Sustainability aspects of biogas and compost production

Kor Zwart

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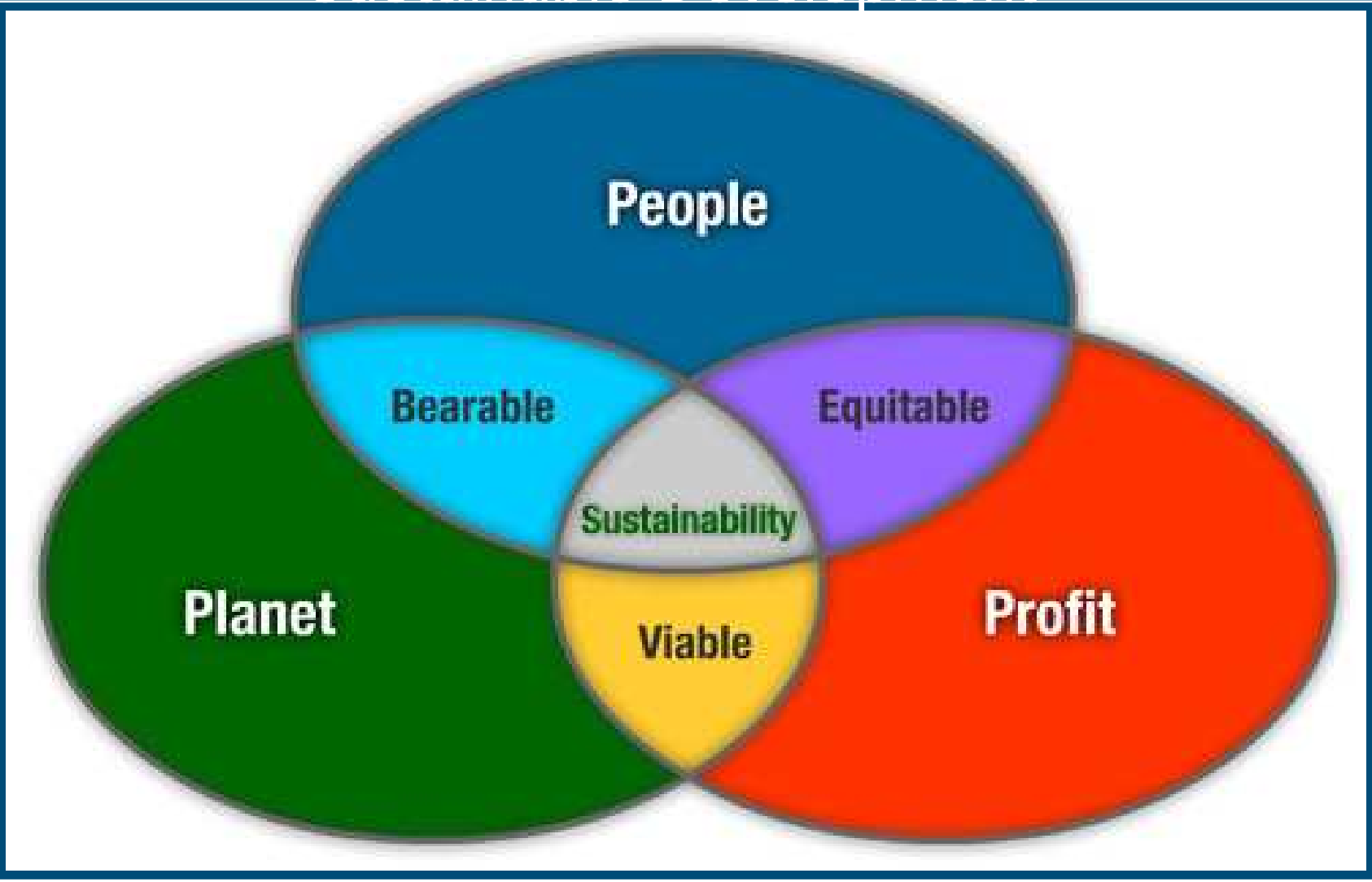
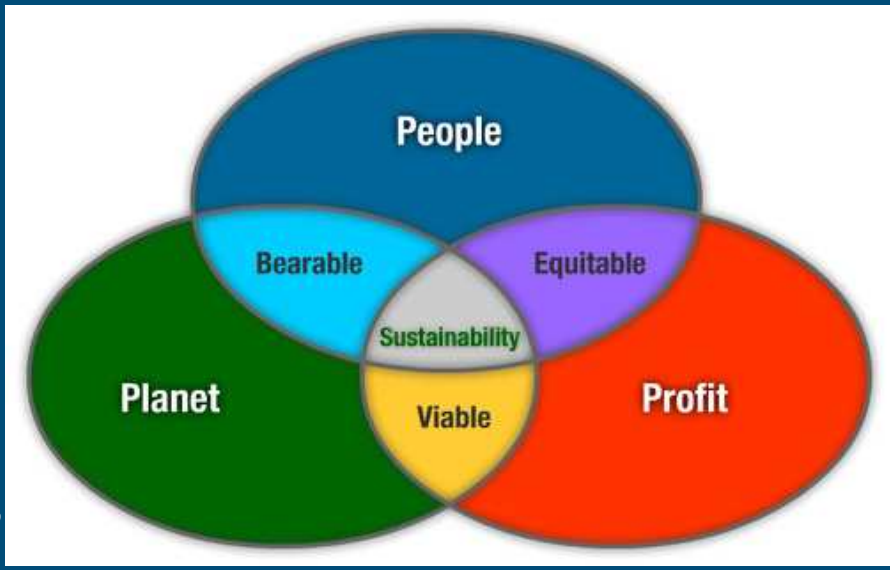
Sustainable Development



