The use of these fuels raises the average temperature of the planet, pollutes the air when they are burned and may cause environmental damage as part of the mining process. The need for alternatives to fossil fuels has never been greater, which makes the timing perfect for the project “Biomass Feedstock for Food and Energy Security in the North: Solutions to Technical Issues, Economic Feasibility and Environmental Sustainability”.

“We have been involved with research on biomass processing and utilization for energy and bioproducts for more than a decade now,” said Dr. Lope Tabil, a professor in the Department of Chemical and Biological Engineering at the University of Saskatchewan. Dr. Tabil is the lead on this project along with Dr. Edmund Mupondwa, research scientist with Agriculture and Agri-Food Food Canada (AAFC) at the Saskatoon Research and Development Centre. Dr. Mupondwa is also an adjunct professor in the Department of Chemical and Biological Engineering at the University of Saskatchewan.

The two other project co-applicants are Dr. Duncan Cree, assistant professor in the Department of Mechanical Engineering, University of Saskatchewan and Dr. Tim Dumonceaux, research scientist with AAFC.

“A number of processing options for biomass have to be researched because they are not well understood,” said Dr. Tabil. “In 2012, BioFuelNet was formed, of which I was one of the researchers. In 2018, we continued our research on biomass processing for energy and bioproducts with the current project activity under Biomass Cluster.”

This project came about as a response to emerging issues related to the use of nonrenewable feedstocks, such as petroleum.

“Canada has great potential to supply agricultural and forestry biomass, but the use of biomass has not yet evolved to a commercial scale due to technical and logistical challenges associated with the utilization of biomass in its unprocessed form,” said Dr. Mupondwa.
In that form, this type of biomass has low energy density, which represents a key obstacle in its exploitation as an energy source. Furthermore, the chemical structure of the biomass requires capital intensive processes to extract valuable sugars that can be used to produce bioenergy, biofuels, biomaterials and biochemicals. As a result, this project came about to provide solutions to these problems and enable commercial utilization of biomass feedstocks for the bioeconomy.

When the growing gets tough...

Those feedstocks are of particular interest to agricultural growers in Canada’s northern latitudes, where the growing season is limited. This activity aims to support those growers by extending their growing season through the supply of biomass feedstock for heat and power generation.

“Examples of the biomass we are studying include agricultural crop residues such as oat hull, wheat, barley and oat straw, along with purpose-grown crops such as camelina and switchgrass and forest residues,” said Dr. Tabil. “As well, we are developing processes for pretreatment of biomass such as torrefaction and steam explosion, and pelletizing of these materials that have been pretreated.”

Torrefaction of biomass is a mild form of decomposition at temperatures typically between 200 - 320 °C. Torrefaction changes biomass properties to provide a better fuel quality for combustion and gasification applications.

At the end of the day, researchers hope that the results from their technoeconomic analysis and life cycle assessment contribute to a critical goal: resolving persistent challenges in designing business models for large-scale commercial use of rich sources of biomass available in Canada for the development of the bioeconomy.

“In particular, our results have near-term implications with respect to our goal of supporting agricultural growers in Canadian northern latitudes to extend their growing season” said Dr. Mupondwa.

For his part, Dr. Tabil is intrigued by the possibility that biomass-to-energy projects may have economic and environmental justification. Until we can colonize Mars, protecting the Earth’s environment must be a top priority.