

# VFA Recovery from Anaerobic Digestion Process A Comparative Analysis with Methane Recovery

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## 1. INTRODUCTION

Resources recovery from Anaerobic Digestion (AD) process is attracting an increased attention in organic waste treatment. This research investigated the two primary resources recovery options-Volatile Fatty Acids(VFA) and Methane recovery. VFA contains higher calorific value and economic value, and hence is considered to be an attractive option. The two recovery options are competitive to each other, since VFA is the substrate for Methane production. **The aim of this research is to determine if VFA recovery is more beneficial than Methane recovery based on Embodied Energy, Economic Value and Embodied Carbon.**

## 2. RESOURCES RECOVERY OPTIONS FROM AD

Nutrients

- Struvite
  - Phosphorous
  - Ammonia
- Sulfur

Metals

- Copper
- Cobalt
- Iron

VFA

R-C(=O)O

Methane

C

WHY

VFA & METHANE

↑

High availability in AD

⚡

High Embodied Energy

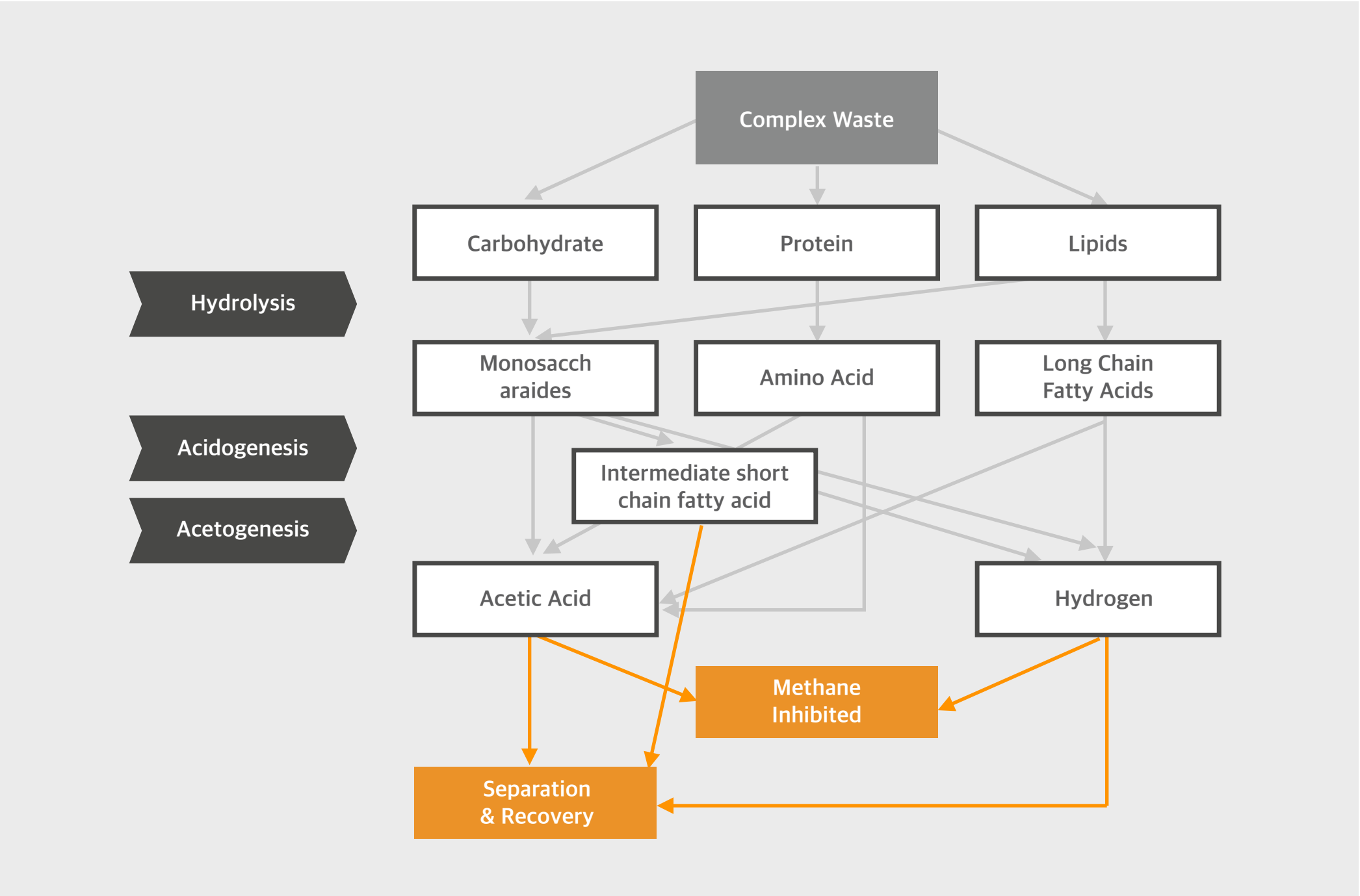
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High Economic Value