John Elkington; Lo Brundtland

Compost and Biogas Sustainability aspects



- Energy production
- Green house gas emissions
- Economics
- Closing carbon & nutrient cycles

Compost

- Conversion of organic (waste) material
- Aerobic biological process (Oxygen)
- Moderately moist conditions
- Carbon dioxide, (ammonia), water, heat
- Dry & stable organic product
- Fertilizer, soil improver
- Nutrients, (N), P & K, micro

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Biogas

- Conversion of organic (waste) material
- Anaerobic biological process (~~Oxygen~~)
- Wet conditions
- Methane, carbon dioxide, ammonia
- Wet (un-)stable product
- Fertilizer, soil improver
- N, P, K, micro

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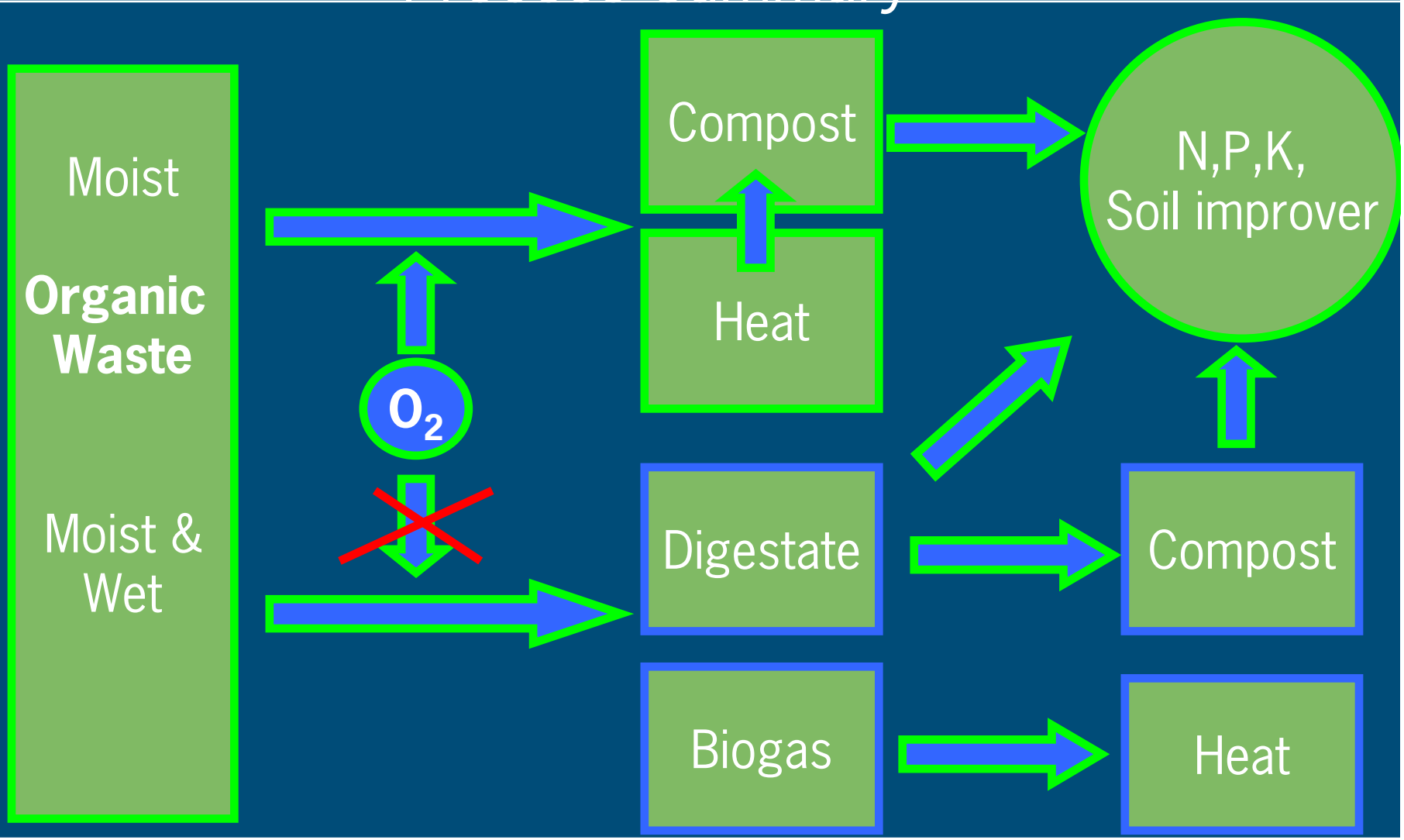
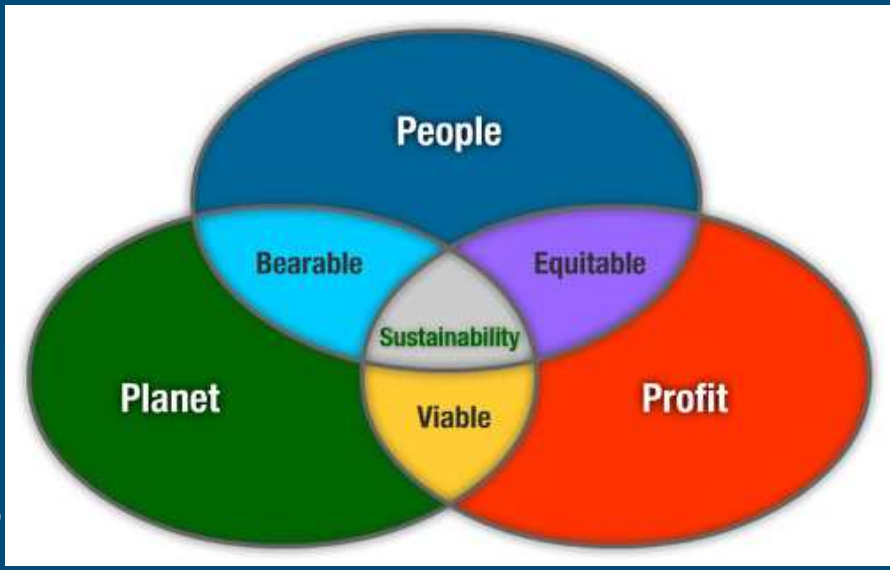
Process Summary



