

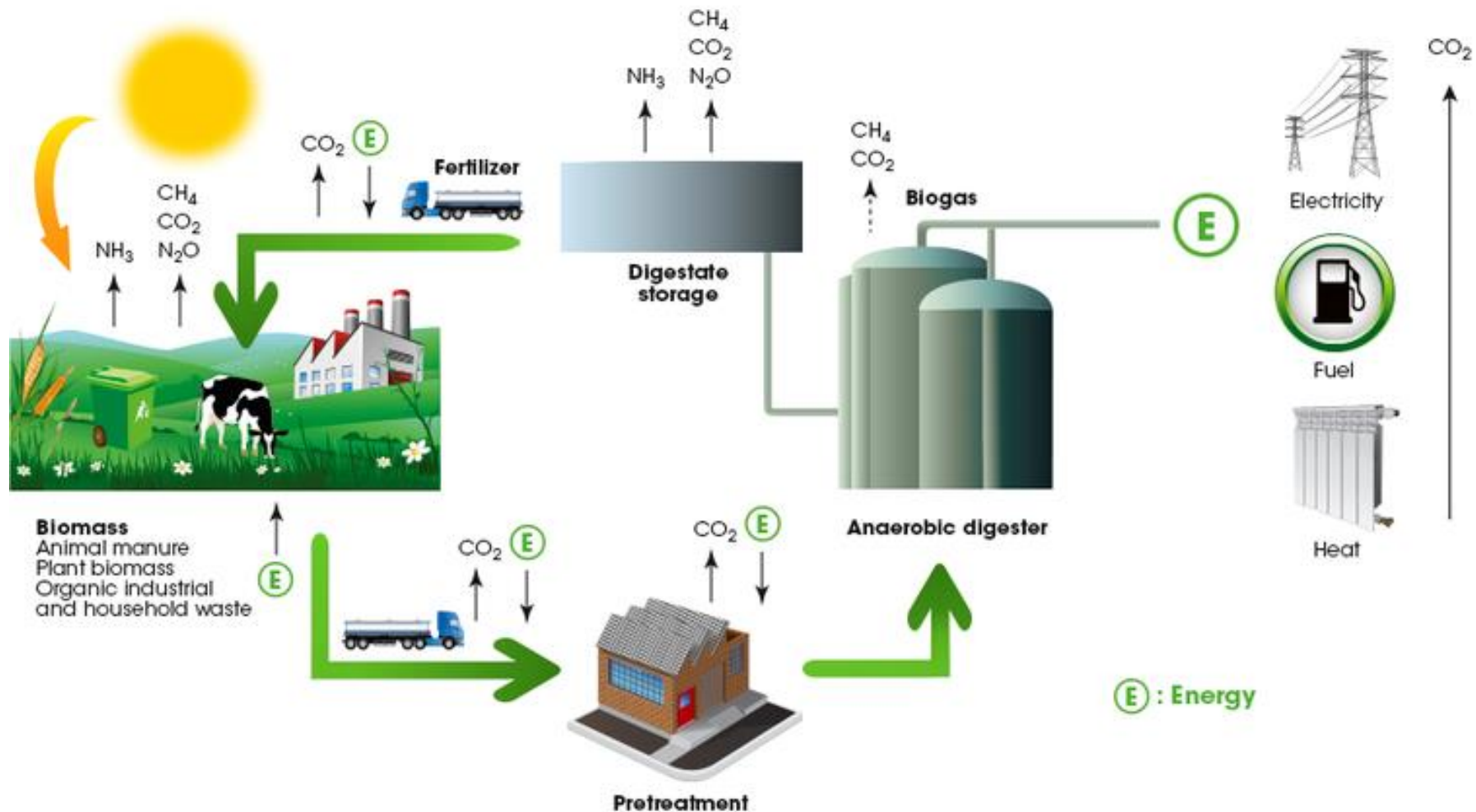


Optimisation of value chains for biogas production in Denmark

