Making CO_2 capture practical for geothermal flash plants

Live site results and global pathways

Lauren Salisbury · CEO

Dr Elnaz Jangodaz · Process Engineer

CAPTIVATE TECHNOLOGY

In collaboration with Mercury

Mercury

90,050

tonnes of CO_2-e

vented at Kawerau, from FY26

Technical challenges have limited deployment of carbon capture and CO2 reinjection in flash plants.

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Captivate is committed to changing that.

- **High-purity CO_2 capture**

  Using a dry, regenerable adsorbent and pressure-vacuum swing process.

- **Tested under geothermal conditions**

  MUF-16 has now conducted small scale, pre-pilot testing on a live flash-plant non-condensable gas stream.

- **Ready for the next stage**

  Site-specific additional testing, process optimisation and then pilot deployment at flash plants.

Introducing MUF-16

A new class of adsorbent, purpose-built for complex geothermal gas streams.

Selective

Strong preference for CO_2 over nitrogen, methane and oxygen.

Stable

H_2S, humidity, sulfur compounds, all tolerated.

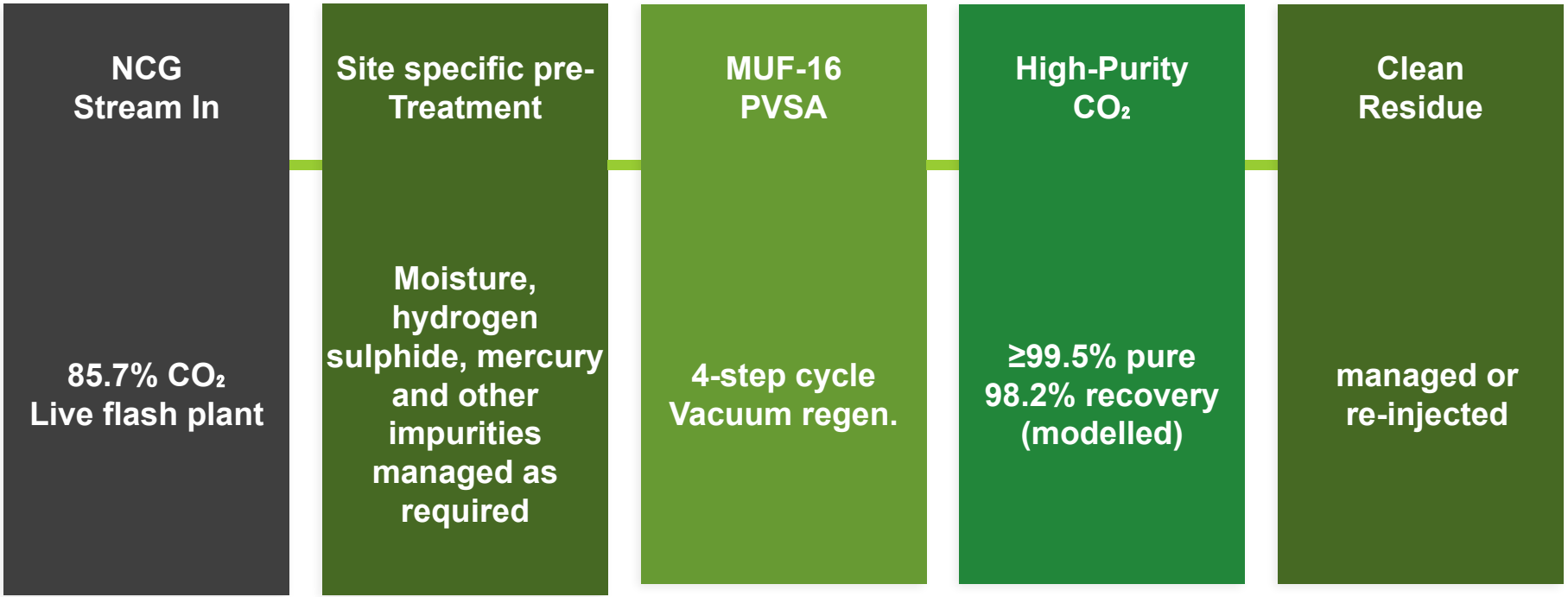
Low energy

<100 kWh per tonne CO_2. Amine scrubbing needs 300–500 kWh/t.

Dry, Toxin Free Process

Vacuum regeneration only. No solvents, no water.

How the Capture Process Works



The process is configured around each plant's gas composition, product specification and destination for the captured CO_2.

