Agricultural Waste Management

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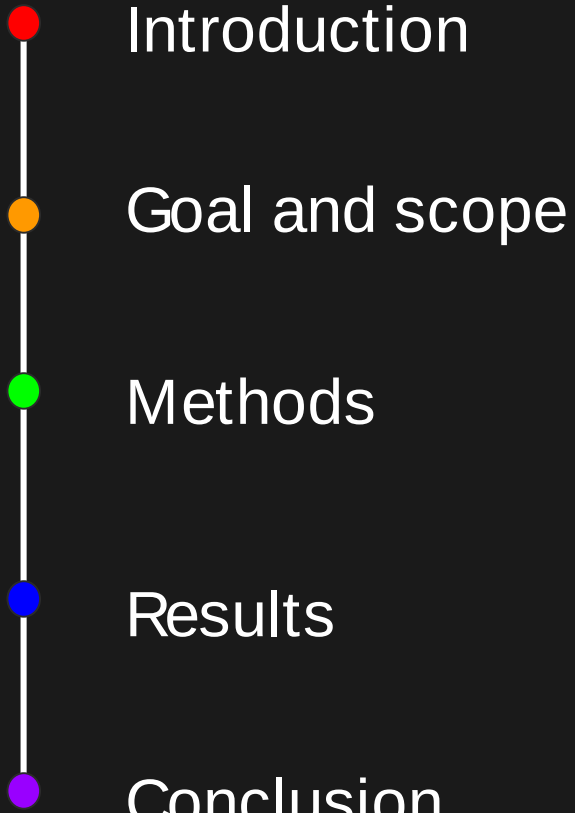
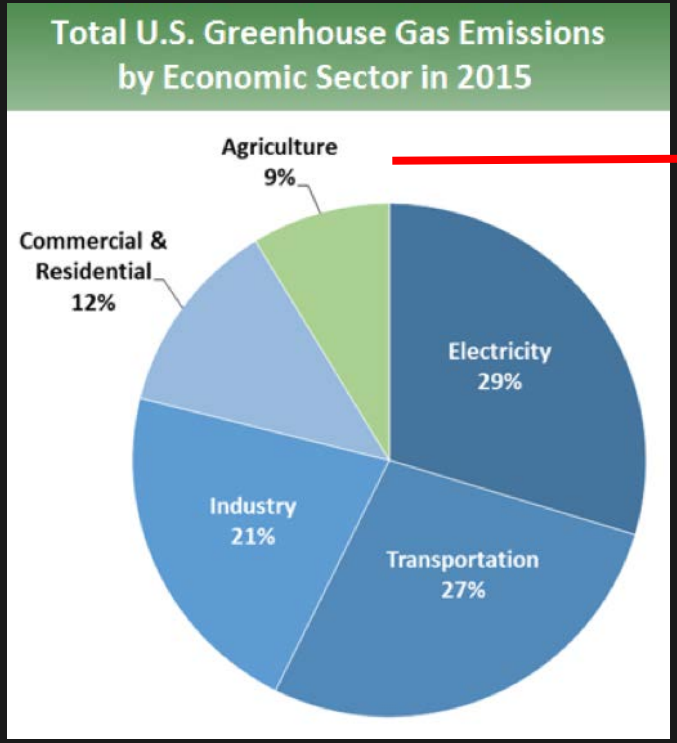
Overview



- Introduction
- Goal and scope
- Methods
- Results
- Conclusion

Agriculture contributes to 9% of US emissions



Source: EPA

~ 600,000 metric tons CO_2 eq.

Traditional manure storage vs Anaerobic digestion

Why anaerobic digestion?

