WesternWater Centre

RESEARCH THEME

- **Value Recovery**
  - >$16M in external funding (last 10 years)
  - Current HQP: 40 graduate students and PDFs
  - 3 state-of-the-art laboratories

4. Value Recovery

FOCUS

- Application of biochemical engineering
- Value recovery from waster water
- Clean water recycling
- Hydrothermal liquefaction

OVERVIEW

- 40 graduate students and postdoctoral fellows
- >$16 M in external funding (last 10 years)
- 10+ industrial partners
- 7+ international academic collaborators
- 3 state-of-the-art laboratories
- Advanced bioenvironmental lab
- State-of-the-art equipment for cell cultivation and analysis

Amarjeet Bassi

Lars Rehmann

Charles Xu

4. Value Recovery

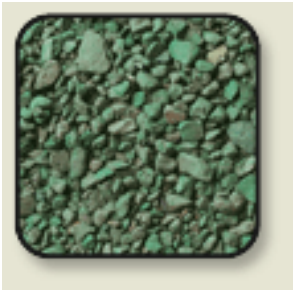
RESEARCH PROJECTS: BASSI LAB

- Microalgae cultivation on anaerobic digester effluent for water recycle and value recovery
- Novel microalgal bioreactor design for enhanced product yield
- Bio-electro desalination cell for road salt mitigation
- Phosphate recovery from wastewater using uninterrupted ion exchange (UIX-Renix) www.renix.ca
- Micro-plastic capture from waste using bio-surfactants
- Bio-surfactants from anaerobic digestate

4. Value Recovery

RESEARCH PROJECTS: BASSI LAB

Animal feed



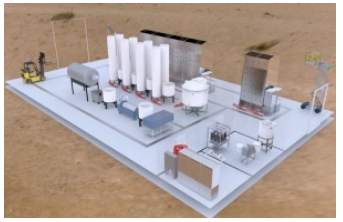
Soil conditioner

water treatment and recycle

Clean Water and Value from Algae

Biological antioxidants

CO2 capture



Biodiesel

Aqua culture- Fish food

Bioethanol

4. Value Recovery

RESEARCH PROJECTS: BASSI LAB

Microalgae Applications for Value Addition

- Biofuels: Biodiesel, oil from hydrothermal treatment (*Chlorella, N. gaditana etc.)*
- *Dunaliella salina*: beta carotene, lutein, lycophene
- *Haematococcus pluvialis:* Astaxanthin

