

**1**

**ELEC / CPEN 481**  
**Lecture 1**  
**Course Overview**

from:  
Penn State  
here to teach

## Administrative overview

- Current Plan: Lectures will be delivered live in Woodward IRC 6.
- Questions encouraged
- Abbreviated version of lecture notes will be posted in advance
- Evaluation:
  - Individual assignments: 7 assignments totaling 53%
  - Group assignment: Business plan 20%
  - Final exam 27%
- Assignments will be submitted online
  - Encourage you to type your submissions
  - If hand written and not legible by TAs, will receive zero score
  - Late submissions penalized 2% of total score per hour
- Business plan proposal and presentation online live in breakout groups
- Business plan report submitted online
- Final exam will be in person, 1.5 to 2 hours long.

## Administrative overview

- Asking questions:

- Questions about course content and/or process: recommend using Piazza. Head TA Xiao Han and I will monitor frequently and respond to questions.
- Requests for clarification or re-grading of your own assignment: email them to head TA Xiao ([xiao.han@ubc.ca](mailto:xiao.han@ubc.ca)) who will coordinate responses
- Questions specific to your personal situation: email me ([jeffjarmichael@gmail.com](mailto:jeffjarmichael@gmail.com) or [jcarmich@ece.ubc.ca](mailto:jcarmich@ece.ubc.ca))

- sometimes ends early

## What will you learn?

good financial  
decision

communication

## What will you learn?

- How to use economic techniques to:
  - decide whether to do a project or not
  - choose among project options
  - help estimate how much money will be needed to implement a project
- How economic measures fit into the broader picture of environmental, social, and other measures when making decisions
- Other challenges to decision making in the real world
- How to clearly portray and summarize info and recommendations
- How financial people handle data
- How to prepare a financial plan
- How to gather and use financial data to start a business or assess how a business is doing
- How economic techniques can help you make good financial decisions in your own life

- especially small companies

→ get what u want.

triple  
bottom  
line.  
analysis.

Accounting &  
finance.

## Why does this matter?

These techniques should help:

- Lead to good professional and personal decisions and recommendations
- Create buy-in from other parties → You get them,
- Align with corporate strategic goals
- Help you start or run a business, with respect to financial needs and techniques
- Enhance your professional opportunities and reputation

engineers can handle finances - age abl.

## Decision making process fundamentals

if goal unknown,  
 poor answer.  
 - fail to consider  
 something  
 - Business as usual  
 alternative?

## Decision making process fundamentals

1. Recognize the problem or opportunity
2. Define the goal or objective
3. Determine and reach consensus on scope
4. Select the criteria to determine the best alternative
5. Identify feasible alternatives, including the default option ("Business As Usual")
6. Assemble relevant data
7. Construct physical and economic models
8. Predict the outcomes or consequences for each alternative
9. Choose and implement the best alternative
10. Audit the results

"fire, ready, aim"

often jump  
tests / model outcomes.

↳ Check guesses

(govt, priv)

- tendency to refuse to admit wrongness
- learn for future similar

## Simple example 1: what to do tonight

### Simple example 1: what to do tonight

- Any limitations? Do we agree?
  - Budgetary / time limit. Agreement?
- Options?
  - Business as usual alternative - TV — Power
  - Alternatives: movie / dinner, exercise, inconvenience
- Level of complexity involved
  -
- Evaluate pros and cons
  - Cost, Laughs exercise, inconvenience
  - Criteria implicit in all decision
  - Lvl of detail analyzed will matter (e.g. gas)

poor use of  
time if does  
not affect  
decision

(cost)

## Simple example 1: what to do tonight

### Evaluation

	Cost	Laughs	Exercise	Inconvenience
Watch TV	None	Low	Zero	None
Dinner & movie	Medium	High	Low	Medium
Skiing	Low	Low	High	Medium
Dancing	High	Medium	High	High

- Do any beat TV?
- what if you're not sure you want to do usual, → consider alt.

## Simple example 2: what car to buy

- Define problem (slope)
    - budgetary / time limit ( $\$$ )
  - Define measures of success ( $\$\right)$ 
    - BAV - What to do anyway
      - get cheapest
    - Alt: cars that cost more but use less fuel
  - Complexity
    - insur, maint, gasol.
- ↓  
→ Insignific.

