

Nuclear Microreactors as a Clean Energy Source for Data Centers and Mining Sites



CATERPILLAR

BUSINESS PROBLEM

This thesis explores the possibility of using nuclear microreactors as a clean, reliable, and safe energy source for mining and data center industries. These industries currently rely on third-party energy generation companies and need alternative technologies to reduce greenhouse gas emissions. The thesis has three objectives: to understand if nuclear microreactors can meet the technical requirements for powering mine sites and data centers, to evaluate the commercial feasibility of this technology in an industry setting, and to describe the sustainability impact of using nuclear microreactors instead of fossil-fueled power.

DATA SOURCES

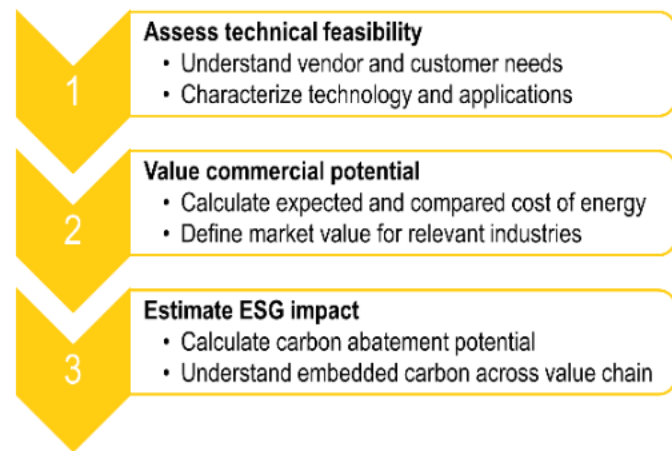
Vendor and customer interviews, market intelligence from Caterpillar and MIT Libraries, disguised and aggregated customer data, load profile information simulation, LCOE and LACE internal and external estimates, ESG reports, industry research.

Data Types and Format

Spreadsheets, simulation software, research papers, market intelligence reports, videoconferences


APPROACH

To solve this question, we look at the technical capability of the technology of providing power in the quantity and quality needed. Secondly, we compare the nuclear microreactor technology with other energy generation sources to understand the commercial competitiveness. Thirdly, we explore the carbon abatement potential of this technology. We leverage simulation tools to achieve these objectives



IMPACT

With the increased pressures by customers to deliver more sustainable power solutions, Caterpillar remains focused on evaluating potential technologies like the emerging nuclear products and the potential impact on key market segments they support. The technical and commercial feasibility analysis will enable Caterpillar to act on upcoming investment and research decisions which enable a portfolio of products and services that support their customer's sustainability goals, as well as their own. The project will ultimately inform executives on whether they should continue to research the nuclear microreactor as a potential avenue for clean energy generation to support mining and data center applications for 2030 and beyond

DRIVERS	Customers in the Mining and Data Center segments have set aggressive goals related to the reduction of GHG emissions by 2030. In support of these goals Caterpillar is involved in several electrification initiatives which will depend on reliable, clean electricity.
BARRIERS	Information around Nuclear Microreactor technology is scarce given its current stage of Research and Development. For this reason, informations related to cost and operation was mostly compiled from informed assumptions provided by MIT and non-MIT experts
ENABLERS	Caterpillar and MIT enabled access to the HomerPro software platform which has heavily used to perform all the simulations needed to answer the question defined in the problem statement.
ACTIONS 	Given that this was a more research oriented project, the solution that came out as a result was that of communication and information access. The results and the potential impact of this technology were communicated across the company in a variety of ways including videocalls, in-person meetings and documentation. The project gave birth to a follow-up internship which will try to find a suitable operational and investment path for Caterpillar
INNOVATION	There were two main innovative aspects of this project. The use of the commercially available energy grid optimizing software for a purpose it was not originally created. Find a way to incorporate a nuclear microreactor into a platform that was not designed for that required and innovative approach. Secondly, the technology itself is innovative as it is still under R&D and its impact can not yet be fully understood.
IMPROVEMENT	Caterpillar has now access to a database of results that spans two industries and several different types of scenarios. These results, including the sensitivity analysis, will enable Caterpillar to make informed decisions on the strategy to decarbonize.
BEST PRACTICES	Two practices were well demonstrated in this project. Organization-wide communication, where we brought on board the project members across different divisions and teams to ensure full support and feedback was accessible. Moreover, project scoping was done early in the process and with a lot of detail to ensure that the remaining time of the project could be used in generating accurate results to answer the agreed upon problem statement
OTHER APPLICATIONS	The nuclear microreactor, as well as the methodology developed to understand its technical and commercial feasibility, can be used to explore the viability of this technology in other industries or similarly with other technologies.