Scene Setting | Melissa Clark-Reynolds

- **Foresight Practitioner**
- **Professional Director**
- **Technology entrepreneur 30+ years**

Melissa Clark-Reynolds
FutureCentre.nz

Challenges & Opportunities for Geothermal & Horticulture

Melissa Clark-Reynolds
FutureCentre.nz
Melissa@Futurecentre.nz
July 2023

Signals from the Future

Big Trends in Food Consumption

- Eating less meat
- Self Care
  - Over consumption
  - Interest in macros
- Newness
- Regenerating nature, animals, farmers
- What is cooking?
- Gourmet on the run
- Farmers of the Future

INDUSTRY AT A GLANCE

Current state

$6 B
in annual sales

40,000+
in regional jobs

3700
growers use assurance programmes (NZGAP, GlobalG.A.P.)

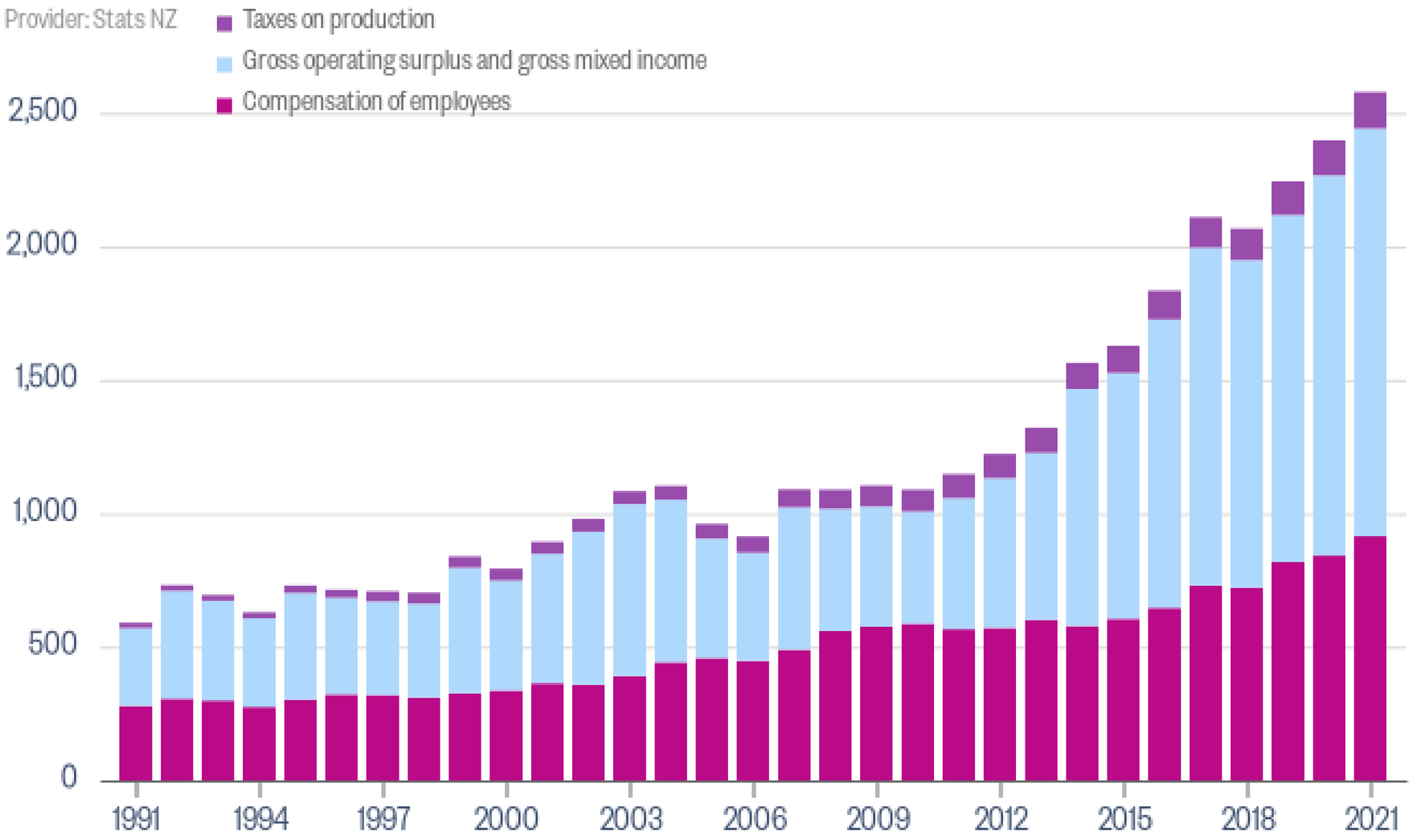
12
horticulture partners in GIA biosecurity agreements

