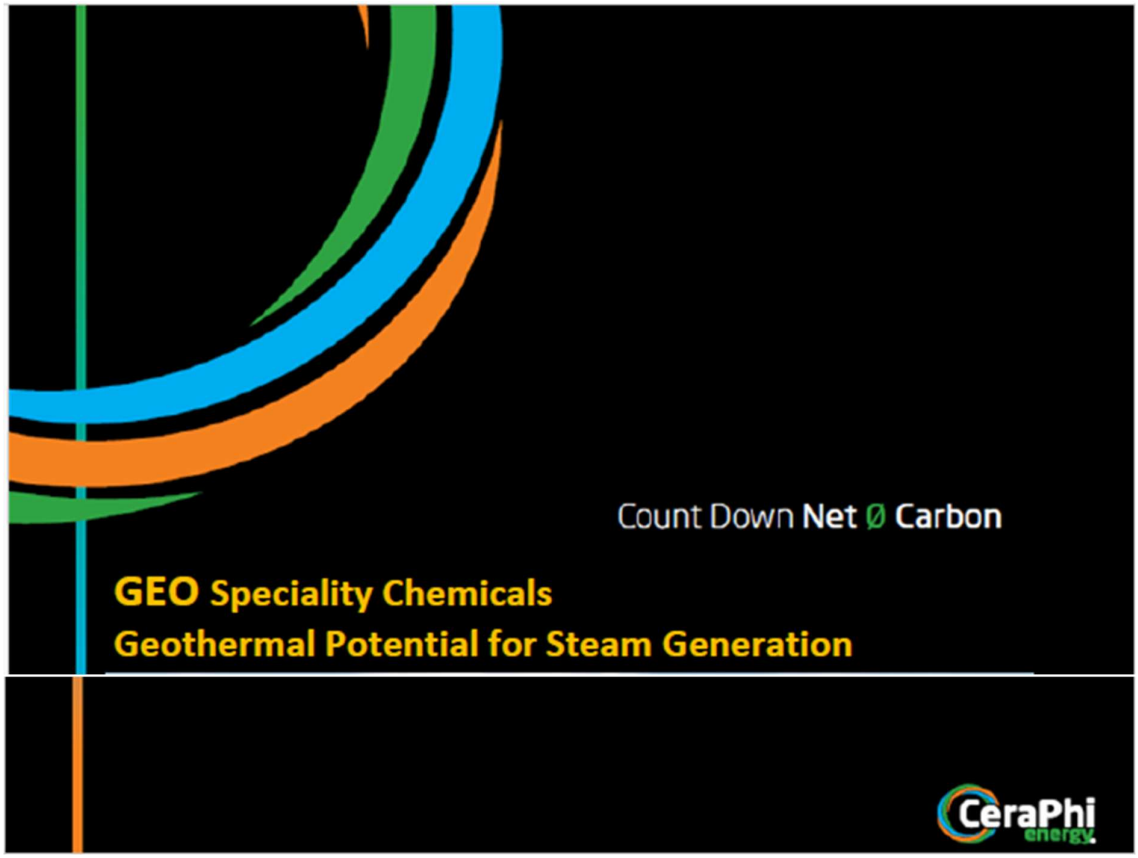

Executive Summary

GEO Specialty Chemicals is a world-leading company that provides high-quality, cost-effective speciality chemicals. The company is looking to replace their gas-powered steam generators at the Hythe site in Hampshire. This report evaluates the commercial viability of installing a geothermal system that could replace gas-powered generators, providing a clean renewable solution.

The CeraPhiWell™ solution proposed in this study operates by circulating a fluid within a closed-loop well. This process harnesses heat energy found at significant depths below ground, transporting it to the surface for delivery to end users. This solution is environmentally clean, requires no natural resources and generates zero direct CO2 emissions. GEO Speciality Chemicals provided CeraPhi Energy with the gas consumption for steam generation at Hythe 2022 and 2023, the estimated power and gas charges for the next five years, process flow diagrams and flow rate, temperature and pressure required in the process.

Three geothermal system solutions were considered in this study, all based on the CeraPhiWell™ technology. The first geothermal system, option 1, consists of a single 5,000m well that will provide preheated water to the process at 80$_{o}$C. Option 2 consists of seven 5,000m wells boosted with ground source heat pumps (GSHP) that provide a water-to-steam solution.

Option 3 is deep boreholes drilled to 1,500m and then boosted with GSHP to the desired process specification. Possible drilling sites were evaluated based on the area required for drilling the CeraPhiWell and site accessibility.

The main parking lot and the green space in front of the main offices were identified as the preferred locations. After drilling, the area will be restored, with minimal space occupied by the well, which could also be left underground or housed in a cellar. The three options were modelled financially, and high-level estimates of the CAPEX and OPEX were prepared.

The analysis results concluded that:

Option 1, a Deep geothermal system 5,000m well to preheat the process water to 80$_o$C, is a commercially viable option with an internal return rate of **5,76%** and a payback period of **36 years**. the well has a life beyond 40 years.

Option 2, a Deep geothermal system, a 5,000m well with water to steam heat pumps, is not a commercially viable option. The Internal Rate of Return (IRR) is very low, **0.37%**, and the payback period will take over 40 years.

Option 3, The use of medium-depth wells, 1,500m, is not a viable option. This solution requires additional heat pumps to bring the water to 80°C on top of the water-to-steam heat pumps required in option 1.

Although fixed energy costs are low, the overall expense to reach 80°C is very high. Our initial economic analysis showed a negative Net Present Value (NPV) for heating the process water to 80°C. Since this option failed to meet the positive NPV requirement in the first stage, we concluded it was not economically feasible. A sensitivity analysis was carried out to see the impact of the different solution variables in the proposed options. The results show that option 1 tolerates nearly 50% fluctuations in inflation and OPEX costs without losing economic integrity, indicating this option could be a good long-term investment. The discount rate significantly impacts economic viability. A 20% increase in either CAPEX or the discount rate would result in a negative NPV.

Option 2 currently has a negative NPV due to high electricity costs. However, incorporating self-generated electricity or a 50% reduction in electricity prices would result in a positive NPV. This shift would enhance economic viability, making the project 100% renewable. The potential carbon emission savings for the proposed development options were estimated.

Option 1 significantly reduces carbon emissions compared to the gas alternative business as usual (BAU).

Option 2 eliminates Scope 1 emissions, achieving a 100% reduction in direct emissions compared to BAU. However, it increases Scope 2 emissions by approximately 40% due to the electricity needed for the heat pumps.

Despite this trade-off, the overall carbon footprint of the project is expected to decrease, positively contributing to environmental sustainability efforts. In this alternative, by reducing

carbon emissions, the project becomes eligible for carbon credits. This study concluded that preheating water to 80$_{o}$C with a CeraPhiWell system is a viable option, reducing costs and carbon emissions compared to gas usage.

Generating high pressure steam is still possible and may be considered later if market conditions change. The recommended next step to advance the geothermal project is to undertake a detailed project development study – Front End Engineering & Design (FEED) to further define the solution and integration with the current system.