GEOTHERMAL FUELS
PROSPERITY:
NEW ZEALANDS DIRECT USE
JOURNEY

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‘No industry or country can reach its full potential until women reach their full potential.’

Sheryl Sandberg
Women in Geothermal (WING)

WING is a volunteer not-for-profit organisation whose mission is to promote the education, professional development and advancement of women in the geothermal community

- Founded at GRC 2013, in Las Vegas Nevada
- ~1800 members – LARGEST geothermal association in the world!!
- 48 countries worldwide
- 22% male membership

The structure of WING is based on local presence and global connection.
WING Structure
Africa WING Countries

WING Kenya
WING Tanzania
WING Djibouti
WING Ethiopia
WING Eritrea
WING Malawi
WING Rwanda
WING Mozambique
Caity Smith
Caity.Smith@nrel.gov
WING El Salvador

- >150 members (in 12 months)
- First ever women focused group
- WING helps with credibility
- First WINGman David Lopez, country team member, advocate for women
- First ever women in geothermal session at Latin American Energy conference, Aug 2018
Women for Results

Narrated by
Connie Britton
UNDP Goodwill Ambassador
Geothermal Solutions for Global problems

• Access to various water sources
• Provision of food security
• Support decarbonisation efforts
• Employment opportunities
• Economic development of poor, rural and isolated communities
• Increased prosperity of indigenous peoples and local communities

World Populations projected to 2100 (United Nations Department of Economic and Social Affairs, 2015)
Water

Provide access to more and previously unusable water.

• Access to fluid through geothermal energy production (wells, condensate)

• Geothermal energy for desalination

The unit uses ~61°C (well head temp) fluid at a 50 m³/h flow-rate to produce on average 3.24 m³/h of fresh water (SETIS, 2016)
Food production and processing using geothermal heat.

**iidea Geothermal Food Dehydrator**

- 20 million tonnes of food waste per year
- 40% fruits and vegetables
- Main exporter of fruits and vegetables to the US
- Pilot at Domo de San Pedro geothermal field, Nayarit, Mexico
- Dehydrating pineapple, guava, mango, pear, papaya, shrimp
- Two containers producing 2kg dehydrated product per day using 50t/hr of 90°C fluid
- Mango requires 7.73kW/kg energy for dry product
- Commercial production (conservatively) 1,000kg/day, 60 (direct) & 150 (indirect) jobs, reduce CO2 emissions by 480t/year, fuel savings US$120k/year
- Nationwide deployment

Images of Nayarit GHD, Jimenez, 2018
### Employment

- Once constructed geothermal power plants require few but highly skilled staff (~0.5-2 persons/Mwe)
- Geothermal direct use project require much larger numbers

<table>
<thead>
<tr>
<th>Business Name</th>
<th>Activity</th>
<th>Size of operation</th>
<th>Geothermal Energy Used</th>
<th>Geothermal Field</th>
<th>FTE*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Miraka</td>
<td>Milk processing facility</td>
<td>~300ML/year milk processed into milk powders and UHT</td>
<td>~2,400t/day clean steam from 2 pre-existing wells</td>
<td>Mokai</td>
<td>~120</td>
</tr>
<tr>
<td>Tenon</td>
<td>Timber Drying</td>
<td>150,000m3/year of timber dried</td>
<td>Geothermal heat plant with an installed capacity of 27 MW to heat 9 timber drying kilns. Consented take of 4110 tonnes/day of ~209°C fluid</td>
<td>Tauhara</td>
<td>265</td>
</tr>
<tr>
<td>Huka Prawn Park</td>
<td>Aquaculture tourism (Prawns)</td>
<td>~7.8 tonnes of prawns produced per year</td>
<td>450 tonnes/hour (~115°C) cascaded fluid from binary plant</td>
<td>Wairakei</td>
<td>60</td>
</tr>
<tr>
<td>Asaleo Care</td>
<td>Tissue &amp; Toilet Paper Manufacturing</td>
<td>~50,000 tonnes/year of tissue product</td>
<td>254,510 GJ energy from geothermal steam (2016)</td>
<td>Kawerau</td>
<td>~200</td>
</tr>
<tr>
<td>Norske Skog</td>
<td>Paper production (Newsprint)</td>
<td>~150,000 tonnes/year paper production</td>
<td>3600 tonnes/day consented (~185°C), Including TA3 generator producing 9MW using 140t/hr steam</td>
<td>Kawerau</td>
<td>161</td>
</tr>
</tbody>
</table>

Examples of New Zealand Industrial Direct Use Operations – Size and Employment (Blair, 2018). (* FTEs = Full Time Equivalents. Including all people working onsite at the operation, and excluding suppliers of steam and other contractors e.g. maintenance etc)

Note: most direct use projects are viable due to the initial costs associated with accessing the fluid are covered by the development of geothermal power plants first.
Economic Development

Embedding geothermal into products

Create environments that are different from host locations opening up new markets and revenue streams.