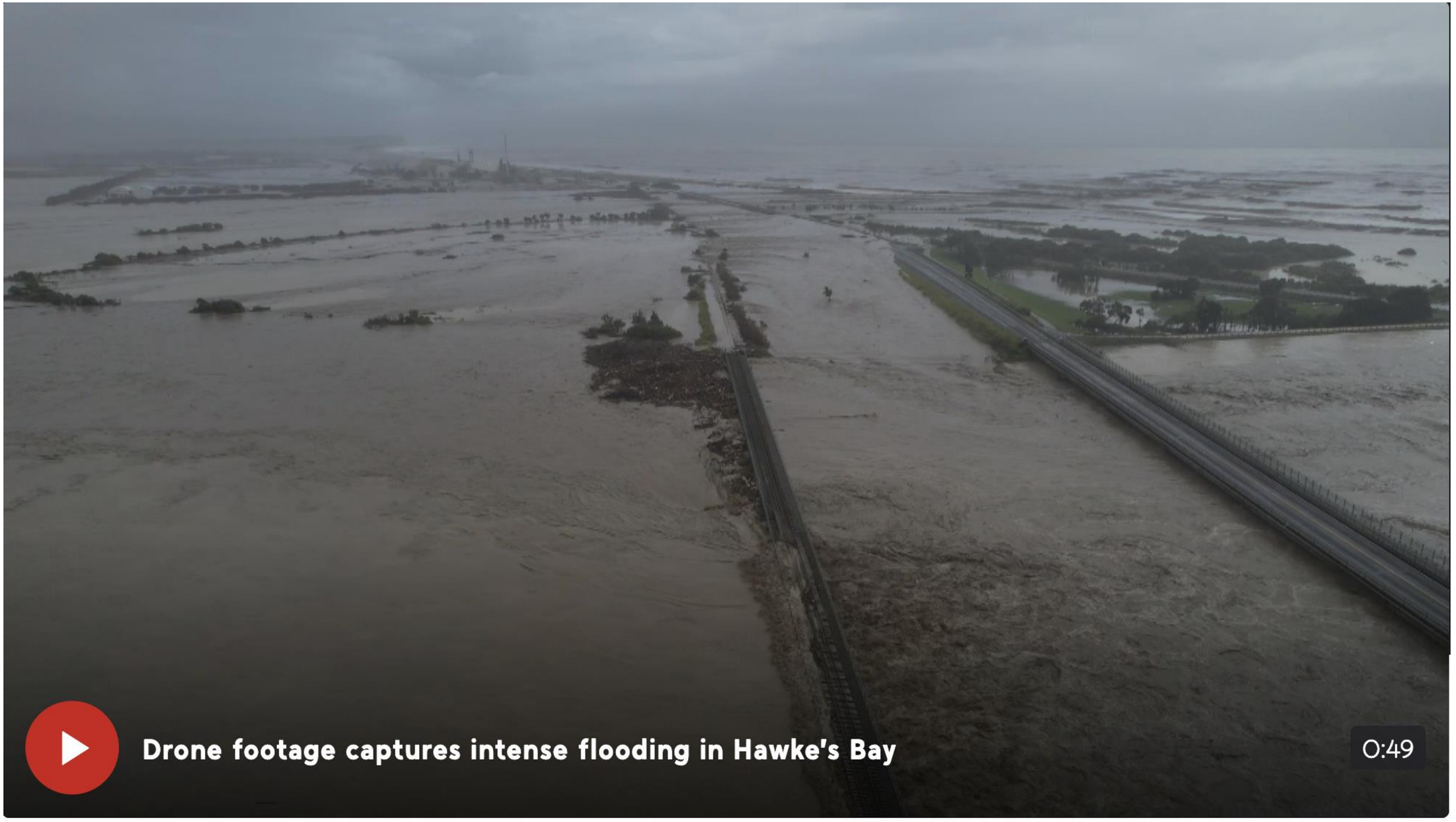
5500
commercial growers

figure.nz

Contribution to GDP by the horticulture and fruit growing industries in New Zealand

