Closed Loop Geothermal Facility Design for End-of-Life Oil and Gas Wells

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Project Sponsor: GeoGen Technologies Inc.

PROJECT OVERVIEW

GROW Energy completed a feasibility investigation of retrofitting abandoned oil and gas wells to produce renewable baseload electricity with geothermal energy.

- **Meet Canada's goal of net-zero emissions by 2050:** Greenhouse gas emissions and worldwide energy demand are at a record high, driving the energy transition.
- **Utilize some of the 370,000 inactive wells in Canada:** Evade high capital costs and environmental damages of geothermal drilling.
- **Enter USD $63 billion market:** Geothermal market is large and growing with government incentives and regulations.

ENVIRONMENT & SAFETY

SAFETY RISKS

- Overpressure
- Blowdowns
- Surrounding Environment/Community
- Equipment Malfunction

ENVIRONMENTAL RISKS

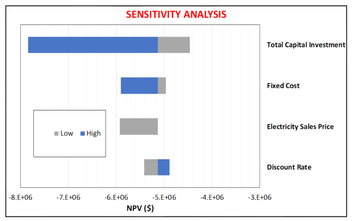
- Venting
- Excess Water
- Blowdowns
- Construction/ Transportation

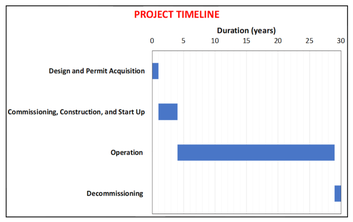
MITIGATION EFFORTS

- Pressure Safety Valves
- Operator Training
- CO_2 detectors
- Personal Protective Equipment
- Temperature, Pressure, Flow Sensors

ECONOMIC ANALYSIS

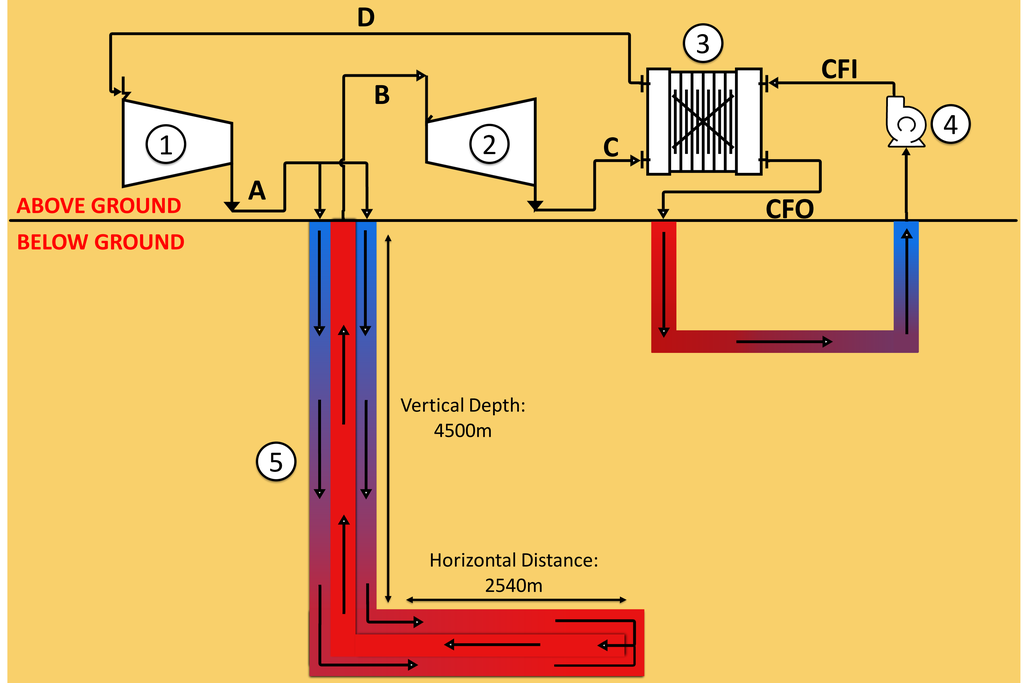
CAPEX: CAD $5,492,794 **OPEX:** CAD $229,294





NPV without incentives	NPV with incentives	Minimum Price of Electricity
-$5,135,411	-$3,859,849	$2.34/kWh

PROCESS DESIGN



1 COMPRESSOR

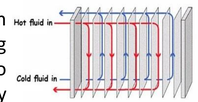
A single stage, isentropic centrifugal compressor is used to drive the supercritical carbon dioxide through the wellbore at an isentropic efficiency of 80%. There is a temperature and pressure increase of the sCO_2 back to the injection conditions of 313K and 10MPa.