- Environmental
  - Less greenhouse gas emissions
  - Capture nutrients for reuse as fertilizer
  - Reduces runoff

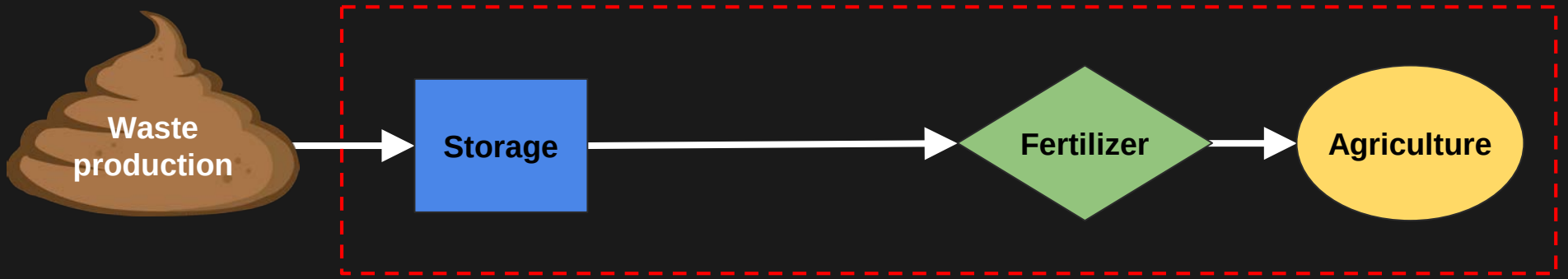
- Economic
  - Producing renewable energy
  - Reducing fossil fuel dependence

Source: USDA

Goal

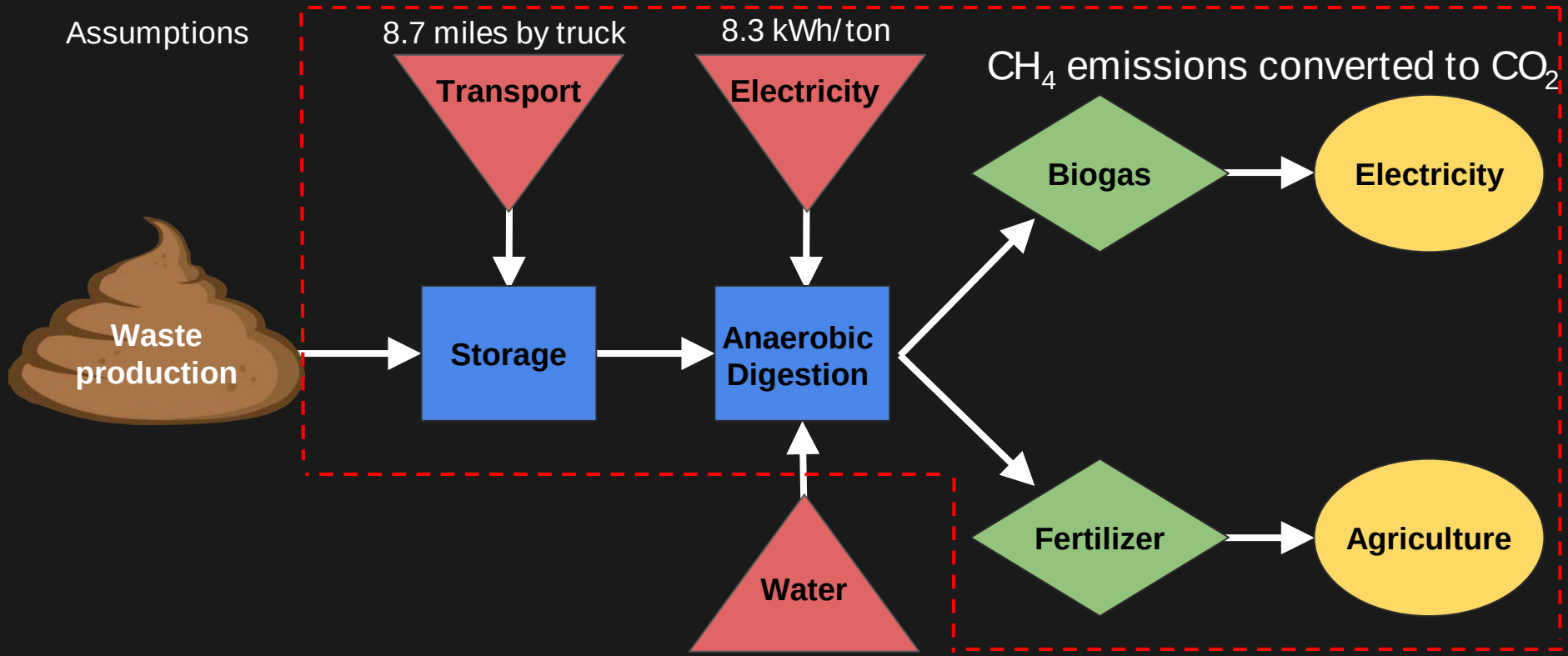
Evaluating environmental and economic impact of using anaerobic digestion for animal waste management

