QUANDELA

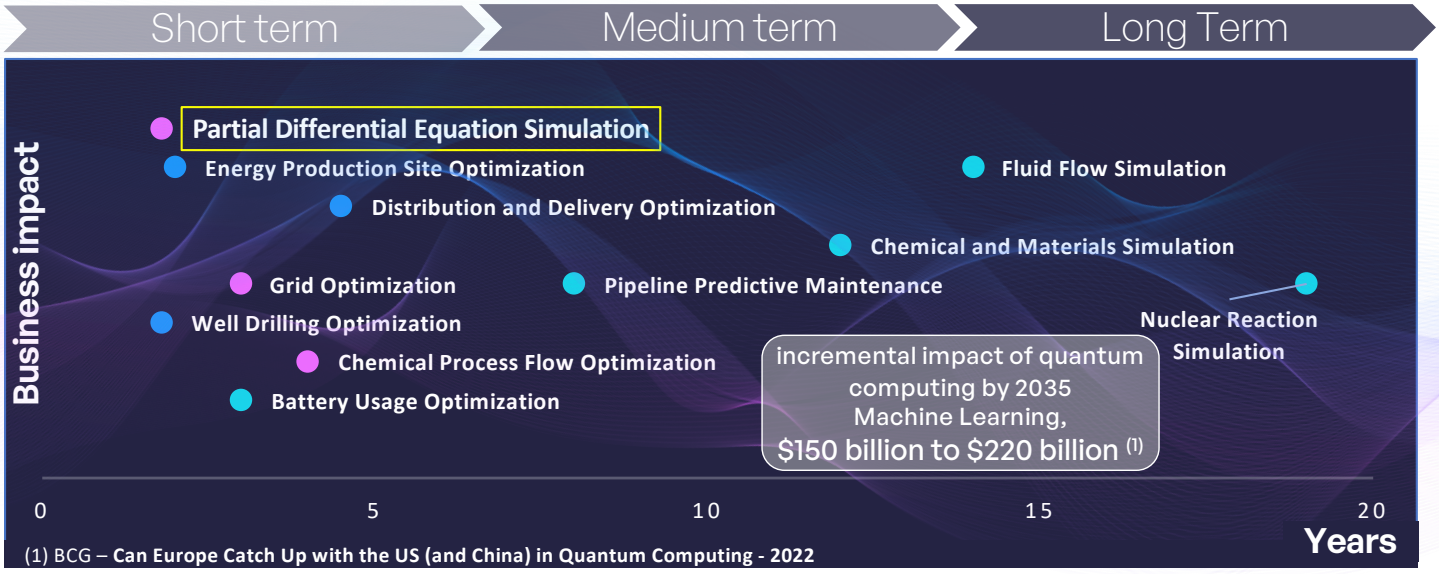
2023- Case story

Energy

EDF improves safety & durability of its industrial infrastructures with Quantum optimization

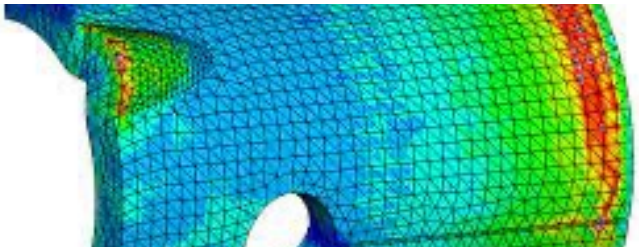
Use-cases for Energy

Quantum Machine Learning	**Partial Differential Equation Simulation**, Chemical Process Flow Optimization, Grid Optimization Prediction
Quantum Simulation	Chemical and Materials Simulation, Nuclear Reaction Simulation, Fluid Flow Simulation, Pipeline Predictive Maintenance, Battery Usage Optimization
Quantum Optimization	Structural Optimization, Energy Production Site Optimization, Well Drilling Optimization, Distribution and Delivery Optimization



(1) BCG – **Can Europe Catch Up with the US (and China) in Quantum Computing - 2022**

Challenge : handling a huge number of parameters with better precision and less computation consumption



EDF, French national electricity provider, needs to deal with **safety and reliability** for its dams and nuclear plants. In particular, it must prevent the occurrence of cracks from a large variety of factors, including environmental factors, aging, or even human errors. Impacts of these cracks can be catastrophic, leading to structural failure, casualties, and significant economic damage.

As such, **it is essential to understand and assess the behavior of cracks in these structures.** In order to improve the predictions from its computational simulations, EDF uses an increasing number of parameters. Therefore, its models lead to an exponential need for computation.

Besides the computing techniques is the sheer scale of the simulations involved. To accurately model the behavior of these structures, simulations must be run on a massive scale, often involving millions or even billions of data points. This **requires powerful computational resources, including high-performance computing clusters and specialized software tools.**

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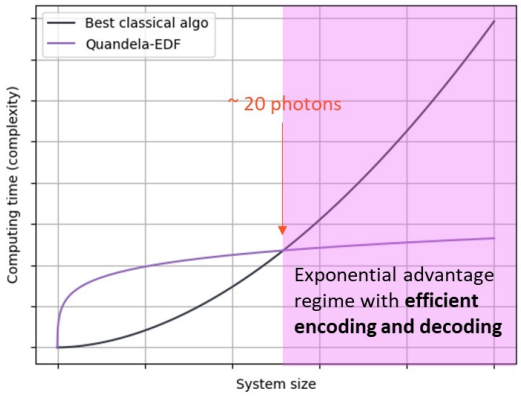
"We have developed Quantum algorithms for mechanical simulation and are testing them on Quandela computers. We are extremely positive with both the perspectives of Quandela Quantum technology to address some of our hardest industrial challenges such as the simulation of hydroelectric dams, and the scientific excellence of the team."

Joseph Mikael - Head of Quantum Computation & Quantum Information project at EDF

Solution : gain an exponential speed-up on the short-term for the simulation of mechanical structures



Quandela and EDF developed a method that brings value to EDF on the short-term (NISQ era). The method is based on a **variational quantum algorithm** and aims at solving a specific set of partial differential equations. A set of differential equations is first converted into a linear system of equations, whose solution is represented by the minimum energy of a quantum observable.

Use of Quantum Computing may lead to an exponential speed-up. Indeed, computing the energy of this system only requires a number of qubits. Besides, only few measurements are needed to have useful information of the system (key point as many methods requires exponential amount of measurement which kills any quantum advantage).

Use of Photonic Quantum Computer scale gives an exponential advantage. **Crossing point between the classical and the quantum curve is system size that can be reached with 20 photons.**

A general framework that can be applied to many other use-cases :

This framework is generic: from an energetic formulation of the problem, candidate **to be encoded efficiently on a Quantum Computer, only a few measurements are necessary to retrieve useful information.**

Therefore, if another use-case fulfills this powerful framework, it can be simply solved and deliver value for the end-users even with the actual Quantum Computing capabilities.

Get onboard the Quantum Journey with Quandela

It is time to make your industry start with Quantum computing, our teams are dedicated to help corporates in their first steps in the quantum world, from the target of problems to their implementation on real QPUs

QUANDELA

Identification of computational problems where Quantum will bring you the most value

Consultation with Quantum scientists to explore the best approaches

Test and benchmark these approaches on state-of-the-art Quantum Processors (QPU)

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