Oserian flower farm, Kenya

- Leased well from KenGen
- Growing temperature and conditions that would otherwise not be possible
- Largest producer of flowers in Kenya, with major exports to Europe
- Started with Statice, now roses carnations and ‘fillers’

Figure 9: Oserian Flower Farm (Source: Harvestflowers.co.uk)
Indigenous Peoples

USAID Kenya Exchange

• Ngati Tahu Tribal Lands Trust and Contact Energy met with the Maasai (Kenya) and KenGen (Kenya)

• Share experiences, lessons and provide guidance on strategies and tools to support long-term positive relationships

• Maasai developed a strategic plan to 2050 to support their social, environmental and economic aspirations

• KenGen is formalising a community engagement framework to support the Maasai achieve their goals

“Indigenous communities have unique relationships and values when it comes to geothermal resources and the natural environment and that recognising this, alongside the unique aspirations of the community are critical to building meaningful relationships into the future.” (Campbell, 2018)
“We went to Kenya. We delivered. We left knowing that Ngati Tahu & Contact Energy will become part of the Olkaria Maasai history”
Aotearoa – New Zealand
The Tāupo Volcanic Zone

GNS Science
‘There is food at the end of my hands’

A person (or people) should use their abilities and the resources around them to create success for them and future generations.
Kaitiakitanga

‘Māori are tangata whenua. Not people in the land or over the land, but people of it.’ (Jackson, 1993:71)

Ngātoroirangi Rock Carving, Mine Bay, Lake Taupo. Credit: Flickr by Abaconda Management Group/ CC BY-SA 2.0
NZ Geothermal Electricity

~1010 MWe installed capacity
1MW=~1000 heated homes
Geothermal Cascade Use
Geothermal Direct Use
Direct Use Geothermal

GeoHeat Strategy target by 2030:

• 7.5 PJ/year additional geothermal direct use

• 500 new jobs in geothermal related businesses

nzgeoheat.org.nz
Geothermal Business Development Lead

Act as a catalyst and connector, cutting across multiple strategies and delivering on investment in and development of the direct use geothermal industry.

Primary Focus

- Brownfield developments
- Industrial and commercial scale projects
- Stocktake of assets, infrastructure and resources
- Develop market value proposition (market side)
- Identify targets – large heat users
- Support/lead pitch to likely targets
- Use central government support mechanisms and resources to attract and convert investment
- Stimulate demand
Geothermal BDL

Secondary Focus
- Advocate for support of direct use geothermal
- Showcase direct use geothermal

Out of Focus
- Greenfield developments
- Residential scale use
- Heat Pumps
- Education/Advice
Geoheat Action Group

• Volunteers working together to complete actions

• Stakeholders engaged: Generators, regulators, industry, engineers, science, iwi, service industry

• Focused on talking outside the geothermal industry – through presentations, papers in other industry conference e.g. wood processing, aquaculture

• Writing papers to get info into the public forum for discussion

• Develop key messages

• Engaging with central government and other key influencers

• Governance Group: Provide oversight, Sounding board for high level strategy direction, and provide wisdom and encouragement
Good for our communities

Good for our nation

www.nzgeoheat.nz
Co-location of Resources

Comparative energy costs in NZ

- Geothermal - direct: $5.01
- Biomass: $7.81
- Coal: $7.97
- Gas: $9.90
- Wood pellets: $10.59

Legend
- Geothermal Field Management Group
  - Yellow: Conditional/Limited development
  - Red: Development
  - Green: Protected

Source: Contact Energy
Miraka

- Established 2011
- 70,000 cows from 100 farms within 85km of plant
- 300ML of milk processed annually
- Exports milk powder and UHT products
- Geothermal steam for processing operations
- Waste solids go to worm farm and fluids are used for irrigation
- Product development: Whai Ora smoothies, Taupo Pure Powders
Integrated Use

Dairy Operation

Glasshouses

Miraka

Geothermal Power Station

Worm Farm

Native plant Nursery

$
Integrated Use
The Rogue Bore

• New Zealand craft beer, brewed by the earth

• The world’s first closed loop geothermal brewery - completely powered by excess energy direct from the geothermal bores at Wairakei Power Station, just north of Taupō.

• Utilising waste energy taking excess process heat from the power station’s reinjection lines.

• Absolutely everything will be powered by geothermal energy i.e. the brewing equipment, refrigeration and heating, cooling and running of the restaurant and bar.

• Minimise water use as much as possible. Constant monitoring of water usage and recirculate/reuse where possible.

• The bulk of beer waste and food residue for stock feed (conveniently, one of the owners is a farmer so it all goes to an environmentally friendly farm).
**Performance**

**Figure 1** plots actual FTE generation since strategy inception and compares this with a linear projection of job growth out to the Strategy target of 500 new FTE’s created by 2030. Figure 1 shows that actual FTE’s are tracking ahead of the linear projection.
Key Learnings

1. You need a CHAMPION!!

2. Rapid opportunity evaluation. Minimise time spent on dead ends - move fast

3. Pursue small number of strong probabilities rather than many low-moderate possibilities

4. Don’t look for investors or work directly with consumers, rather partner with sales channels to accelerate access to market

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Key Learnings

5. Chase growth products with large ready-made offshore market

6. No products that require offshore legislative or building code changes, or could not be exported cost effectively

7. The economics come first and ‘green’ operation is a close second

8. Co-location of resources - focus on using geothermal to enhance industry that already exists

9. Look for patterns

10. Talk outside the geothermal industry
Women Spend The Money

“Consumption is the one area of the economy where women don’t need to beg for power because they already have it.”

— Professor Linda Scott, DoubleXEconomy