Compost and Biogas Sustainability aspects



- Energy production
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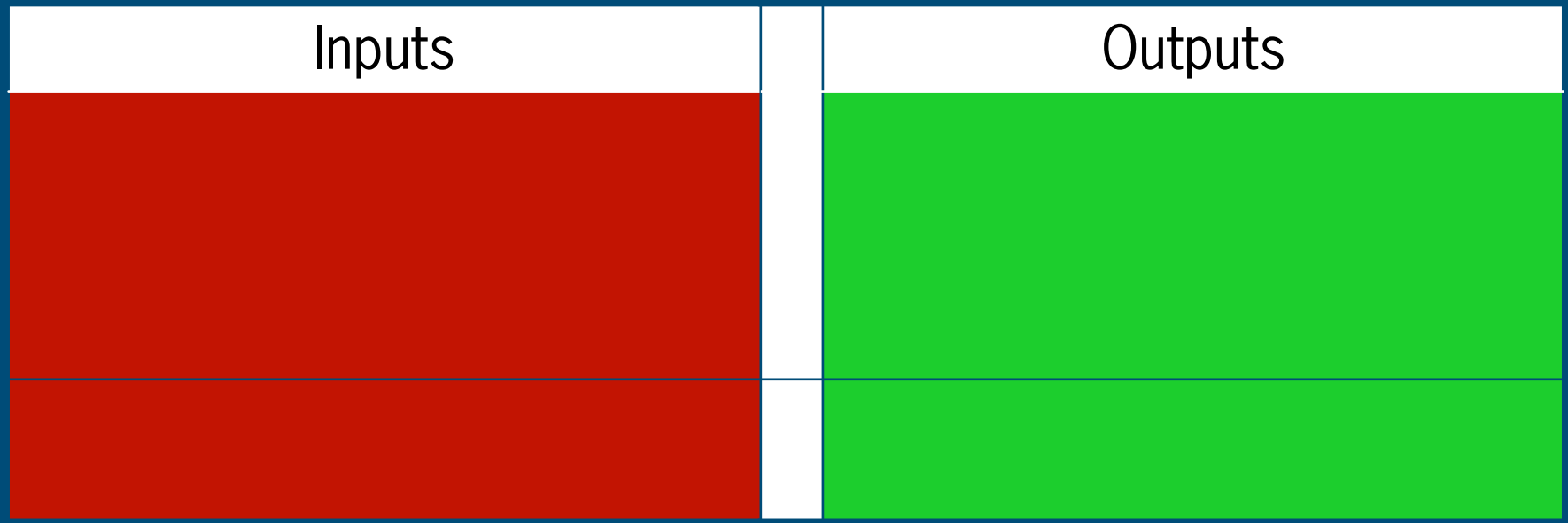
Energy Balance



Energy Balance

Inputs		Outputs
(Feedstock production) Transport Process (Installation)		Heat Biogas (Electricity & heat)

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Small Survey

	Compost	Biogas	No difference / Don't know
1. Energy balance			

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Energy INPUT

	Small scale		Large scale	
	Compost	Biogas	Compost	Biogas
Feedstock production				???
Feedstock transport			+++	+++
Process			+++	+++
Product transport			+++	+++

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Energy OUTPUT

	Small scale		Large scale	
	Compost	Biogas	Compost	Biogas
Biogas		+++		+++
Electricity/ Heat	(+)	(+)	(+)	+++