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biochain



1st Generation Biochain model

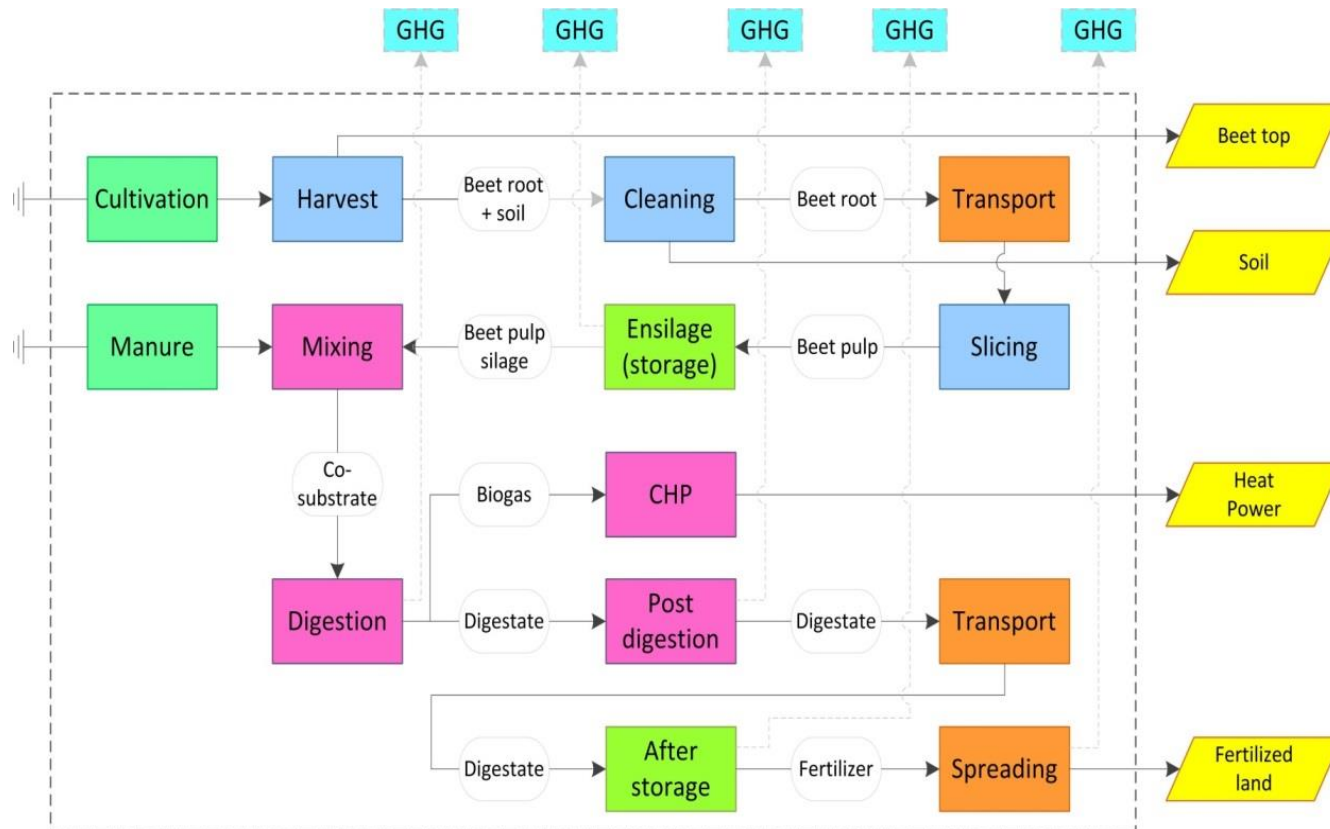
Integrated model:

- Mass
- Energy
- GHG
- Economy

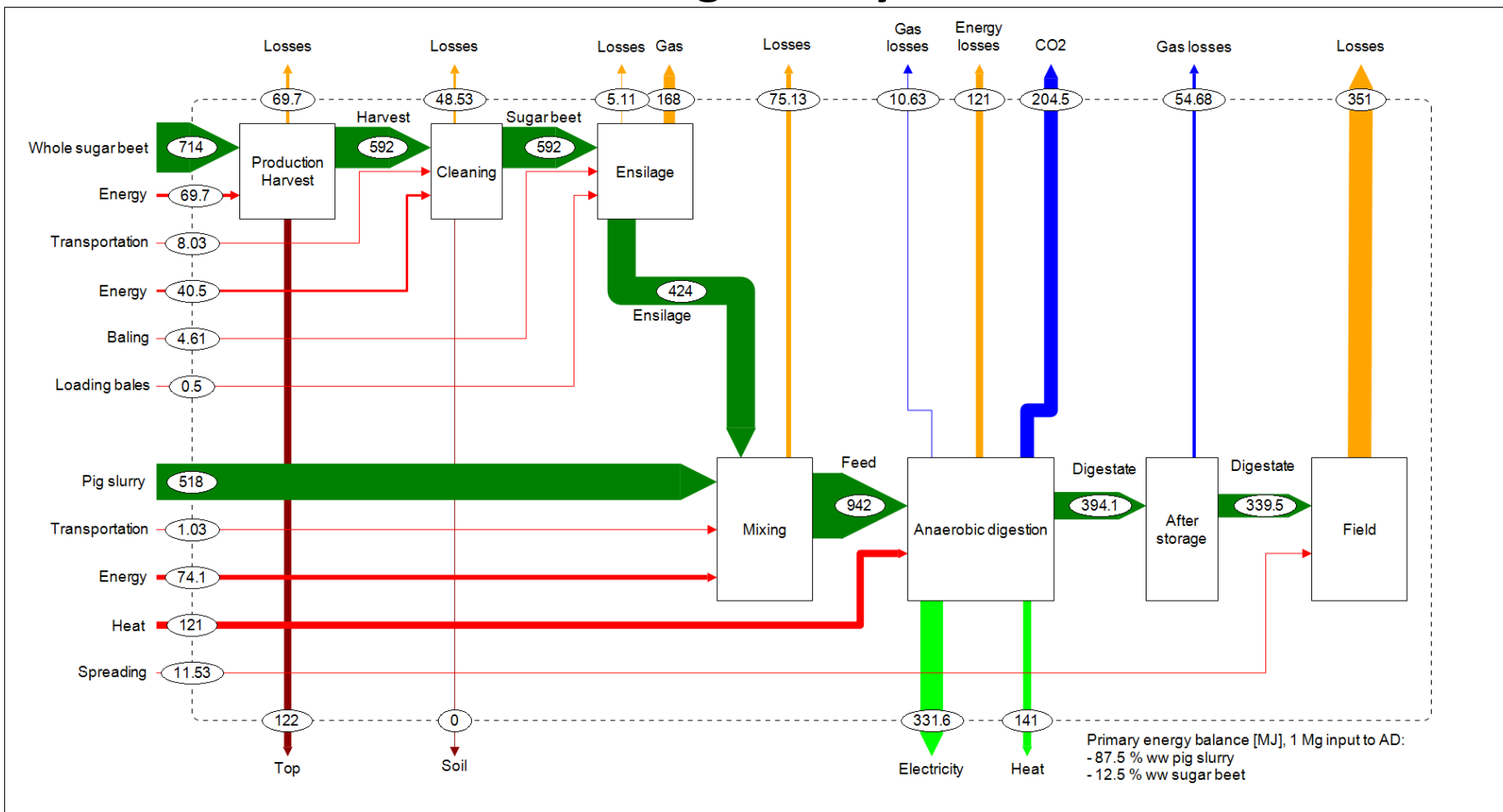


Optimization:

- Input mix
- Scale
- Operation



1st Generation Biochain model – economy, engineering, biology, agronomy

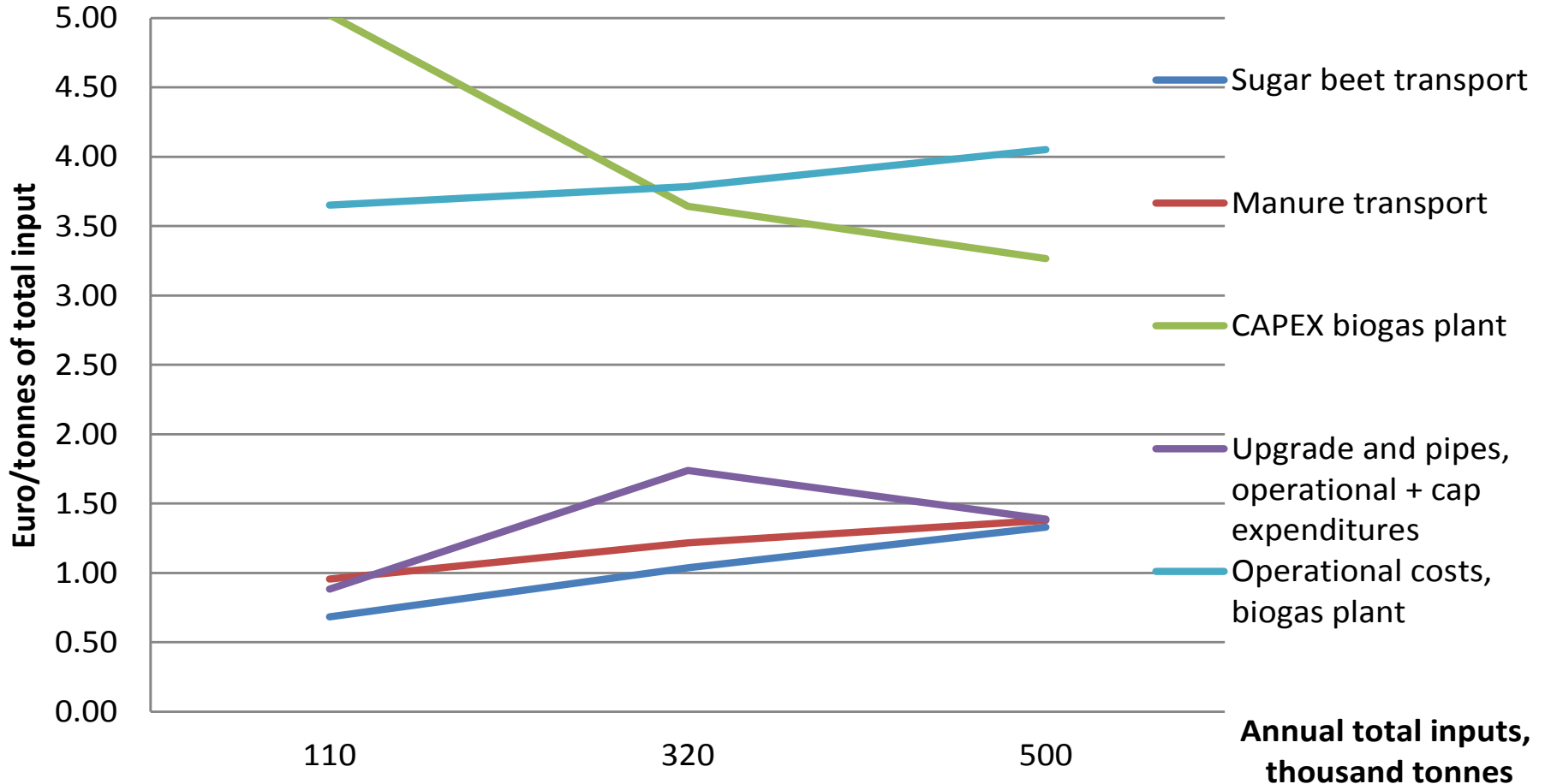


Feedstock mix	% wet weight		
	PSSB-0	PSSB-12.5	PSSB-25
Pig slurry	100	87.5	75
Sugar beet	0	12.5	25