4. Value Recovery

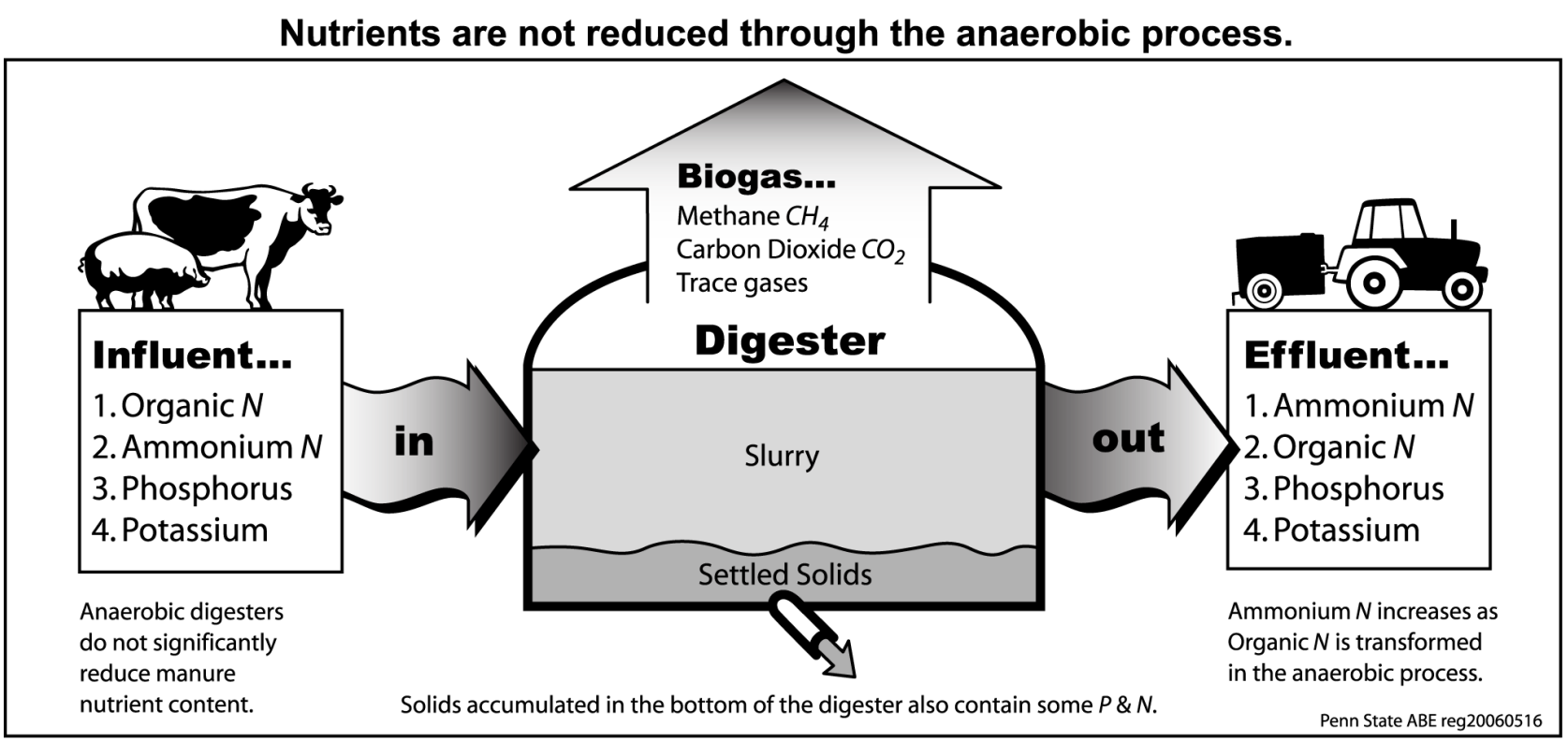
BASSI GROUP RESEARCH FOCUS

- Dairy farm Effluents
- Hog Farm Effluents
- Septic Tank overflow
- Surface Run-off from Farms/Fields
- Anaerobic Digester Effluent
- Greenhouse (vegetable/ flower) effluent
- Landfill Leachate

4. Value Recovery

BASSI GROUP RESEARCH FOCUS

How Do Anaerobic Digesters (AD) Work?



Source: http://www.abe.psu.edu/extension/factsheets/g/G71.pdf

4. Value Recovery

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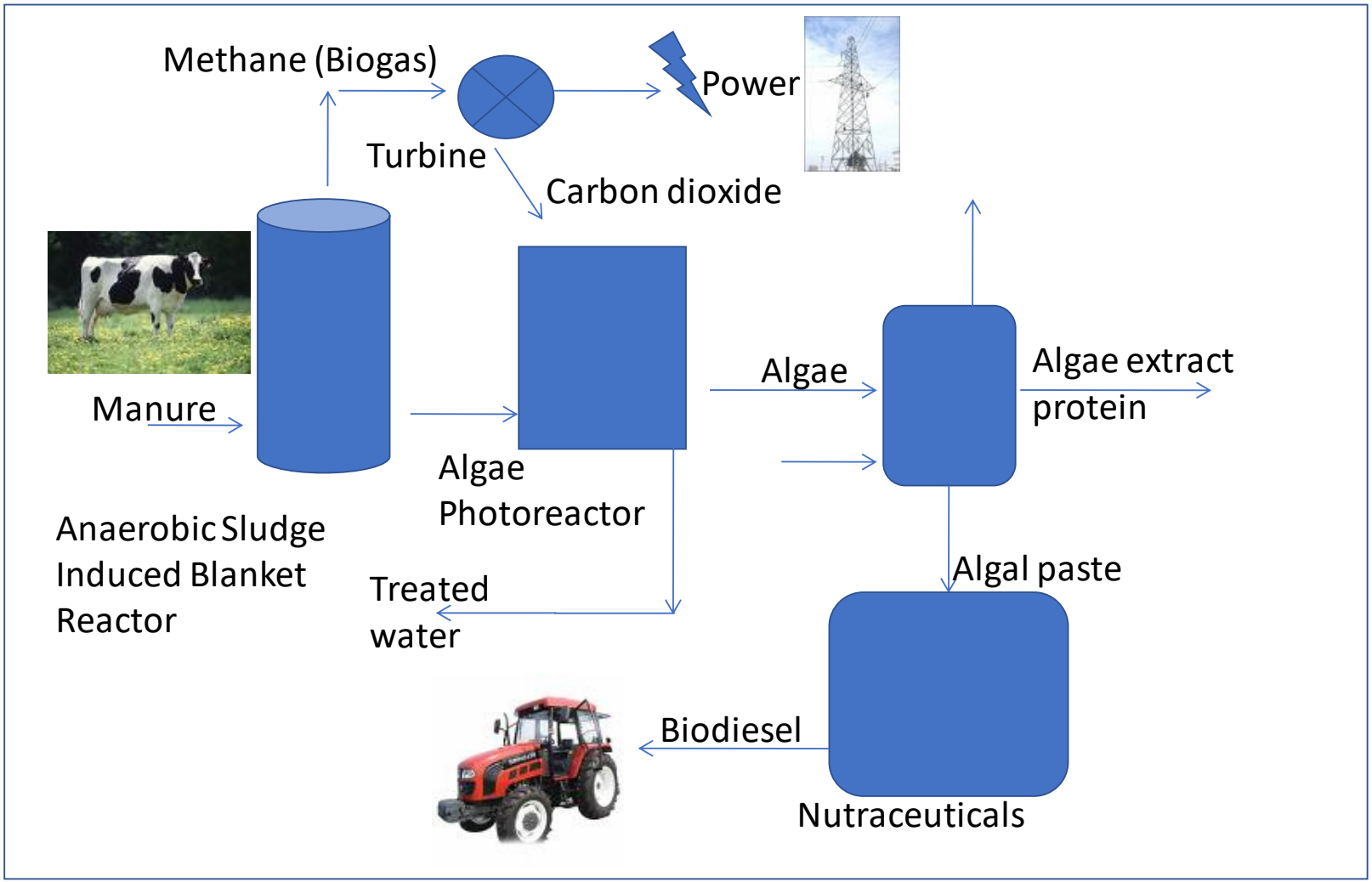

