Prospective Life Cycle Assessment of The Emerging Technology in Circular Economy Context

Haodong Lin & Aiduan Borrion

Department of Civil, Environmental and Geomatic Engineering

University College London (UCL)

haodong.lin@ucl.ac.uk

21st October 2024

Content

Introduction

- Circular economy (CE) benefits the environment, economy, and society[1]
- Emerging technology contributes to circular economy transition[2-3]
  - Exploring and optimising early CE designs
  - Improving resource efficiency
  - Bettering life cycle management
- Yet, assessing environmental impact of such emerging technologies in CE context are still challenging

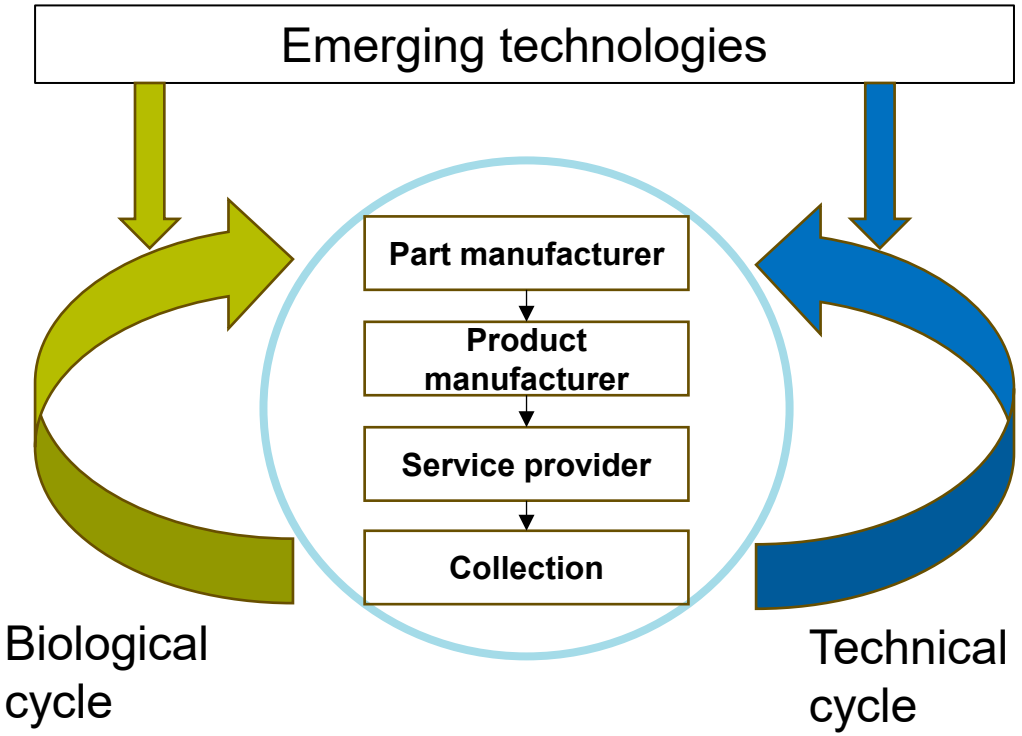

Fig 1. Emerging technologies in circular economy system.

1. Ogunmakinde et al. (2021). https://doi.org/10.1007/s10098-020-02012-9
2. Gan et al. (2020). https://doi.org/10.1016/j.jclepro.2020.120012
3. Rosa et al. (2020). https://doi.org/10.1080/00207543.2019.1680896

