

# **A Critical Assessment of Wet and Dry Anaerobic Digestion Processes for the Treatment of Municipal Solid Waste and Food Waste**

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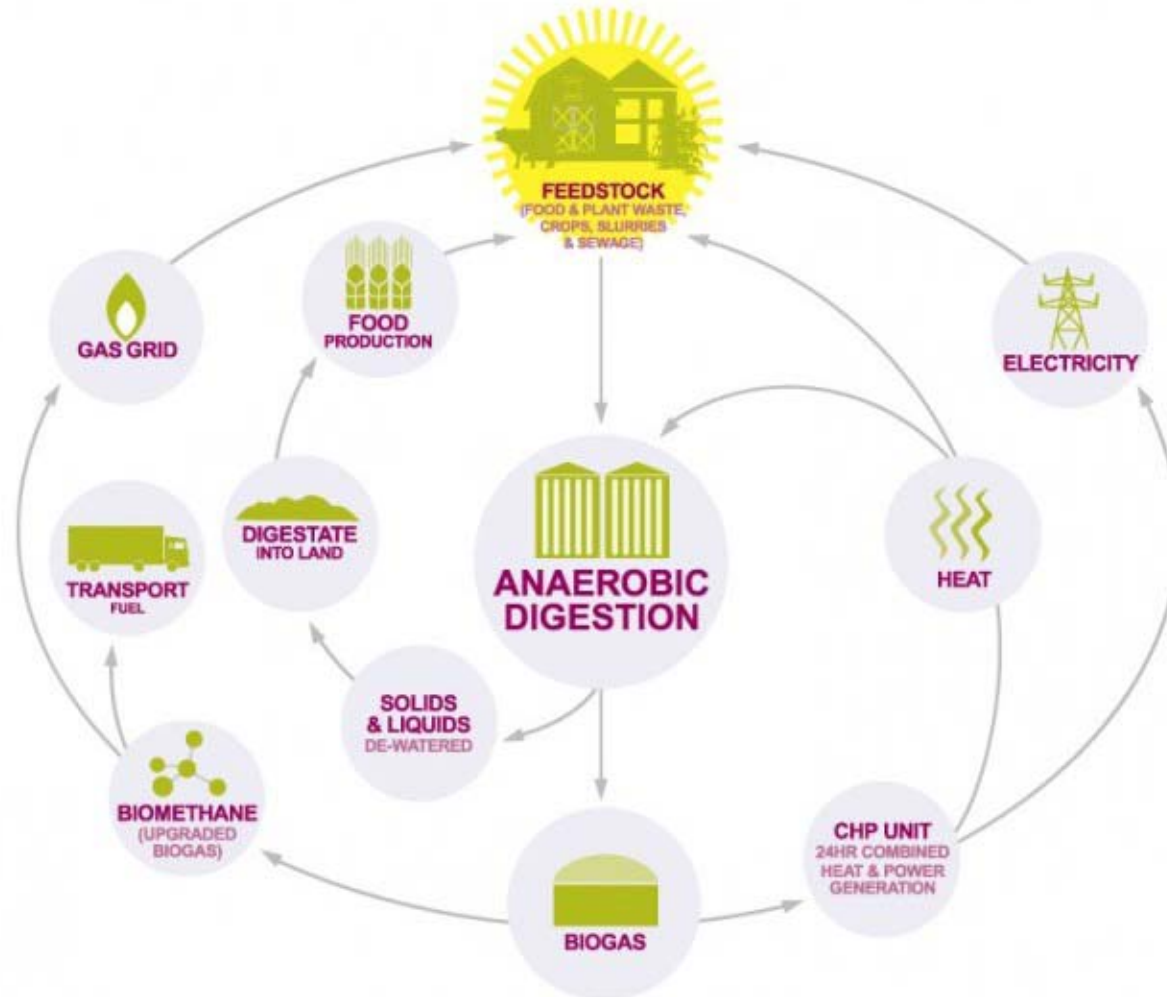
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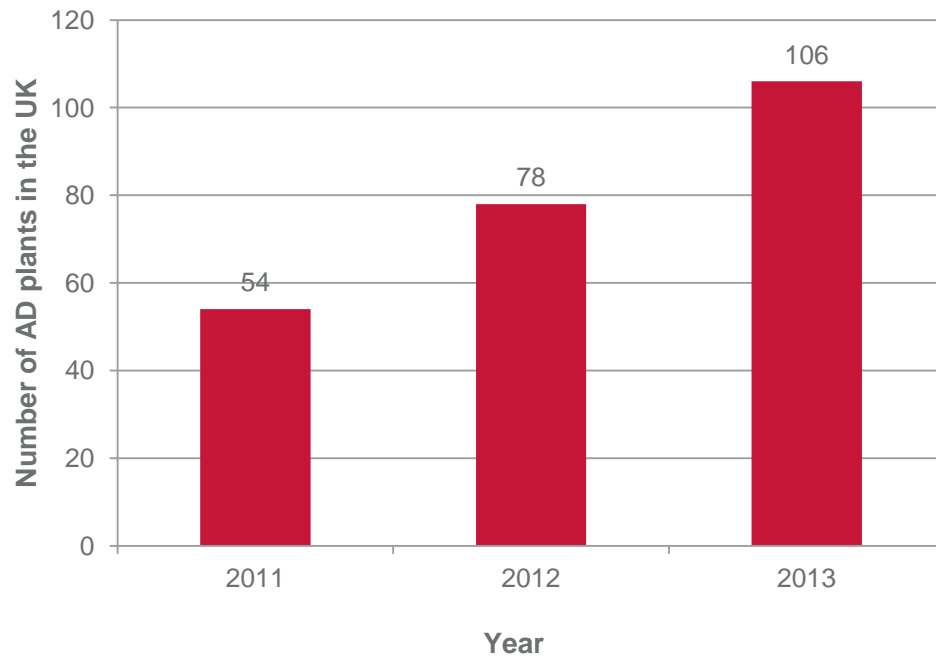
# Introduction