## Simple example 2: what car to buy

Challenges: Legal and procedural issues

- Capital cost as traditional and only factor
- Life cycle analysis (EPA fuel economy standards)
- Legal / procurement limitations

→ if elec only, gas  
wmp. succ.

Challenges: economic analysis (time value of money)

We will go through this example in greater detail later.

## Example 3: wastewater infrastructure decisions

- Design decision: include stairway to access below-ground chamber *<vs ladder>*
- Implications on capital cost vs ongoing maintenance costs
  - confined space, 2 ppl in, mitig.
  - 
  - Concrete stairway slightly more
  - They picked ladder

## Example 4



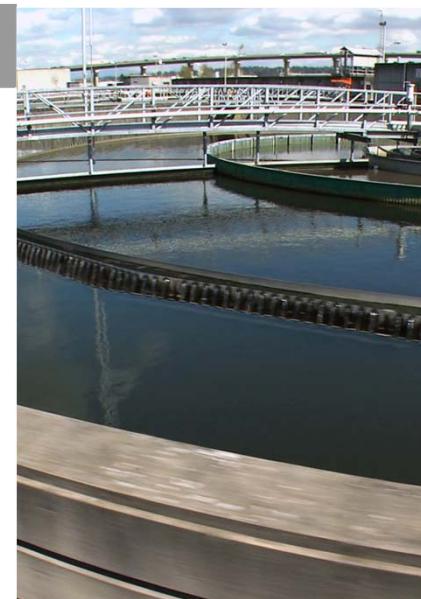
Wastewater treatment biogas use

31

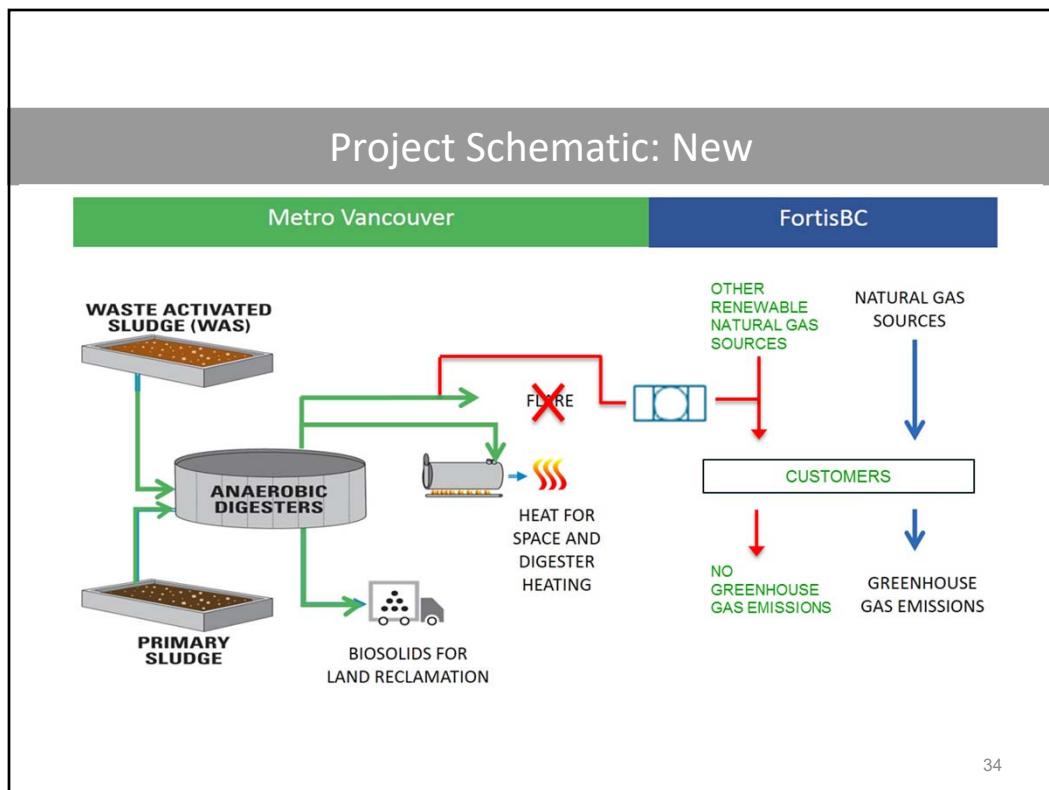
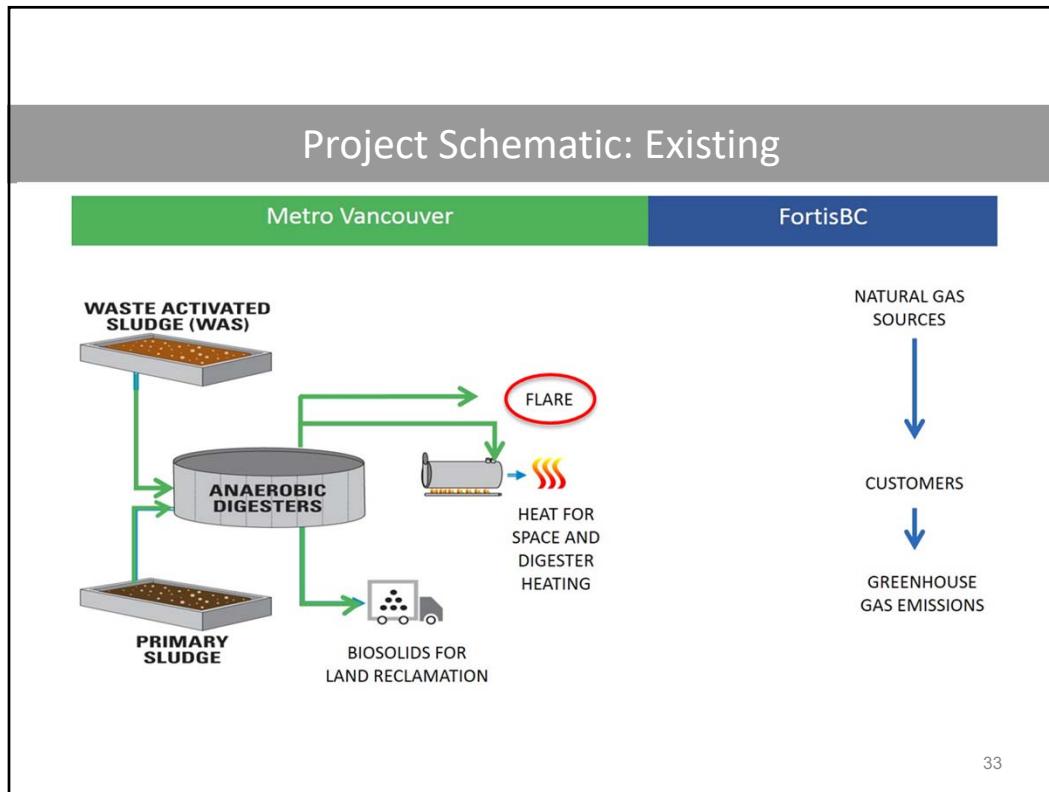
### Example 4: wastewater treatment biogas use