Objectives

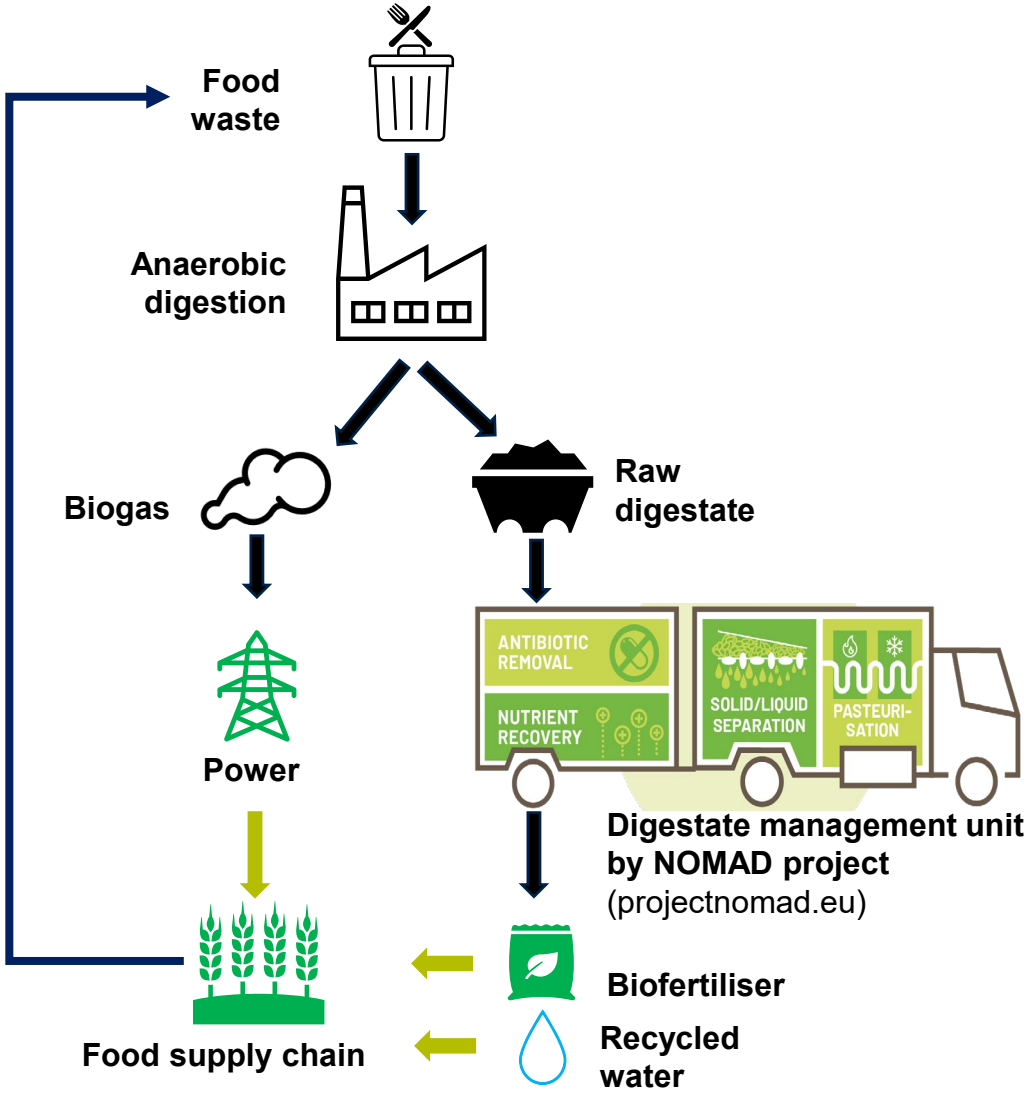

Fig 2. Circular food system studied.

- A circular food system
  - An emerging digestate treatment technology incorporated with anaerobic digestion (AD) industry
  - Renewable power and resources recovered from food waste for food system
- Research question
  - What are the environmental impacts of consequence when the studied emerging technology is upscaled and introduced into the UK's AD industry in 2030?

Methodology

- Consequential Life Cycle Assessment method is applied
  - Functional unit: processing 1 tonne digestate
  - System boundary
  - 4 impact categories assessed
  - Foreground: primary and secondary data collected for the emerging technology at pilot scale, while inventory of upscaled technology estimated by the design team
  - Background: Ecoinvent database (consequential data)