Figure: Closing the Loop- A simplified representation of high value from waste using microalgae

4. Value Recovery

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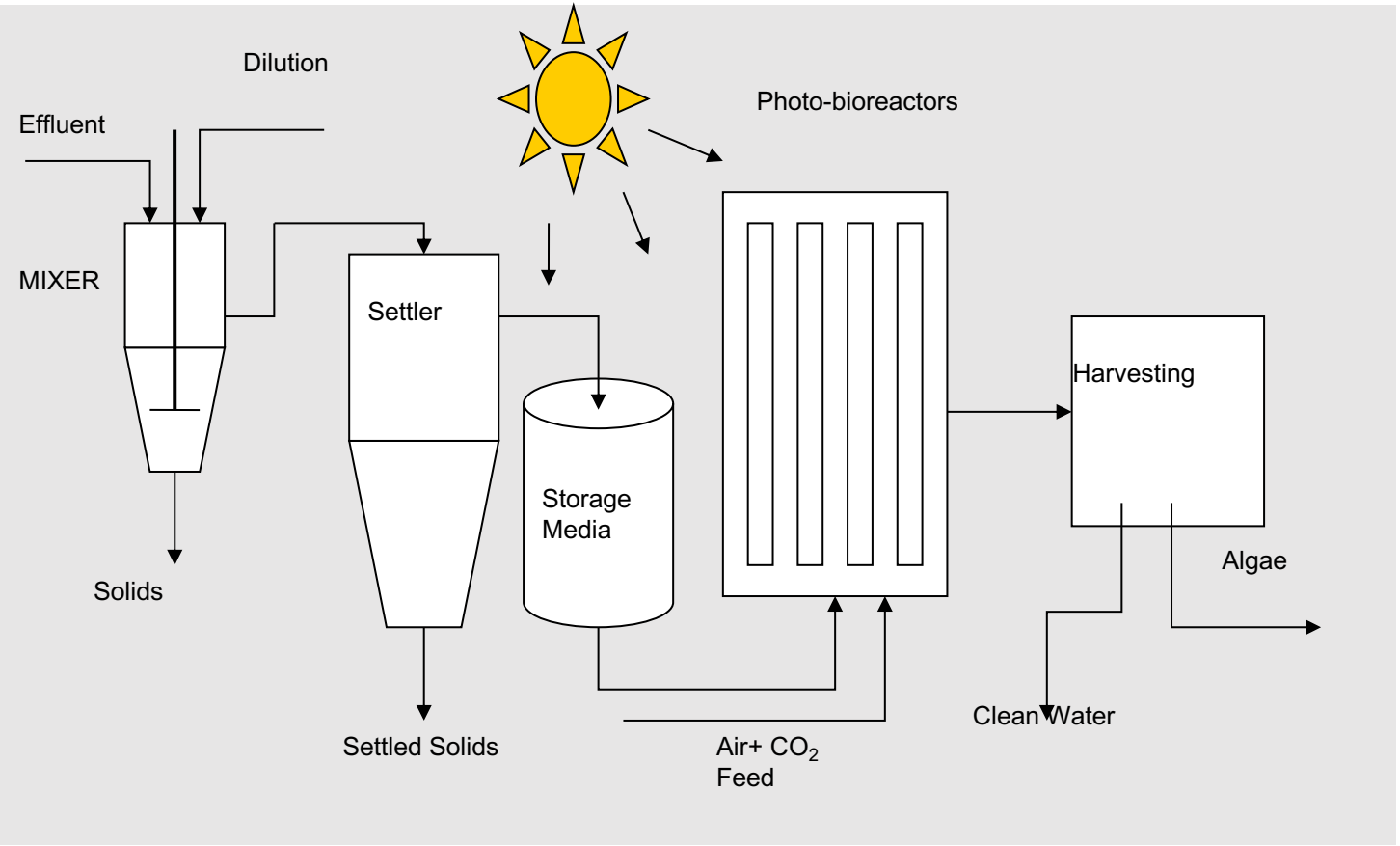
On farm Algal Cultivation