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High Embodied Carbon

## 3. AD PROCESS Where is VFA and Methane produced?



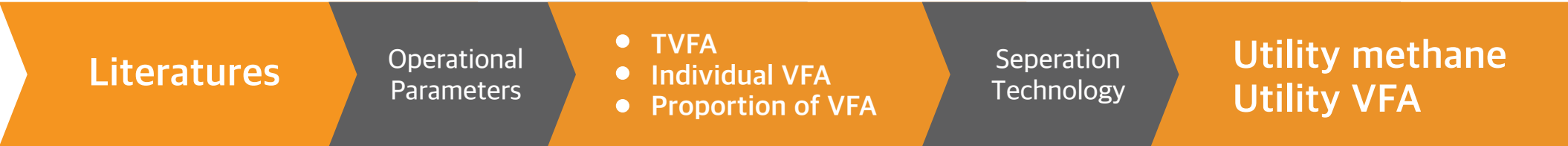
- Hydrolysis- Break down Lipids, Protein & Carbohydrates to monomers and oligomers
- Acidogenesis- Monomers converted into VFA
- Acetogenesis-VFA converted into Acetate, CO<sub>2</sub> and Hydrogen
- Methanogenesis-Acetate, CO<sub>2</sub> and Hydrogen converted into Methane
- To recover VFA , Methanogenesis is required to be inhibited

## 4. LITERATURE REVIEW-OPERATIONAL PARAMETER AFFECTING VFA PRODUCTION

pH	Organic Loading Rate	Temperature	Feedstock	Retention Time
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**pH and Retention time are the two most influential parameters**

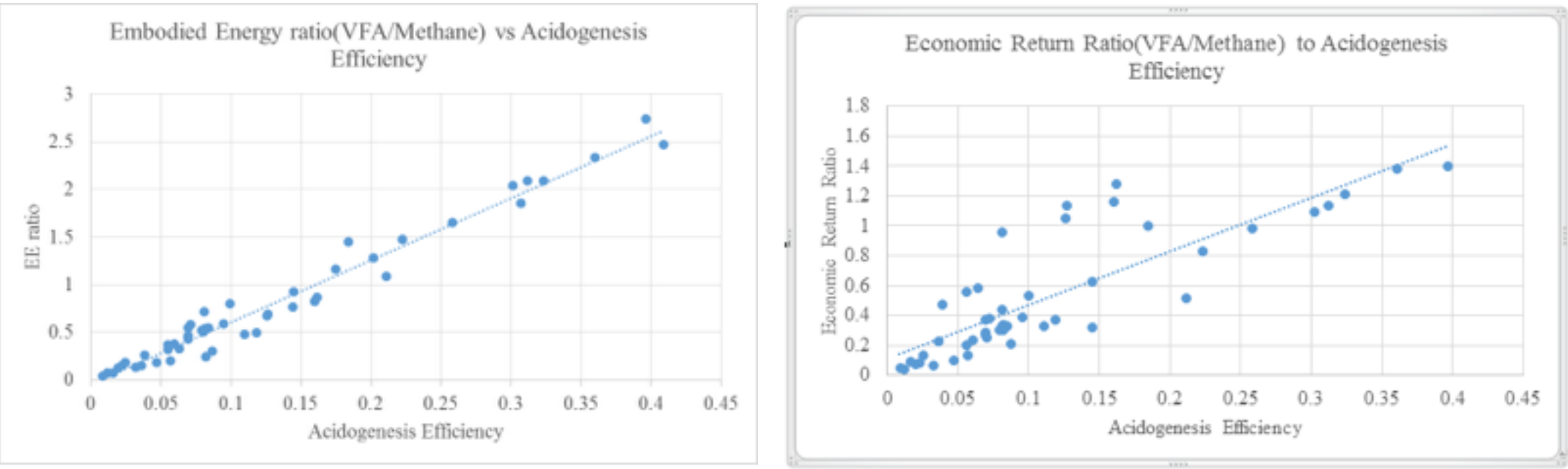
- Optimal pH- High pH for sludge, Neutral pH for Food wastes
- Low pH for Municipal Solid Wastes
- Higher retention time – Increased production of higher chain length VFA



## 5. INTERPRETIVE ANALYSIS OF LITERATURE DATA

### Comparison of Utility of VFA and Methane recovery

Type of Utility	Number of literature		
	Embodied Energy	Economic Return	Carbon captured(for Methane since it is combusted to produce electricity ,thus the net embodied carbonmethane=0)
1. Utility VFA> Utility Methane	5	5	18
2. Utility Methane> Utility VFA	6	6	0
3. Utility VFA>Utility Methane ( when there was change in parameters applied in the literature )*	7	7	0
TOTAL	18	18	18



