The business case for biogas from solid waste in the Western Cape

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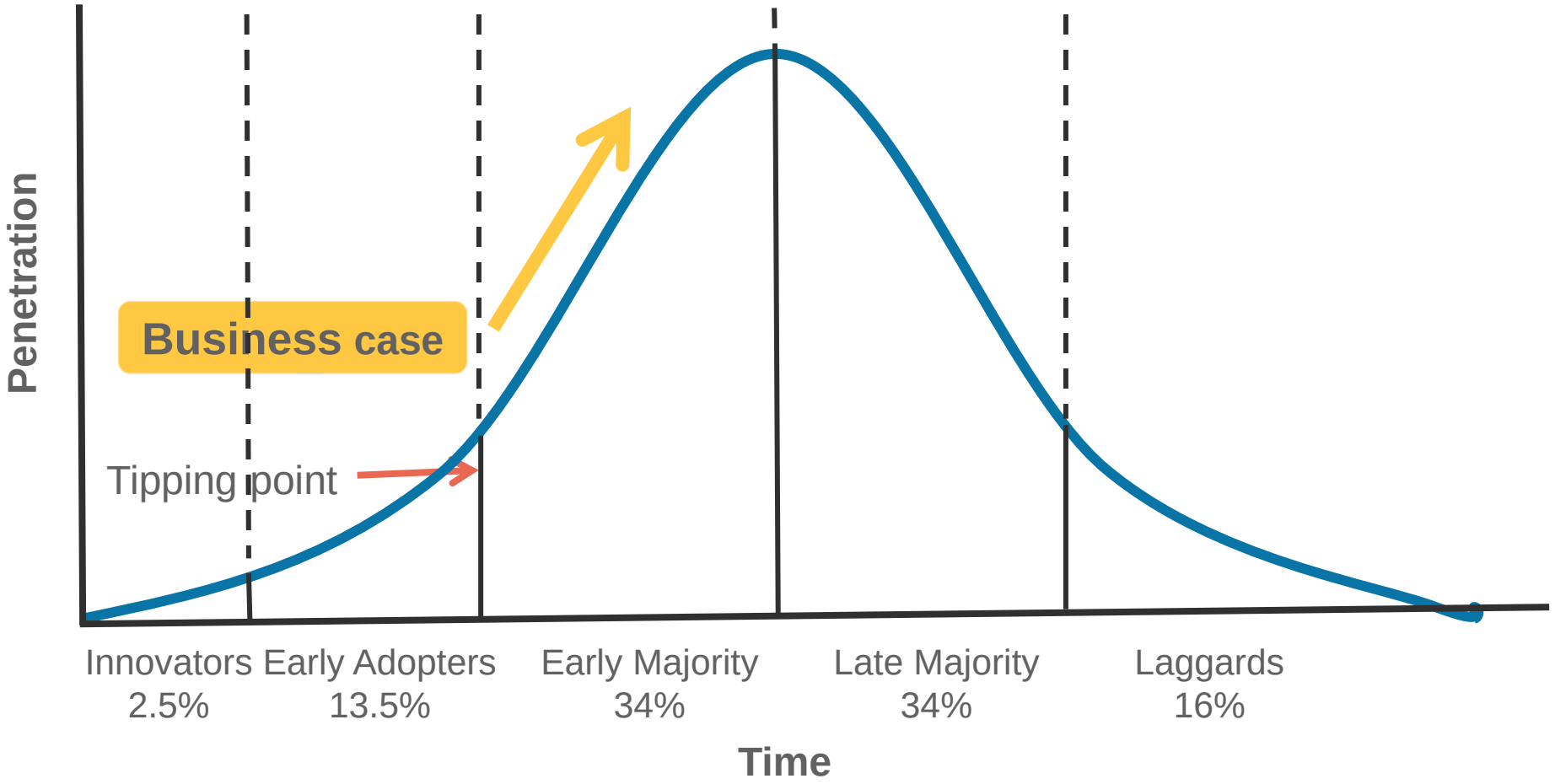
Presentation Overview