UWO-STANTON FARMS COLLABORATION

4. Value Recovery

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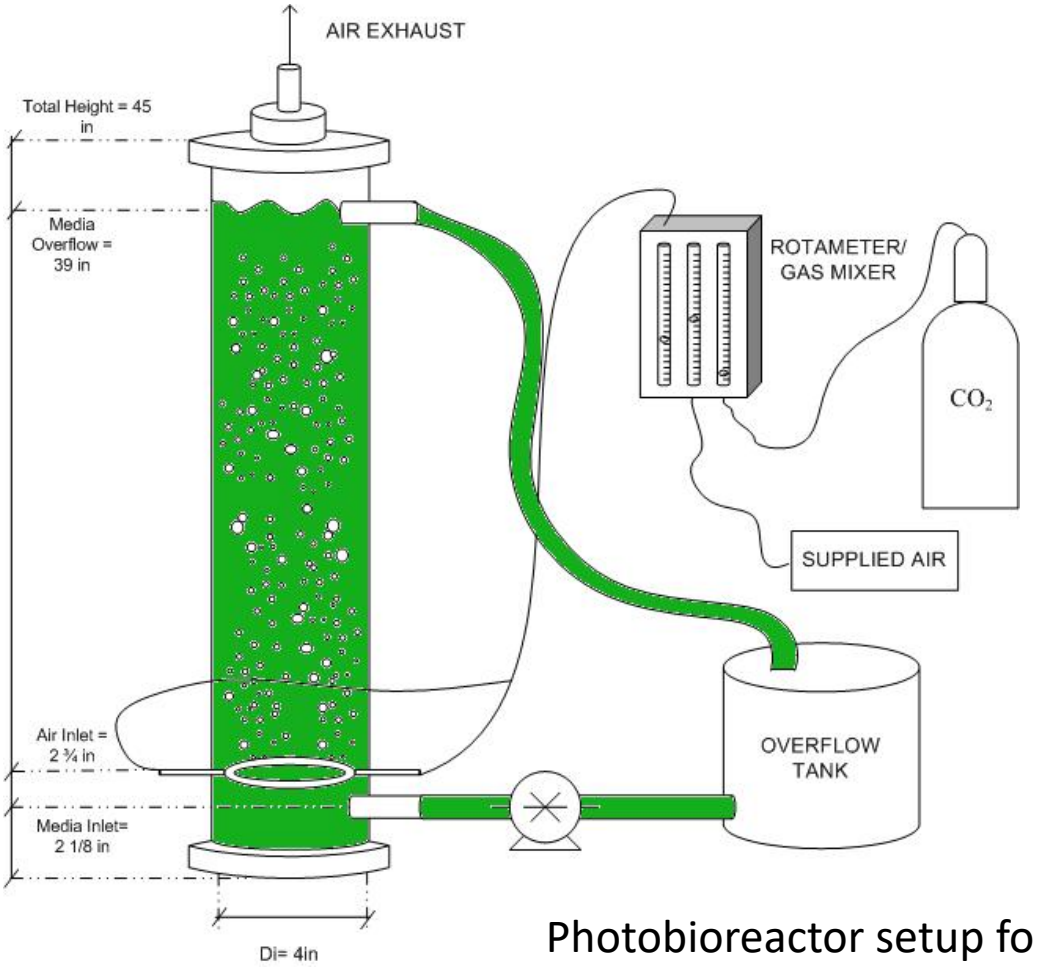

