E-fuels can play a huge role in Canada's journey toward a net-zero future

November 3 2023, by Keena Trowell and Jeffrey Bergthorson

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As countries around the world face the challenges of moving away from oil to stave off the worst effects of climate change, Canada is in an enviable position.

Canada is rich in what's needed to transition to a renewable energy system: abundant renewable energy potential, land and the necessary

intellectual and industrial resources. All we need is the will to act.

Renewables are typically framed as insufficient to meet our needs, too costly and too intermittent to provide a safe and secure energy supply.

But our recent research shows that the most frequently cited impediments to adopting renewable power—specifically consistency of supply, land requirements and the scarcity of renewable energy sources—are not true barriers.

The importance of e-fuels

With the intention of doing everything wrong, we deliberately designed a flawed renewable energy system, hoping the exercise would reveal where barriers may exist.

On paper, we created an energy system based on a single form of renewable energy (solar), located all the power generation in Alberta—a place with only average sun exposure—and assumed solar panels as the primary energy source for everything.

What we found was that even this terrible version of an energy system was viable.

The first challenge was to address the mismatch between supply (which tends to be higher in summer) and demand (which tends to be higher in winter). We also wanted to avoid a geographic mismatch by putting some distance between massive energy installations from large population centers.

The lever in both cases was electrofuels, known as e-fuels: materials that reliably and efficiently store energy until we need to use it and can readily be moved from place to place.

E-fuels store energy in a chemical form, such as metals, hydrogen and synthetic hydrocarbons. Sustainable e-fuels are circular in nature. Metal fuels, for example, once oxidized, produce a recyclable oxide. Synthetic hydrocarbons can be produced using green hydrogen and carbon dioxide.

E-fuels can also be exported. Exporting e-fuels would maintain Canada's place as an energy exporter, establish Canada as a driver in global decarbonization efforts and provide a secure energy source for regions that can't meet their own energy needs.

Farmland not threatened

Changing over to renewable energy does not threaten farmland. Alberta's Conservative government has made this claim and imposed a moratorium on renewable energy.

According to our research, covering just 16% of built-up land (rooftops, for example) in solar panels, or seven percent of the land now used for oil and gas projects, would deliver enough electricity to fully decarbonize the Canadian grid.

Completely decarbonizing our domestic energy use, including e-fuel production and seasonal storage, could be done using only marginal land—previously used land that can't be repurposed for agriculture or industry, but has sufficient sun exposure.

Maintaining energy exports, in the form of sustainable e-fuels, would require more land, but not farmland. The amount would depend on the targeted amount of energy exports.

We chose Alberta for our worst-case scenario in part because there is understandable fear in the province over the uncertain future of oil and gas jobs as decarbonization efforts force a reduction in the demand for

Canadian crude oil.

But the future of renewables holds a lot of promise for job creation. Evidence shows that renewable facilities create between 1.2 and 7.9 times more jobs per unit of electricity than coal or natural gas-fired plants.

The real challenge lies in policy and investment, and it starts with understanding the scope of the change required, especially considering the expected increase in demand for electricity.

Grid investment needed

Forecasts that the electric grid will need to double or triple massively underestimate the real demand once Canada adopts a full net-zero energy system. What Canada will really need is a grid that can handle five to eight times as much electricity as today.

This represents a big investment, but not investing would be at least as costly. This is where government policy will play a huge role. Bad policy creates a hostile investment landscape, further slowing change, but good policy can encourage and accelerate investment and create efficiencies in systems.

This is, of course, a simplified view of what would be a profound and complex change, but the facts support the idea that even a poorly constructed scenario could be successful.

Now imagine what it would be like if we designed a good system.

A net-zero future will rely on a combination of primary energy sources, including both a mix of renewables and nuclear, and secondary energy sources in the form of e-fuels.

The scale of investment it will require is of the type we have not seen for a generation, but it will pay dividends for generations to come in terms of economic security, safety and the environment.

Why wait?

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