LCA - Traditional manure management



LCA - Anaerobic digester

Assumptions



Approach and Methods

LCA -- g CO_2 eq/ton of manure

CBA -- $/ton of manure

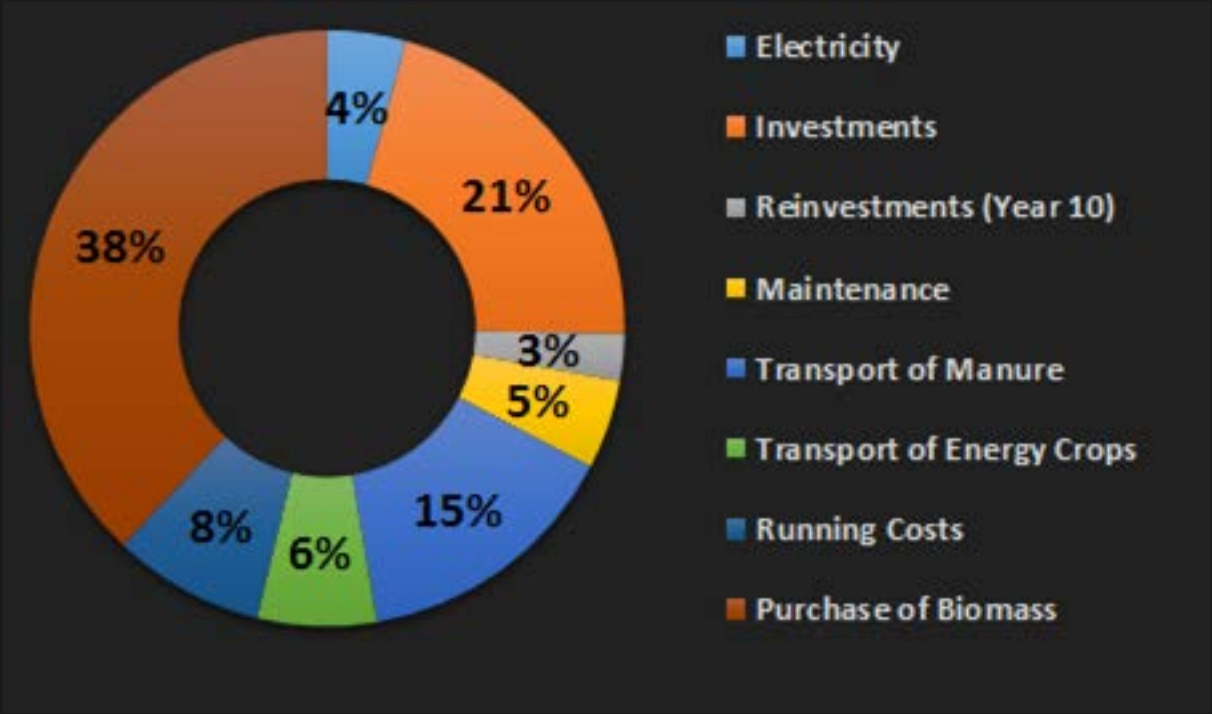
2 Primary Data Sources

The Economics of Biogas in Denmark

Methane Production by Anaerobic Digestion of