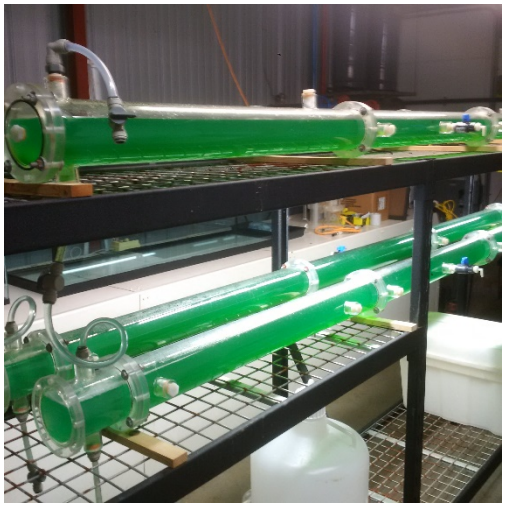

Photobioreactor setup for Microalgae production- on farm
(University of Western Ontario)

4. Value Recovery

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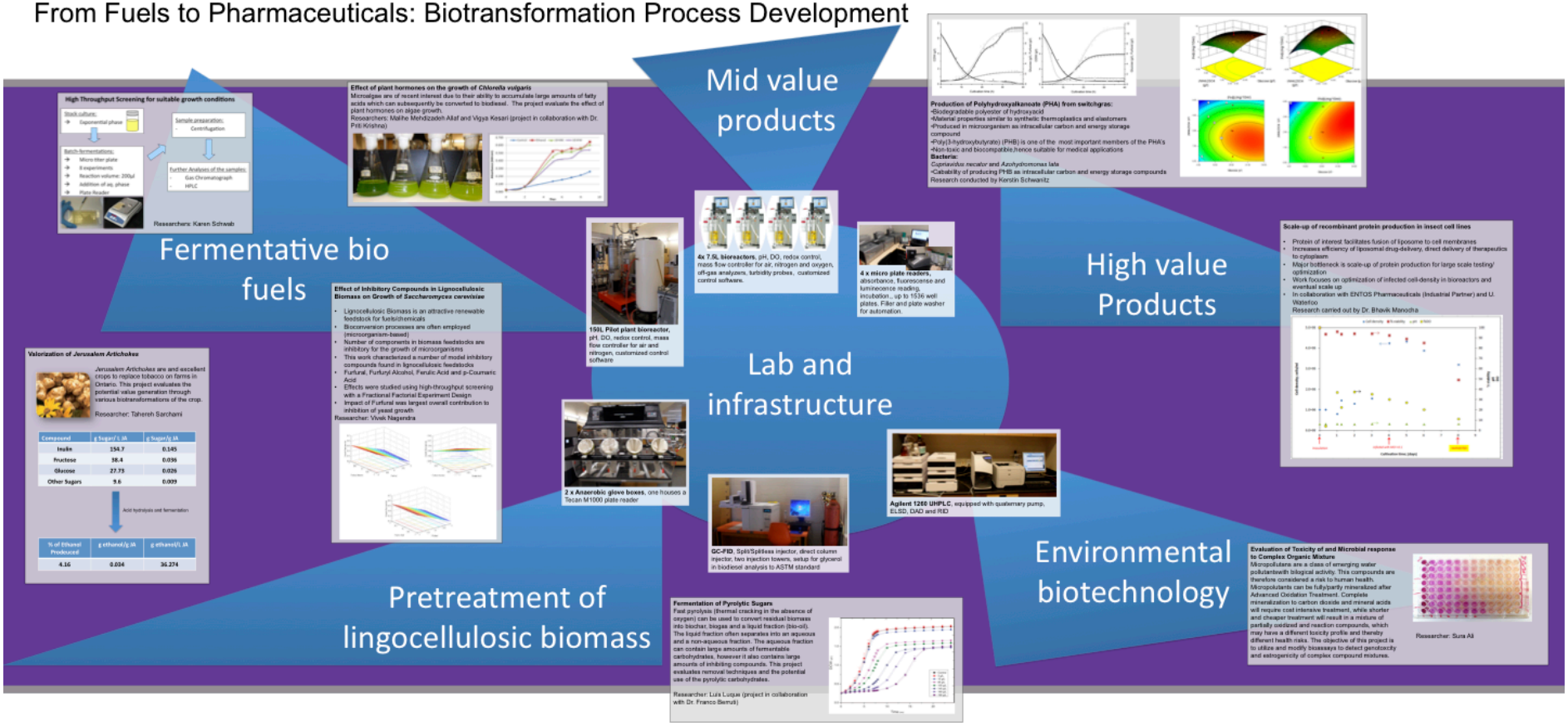
Bio-oil extracted from algae using steam explosion

