THE UNIVERSITY OF BRITISH COLUMBIA

GROUP M1

# Renewable Natural Gas from Food and Livestock Waste

Ashna Misra, Ayesha Shah, Ian Harvey, Jackson Herron, Lucy Vincent-Smith, Matthew Gin, Tom Johnston, Victor Rizov
Department of Chemical and Biological Engineering, The University of British Columbia, Vancouver BC

## INTRODUCTION

This project utilizes the emerging sustainable technology of anaerobic digestion to produce renewable natural gas (RNG) from food waste and cow manure. These digesters operate at high, thermophilic temperatures to increase biogas yield and reduce pathogens. The biogas produced is refined by gas upgrading before distribution in local natural gas pipelines. Common in Europe and Asia, anaerobic digesters have been slow to enter the North American market due to the comparatively low cost of natural gas. However, a growing demand for renewable energy sources and waste reduction has given rise to several climate driven targets and policies that create economic opportunity for anaerobic digesters in Canada. This design also features the processing of digestate for nutrient and fibre recovery as additional revenue streams.

## FRASER VALLEY LANDFILLS

**90% WASTE DIVERSION** 2025

BRITISH COLUMBIA RNG PIPELINE GOALS

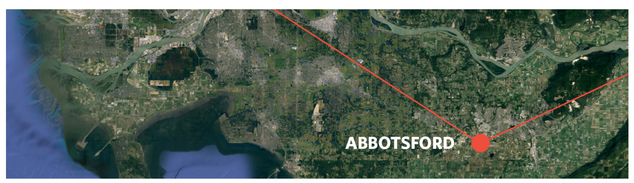
CARBON EMISSIONS

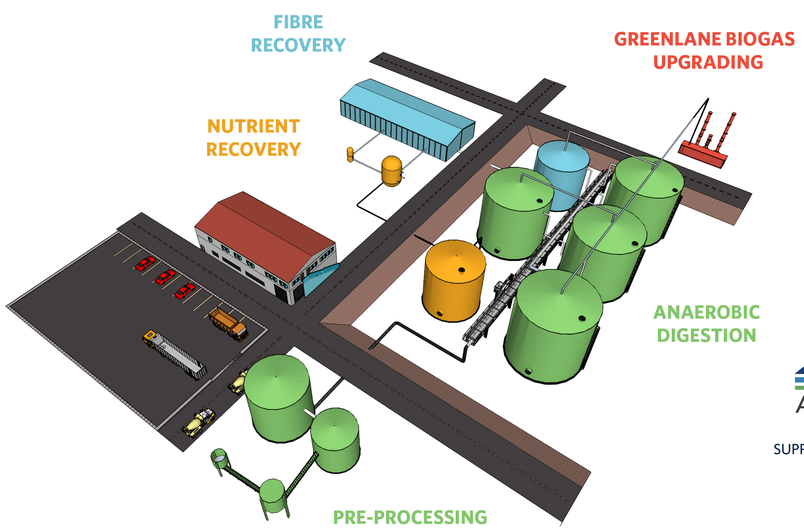
**0.3%** TODAY

**5.0%** BY 2025

**116k tonnes** $CO_2e$ AVOIDED EACH YEAR

## PLANT LAYOUT & LOCATION




**40%** OF ABBOTSFORD FOOD WASTE

**4,000** DAIRY COWS NEEDED 73,000 IN THE FRASER VALLEY

**15,000m³** WATER PER YEAR

**31,900t** FOOD WASTE PER YEAR

**75,000t** COW MANURE PER YEAR

## ANAEROBIC DIGESTION

Food waste, cow manure and water are mixed and are continuously fed into three CSTR anaerobic digesters. This is a thermophilic wet digestion process that produces raw biogas and digestate.

**3** ANAEROBIC DIGESTERS

**21** DAY RETENTION TIME

## FIBRE RECOVERY

Solid digestate, separated by a decanter centrifuge, is sent to a belt dryer. The belt dryer reduces the water content in solids from 70% to 10%.

**5,100t** ANIMAL BEDDING PER YEAR

## GAS UPGRADING

Raw biogas is upgraded from a methane content of 50-65% to 98% using water washing technology from GreenLane Biogas.

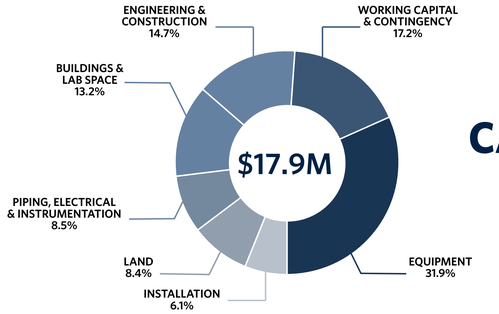
**1,500** HOMES HEATED PER YEAR

## NUTRIENT RECOVERY

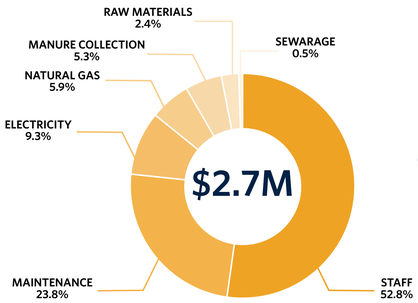
The liquid output from the decanter centrifuge is sent to a stripper and absorber. This process provides liquid ammonium sulphate for fertilizer and clean water to recycle into the digesters.

**1,800t** AMMONIUM SULPHATE FERTILIZER PER YEAR

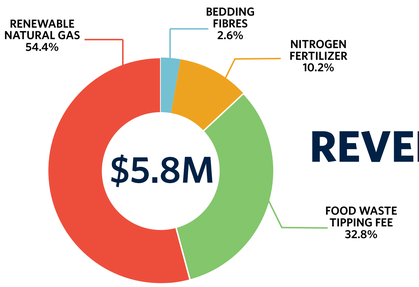
**50%** PROCESS WATER RECYCLED



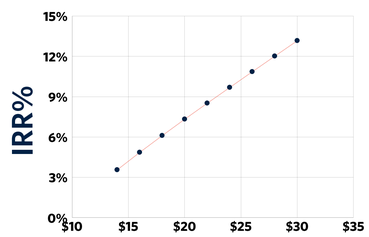

## CAPEX




## OPEX




## REVENUE




**8.3% IRR** BASED ON THESE ASSUMPTIONS

- 20% CAPEX COVERED BY GRANTS
- 10 YEAR LOAN, LOW 5% INTEREST RATE
- $22/GJ of RENEWABLE NATURAL GAS
- $60/t of FOOD WASTE
- 30 YEAR PROJECT LIFE

## STAKEHOLDER ANALYSIS

| | | | | |
|---|---|---|---|---|
| ABBOTSFORD | Fraser Valley Regional District | FORTIS BC | BRITISH COLUMBIA | Canada |
| SUPPLIER OF ORGANIC WASTE | REGULATOR LEGISLATOR | PURCHASER OF RENEWABLE NATURAL GAS | REGULATOR LEGISLATOR FUNDER/INVESTOR | REGULATOR LEGISLATOR FUNDER/INVESTOR |

## INDUSTRY PARTNER

GREENLANE BIOGAS

With over 100 plants worldwide, Greenlane Biogas is a recognized leader in the biogas upgrading industry. Their company offers three upgrading technologies; water washing, pressure swing adsorption, and membrane upgrading. Our plant uses water washing, Greenlane Biogas' most popular and cost effective upgrading method. Water washing uses only water, no chemicals, and can produce biomethane with a purity of over 98%.

Thank you for sharing your time and knowledge with us.