Cost-Benefit Analysis - The Biogas Plant

Total Annual Cost:
4.95 Million USD

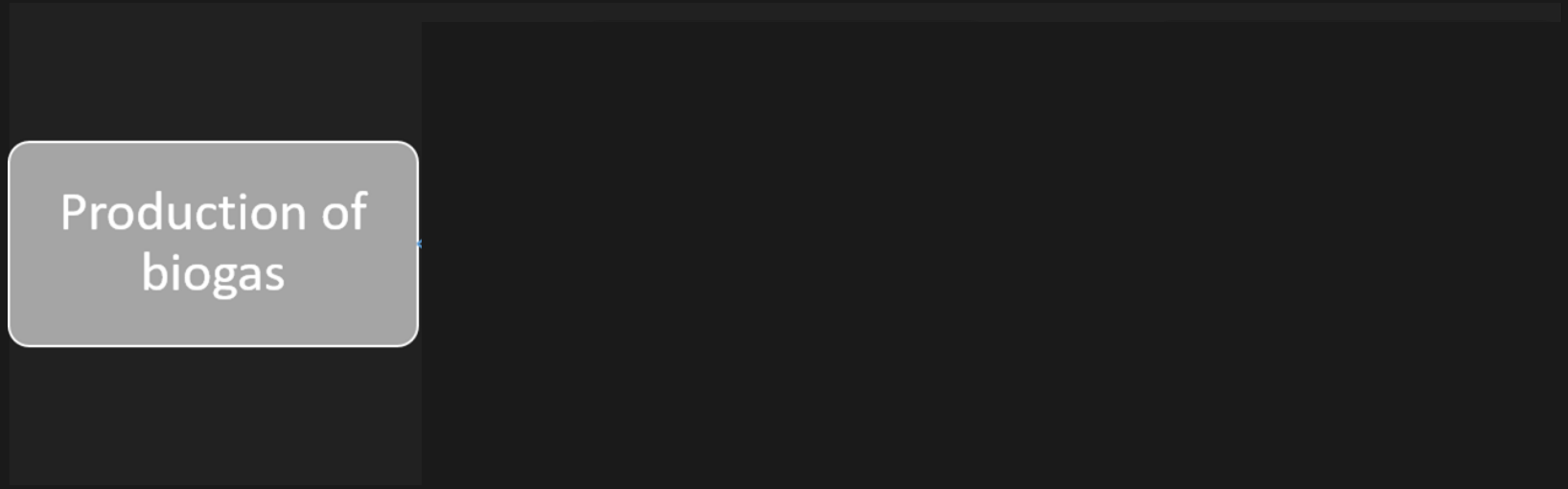


Source: Jacobsen et al., 2013

Cost-Benefit Analysis - The Biogas Plant

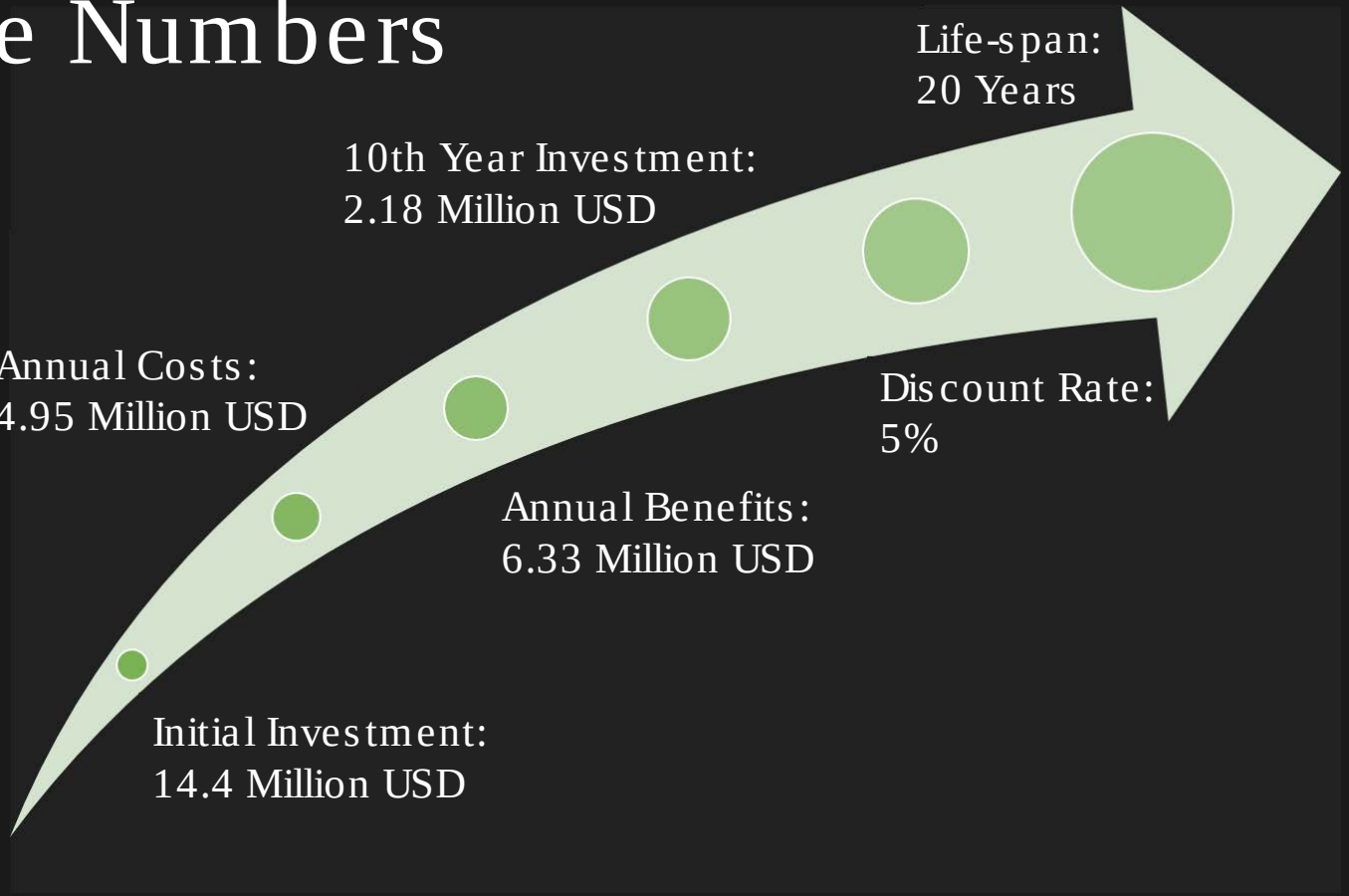
Benefits:

- Production & sale of biogas
- Sale of byproduct (fertilizer)