4. Value Recovery

RESEARCH PROJECTS: REHMANN LAB

From Fuels to Pharmaceuticals: Biotransformation Process Development



4. Value Recovery

RESEARCH PROJECTS: REHMANN LAB

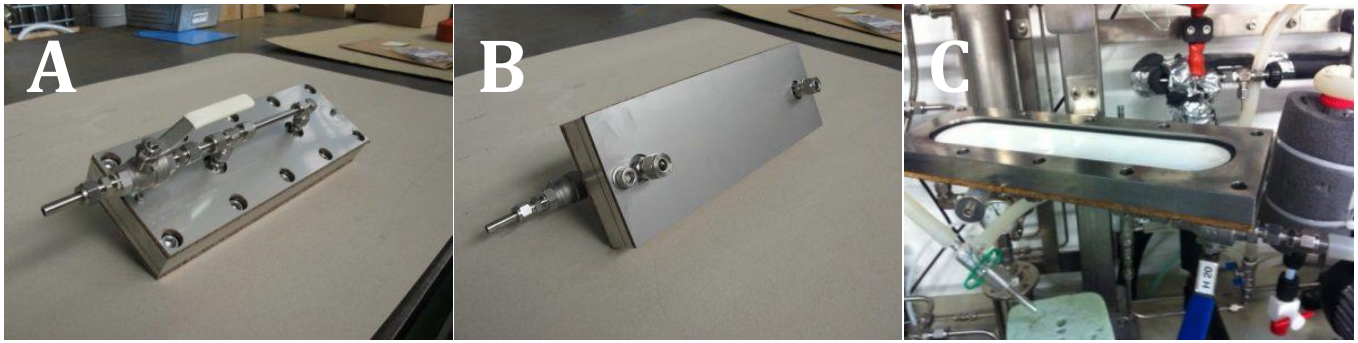
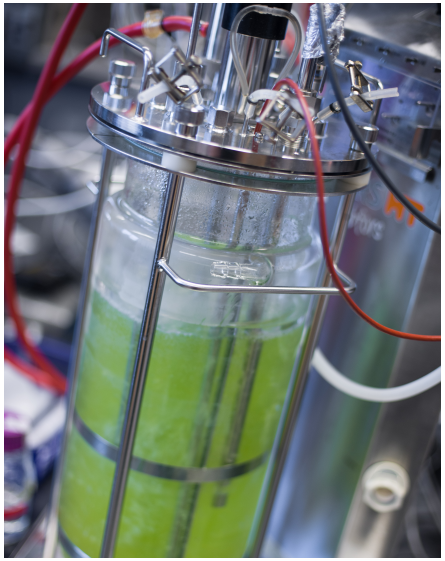
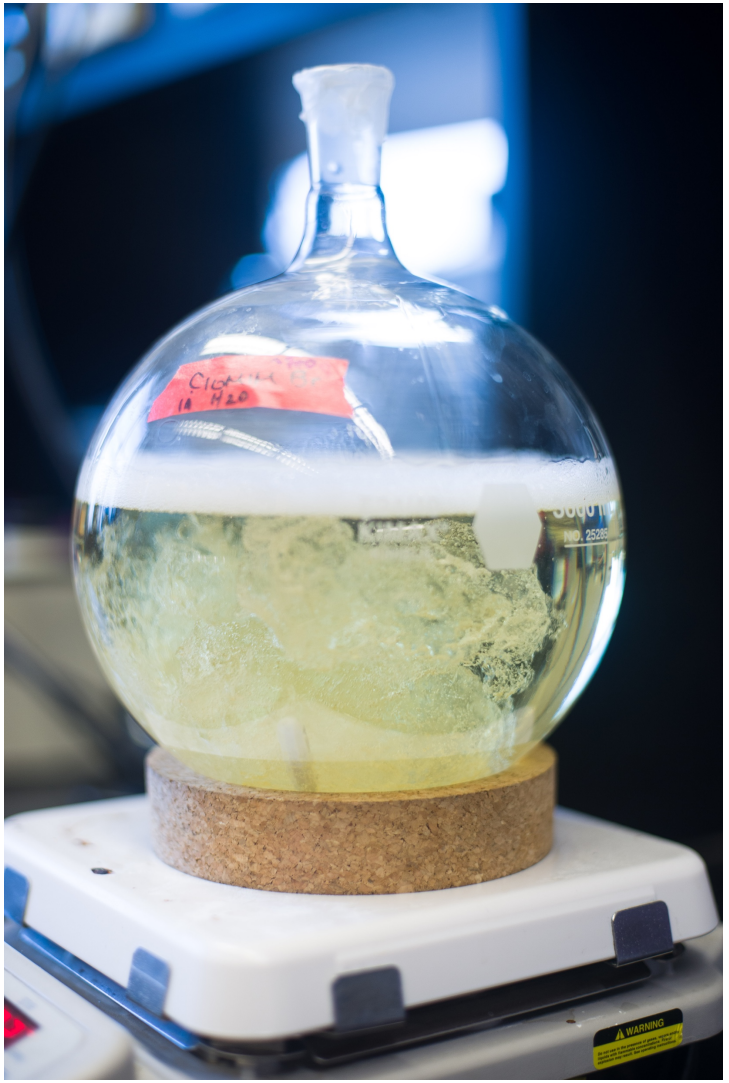