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Energy Balance

Conclusion

- Biogas > Compost

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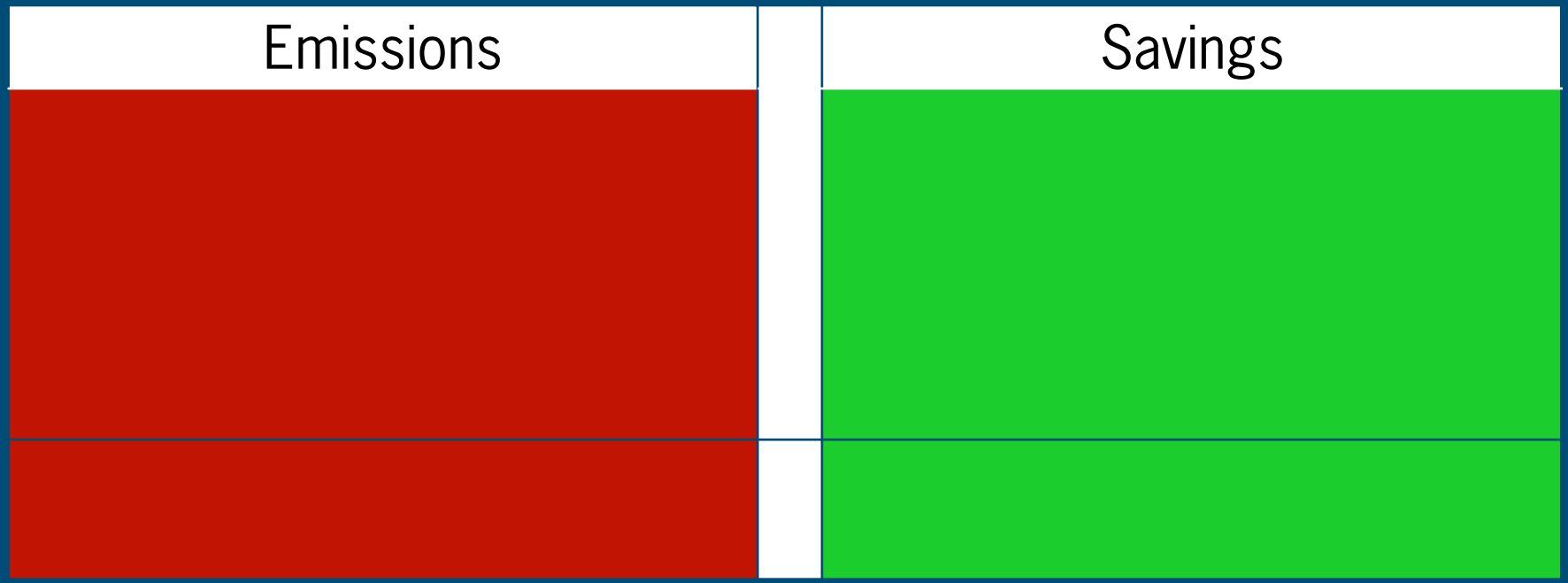
GHG Balance



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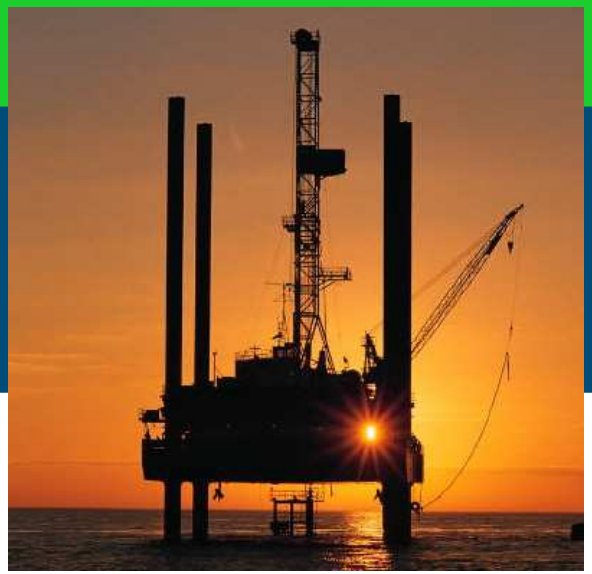
GHG Balance

