geo-thermal power and environmental sustainability. It will cut greenhouse gas emissions at the hostel and the savings will help cut emissions at one of YHA New Zealand's largest city hostels.**

## **DETAILED PROJECT INFORMATION**

YHA New Zealand was one of the first national member associations of HI to formally adopt its Environmental Charter and reported in its 1996 Annual Report that its progress was foremost amongst the then 64 member associations of HI.

For YHA New Zealand this long-standing concern for the environment has naturally progressed in the past decade into concern for the climate. YHA New Zealand is committed to combating climate change within all aspects of its business, as the hard reality is that every aspect of hostel accommodation operations has an impact on the environment, something that YHA believes it cannot ignore. To have continued success as a tourism business in New Zealand is to be inextricably tied to the country's clean green image in alignment with the New Zealand Government's 100% Pure New Zealand brand.

YHA New Zealand has formalised its commitment to environmental sustainability within its Mission Statement and its Sustainable Development policy. YHA New Zealand's Mission is:

*'To deliver services to members which enrich their understanding of others and the environment by providing quality accommodation and travel experiences'*

YHA New Zealand is committed to sustainable development, which is defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. This commitment is expressed through triple bottom line reporting, considering not just its economic performance but also its social and environmental performance. It is the responsibility of Y

YHA's Senior Leadership Team to ensure that the triple bottom line principles are communicated and understood across YHA, and that appropriate measures are established, recorded, maintained and reported.

From the senior management and Board to front-line Hostel staff, the commitment to sustainability is an integral part of YHA's organizational culture and forms a vital part of recruitment, induction, position descriptions and performance appraisals. Sustainability is all pervasive in YHA New Zealand's policy, procedures, operational systems and long-term strategy.

## **Rotorua History**

New Zealand is where the Pacific and Australian tectonic plates collide, and nowhere is this more evident than in the city of Rotorua and the lake it surrounds. The region's thermal activity started with



Lake Rotorua. It may be beautiful and peaceful today, but this lake has a violent history. Mt Tarawera looms over the region 25km southeast of Rotorua. One of several large volcanoes in the region, its underlying magma chamber collapsed after a massive eruption around 200,000 years ago. The collapse created a circular caldera about 16km wide, which filled with water to form the North Island's second largest lake. Lake Rotorua and the region's other 15 lakes are connected with the Rotorua caldera and Mt Tarawera.

Bubbling mud pools and spectacular geysers are proof of Rotorua's volcanic background. This thermal activity makes itself known in every corner of the city, and is the reason for the area's famed sulphur scent. Clouds of steam drift across towards YHA Rotorua Hostel from Kuirau Park, home to boiling mud pools, crater lakes and sulphur vents.

Rotorua's geysers and mud pools are now among the city's biggest draw cards. The main thermal areas are Whakarewarewa, Waimangu Valley, Wai-o-tapu and Hell's Gate. Fumaroles, geysers and silica terraces displaying amazing colours can also be found within minutes of the city centre.

The renowned Pohutu geysers, and geysers elsewhere in the region, are also attractions. Pohutu geyser, in the Whakarewarewa Thermal Valley, erupts several times a day.

### **YHA Rotorua**

YHA Rotorua is a 5 star and Enviro Silver Qualmark rated and HI-Q Level 2 hostel. It is staffed 24 hours a day and offers excellent amenities. <https://www.yha.co.nz/hostels/north-island-hostels/yha-rotorua/>

The hostel accommodation includes multi-share rooms, twin and double ensuite rooms and standard double rooms. It is located in Rotorua's central business district only a short stroll from geothermal attractions.

The clean, modern and secure hostel is also an active member of the **Rotorua Sustainable Tourism Charter** - recycling, energy efficiency and biodegradable laundry powders and cleaning products are just some of the measures taken at YHA Rotorua.

### **The Project**

YHA Rotorua has access to a geothermal heat source via a geothermal bore that is currently located on the hostel site. YHA New Zealand has resource consent from the Bay of Plenty Regional Council to remove heat from this bore site via a down-bore heat exchanger. To date this has not been implemented and instead YHA Rotorua has relied on natural gas and electricity to provide its energy requirements.