Figure 3.2: Pervap 4060 membrane and test cell: (A) Assembled test cell showing permeate (vacuum) connection, (B) assembled test cell showing feed and retentate connections, (C) test cell permeate part showing sinter plate, membrane and O-ring installed.



4. Value Recovery

RESEARCH PROJECTS: REHMANN LAB



4. Value Recovery

RESEARCH PROJECTS: XU LAB

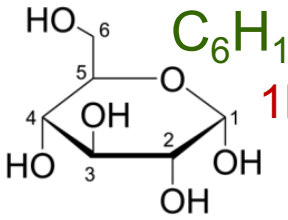
- Renewable hydrogen from high TOC wastewater via supercritical water gasification (Dr. Xu)
- Hydrothermal Liquefaction and conversion of bio-solids/ wastewater sludge into bio-crude oils for bio-fuels and high-value bio-products (Drs. Xu, Bassi, Ray)

4. Value Recovery

RESEARCH PROJECTS: XU LAB

Renewable hydrogen gas production via supercritical water gasification

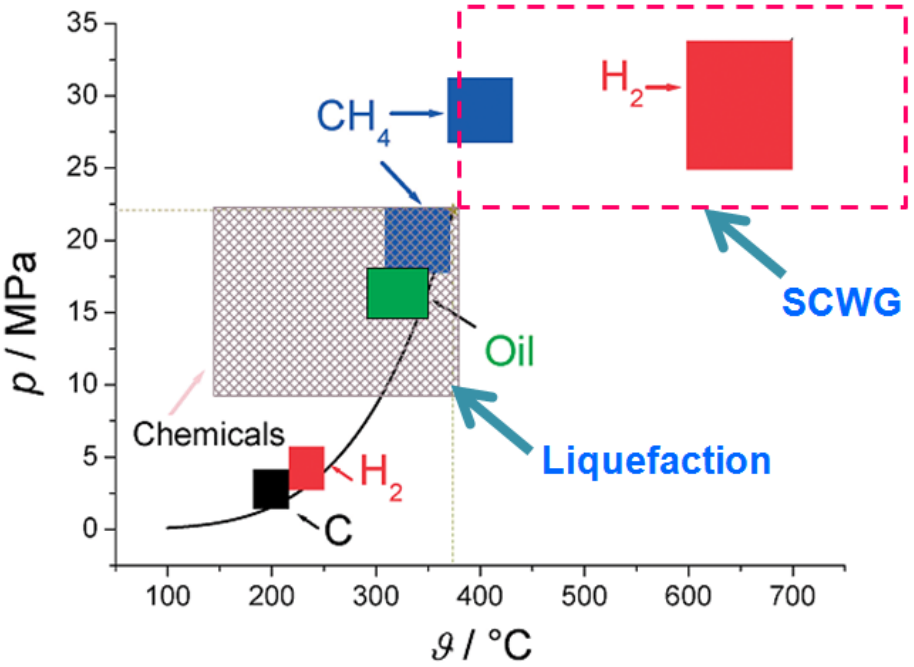
- Overall reaction (Take glucose as an example)



