

— WHAT'S NEW IN GEOTHERMAL

Geothermal energy is gaining more and more traction as technological advancements, new ideas for mature prospects, and regulations are clearing the path forward.

In this insight, we'll explore how some of the developments in well and casing design for geothermal projects are making geothermal wells cheaper, easier to drill, and more profitable. We'll look at how, in Canada, geothermal wells using technologies developed for the Steam Assisted Gravity Drainage (SAGD) processes in heavy oil production may give new life to the country's oil sands. There's also a round-up of some of the new regulatory frameworks being adopted at international, national and regional levels.

TREVOR RATH, OPERATIONS ENGINEERING SPECIALIST, ASSOCIATE

Developing geothermal systems after Steam Assisted Gravity Drainage (SAGD) use in heavy oil

Canada's oil sands are an unconventional oil and gas resource that contains the world's single largest bitumen deposit – but bitumen deposits at depths of over 75m are too viscous to extract easily. One possible solution could come from Steam Assisted Gravity Drainage (SAGD), a method where natural gas is used to generate steam at temperatures above 200° Celsius. The steam is injected into a well to reduce the viscosity of bitumen in the reservoir, increasing its ability to flow through pipelines. Unfortunately for the heavy oil industry, the gas combustion used to generate the steam causes greenhouse gas emissions and increases operating costs. At the end of an operation, a significant amount of energy, in the form of heat, is lost to the surrounding geological formations, creating an artificial geothermal system – which could be used in geothermal energy production.



A recent paper published in the journal Energy, titled **“Subsurface waste heat recovery from the abandoned steam-assisted gravity drainage (SAGD) operations”**, explores a novel concept. Could the thermal energy from oil sands reservoirs be harnessed, offsetting operating

costs and reducing CO₂ emissions? In many cases, the seismic and formation data, surface facilities and existing wellbore could reduce the development cost and risk compared with a new geothermal development.

Oil and gas technology, experience and expertise transfer to geothermal well design

Geothermal development should use the deep levels of experience and expertise in thermal well design, drilling and operations from the SAGD for heavy oil production. Geothermal wells and heavy oil both face many of the same challenges because heat is heat, and it affects the wellbore tubulars in the same way, no matter the application.

Casing design

While there are many similarities in the design of an oil or gas well to a geothermal well, there are some significant differences that can't be overlooked due to the fluids and temperatures involved.

Standard geothermal boreholes rely on the geothermal gradient to build up heat and consequently can also be up to 6000m deep necessitating a large number of pipe connections (representing a considerable cost factor), but the risk factor and increased risk of individual leakage points caused by corrosion can be decreased by reducing the probability of failure of the fittings. Titanium alloys are one potential solution, as they have shown that they resist corrosion.

A recent engineering study, presented at the SPE Thermal Well Integrity and Production Symposium in November 2022, examined the structural performance and sealability of casing and casing connections made from a proprietary titanium alloy material. Compared with standard **L80, a medium carbon steel**, the titanium alloy connections showed a much more stable sealability response. This was attributed to the elastic response of the pipe body, relatively low thermal stress, and minimal plastic deformation within the connection.

In high-temperature geothermal well applications, the development and use of casing and premium casing connections with titanium alloys could hold potential solutions to improving casing integrity. As a result, wells could be drilled and operated more economically, which is essential to reducing the development cost of this carbon-free energy source.

SPE members can read the complete paper [here](#).

Logging while drilling in extreme heat

There are many limitations to using directional-drilling and logging-while-drilling (LWD) technologies in geothermal drilling environments due to the extreme bottomhole temperature (e.g. 325° C), borehole washout, mud losses and vibration. A novel technique was recently tested on the [Marapi Geothermal Field in Indonesia](#) using a LWD string consisting of electromagnetic (EM) telemetry, pressure while drilling (PWD), vibration (DDSr), and acoustic calliper (ACAL). In real-time and recorded mode, the operator captured drilling mechanics and calliper logs that enabled the effective monitoring and evaluation of wellbore stability, which is critical to drilling effective wells. Compared with conventional tools, the new configuration using EM telemetry provided a three times faster data rate to the surface unit. The advantage of this significantly faster data rate is that borehole conditions became more visible to the directional driller. This, in turn, allows better control while drilling, minimising vibration, and achieving optimum hole cleaning in washed-out or tight formation sequences.

SPE members can read the complete paper [here](#).

Regulatory updates



Global

In October 2022, The United Nations Framework Classification for Resources (UNFC), a globally applicable standard for classifying resources, updated its framework to include geothermal resources. These specifications provide a common methodology for financial reporting, internal resource management and fundraising. Many countries, including Ethiopia, Indonesia, Mexico and St Lucia, have begun to adopt the framework. Queensland, Australia, was the first region to legislate its use. Read more about the UNFC standard [here](#).

Australia

A **draft Bill** to amend the Petroleum and Geothermal Energy Act 2000 (PGE Act) was introduced into Parliament on 25 August 2021. However, it did not progress before the change of government in March 2022.

Alberta, Canada

Directive 089 - Geothermal Resource Development

was released on 15 August 2022. It establishes licencing and operating standards for geothermal development in Alberta. It is designed to encourage the efficient, safe, orderly and environmentally responsible development of Alberta's geothermal resources. This regulation enacts rules governing well licencing, abandonment, drilling, and other production operations. It also establishes administrative standards for recording, collecting, and reporting geothermal well and facility data.

United Kingdom

Unlike water or gas, geothermal energy in the UK has no specific regulatory framework for the licensing, ownership and management of geothermal resources. Currently, geothermal resources are controlled under existing oil and gas or water regulations, and the lack of a bespoke regulatory system has received criticism from UK stakeholders. In a **research briefing from the Parliamentary Office of Science and Technology (POST)**, the authors noted that "industry stakeholders regard certain aspects of this repurposed regulatory system as being over-engineered for regulating deep geothermal energy in the UK. In addition, the multi-agency set-up for deep geothermal is seen as a barrier to deployment by some as it makes the approval process complicated and time-consuming."

United States

In the US, multiple national government agencies govern geothermal resources, such as the federal government, the Bureau of Land Management, and the National Environmental Policy Act. Each state may also have their own regulations.

California

8 February 2022 – **California Geologic Energy Management Division (CalGEM)** released an updated Discussion Draft proposing updates to the statewide regulations for geothermal wells.

Colorado

A bill that modified statutory provisions that apply to solar energy to geothermal energy was passed in **June 2022**.

West Virginia

House Bill 4098 gives the Department of Environmental Protection regulatory oversight over geothermal development was passed early in 2022.

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