



# UNDERSTANDING GEOTHERMAL ENERGY

Real-life science, technology, social science investigations from:



<http://www.mightyriverpower.co.nz/Generation>  
> select Geothermal

## TUNING IN TO GEOTHERMAL ENERGY

- How many students have visited Rotorua or any other geothermal area of New Zealand? Ask students to list the things we find in a geothermal area that make them different to other parts of our country, **eg**
  - steaming pools of water
  - bubbling mud pools
  - clouds of steam
  - geysers
- Tell students that the word 'geothermal' is made up of two words – geo + thermal. Use dictionaries to find out what the word means (geo = of the earth; thermal = hot).
- Where do students think that this heat is coming from?



## INTRODUCING OUR GEOTHERMAL RESERVOIR

- Tell students that our earth's interior (like the sun) provides heat and at the centre of the earth (6450 km deep), temperatures can be as high as 5000°C.
  - Have students carry out on-line research at: [http://en.wikipedia.org/wiki/Mount\\_Ruapehu](http://en.wikipedia.org/wiki/Mount_Ruapehu) to find out when the last three eruptions of Mt. Ruapehu took place and their consequences. Tell students that volcanic eruptions bring very hot molten rock (magma) from deep in the earth's interior to the surface where it is called lava.
  - Introduce students to the idea that most of the magma stays deep in the earth's crust where it heats rock and rainwater that has seeped into the earth. This water can be heated to as much as 700°C. Have students speculate on how some of this hot water reaches the surface, **eg**
    - it seeps up through cracks and faults in the earth and forms hot springs and geysers
- Tell students we call this water our geothermal reservoir.
- Can students think of any ways we have and can use this natural resource for our benefit, **eg**
    - Māori use/d it for cooking
    - we promote it because it attracts tourists
    - hot pools and spas for health benefits
    - people use it to heat their houses and pools
  - Introduce the idea that we can use it to generate electricity. Have they any ideas how this is done? List responses.

## Curriculum Links

### Technology:

- Understanding why using geothermal energy technology to generate electricity is a positive way that society can improve its relationship with the environment.
- Developing an understanding of the technological processes involved in this method of generating electrical energy.

### Science:

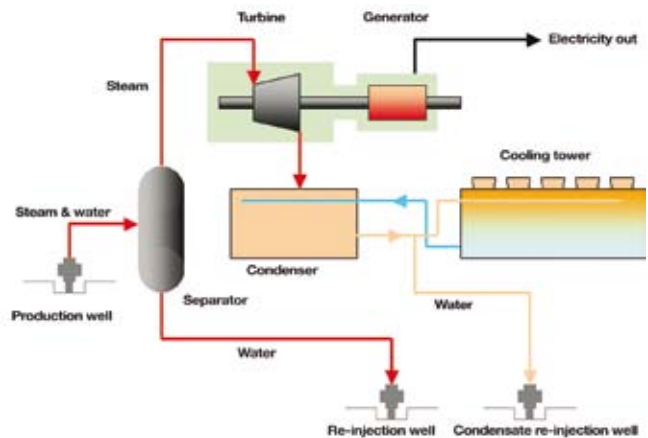
- Understanding that geothermal energy is a natural and renewable form of energy that helps us conserve the Earth's resources.
- Being able to describe and identify the components and processes involved in geothermal electricity generation.

### Social Sciences

- Understanding how and why geothermal energy makes a positive contribution about our access to and use of resources.

## Links to English, Maths, The Arts

Best suited to Curriculum Levels 3-5



## GEOTHERMAL POWER RESEARCH PROJECT

- What is the current student knowledge about how electric power is generated? Ensure students understand the following simple explanation:
  - a turbine is a large machine that is turned by something such as water, wind or steam
  - a turning turbine turns another machine called a generator and this produces the electricity
- Tell students that what ever is used to turn/spin the turbine is the name we give to how the electricity is generated, **eg**
  - if it is water we call it hydro generation
  - if it is wind we call it wind generation ...
- Introduce the idea that when we use steam to turn the turbine, this is called geothermal generation.

# ENERGY FROM INSIDE THE EARTH



**A Giant Steam Turbine that turns the Generator**

- Download the *Mighty River Power Geothermal Power student fact sheet* at: [www.teachingonline.org/geothermal.pdf](http://www.teachingonline.org/geothermal.pdf) and distribute to the students. Use the fact sheet for shared reading and/or for individual and group research. Have students answer, discuss and complete the following activities.
  - *what is taken out of the ground at a geothermal power station?*
  - *how is it taken out of the ground and what special measures are taken to extract the water and steam?*
  - *what are the purposes of the valves and pipelines?*
  - *why are the pipelines covered with insulation?*
  - *what important part is played by the separator before steam is sent to the turbine?*
  - *what is used to turn the turbine and what causes it to spin?*
  - *what generates the electricity?*
  - *what happens to the water after it has been separated from the steam and what happens to the steam after it has been through the turbine?*
  - *list benefits of putting the water back in the ground*
- Spend time to ensure students understand the process by working through the operations using the schematic diagram of the electricity generation process.
- Tell students that the pictures on the page are from the new Mighty River Power geothermal generation station at Kawerau in the Bay of Plenty. Locate Kawerau using atlases.
  - *how many houses can Kawerau produce power for?*
- Have students visit the following site to get a basic understanding of how a transformer works: [www.energyquest.ca.gov/how\\_it\\_works/transformer.html](http://www.energyquest.ca.gov/how_it_works/transformer.html) Ensure they understand that a transformer can also increase (stepped up) the voltage as well as decrease (stepped down) the voltage.
  - *what is the reason for stepping up the voltage once it has left the generator?*
  - *what has to be done to the power voltage before it can be used in our homes?*
- Tell students that in 2007, 8% of our electricity was generated by geothermal energy and that Mighty River Power has interests in three geothermal power stations –

...Mokai, Rotokawa and Kawerau (nearing completion). Have students type in each name in turn into the 'Fly To' box of Google Earth to locate these power stations, **eg**

- *Mokai New Zealand.*
- *Use Waikato option for Rotokawa.*

## GEOTHERMAL POWER BENEFITS

- Remind students that geothermal power is a renewable resource. Have students brainstorm and list other renewable resources we use in NZ to generate electricity, **eg hydro and wind**. Can the students see any advantages that using geothermal generation could have over the other two methods? **eg**
  - *the wind doesn't always blow*
  - *low rainfall/snow melt to fill our hydro lakes?*
- Remind students that we also use coal, gas and diesel to generate electricity in New Zealand. Identify any environmental problems associated with these methods? Why doesn't hydro, wind and geothermal have these problems?
- How much less greenhouse gas does a geothermal station produce compared with thermal stations (30%)?

## CONCLUDING STUDENT ACTIVITIES

- Using the fact sheet, conduct some research on base load generation and capacity and report back on the advantages that geothermal generation has.
- It is the opening of the Mighty River Power Kawerau Geothermal Power Station. In groups, write and produce a radio report that interviews 'people' about the process of geothermal generation and the various components and resources used at the plant.
- Debate: New Zealand must make greater use of renewable resources for future generation of electricity.
- Have all students contribute to a factual account on the hows and whys of geothermal generation in New Zealand.
- Conduct some Google research to find out the locations and operators of geothermal power stations in NZ.
- Prepare a report for the class/school web page on geothermal power and other renewable resources. Include links to relevant websites.



**Bore Testing**



**Mighty River Power Kawerau Geothermal Power Station**