By component (excl. subsidies), year ended March 1991–2021, NZD millions (nominal)




Drone footage captures intense flooding in Hawke's Bay
0:49

Alpine Energy enables electrification and decarbonisation at WoolWorks

21 June 2023

Alpine Energy is proud to partner with WoolWorks, the world's largest wool scourer, in its remarkable decarbonisation journey. This case study highlights the successful collaboration between Alpine Energy and WoolWorks, showcasing the electrification of WoolWorks' Canterbury wool-scouring site and the significant benefits achieved through this sustainable initiative.

Objectives

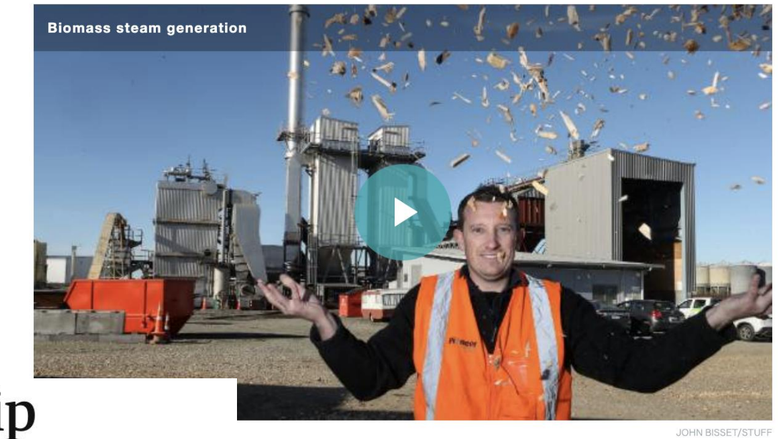
The primary objective of the partnership between Alpine Energy and WoolWorks was to enable the decarbonisation of WoolWorks' Timaru facility.

US renewable energy farms outstrip 99% of coal plants economically – study

It is cheaper to build solar panels or cluster of wind turbines and connect them to the grid than to keep operating coal plants