- If Acidogenesis Efficiency is higher than 16% it is likely that recovering VFA is energetically more beneficial than methane recovery.
- If Acidogenesis Efficiency is higher than 24% it is likely that recovering VFA is economically more beneficial than methane recovery.

pH	10(maintained by NaOH)
OLR(g/Ld)	7.33
Temperature	Mesophilic
Additives	-
SRT(days)	14
HRT(days)	6
TCOD(mg/L)	18221
TVFA(mg/L)	7453
Flow into AD (m <sup>3</sup> /day) in a conventional waste water treatment plant	800
Reference	Ucisk & Henze, 2008; Henze and Comeau,2008

	Modified 2 phase AD	Standard 2 phase AD	Unit
Total EE	27705	8662	(GJ/year)
Total ER	1,124,124	225221	(£/year)
Total EC	500	0	(ton/year)

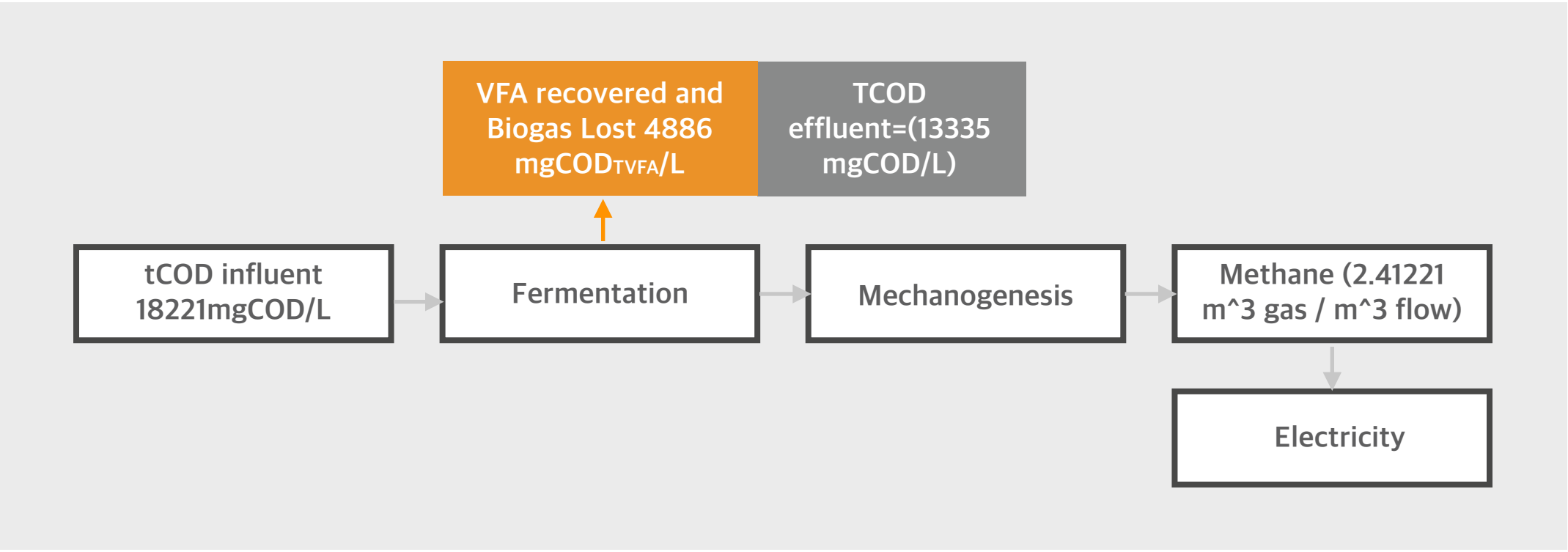
### Case Study

The modified 2 phase AD in sludge digestion(Incorporate VFA recovery before methane generation) compared with the conventional 2 phase AD

Result showed that the modified 2 phase AD is more beneficial than the conventional 2 phase AD.

### Conclusion

VFA recovery can be significantly more beneficial than methane recovery



## ACKNOWLEDGEMENTS

I wish to express my sincere gratitude to Professor Stephen Smith, for the continuous support and patience. His guidance helped me in all the time of research and writing of this thesis. This research could not be completed without him.

## REFERENCES

Ucisk, A.S. & Henze, M. 2008, "Biological hydrolysis and acidification of sludge under anaerobic conditions: The effect of sludge type and origin on the production and composition of volatile fatty acids", Water research, vol. 42, no. 14, pp. 3729-3738.

Henze, M. & Comeau, Y. 2008, Wastewater Characterization, IWA Publishing, UK.