Emissions	Savings
Energy consumption (Prod, Transp, Install) N_2O; CH_4	Heat Biogas (Electricity & heat)



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Small Survey

	Compost	Biogas	No difference / Don't know
2. GHG balance			

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GHG savings (fossil energy savings)

	Small scale		Large scale	
	Compost	Biogas	Compost	Biogas
Biogas		+++		+++
Electricity/ Heat		(+)		+++

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GHG emissions

	Small scale		Large scale	
	Compost	Biogas	Compost	Biogas
Feedstock production				???
Feedstock transport			+++	+++
Process		+++		+++
Product transport			+++	+++

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GHG emissions

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GHG emissions Biogas Installation

- Leakage results in methane emissions
  - Leakage from the digester
  - Leakage from digestate
- Methane ~ 20 times stronger GHG than CO_2
- Leakage must be << 5%
- Otherwise emissions >> savings

GHG balance

Conclusion

- Biogas >> Composting?????

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Economics Balance

Economics Balance

Costs		Benefits
Investment Operation Feedstock		Products value

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Small Survey

	Compost	Biogas	No difference / Don't know
4. Profit			

Economics balance

- In W-Europe:
- Composting market defined activity
- Biogas production needs to by subsidized by governments

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Economics balance

Conclusion:

Compost > Biogas

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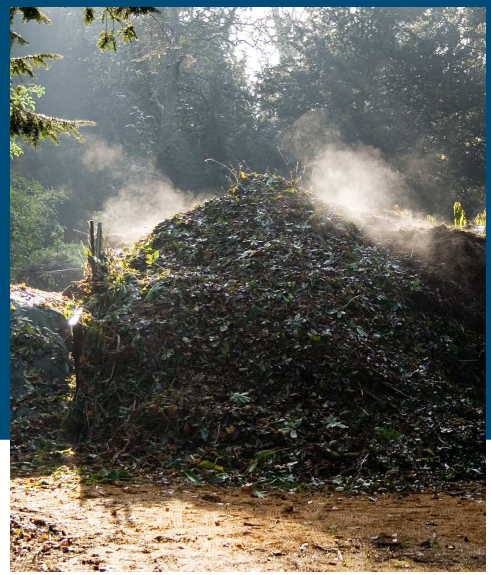