#### Project Overview

- Install biogas cleanup equipment at Lulu Island WWTP in Richmond
- Use excess digester gas beneficially by cleaning up and selling to FortisBC as renewable natural gas



32





## Biogas Upgrading Assessment

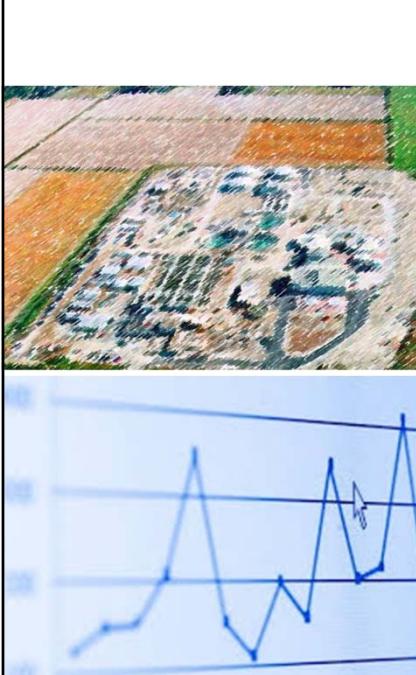
### Concept:

- Quality requirement
- Innovative but not 'bleeding edge'

### Process assessment:

- technologies reviewed
- Waterwash and Pressure Swing Adsorption (PSA)

35



## Business Case Analysis

- 25 year equipment life
- Est \$12.3M capital costs
- Initial biomethane sales \$630,000 / yr
- Initial O&M costs \$150,000 / yr
- Carbon price policy benefits \$330,000 / yr
- Positive business case: +\$5.4 million NPV

36

- Details not important for manager.