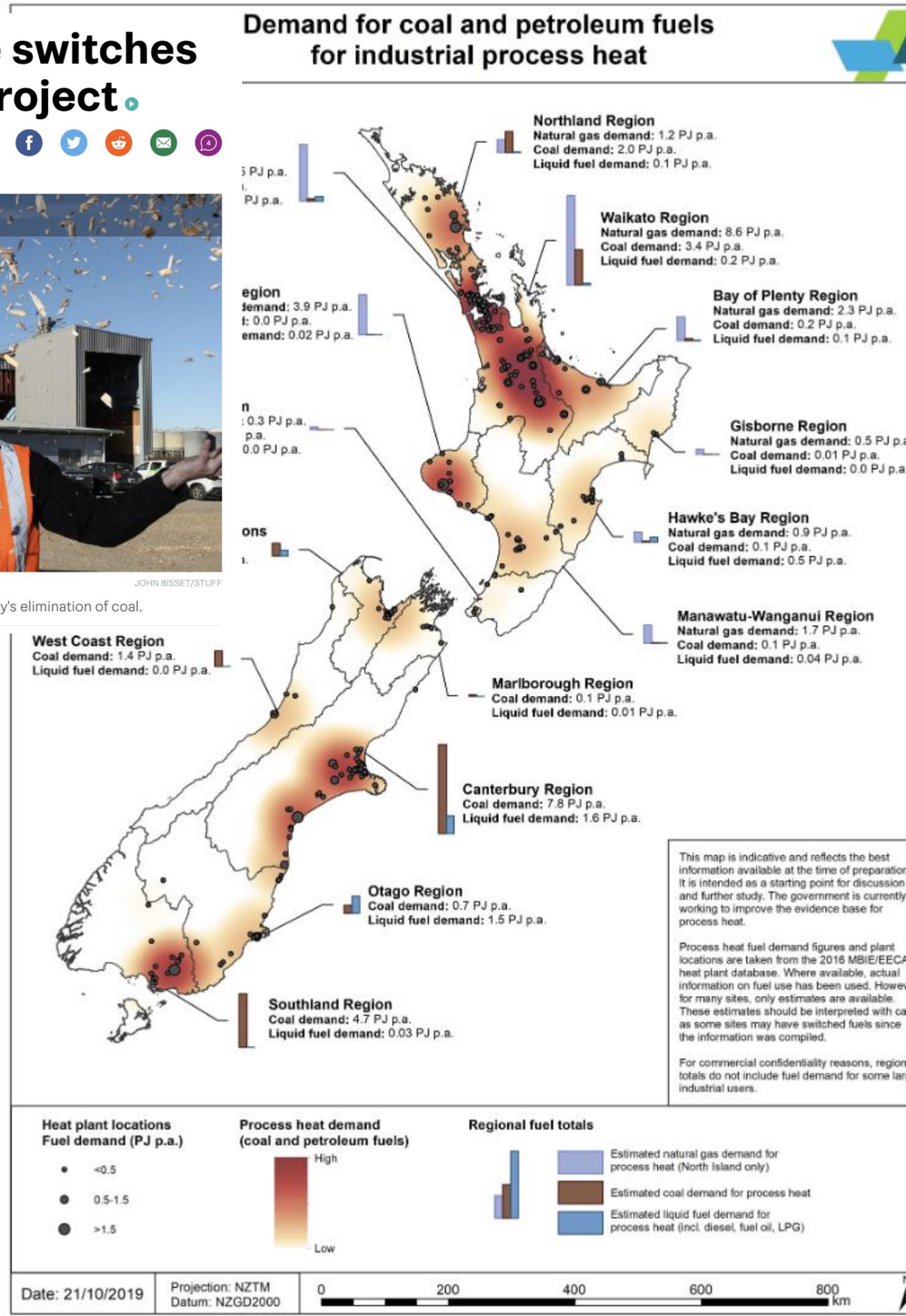
Timaru energy centre switches from coal in $2.28m project

Rachael Comer • 16:35, Jun 07 2023



JOHN BISSET/STUFF

e Energy Centre, talks about the company's elimination of coal.



HIRANGA WHAKAMAHI
WORLD-CLASS FACTORY

Miraka is one of just two dairy factories in the world powered by geothermal energy, using nature's heat to dry and process our milk products.

We make milk, not waste. Milk that doesn't make it through the production process is taken to a local worm farm, where worm castings are used to grow trees for riparian plantings. Water from milk processing is re-used in processing or for irrigation.

The use of geothermal energy in New Zealand is displacing around 2 million tonnes of CO_2 annually as of 2016 (Blair et al., 2018).

In 2011 in the lush green valleys of Mokai, north of Taupō, New Zealand, two Māori-owned organisations joined together to build the world's first dairy-processing plant powered by geothermal energy. Their ambition was to use milk production to bring prosperity to the local community, while applying world-leading sustainable farming practices.

KEY PRIORITY 1.5: TRANSITION TO A LOW-EMISSIONS ECONOMY

Reduction plans target investment in key carbon-emitting areas

The Challenge: While it is recognised that some of our growing practices need to change if horticulture is to play its part in reaching climate change targets, there are significant financial and technological barriers holding back the transition to improved systems.

Actions	Outcomes
• Develop and agree on a horticulture sector roadmap for transition to net zero carbon by 2050.	The horticulture sector supports the New Zealand economy to achieve climate change targets.
• Trial mitigations for reducing emissions from crop residues and cultivation.	There is investment in emission-lowering technologies and research for crops and cultivation.
• Identify energy-intensive areas of the horticulture value chain and support conversion to systems that reduce greenhouse gas emissions.	Financial structures support conversion to higher productivity and lower input/ emission systems.

KEY PRIORITY 1.6: OPTIMISE LAND-USE ADAPTATION

Maximise appropriate conversion to horticulture crops as part of informed land use and protection of biodiversity

The Challenge: Appropriate use of our finite land resource must be well thought out, rather than piecemeal, if we are to produce food sustainably into the future.