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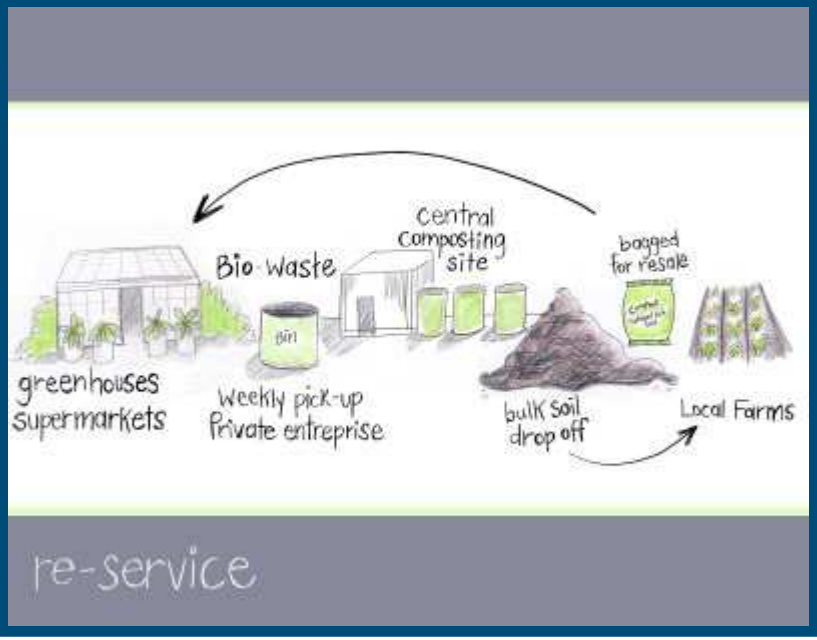
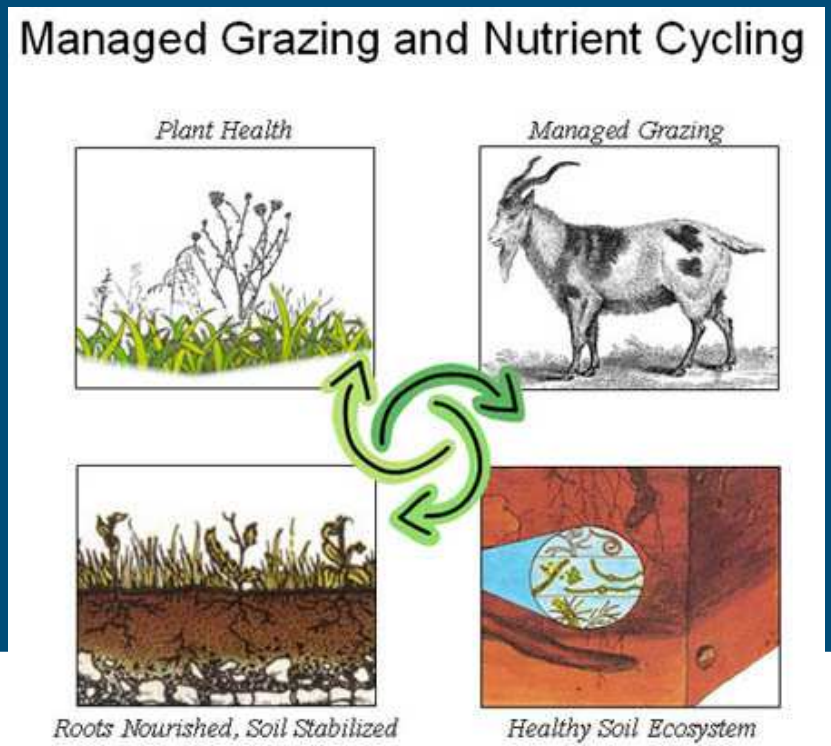
Closing the Carbon & Nutrient Cycle

Compost & Biogas digestate both positive as compared to chemical fertilizer





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Closing the Carbon & Nutrient Cycle

Feedstock		Compost / Digestate
Organic Carbon		Organic Carbon
Nitrogen		Nitrogen
Phosphate		Phosphate
Potassium		Potassium
Micro-elements		Micro-elements

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Closing the Carbon & Nutrient Cycle

Feedstock		Compost / Digestate
Organic Carbon		Organic Carbon
Nitrogen		Nitrogen
Phosphate		Phosphate
Potassium		Potassium
Micro-elements		Micro-elements