1. Motivation and scope
2. South African and Western Cape biogas context
3. Drivers and challenges
4. Western Cape case studies
5. Financial viability and sensitivity analysis
6. Conclusions

Motivation

- GreenCape
  - non-profit sector development agency that supports and promotes the green economy
- Biogas business case document:
  - identify conditions for successful uptake and operation of anaerobic digestion (AD) installations
  - provides insight on factors affecting financial viability and assists stakeholders
    - developers: insight to which clients would be most suitable to approach with their business model / design
    - potential clients: basic understanding of about suitability and financial viability of biogas installation in their contexts
  - current focus: application of biogas for electricity generation or co-generation only; Western Cape

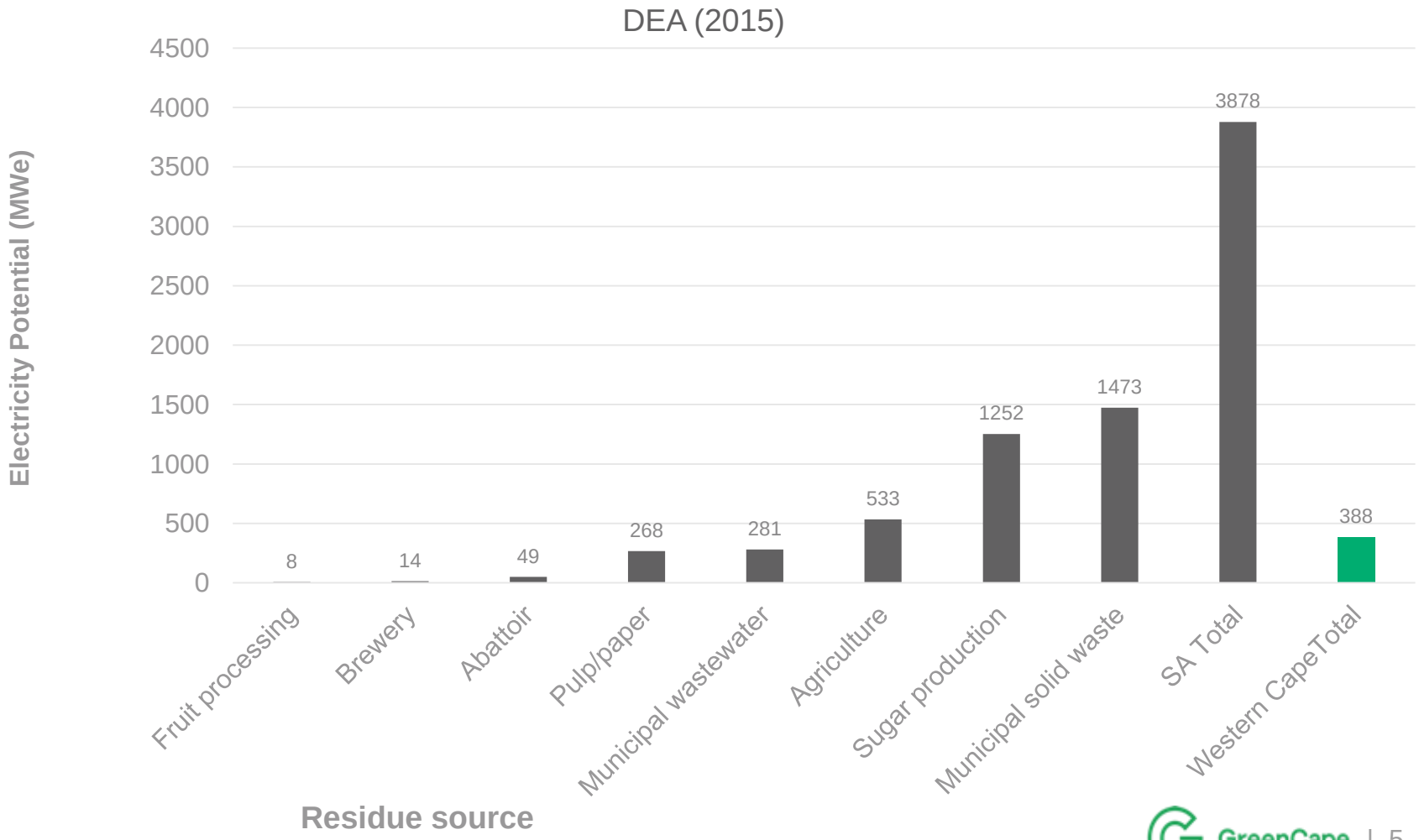
Current South African biogas market



Rogers, E. : Diffusion of Innovation

Biogas in the Western Cape

Potential for electricity generation