Actions	Outcomes
• Develop an adaptation blueprint by region and crop to test policy settings and ensure they enable the right crops to be grown in the right places to meet expected future demand (domestic & export).	Settings allow the right crops to be grown in the right places to maximise profitability, environmental care, food security and climate adaptation and mitigation.

Great demand for geothermal greenhouse tomatoes from Turkey

Tomatoes (source: flickr/ liz west, creative commons)

This 2-Acre Vertical Farm Is Managed by AI and Robots and Uses 99% Less Land

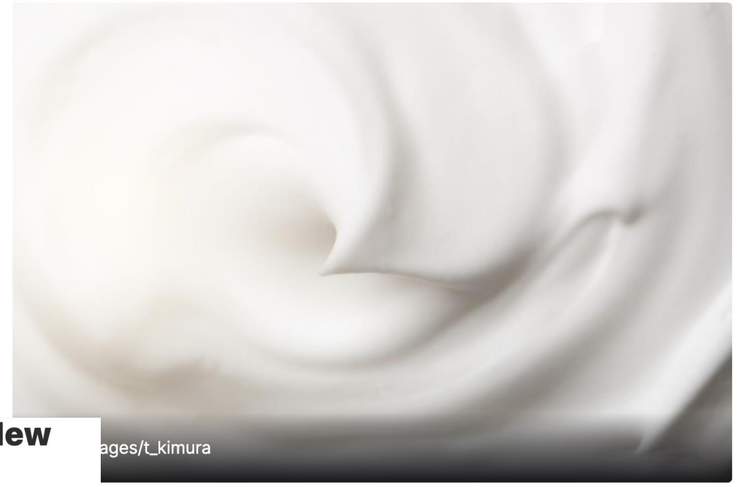
By Samantha Pires on December 29, 2020

Nestlé and Perfect Day's Cowabunga milk is now available in select locations | Courtesy

Wilk serves up hybrid yogurt made with cultivated milk fat

By **Teodora Lyubomirova**
22-Nov-2022 - Last updated on 22-Nov-2022 at 16:18 GMT

SHARE



Mars Collaborates With Perfect Day To Launch New Vegan Chocolate Bar

By **Amy Buxton** — Last updated **Jul 6, 2022**

ALT PROTEIN | CHOCOLATE | FERMENTATION-BASED ALT PROTEIN

Mars and Perfect Day partnered on a precision fermentation milk chocolate | Courtesy