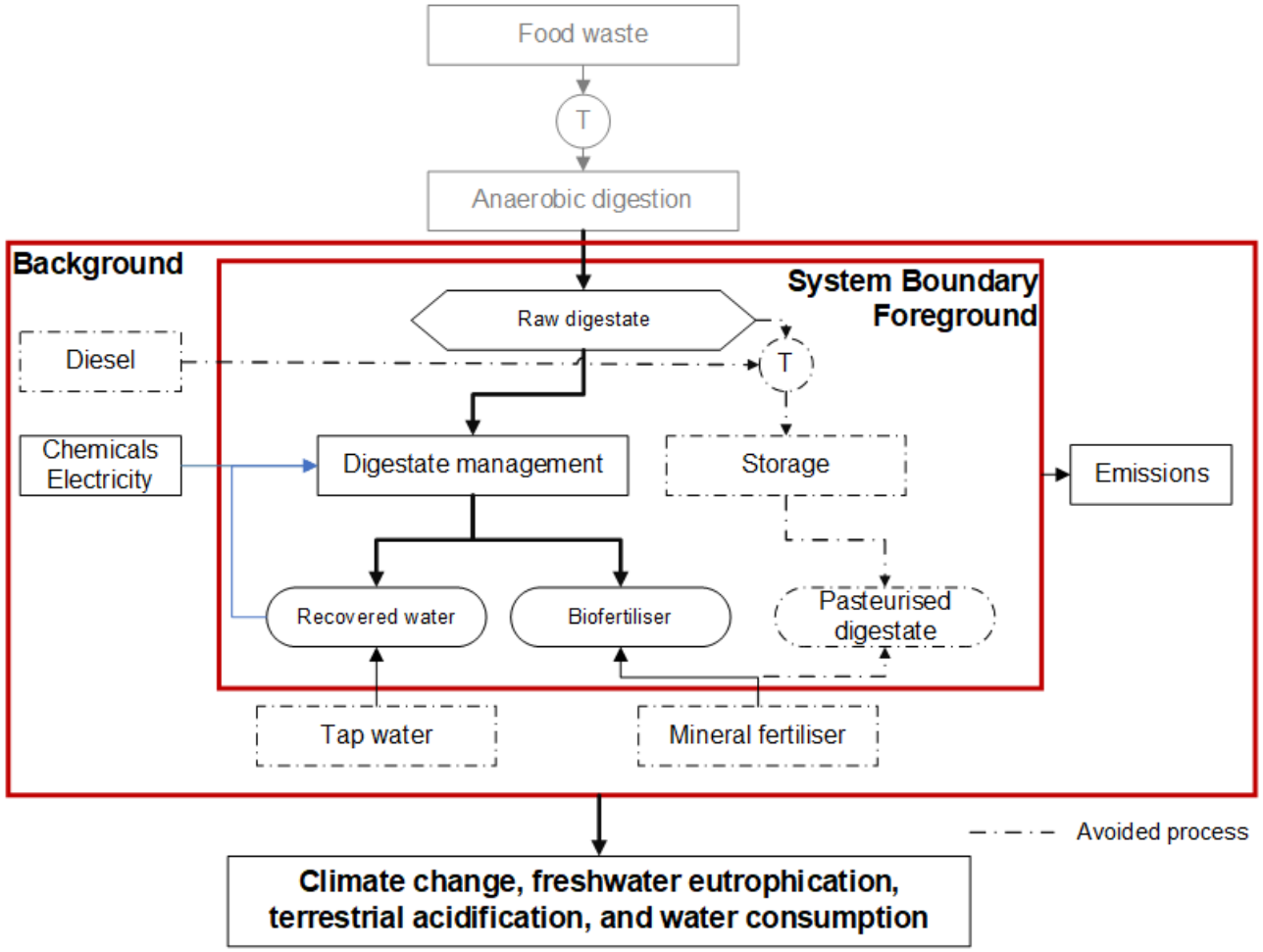

Fig 3. System boundary and 4 impact categories assessed.

Results

- Digestate management technology studied brings insignificant impacts when upscaled and introduced to UK anaerobic digestion (AD) industry
- Overall impact reductions achieved, due to
  - avoided mineral fertiliser production by recovered biofertiliser
  - avoided water production and use by recovered water
  - avoided digestate storage, and
  - avoided transportation