Market potential in Western Cape

Outcome	Potential Western Cape benefits
Investment	R4 billion – R13 billion (€280 m – €933 mil)
Job creation	320 – 3 950 direct jobs (389 – 6 300 jobs including indirect & induced)
Electricity generation	87 – 395 MWe
Greenhouse gas emission reduction	471 900 - 1 540 000 tCO_2e/yr [6]

Western Cape Government (2015)

Current South African biogas market

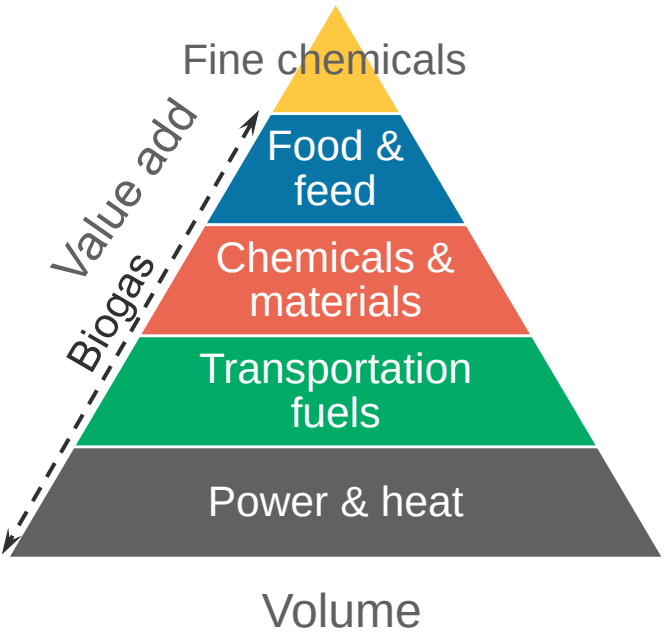
Market Drivers

- Energy security
- Energy affordability and cost savings
- Legislative pressure
  - More stringent organic waste management regulations
- Successful, demonstrative plants

Market Barriers

- High capital costs
- Nascent industry
  - Lack of operational skills and expertise
  - Lack of familiarity with biogas
- Long payback periods
- Digestate management
- Grid feeding regulations
- Low cost of landfill

South African case study examples



New Horizons Energy

Elgin Fruit Juice

Zandam Cheese & Piggery

Uilenkraal Dairy

Source: Bio-based Hierarchy, Netherlands Study Tour (2015)