BUILDING THE BIOWORKFORCE OF THE FUTURE

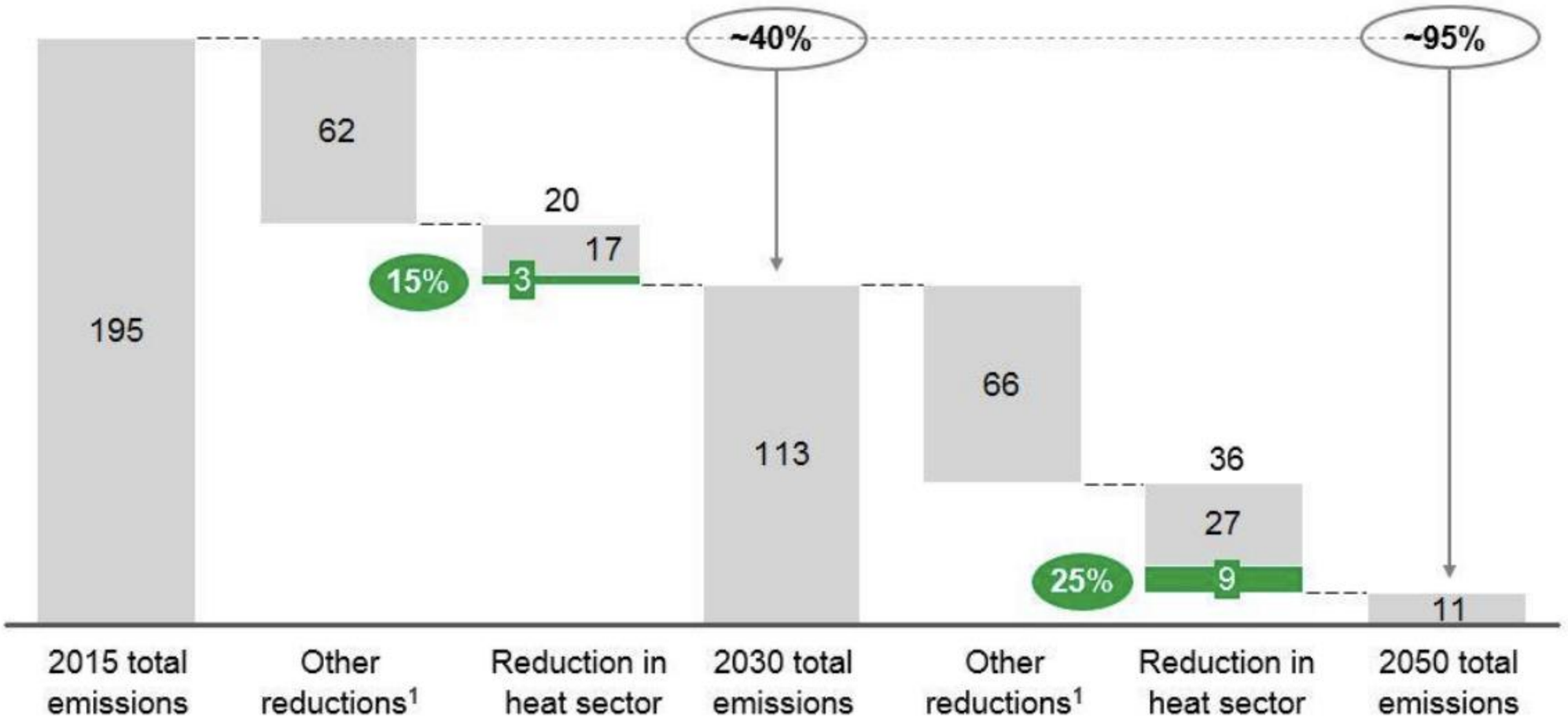
EXPANDING EQUITABLE PATHWAYS INTO BIOTECHNOLOGY AND BIOMANUFACTURING JOBS

JUNE 2023

THE WHITE HOUSE
WASHINGTON

Figure 1: Geothermal energy can contribute 15% to the necessary reduction in CO_2 emissions in the heat sector in 2030, and 25% in 2050

CO_2-eq emissions, in mton



1 Including reduction due to decreasing demand for heat

SOURCE: Coalition Agreement 2017-2021

How Nestlé's climate change decision could affect New Zealand farmers

Craig Hickman . 05:00, Jul 18 2023

UNSPLASH

Last week Nestlé, the world's biggest food manufacturer, buckled under pressure to take action on its environmental impact.

Tesco's warning to New Zealand farmers

Gerhard Uys . 09:51, Dec 19 2022

SAM SCANNELL/STUFF

Farms that send meat, dairy and fresh produce to UK supermarket Tesco will have to have a third party verify their climate actions between 2025 and 2030.

Tariffs for Climate Impact?

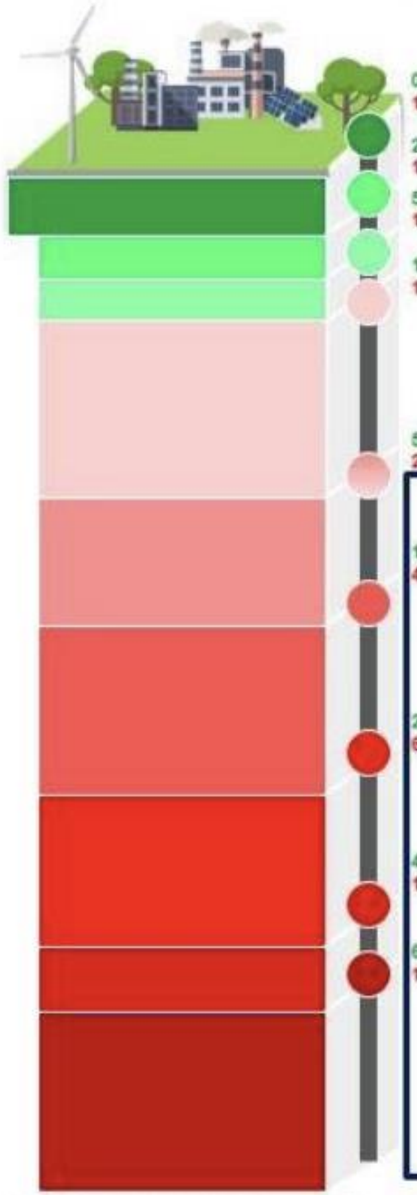
The EU signed the CBAM Regulation in May 2023, with its transitional phase set to commence on 1 October 2023. Initially, the CBAM will apply to specific goods and precursors associated with carbon-intensive production, being cement, iron and steel, aluminium, fertilisers, electricity, and hydrogen. However, this list will be subject to change as the CBAM progresses.