## Anaerobic Digestion



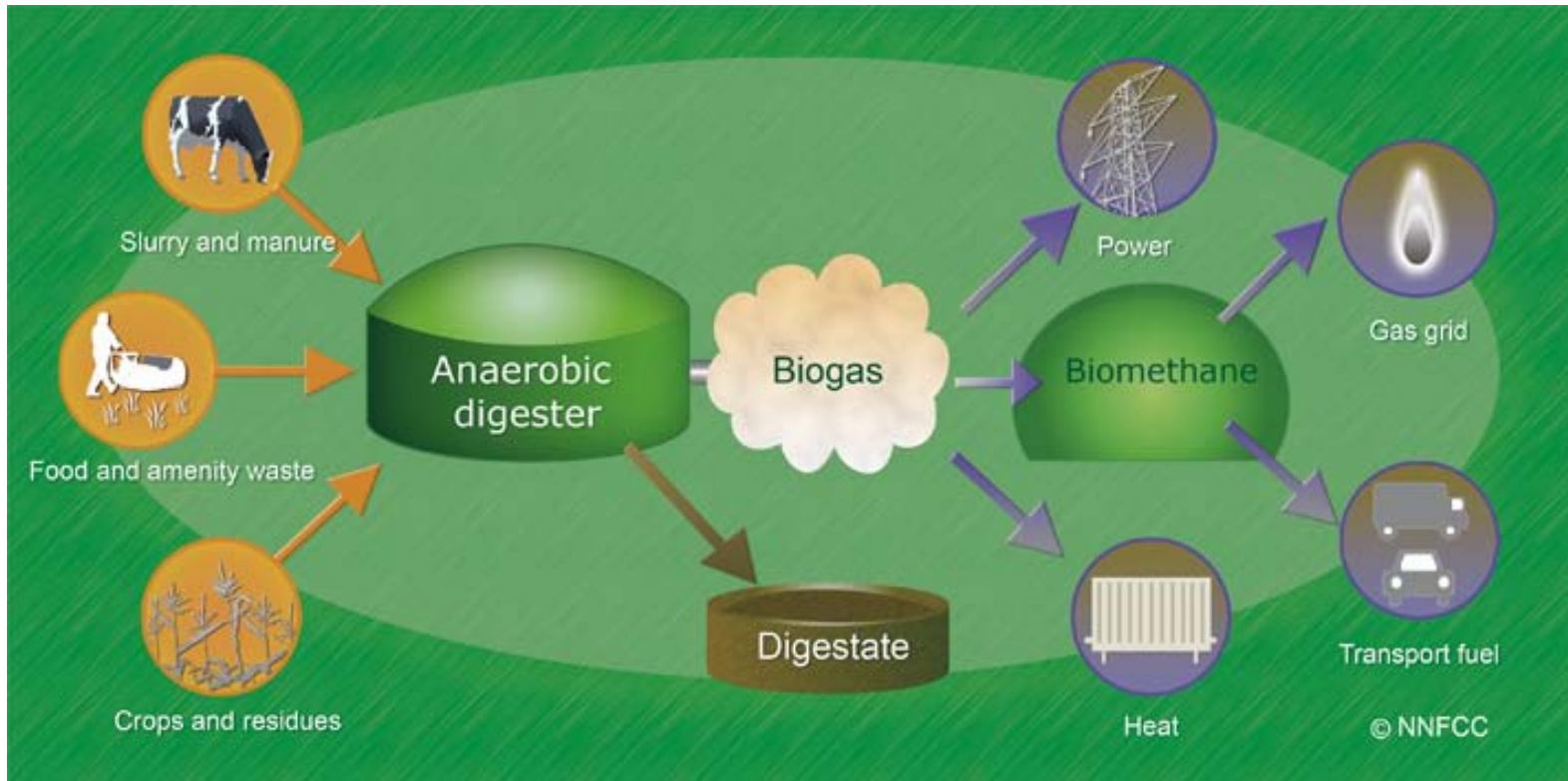
# Introduction

## Anaerobic Digestion in the UK



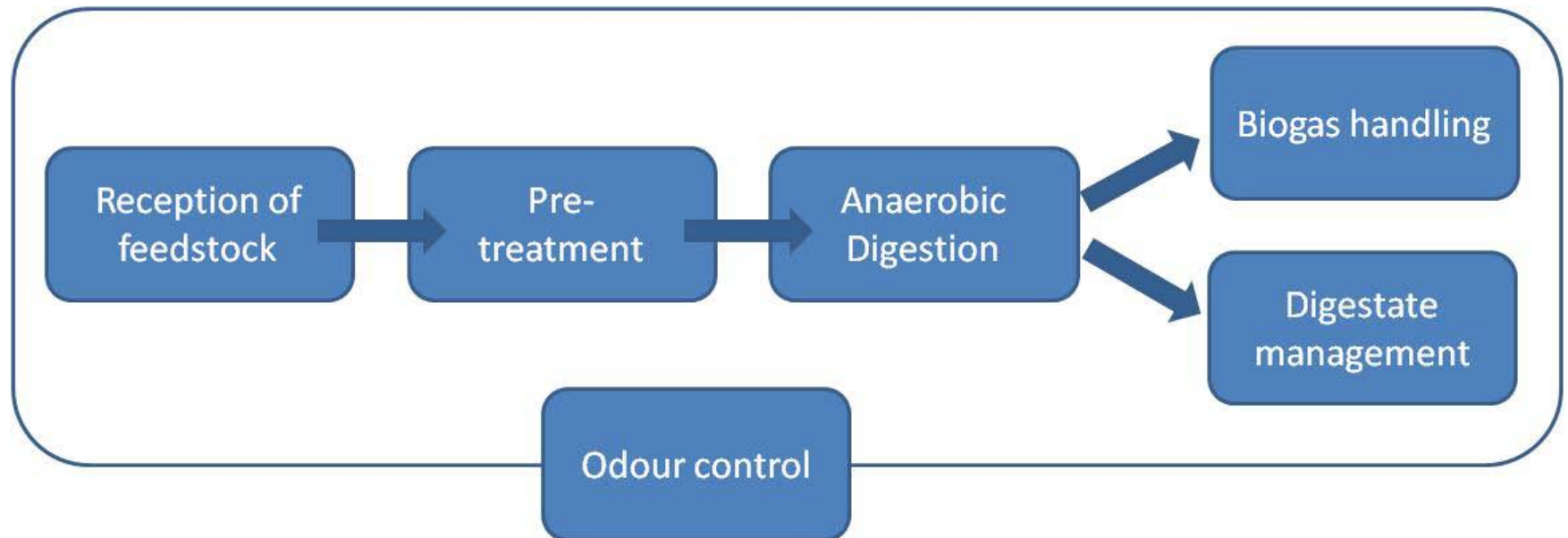
# Introduction

## Anaerobic Digestion



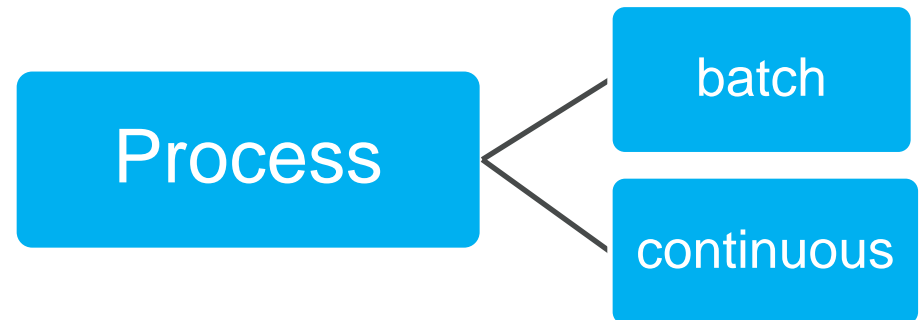
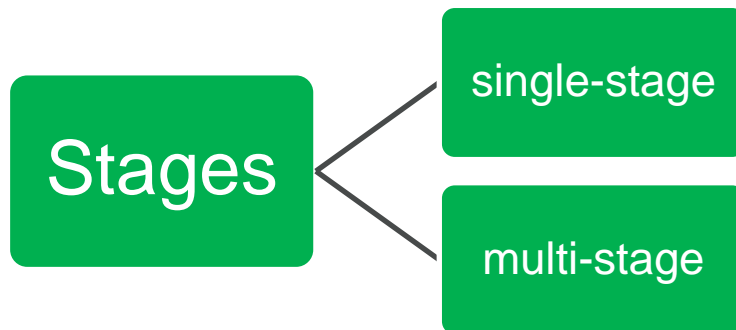
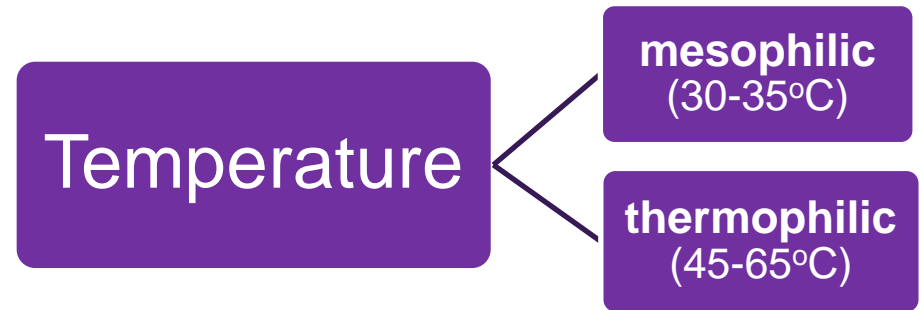
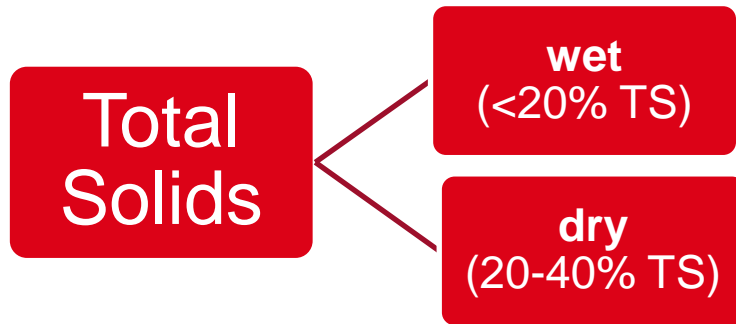
## Introduction

### Anaerobic Digestion System



# Introduction

## Types of AD systems



## Aim & Objectives

### Aim

to investigate and compare  
different AD processes  
for MSW and food waste

**Technical status**

**Economic performance**

**Energy balance**

**Output marketability**

### Objectives

- to conduct a technology assessment of wet and dry AD processes
- to carry out a case study assessment of AD facilities in the UK and Europe

## Methodology

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- **Literature Review**
- **AD Technology Assessment**
- **Questionnaire**
- **Site Visits**
- **Case Study Assessment**



# Methodology

## AD Technology Assessment

**O/W/S**

**Valorga<sup>®</sup> Methanization Process**

**Aikan<sup>®</sup>**  
CLEANTECH BY THE SOLUM GROUP

**DRANCO**

**Orgaworld**  
Part of Shanks Group

**BIOFERM<sup>™</sup>**  
ENERGY SYSTEMS

**VIESMANN Group**

**axpo**

**Axpo Kompogas**

**MYT<sup>®</sup> Maximum Yield Technology**

# Methodology

## Questionnaire

1

Technical status

- pre-treatment
- type of feedstock
- TS (%)
- temperature range (°C)
- loading rate
- water usage
- post-treatment
- retention time