## Challenges and Opportunities

### Challenges:

- Scope
- Partnerships
- Financial considerations
- Legal and regulatory considerations

### Opportunities:

- Hands-on operational experience
- Environmental benefits
- Demonstration of innovation
- Synergies and incentives

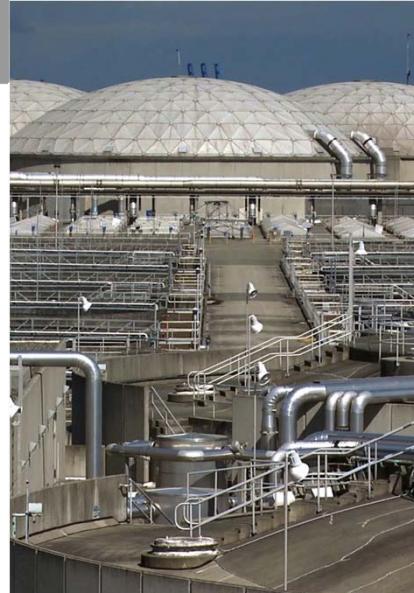


37

## Biogas Enhancement and Use

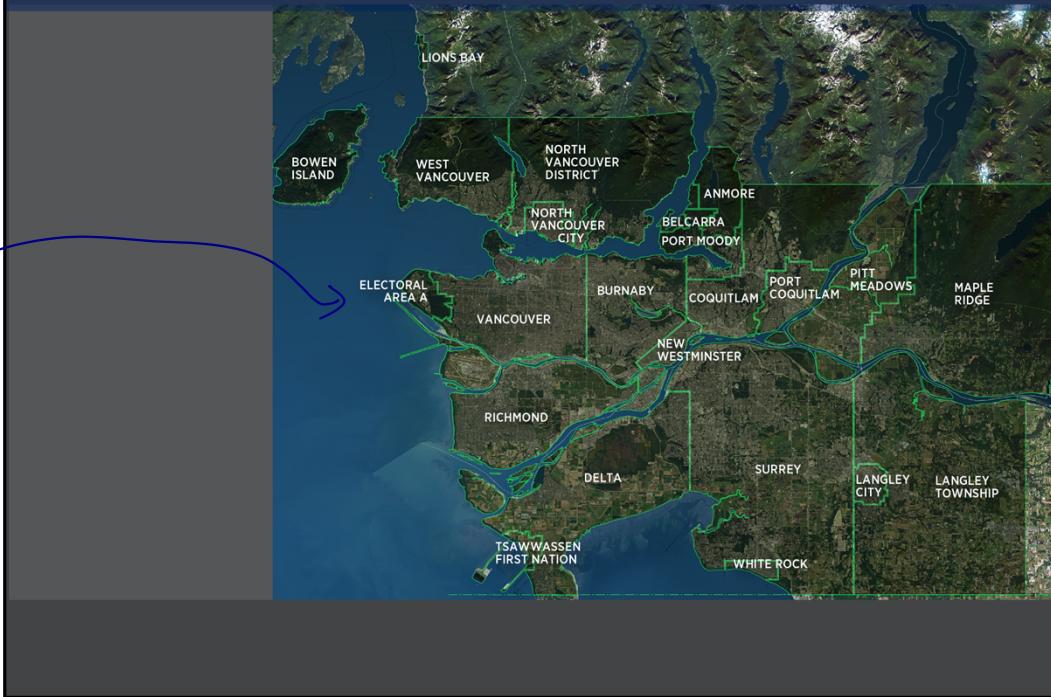
### Enhancement possibilities:

- Free up additional biomethane
  - Effluent heat recovery
- Enhance generation: Co-digestion
  - Direct addition of energy-rich materials to anaerobic digesters, generating biogas
- More complete digestion
  - Thermal hydrolysis
  - Microwave-enhanced oxidation

