

Reducing greenhouse gas emissions by turning solid waste into energy and fertilisers in the Lower Mainland

Xiaotao Bi & Haoqi Wang

About the projects

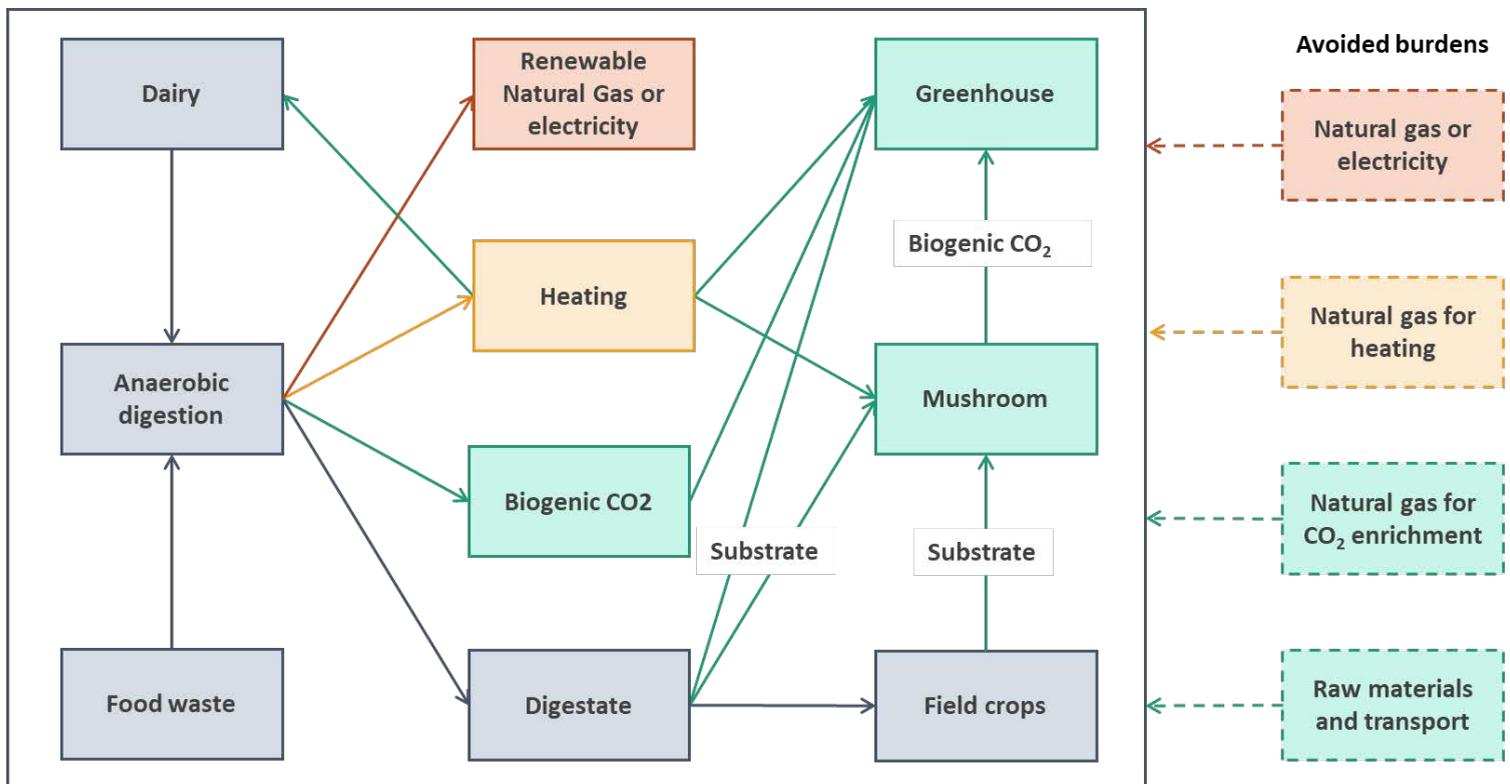
Many of us are aware of the high amounts of greenhouse gas emissions that are associated with dairy farming due to the methane emitted by cows. To try to improve the carbon footprint of the agricultural sector, Dr. Xiaotao Bi's research group investigates the potential of applying anaerobic digestion to cattle manure.

Project Highlight:

With agricultural partners in the Lower Mainland, UBC researchers are turning methane-emitting cattle manure into an energy providing product which can be used in greenhouses and other farming practices. dioxide.

The Team:

- Dr. Xiaotao (Tony) Bi, Professor, Department of Chemical and Biological Engineering & Director, UBC Clean Energy Research Centre
- Dr. Haoqi Wang, Postdoctoral Fellow, Department of Chemical and Biological Engineering & UBC Clean Energy Research Centre
- Siduo Zhang, Research Manager, Department of Chemical and Biological Engineering
- Dr. Roland Clift, Adjunct Professor, Department of Chemical and Biological Engineering



Among stand-alone biogas options, **heating** has better performance than **RNG and CHP** in greenhouse gas mitigation and cost; **Integrating AD into a broader system** can achieve at least 80% greater benefits than stand-alone options.

Wang, a postdoctoral fellow with Dr. Xiaotao (Tony) Bi's group at UBC's Clean Energy Research Centre, points out the problems with current practices in managing cattle manure. Usually, the material is applied to fields as organic fertiliser. While the method does reuse the material rather than wasting it, the benefits seem to end there. Unfortunately, methane keeps emitting from the cattle manure after application and nutrient elements from the fertiliser like nitrogen are either washed away by rain or become vaporised into the atmosphere.

"Anaerobic digestion is a good, alternative way to deal with cattle manure," says Wang. "Basically, you shuffle these materials into a closed reactor, and force them to turn into methane using anaerobic digestion. Because the process is occurring in an enclosed reactor, all the methane that is generated can actually be harvested and turned into biogas, which is similar to natural gas that we burn for energy."

The production of biogas from cattle manure is hugely beneficial for agricultural activities in BC, where fossil fuels are used in greenhouses. Greenhouse farming is quite energy intensive; energy needs to be burned in winter for warmth and in summer for providing vegetables with carbon dioxide.

Originally, then Master's student Siduo Zhang led the group's initiative to connect biogas produced by anaerobic digestion in the Lower Mainland with mushroom and field crop producers in BC. To promote design integration, different business owners in the Lower Mainland will need to come together and sign agreements ensuring each other that their byproducts are of design quality so that the others can safely use them without jeopardising their own production.

"The idea of integrating anaerobic digestion into agricultural activities is not new. But there was no really detailed design or analysis of the environmental impacts and economic benefits. We tried to take the steps to actually quantify the exact benefits these kinds of integrations can achieve in southern BC," says Wang.

To expand the project, Wang is developing scenarios based on everything the group has already found about the feasibility of integrating anaerobic digestion into agricultural activities in BC. Importantly, policy hurdles are a focus of his work.

"I do economic analysis with or without policy impacts," he says. "One is the pure revenues or pure net losses associated with different scenarios if there is no policy support. Based on these environmental and economic results we can have some policy implications."

The results produced by Bi's group are based on case studies in BC's Lower Mainland, but they can also be generalised to other parts of the world where greenhouse farming is conducted in proximity to animal husbandry. The group has been publicising their research, and is hoping to maintain existing business partners and establish new connections with dairy farmers and potential investors.

"This planet has limited resources. If we keep enjoying all these resources that we have used in excess for the past 200 years, they're going to run out eventually. That's why we're trying to promote this project," says Wang.