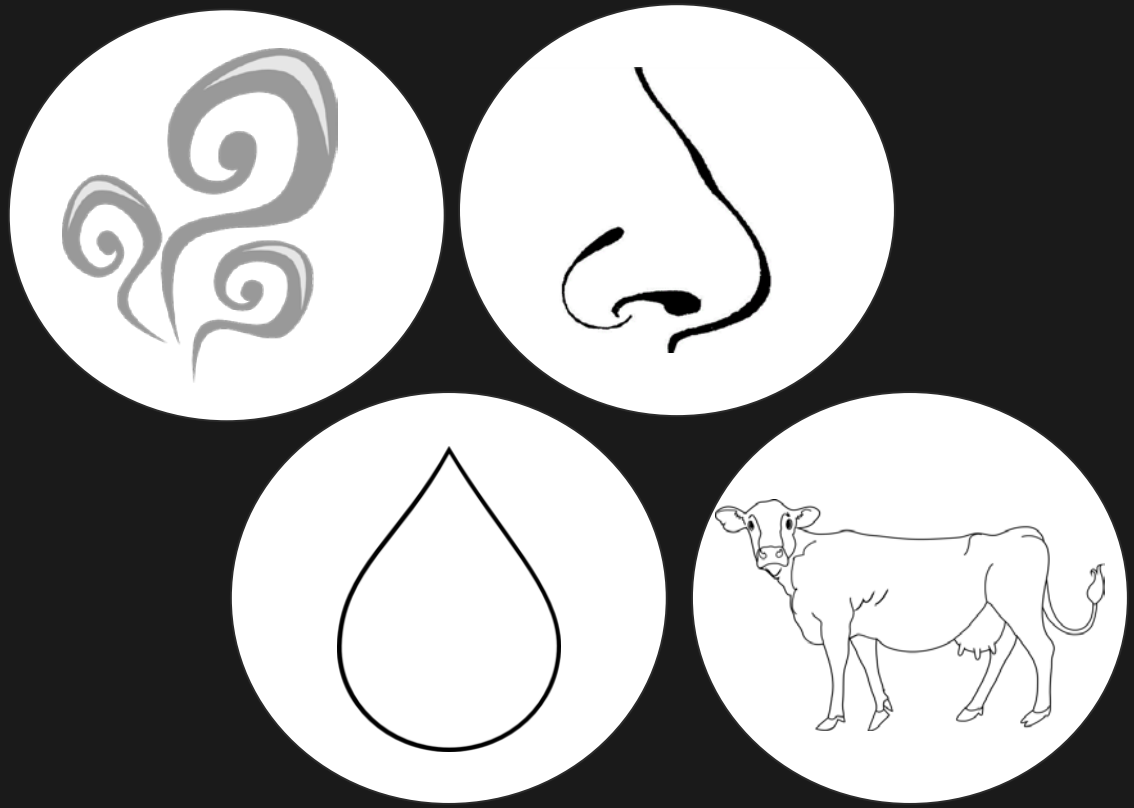


CBA - By the Numbers

For a centralized biogas plant (250,000 tonnes/year):



