Quantum City | UNIVERSITY OF CALGARY

2023 QUANTUM CITY CHALLENGE

SECTOR:

Energy; Oil & Gas

CHALLENGE TRACK USE CASE:

Tailings Treatment

When extracting bitumen from oil sand, the ore is mixed with hot water to create a slurry where the bitumen floats to the top. The remaining mineral slurry (sand, clays and other trace materials) settles into layers of sand, water, and "fluid fine tailings" (FFT).

This fluid fine tailings layer is the focus of this challenge: When negatively charged, water-suspended clay particles tend to repulse each other, preventing their aggregation into larger particles that would settle more readily. This presents a challenge for mine site remediation, because, without further treatment, the layer will not gain enough strength required to build reclamation soils on top.

BACKGROUND:

In late 2023, the Quantum City Challenge was launched at the annual summit, qConnect. Three problem statements were posed, curated by two distinguished organizations, ATCO and Canadian Natural. These statements encompassed electric vehicle charging optimization, bitumen viscosity management, and tailings treatment. Each problem statement had been crafted to tackle real-world challenges, encompassing environmental and financial implications, while also providing an opportunity to explore and harness the potential of quantum technologies.

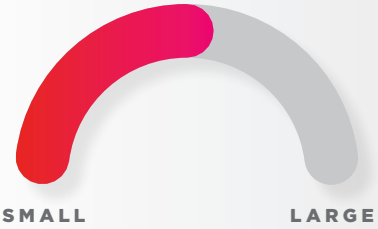
CHALLENGE PROVIDER:

Canadian Natural

WINNER:

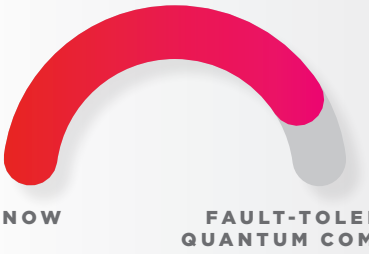
accenture

SOLUTION IMPACT:



Accenture's Hybrid Quantum Neural Network has the potential to revolutionize industries by enabling faster and more efficient process optimization. This could lead to significant cost savings and environmental benefits as quantum technology continues to advance.

TIME TO ADOPT:



As quantum technology progresses, the adoption of Accenture's Hybrid Quantum Neural Network has the potential to accelerate rapidly. This could bring transformative efficiency and cost benefits to industries in the near future.

PROPOSED SOLUTION:

Accenture's submission was selected based on their proposal of a Hybrid Quantum Neural Network for identifying the optimal combination of flocculants and coagulants in tailings treatment. Their model demonstrated comparable performance to state-of-the-art classical machine learning approaches and indicated potential quantum advantages.

Models of this nature have the potential to replace expensive and time-consuming laboratory experiments, facilitating the discovery of optimal dosages for tailings treatment in a faster and more cost-effective manner.

FUTURE APPLICATION:

The solution submitted by Accenture showed that a simple Hybrid Quantum Classical Neural Networks could predict the initial settling rate of a flocculation process depending on the choice of flocculant and initial conditions of the experiment.

As quantum hardware improves, more sophisticated versions of this model may be able to make predictions about the settling rates for mixtures of multiple flocculants, or mixtures flocculants and coagulants. These models may be used to find optimal dosages depending on initial conditions (pH, temperature, concentration, etc.) of the fine fluid tailings layer, improving treatment.

More generally, Hybrid Quantum Classical Neural Networks like the one presented by Accenture have the potential to solve classification problems and make accurate predictions that classical neural networks cannot accomplish by themselves, with possible applications across a range of industries.