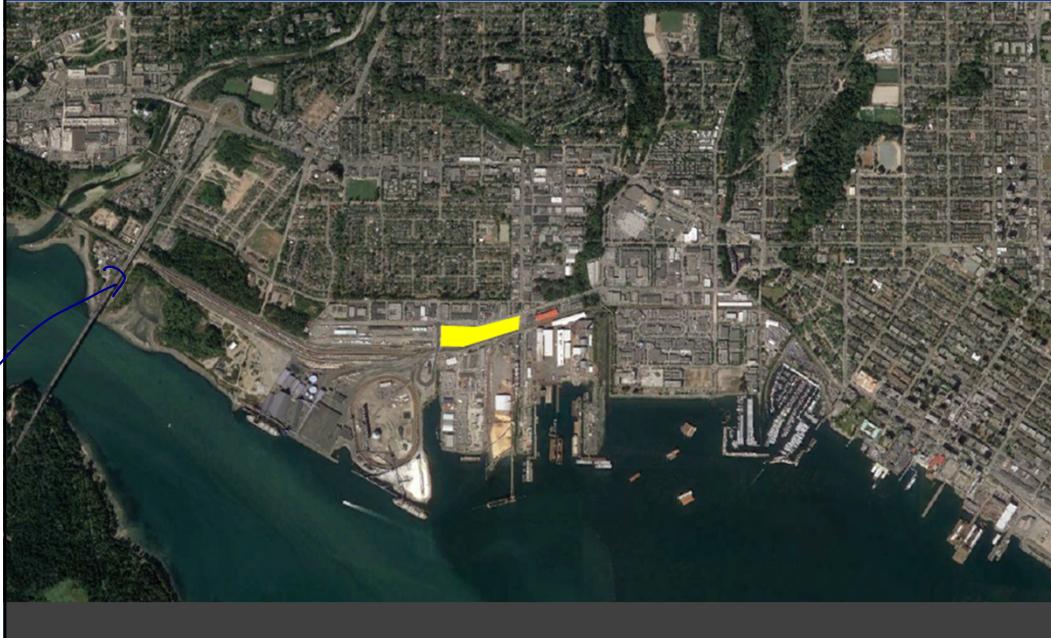


38

## Example 5: North Shore Wastewater Treatment Plant



## Example 5: North Shore Wastewater Treatment Plant

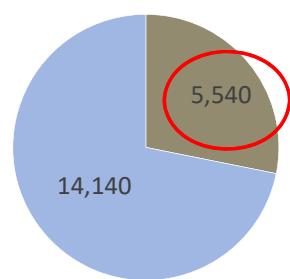


## Example 5: North Shore Wastewater Treatment Plant Effluent heat recovery project



## Example 5: North Shore Wastewater Treatment Plant Effluent heat recovery project

2016 corporate GHG emissions (tonnes)



■ Liquid Waste utility  
■ Metro Vancouver remainder

### Costs and Benefits

	Net capital investment	Annual GHG credits (tonnes/yr)
Metro /feds /province	\$16,926,000	5,700
Carbon price (benefits)		\$150 / tonne
Total value of benefits		\$21,375,000

Board decision to approve, on basis of value of GHG reductions

- how to get people to agree —
- e.g. project w/ major beef delayed

*- techniques  
don't always  
work*

## Challenges

- Valuation of environmental improvements
- Parties with different goals, who pays, regulatory challenges
  - Each participant has their own goals
- Who pays
  - Who pays and who benefits can matter a lot
- Regulatory challenges
  - Regulations are past-facing, not future-facing

## Context: Triple Bottom Line Analysis

## Triple Bottom Line Analysis

- Not all criteria for success are financial
- Need for decisions and recommendations to consider triple bottom line / sustainability goals
- Comparison with business case analysis

Software lets you capture value.

### Back to Example #1: Triple Bottom Line Analysis

	Cost	Laughs	Exercise	Inconvenience
Watch TV	None	Low	Zero	None
Dinner & movie	Medium	High	Low	Medium
Skiing	Low	Low	High	Medium
Dancing	High	Medium	High	High

- can give points. Non-scientific: value-based  
 - weightings self assigned -

- good for public, less so private:

## Organization of course material and textbook

How economic techniques can help you make good financial decisions in your own life

- Chapter 3

Core material on economic techniques ("business case analysis")

- Chapters 4-8 and 14

Other important factors to take into account in economic techniques

- Chapter 10, and parts of 9 and 13

How financial people think, work, and handle financial data

- Chapters 2, 11, 12, and parts of 3, 9, and 13

How economic measures fit into the broader picture of environmental, social, and other measures

Other challenges to decision making in the real world

How to clearly portray and summarize decision recommendations

Business planning

- Not in textbook. Some is my own material and some drawn from supplementary textbook. Included in additional examples throughout.