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Small Survey

	Compost	Biogas	No difference / Don't know
4. Nutrient Cycling			

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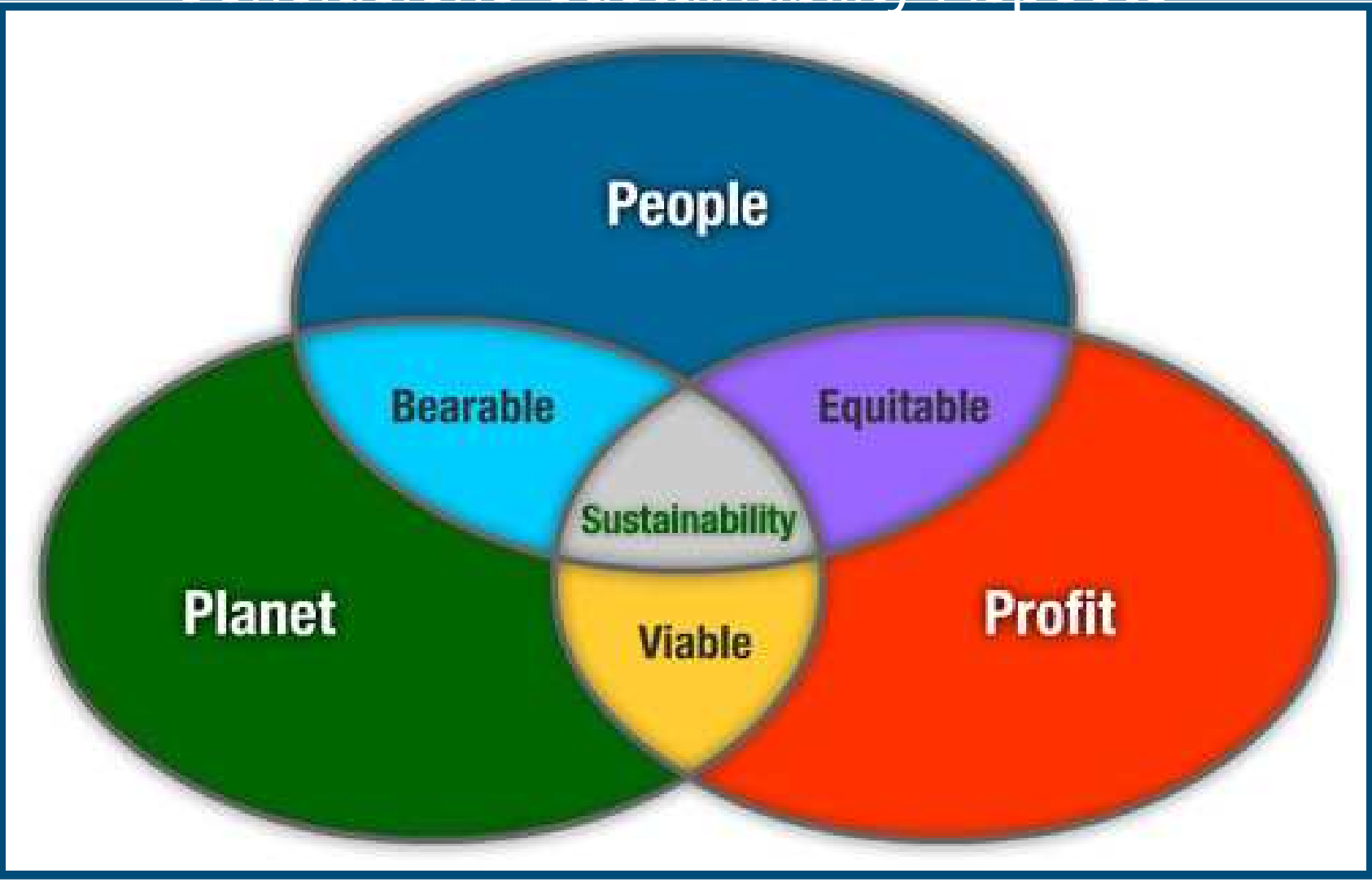
Closing the Carbon & Nutrient Cycle

- Only if digestate is applied to soil:

Nitrogen value

  - digestate > compost
- Other elements:
  - Digestate = Compost
- Organic matter:
  - Digestate = Compost, but compost easier to handle

Conclusions Sustainability Aspects



Conclusions-1

- Energy, GHG, economy, C&N cycles are important aspects to assess sustainability of compost and biogas
- Biogas is ‘more’ sustainable regarding energy and may be for nitrogen recycling, but application of digestate is then required
- Process conditions decide on GHG emissions

Conclusions-2

- Economics depends on many volatile factors, but in W-Europe compost is more sustainable
- If applied well, digestate from biogas is a better nitrogen supplier than compost
- If digestate is discarded, compost is far better