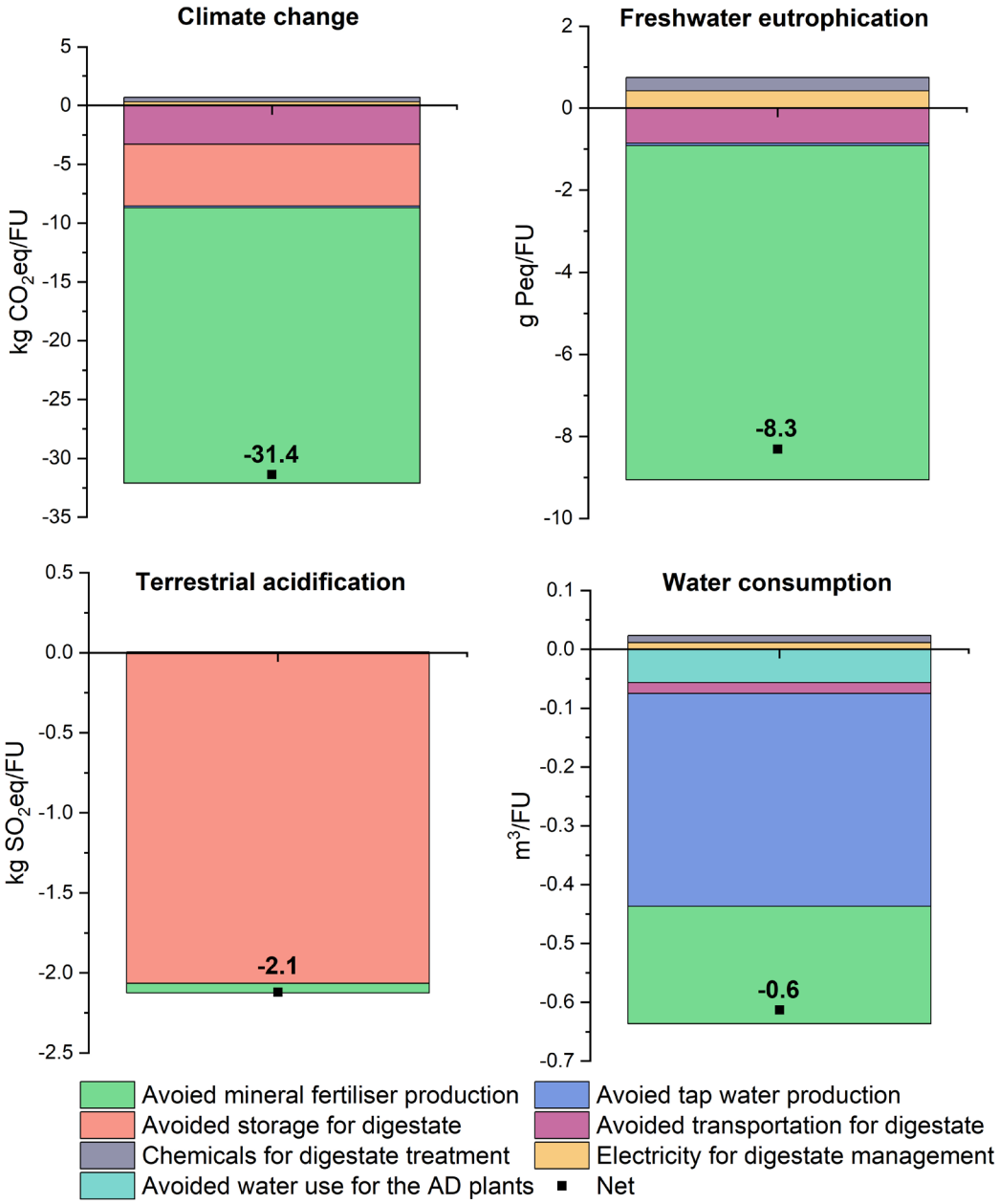

Fig 4. Results of the consequential life cycle assessment.

Conclusions

- Digestate management technology studied can be environmentally beneficial for UK anaerobic digestion (AD) industry in future
  - Recovered biofertiliser and water from digestate play a key role
  - Avoided digestate storage and transportation also benefit the environment
  - It can decarbonise the AD industry and contribute to national policy, e.g., Net-Zero GHG target in the UK
- Limitations and future studies
  - Low data availability and quality – future data gap, e.g., food waste generation and capacity of the AD industry in 2030, and marginal background data
  - Scopes of the study – e.g., limited to commercial AD plants and mineral fertiliser production
  - Uncertainty and scenario analysis will be conducted next

Many thanks for listening!

Q&A

Haodong Lin

Department of Civil, Environmental and Geomatic Engineering

University College London (UCL)

haodong.lin@ucl.ac.uk

21st October 2024