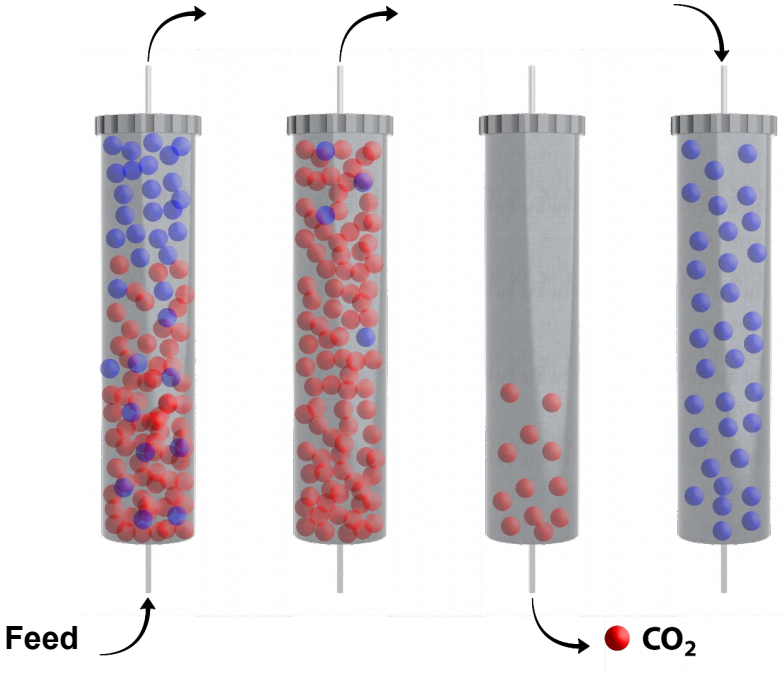
How the 4-step PVSA (Pressure-Vacuum Swing Adsorption) Process Works

Gas passes through pelletized MUF-16 packed in simple adsorption process.

MUF-16's channels selectively grip CO_2 tightly, while rejecting other gases at atmospheric pressure

A mild vacuum regenerates the bed, releasing high-purity CO_2

Low energy and cost
Flexible and easily adaptable to different scenarios



STEP 1	STEP 2	STEP 3	STEP 4
Adsorption	Blowdown	Reverse evacuation	Pressurization

Mercury's objective was to test MUF-16 as a CO2 capture/gas clean up option for reinjection.

We deployed our KEA test rig onsite.

Gas stream

Live Kawerau GES exhaust, not synthetic, not a lab mix

Composition (vol%)

85.7% CO_2 · 3.3% H_2S
3.1% O_2 · 5.6% N_2 · 2.3% CH_4

Two stages

Stage 1: H_2S pre-treated, CO_2 captured
Stage 2: H_2S co-adsorbed alongside CO_2

Post-trial assessment

Performance data was collected during testing, followed by laboratory analysis of the MUF-16 material.

Demonstrated during the live-site trial

- Repeatable CO_2 separation from the Kawerau gas stream
- Hydrogen sulphide did not prevent CO_2 separation, with trace competitive adsorption under the tested conditions
- MUF-16 retained its crystalline structure following the trial

What remains to be proven at pilot scale

- Oxygen optimisation modelling
  (trial reduced 3.6% to 0.7% using non-optimised process, optimisation testing to reduce further).
- Site-specific impurity and pretreatment requirements
- Full-system economics and operational integration

Recovery, purity and energy figures are process-model outputs based on actual Kawerau gas data. They are not yet full-scale pilot results.

The modelled results post testing on site

98.2%

CO_2 recovery

From the full Kawerau NCG stream

99.5%

CO_2 purity

Commercial-ready

67

kWh per tonne CO_2

vs 300–500 kWh/t for amine scrubbing

**excluding compression*

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Modelled on actual Kawerau GES gas composition data · Published under Mercury data use agreement

What we've demonstrated

- ✓ Live geothermal testing completed
- ✓ CO_2 separation demonstrated
- ✓ Engineering pathway established
- ✓ Active testing programme continuing with Mercury

What's next

- ▸ Explore more geothermal fields
- ▸ Different gas compositions
- ▸ Validate operating conditions
- ▸ First Captivate commercial pilot

Mercury trusted us to demonstrate this technology on one of New Zealand's largest geothermal assets.

Together we've shown that selective CO_2 capture from a live geothermal gas stream is possible.

We're now looking to collaborate with geothermal operators to evaluate this pathway across different geothermal fields.

Thanks

Lauren Salisbury · CEO & Founder

lauren@captivatetechnology.com

Dr Elnaz Jangodaz · Process Engineer

elnaz@captivatetechnology.com

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