Installation of a down-bore heat exchanger would result in the heat energy from the geothermal bore being used instead of natural gas to heat the potable hot water supply for the hostel.

The geothermal bore is rated at 70oC at its 45 metre depth. The potable water will be piped from the bore into the hostel mechanical plant room where hot water storage tanks will be installed to hold the hot water until it is required by the hostel guests.

The capacity of the existing bore will unfortunately not be able to supply the entire requirements of the hostel. Natural gas will still have to be used in times of high demand and as a backup during maintenance periods however the geothermal energy will provide 70% of the current natural gas potable hot water heat load thereby reducing the CO2e (carbon dioxide equivalent greenhouse gas emissions) by 18 tonnes per year. Natural gas heating is used for space (room) heating during the winter months and this project will not affect the gas consumption for space heating. Comparisons of previous gas accounts will enable monitoring of effectiveness of the geothermal heat source.

### Project Investment costs

The project costs include the supply and installation of the down-bore heat exchanger, connection and installation of above ground pipework and high grade thermal insulation, supply and installation of hot water storage tanks and associated pumps and controls.

The project budget is NZD \$52,000 + GST (Goods and Services Tax) which at today’s exchange rate equates to approximately GBP £28,500.

### Why YHA Rotorua?

This hostel emits more than its expected share of emissions given its size and annual overnights. The pie chart titled ‘Percentage of GHG emissions for each YHA Hostel 2011/12’ (Appendix 1) highlights that YHA Rotorua is responsible for **8%** of YHA’s greenhouse gas emissions. The reasons for this are many, however there is a unique opportunity due to Rotorua’s geothermal activity to significantly reduce these emissions and it is located right on the hostel site.

YHA National Top ten emissions sources

GHG emission sources	Tonnes CO <sub>2</sub> e 2011/12
Electricity (kWh)	455.02
Natural Gas - distributed commercial (kWh)	169.92
LPG (kg)	94.59
Public transport Air travel domestic (pkm)	72.31
Waste landfilled - No LFGR Mixed waste	26.38
Waste landfilled - LFGR Mixed waste	19.72
Public transport - air travel long haul (econ)	18.94
Petrol - regular (litres)	13.82
Public transport - air travel short haul (econ)	13.31
Natural Gas - other stationary (m3)	9.23
Other emissions	15.95
<b>Total emissions</b>	<b>909.18</b>

The table below titled ‘YHA National Top ten emissions sources’ demonstrates that for the 2011/12 reporting period 18.69% or 169.92 tonnes CO2e of YHA’s total emissions were natural gas emissions. Of this 33% of the total YHA natural gas emissions equating to 56.94 tonnes CO2e is generated at YHA Rotorua. Clearly there is opportunity to improve.

Our calculations are that installation of a geothermal down-bore heat exchanger would result in a 30% or 18 tonnes reduction in total YHA Rotorua greenhouse gas emissions. This would reduce the hostel's emissions to approximately 38 tonnes per year.

The financial impact of this is significant for YHA New Zealand as the table below demonstrates. Once installed, the annual projected savings are NZD \$8667 or approximately £4,750.

YHA Rotorua energy costs (NZD \$)	
2011	\$25,845
2012	\$25,511
2013 - budgeted	\$26,000
2014 - projected	\$17,333

### **Reinvestment of Savings Project**

The savings realised from installation of the down-bore heat exchanger would be reinvested to support YHA's commitment to reduction of its carbon emissions. A prime candidate for re-investment is YHA Auckland International. This is because this hostel emits 15.56 tonnes CO<sub>2</sub>e per year as a result of natural gas consumption for production of potable hot water. We believe that with some investment this can be significantly reduced. A proposal to install hot water heat pumps in this hostel would therefore be instigated.

This would assess the feasibility and cost of heating the potable hot water via heat pumps technology so that the natural gas boilers could be decommissioned. Indicative high level costing are approximately NZD \$55,000 (£30,000) for this project and the savings from YHA Rotorua would provide a strong contribution to this cost.