- Immediate impact on New Zealand exporters: Exporters in the carbon-intensive industries will need to meet reporting obligations under the EU's CBAM implementation when exporting to the EU.
- Price increase for New Zealand importers: Importers of carbon-intensive goods may face price hikes throughout their supply chains as suppliers try to pass on the costs associated with the EU's CBAM.
- Monitoring EU's CBAM and Australian mechanism: New Zealand businesses should closely monitor the progress of the EU's CBAM and the Australian mechanism. These developments can provide insights into future policies in New Zealand, allowing businesses to proactively prepare for potential CBAM-related initiatives in the country.

Source: Deloitte

Figure 9: Various types of heat from the subsurface

Component Master Plan



	Name	Goal	Typical end users
0-500 metres	Heat and Cold Storage (HCS)	▪ Excess heat or cold is stored in the ground for use during periods of high demand for heat (winter) or cold (summer)	▪ Heating and/or cooling of buildings
500-4,000 metres	Geothermal energy	▪ Up to depths of 2,000 metres, the temperature is between 30-60 ° C, which requires a heat pump to increase the temperature to the desired value (~80 ° C) ▪ Between 2,000-4,000 metres, higher temperatures can be extracted (60-120 ° C)	▪ Greenhouse horticulture ▪ Urban environment ▪ Light industry
4,000+ metres	Ultra-Deep Geothermal (UDG)	▪ UDG is a method of producing heat with temperatures from 120-250 ° C	▪ Light industry ▪ Generating electricity[1]