2

Economic performance

- capital cost
- operational cost
- cost of digestate management
- gate fee
- revenues from electricity
- other revenues

3

Energy balance

- biogas yield
- biogas composition
- biogas utilisation
- electricity production
- % of energy consumed

4

Output marketability

- form of digestate
- digestate management
- storage
- transportation
- uses of digestate
- markets for digestate

# Methodology

## Case Study Assessment

Case Study No	AD Facility	Country	AD System	Technology	Technology Provider
1	Holsworthy biogas plant	England	wet	CSTR	-
2	Cassington AD plant	England	wet	CSTR	-
3	Biocel plant	Netherlands	dry	Biocel	Orgaworld
4	Twence fermentation plant	Netherlands	dry	DRANCO	Organic Waste Systems (OWS)
5	Meerlanden plant	Netherlands	dry	Kompogas	Axpo-Kompogas
6	ZAK plant	Germany	dry-percolate	MYT	ZAK, WEHRLE Umwelt GmbH
7	Ecoparc 2	Spain	dry	Valorga	Valorga International (Urbaser)
8	-	Italy	dry	-	-
9	Aikan showcase plant	Denmark	dry-percolate	Aikan	Aikan

# Methodology

## Case Study No2 : Agrivert AD plant, Cassington, UK

Plant Characteristics	Case Study No 2
AD Technology	wet AD system, 2 CSTRs
Total Capacity	50,000 tpa
Types of Feedstock	source separated household food waste, C&I food waste and energy crops
Capital Cost	£9.5-10 million
Final Product	digestate
Biogas Yield	150 m <sup>3</sup> /t



## Methodology

### Case Study No 7:

Ecoparc 2, Barcelona,  
Spain



### Case Study No 5:

Meerlanden plant, Rijsenhout,  
Netherlands



## Results

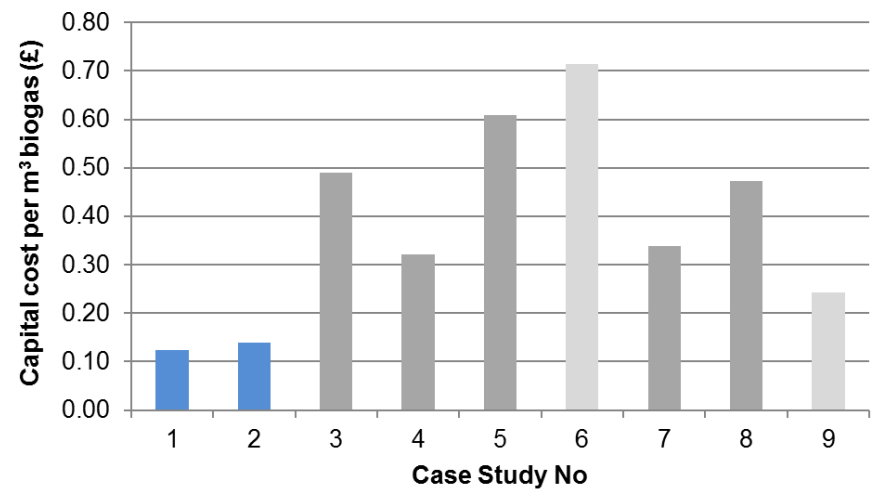
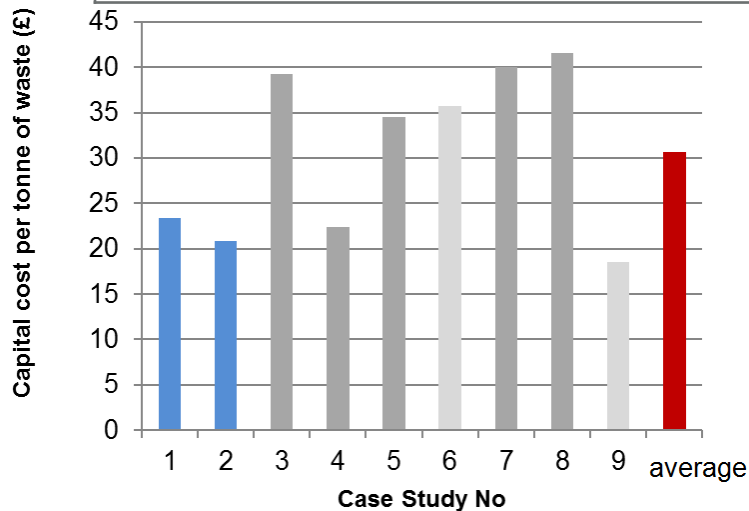
### Technical status