2 TURBINE

An expanding turbine is at the exit of the wellbore which uses the high temperature and pressure of the working fluid to drive a generator shaft and produce electricity, with an isentropic efficiency of 75%. There is a temperature and pressure drop to 335K and 7.5MPa.

3 HEAT EXCHANGER

A counter-current plate-and-frame exchanger is used with glycol. It cools the working fluid to create a strong heat to power conversion efficiency and consistent injection conditions



4 PUMP

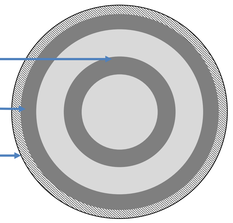
A centrifugal pump drives the cooling fluid, ethylene glycol, through the heat exchanger after it flows through underground piping, which cools it. It has a minor temperature and pressure increase to 293K and 0.1MPa.

5 WELLBORE

Inner Tubing
- 0.053m ID

Annular Casing
- 0.12m ID

Cement
- 0.04m thickness



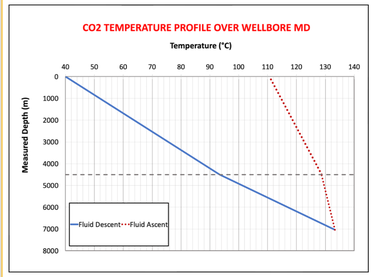
6 WORKING FLUID – sCO_2

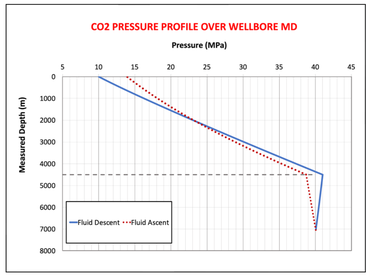
The working fluid is supercritical carbon dioxide:
- Easily accessible
- Low cost
- Eco-friendly
- Attractive thermophysical properties
- Asphyxiant

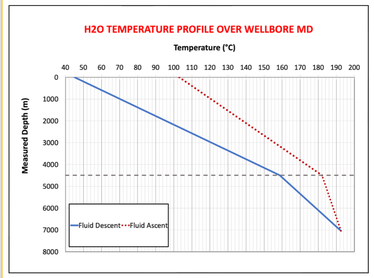
PROJECT OVERVIEW

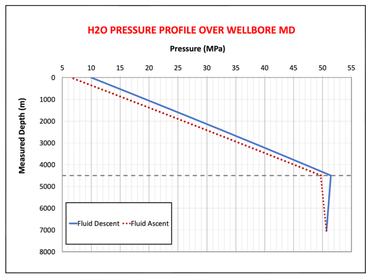
THERMOSIPHON

A thermosiphon is employed to circulate the working fluid without an external driver. The working fluid becomes hotter as it flows in the wellbore, the density decreases, causing the gas to rise to the wellbore outlet, while the colder and heavier fluid sinks to the bottom.









STREAM CONDITIONS

STREAM	A	B	C	D	CFI	CFO
T (K)	313	384	335	304	293	323
P (MPa)	10	13.9	7.5	7.4	0.1	0.1
$\dot{m}$ (kg/s)	3	3	3	3	6.7	6.7
h (kJ/kg)	312	492	469	305	83	205

PLANT PERFORMANCE

- **Turbine Output:** 64.7 kW
- **Compressor Requirement:** 15.9 kW
- **Pump Requirement:** 0.17 kW

NET POWER OUTPUT OF 49 kW

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