works, and Moderna launched the world's first mRNA vaccines for COVID-19 in the late fall of 2020, a lightning-quick pace compared to earlier vaccines. They were successful because of the basic science that had been in development by scientists working in universities over decades.

The Search for Cheaper Lithium

In Canada, this pattern is playing out across industries. Daniel Alessi, a geochemist and professor of Earth and Atmospheric Sciences, is revolutionizing the extraction of lithium, setting the province up to be a critical player in a green energy revolution.

Demand for lithium has been rising sharply over the last decade, driven by the growing need for lithium-ion batteries for electric vehicles and large-scale renewable energy storage. Lithium's cost is also skyrocketing: it has increased nearly 900 per cent since January 2020, a rate almost 10 times that of other critical raw materials in batteries like cobalt and nickel, according to Benchmark Mineral Intelligence, a research firm. This trend is expected to continue well into the future, with demand predicted to grow nearly eightfold by 2030.

Today, we mine lithium primarily in two ways. The most common is through salars, the lithium-rich, salt-encrusted depressions on the basins of evaporated lakes that are found mostly in Argentina, Bolivia and Chile. This method of lithium extraction is cheap and efficient but environmentally intrusive. In order to glean lithium from the salars, extractors draw in groundwater from the surrounding areas, which are often places where water is scarce. Lithium is also sourced through hardrock mines, but these mines leave scars on the landscape and requires vast amounts of energy. Estimates suggest that about 15 tonnes of CO_2 are released into the atmosphere for every tonne of lithium extracted from hardrock mines.

There is potential for a third way with a smaller environmental footprint. In this scenario, Alberta could be a key player. Most oil and gas wells in Alberta produce saline water, or brine. This brine is five to 10 times saltier than seawater and, among its components, is a bit of lithium: about 50 to 100 parts per million, which is between five and 10 percent of the lithium concentration in salars. Companies face an enormous technological challenge in separating the lithium from other components in the brine.

"It's a needle in a haystack problem," explains Alessi, who holds the Encana Endowed Chair in Water Resources.

In 2016, Alessi's lab was approached by E3 Metals Corp. (now E3 Lithium) about developing a technology to help extract and separate lithium from oilfield brines in Alberta.

With his colleague Salman Safari, Alessi worked on three grants from the Natural Sciences and Engineering Research Council of Canada to develop a technology that would use basic science principles to understand the materials in the brine and find solutions for how to separate the lithium from other components.

In 2019, Safari and Alessi founded their own company, Recion Technologies, Inc., to

Resistant Questions

Basic science is everywhere across the Faculty of Science. For example, at the Charlebois Lab, researchers are asking big questions about the intersection of antimicrobial resistance, bioelectromagnetics and biophysics. Their research exists at the interface of physics and biology and aims to make fundamental advances in our understanding of living systems. They use quantitative mathematical, computational, and machine learning models to perform experiments on genetically engineered and pathogenic yeasts. The team works in the Charlebois biosafety level two biophysics-microbiology laboratory in the Centennial Center for Interdisciplinary Science.They want to apply this knowledge to the growing problem of antimicrobial drug resistance.