1 Not included in the Master Plan

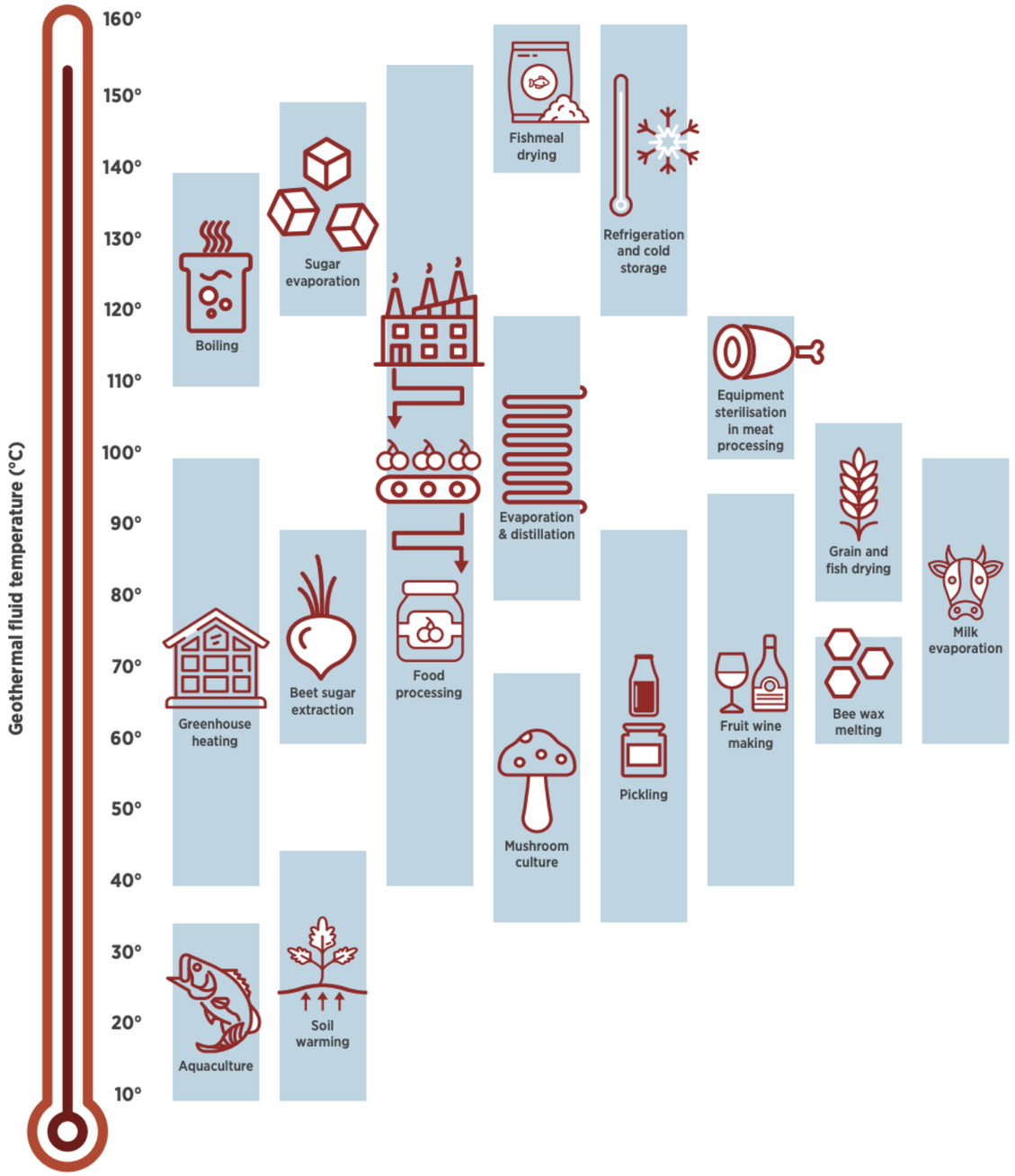
SOURCE: www.hoewerktaardwarmte.nl

Table 2 Geothermal applications in agri-food value chains

Primary production	Post-harvest and storage	Transport and distribution	Processing	Retail preparation and cooking
• Water for irrigation • Heating of greenhouses and soil warming • Aquaculture heating • Sterilisation of soil, irrigation water and substrate for mushroom culture • Enhancing photosynthesis through CO_2 from geothermal sources • Fertiliser manufacture from sulphur • Running of water pumps using geothermal electricity	• Drying and dehydration of grains, fruits, vegetables, meat and fish, etc. • Cold storage and refrigeration (electric and thermal driven)	• Ice generated using geothermal energy • Electric vehicles charged using geothermal energy	• Process heating applications • Pasteurisation, *e.g.* milk • Sterilisation, *e.g.* food canning • Fermentation and distillation, *e.g.* beer, wines and spirits • Evaporation, *e.g.* milk powder • Powering of processing equipment using geothermal electricity	• Pre-cooking, *e.g.* food canning • Baking

Adapted from IRENA, 2019.

Figure 3 Lindal diagram of potential uses of geothermal energy in the agricultural sector



Source: Adapted from FAO, 2015.

Figure S1 Recommendations on priority actions to scale up geothermal deployment in the agri-food sector

Changes in Food Production

- Pressures on Workforce
- Changes in Environment
  - More water, less water
  - Heat
- Changes in technologies
- Need to decarbonize
  - Changes in Energy Use
  - Reduction in transportation
- Controlled Indoor Agriculture with less inputs

Stay Curious

"Imagination is more important than knowledge. Knowledge is limited. Imagination encircles the world."
Einstein

- What does this mean to us? How might this be a threat or slow us down? Where are our blindspots? How might it enable us to amplify the impact we want to have? How might it improve? When the Business Model Changes, what changes?
- What era of would "Free Energy" & Climate Change mean for us?
- How do changes in Food Production change our energy needs?

Nō reira mihi nui kia koutou

Kia manawa

Kia pai te rā

Melissa Clark-Reynolds
@HoneyBeeGeek
melissa@futurecentre.nz