South African case study examples

Case study example	Zandam Cheese & Piggery	Uilenkraal Dairy	New Horizons Energy - Athlone	Elgin Fruit Juices
Process Overview	• Pig manure feedstock • 75 kWe base • 100 kWth average	• Cow manure feedstock • 500 kWe capacity • 2 x 250 kW CHPs	• MSW feedstock • 500 – 600 t/day of which 200t/day organics • MRF (organics, recyclables & other)	• Mixed organic waste (off spec fruits & veg) • 527 kWe • 500 kWth (at max capacity)
Investment & Financing	• R 8.5 million (CAPEX) – 1:1 • Renting & electricity supply agreement	• R 11 million (CAPEX) – 2:1 • Electricity supply agreement with 10 year ROI	• R 400 million (CAPEX) – shared • 30% - gas treating • MRF costs	• R 20 million (CAPEX) by site owner
Challenges	• Grid feed in • Manure slurry only 6% solids	• Grid feed in • Crusting due to straw in feedstock	• RDF quality • Volume of liquid digestate	• Grid feed in • Odour • Digestate management
Benefits	• Electricity & heating cost savings • Reduced carbon footprint	• Meets 95% electricity requirements • Animal bedding	• 760 Nm^3/h CH_4 • 740 Nm^3/h CO_2 • Recyclables, RDFs & digestate	• 500 kg/h steam at 10 bar • Electricity & heating cost savings • Centralised waste management solution

What made the business case?

Key conditions (based on case studies)

- Consistent volume of feedstock
- Waste management costs
- On-site use for electricity *and* heat energy supplementation

- Additional factors
  - Higher value product – Gas (CH_4, CO_2) compression and bottling
  - Management of digestate stream (cost for disposing or value add product)
  - Available skills capacity

Business Case

Prefeasibility tool

Inputs

- Feedstock type
- Feedstock amount
- Electricity tariff
- Logistics (mass, distance)
- Gate fee
- Financial variables (inflation, loan/equity split, interest rate)

Outputs

- Capital cost
- Operating costs
- Electricity production
- Heat production
- Financial indicators (PBP, IRR, NPV, LCOE)

Financial viability assessment and sensitivity

Scenarios

- **Scenario A**: A small-scale, commercial biogas installation
  - Not financially viable, even under optimistic conditions

- **Scenario B**: A medium size, red meat abattoir biogas installation
  - B1: No waste disposal cost
  - B2: High waste disposal cost
  - B3: Lower waste disposal cost, lower electricity price and extent of provision of on-site heat needs

Scenario B: results of sensitivity analysis

Size (kW)	Scenario B		IRR	NPV	Required size for viability (NPV > 0, IRR > 15%)
250	Case B1	R1.00/kWh Free disposal 100% electrical and thermal (coal) usage	11%	-R2.7 million	>575 kW
125			7%	-3.9 million	
250	Case B2	R1.00/kWh R500/ton gate fee + 30km logistics 100% electrical and thermal (coal) usage	46%	R28 million	>40 kW
125			34%	R11 million	
250	Case B3	R0.80/kWh R200/ton gate fee + 10km logistics 100% electrical, 50% thermal (coal) usage	20%	R4 million	>140 kW
125			14%	-R0.47 million	

Conclusions

Insights from the viability assessments

- Scale and waste management costs play a key role in determining the viability of a biogas installation
- Small-scale commercial biogas facilities (<50 kWe)
  - Not considered financially viable under current landfill disposal costs and energy costs
- Medium size biogas facilities at abattoirs (>50 kWe; <1MW)
  - Financially viable at the middle to higher end of the scale
  - When waste management costs (gate fees, logistics costs) are high
  - Current energy prices and high full utilisation of energy on-site

- Waste management costs could be a stronger driver for biogas installations in South Africa than energy savings

Conclusions

Insights from case studies

- Failure of projects has primarily been due to unfavourable cost-benefit ratio - particularly when electricity generation was not utilised or insufficient scale

- Success drivers a result of a variety of models
  - Feedstock
  - Utilisation of energy for heat and electricity
  - Off-take of products

- Common challenges
  - Waste collection and separation
  - Lignocellulosic contaminants
  - Grid feed-in
  - Odour
  - Digestate management
  - Skills and training

Next steps forward

For document:

- Distribution of biogas business case document to developers and organic residue generators
- Also available from GreenCape's website.

Further work

- Expand identification of success conditions:
  - alternative value-add products
  - wider South African context
- More in-depth look at **financing of** biogas installations

Thank You

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