Cost-Benefit Analysis - Society



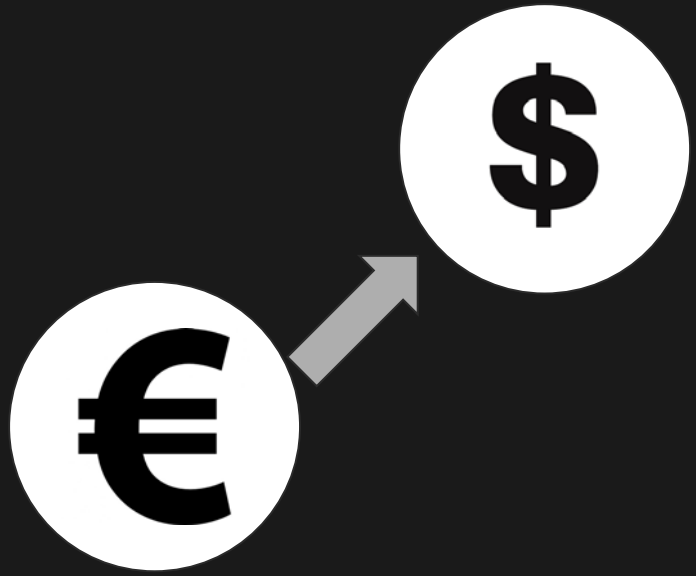
Assumptions

European data can be applied to US

Conventional manure storage and usage

Discount rate

Lifetime of 20 years for biogas plant



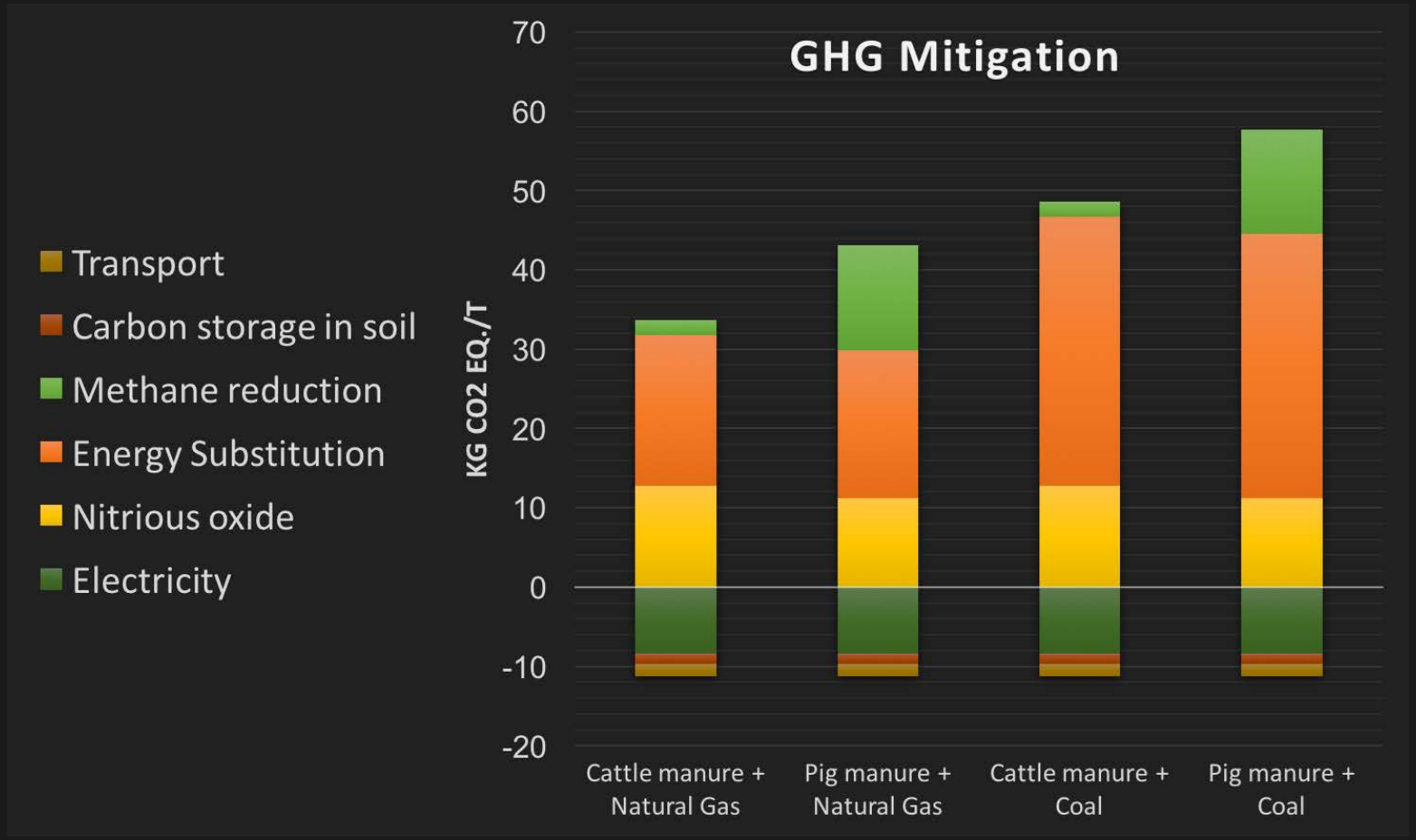
Results and Discussion

Analysis

- Potential for a more sustainable agricultural waste management system
- Potential for higher quality fertilizers
- Can be profitable

Challenges

- High initial costs
- Dependency on governmental support
- US lacks necessary infrastructure


GHG Mitigation
KG CO2 EQ./T
70
60
50
40
30
20
10
0
-10
-20
Transport
Carbon storage in soil
Methane reduction
Energy Substitution
Nitrious oxide
Electricity
Cattle manure + Natural Gas
Pig manure + Natural Gas
Cattle manure + Coal
Pig manure + Coal

Putting the savings into perspective

=

× 48

4.7 tonne CO_2/year

97 kg CO_2/head/year

Putting the savings into perspective

4.7 tonne CO_2/year

690 kg CO_2/head/year

CBA - Results

CBA for selling to CHP

Our spreadsheet:

	Year			
Project Cost Benefit Analysis	0	1	2	3
Benefits		$6,335,357	$6,335,357	$6,335,357
Costs		$4,950,672	$4,950,672	$4,950,672
Capital Costs	$14,382,100			
Net Benefit	($14,382,100)	$1,384,685	$1,384,685	$1,384,685
(@ 5%)	($14,382,100)	$1,318,747.62	$1,255,950.11	$1,196,142.97
Initial Investments	$14,382,100			
Operating Costs	$4,950,672			
Annual Revenue	$6,335,357.00			
Discount	5%			
Investment (10 Year)	$2,179,236			

Conclusions

Successful in Denmark

GHG emission reductions

Challenges to widespread US implementation

Questions?