$$C_6H_{12}O_6 + 6H_2O \rightarrow CO_2 + 12H_2$$

1kg ⟶ 1.5 m^3

- Unique features
  - Water is a solvent & reactant
  - Homogeneous reaction
  - Small footprint
  - High efficiency



4. Value Recovery

RESEARCH PROJECTS: XU LAB

Continuous- flow SCWG tractor at Xu lab

4. Value Recovery

RESEARCH PROJECTS: XU LAB

Wastewater Sludge

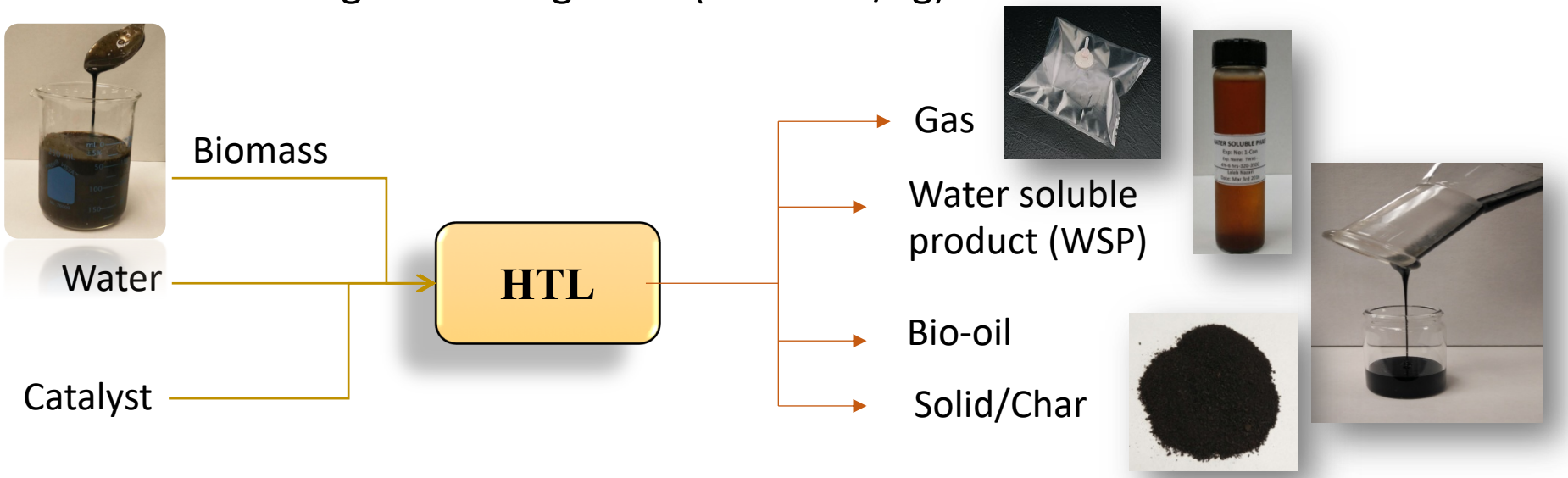
- Wastewater sludge is the main waste from wastewater treatment plants
- It contains high percentage of water (> 90% on wet mass basis)
- Sludge management is one of the most difficult and challenging, and hence costly tasks of wastewater treatment plants
- Traditional sludge disposal methods: incineration, land application and landfill

4. Value Recovery

RESEARCH PROJECTS: XU LAB

Hydrothermal Liquefaction (HTL)

- A thermo-chemical process for conversion of high-water-content biomass
- Does not require drying
- Mostly uses water as solvent
- Operates at high pressures (5-20 MPa) and moderate temperatures (< 400 °C)
- Compared to pyrolysis, the bio-oil from HTL has lower water and oxygen content and thus has higher heating value (30-35 MJ/kg)



4. Value Recovery

RESEARCH PROJECTS: XU LAB

Hydrothermal Liquefaction (HTL) reactors in Xu Lab

16 L large batch reactor for liquefaction of biomass into bio-crude oils (5kg per batch)