Design and/or operational parameter	Wet AD Plants	Dry AD Plants
Plant footprint	comparable	comparable
Plant capacity	comparable	comparable
Type of feedstock	source separated food waste	source separated food waste and green waste
Total Solids content	lower	higher
Volatile Solids content	higher	lower
Pre-treatment	less	more
Post-treatment	less	more
Water usage	higher	lower or 0
Retention time	longer	shorter

# Results

## Economic performance

Economic parameter	Wet AD Plants	Dry AD Plants
Capital Cost	comparable	comparable
Specific Capex (£/tonne waste)	lower	higher
Specific Capex (£/m <sup>3</sup> biogas)	lower	Higher
Operational Cost	[no data]	[no data]
Revenues	gate fees, electricity	gate fees, electricity, recyclables



**Energy balance**

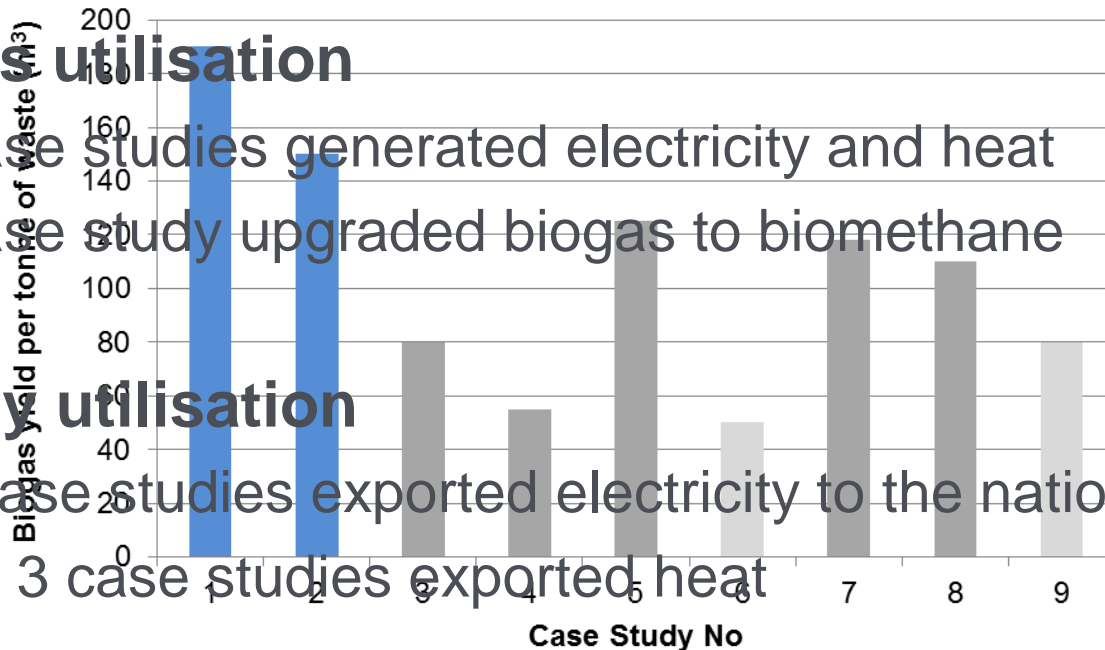
Energy parameter	Wet AD Plants	Dry AD Plants
Biogas production	higher	lower
Biogas composition	comparable	comparable
Parasitic energy	[lower]	[higher]

**Biogas utilisation**

- 8 case studies generated electricity and heat
- 1 case study upgraded biogas to biomethane

**Energy utilisation**

- all case studies exported electricity to the national grid
- only 3 case studies exported heat





## Types of end-product

- digestate
- compost
- RDF

## Management options

- agriculture, horticulture, gardens
- bedding material for housed cattle
- landfill cover, land restoration
- in cement plants, paper factories, heating plants

## Conclusions

### Wet AD Plants

**biogas production**  
(m<sup>3</sup> per tonne of waste)



**specific capital cost**  
per tonne of waste



**specific capital cost**  
per m<sup>3</sup> of biogas



### Dry AD Plants