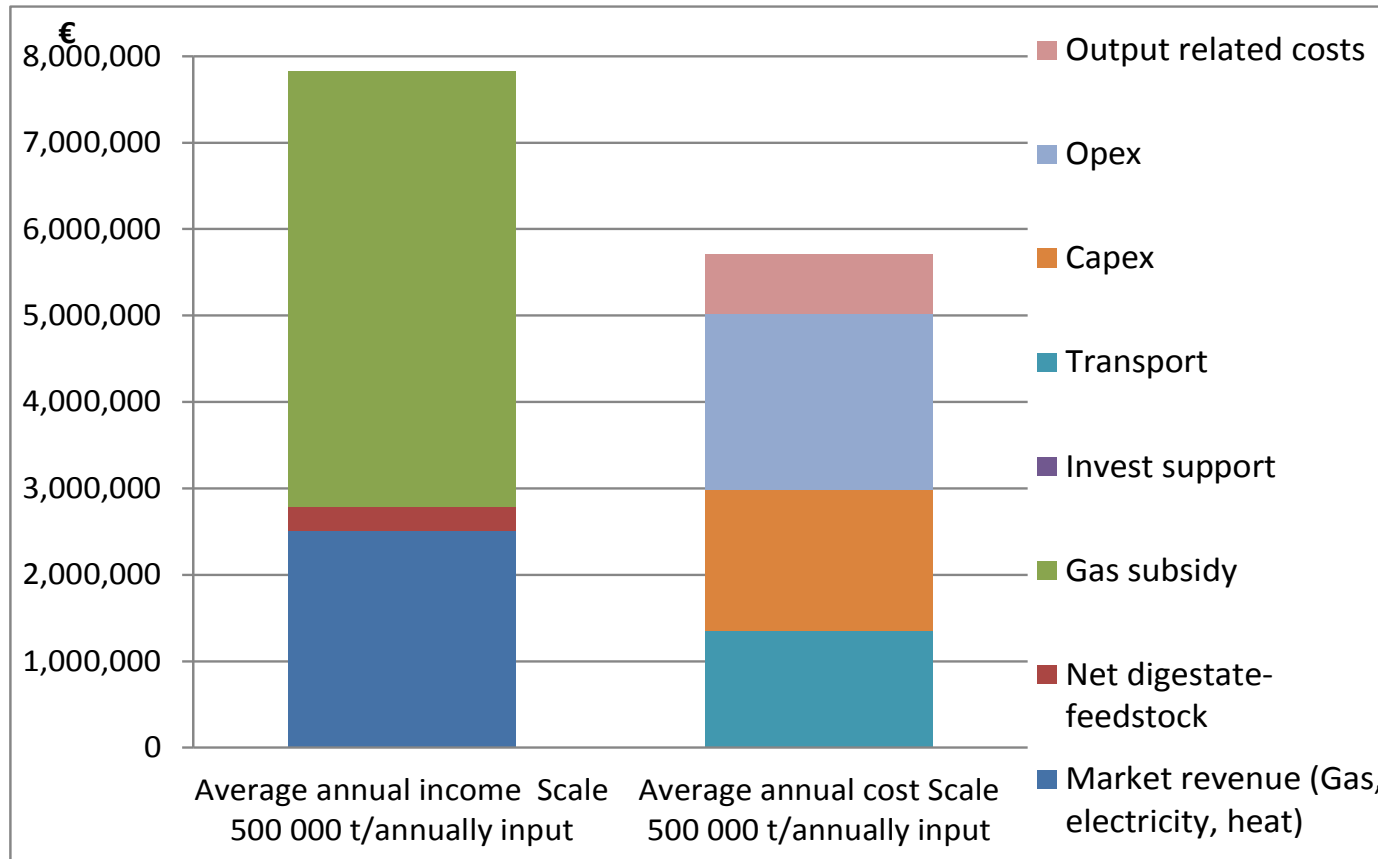
Plant size: Ton per year	110,000	320,000	500,000
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Trade off between rising operational and transport costs against reduced capital costs

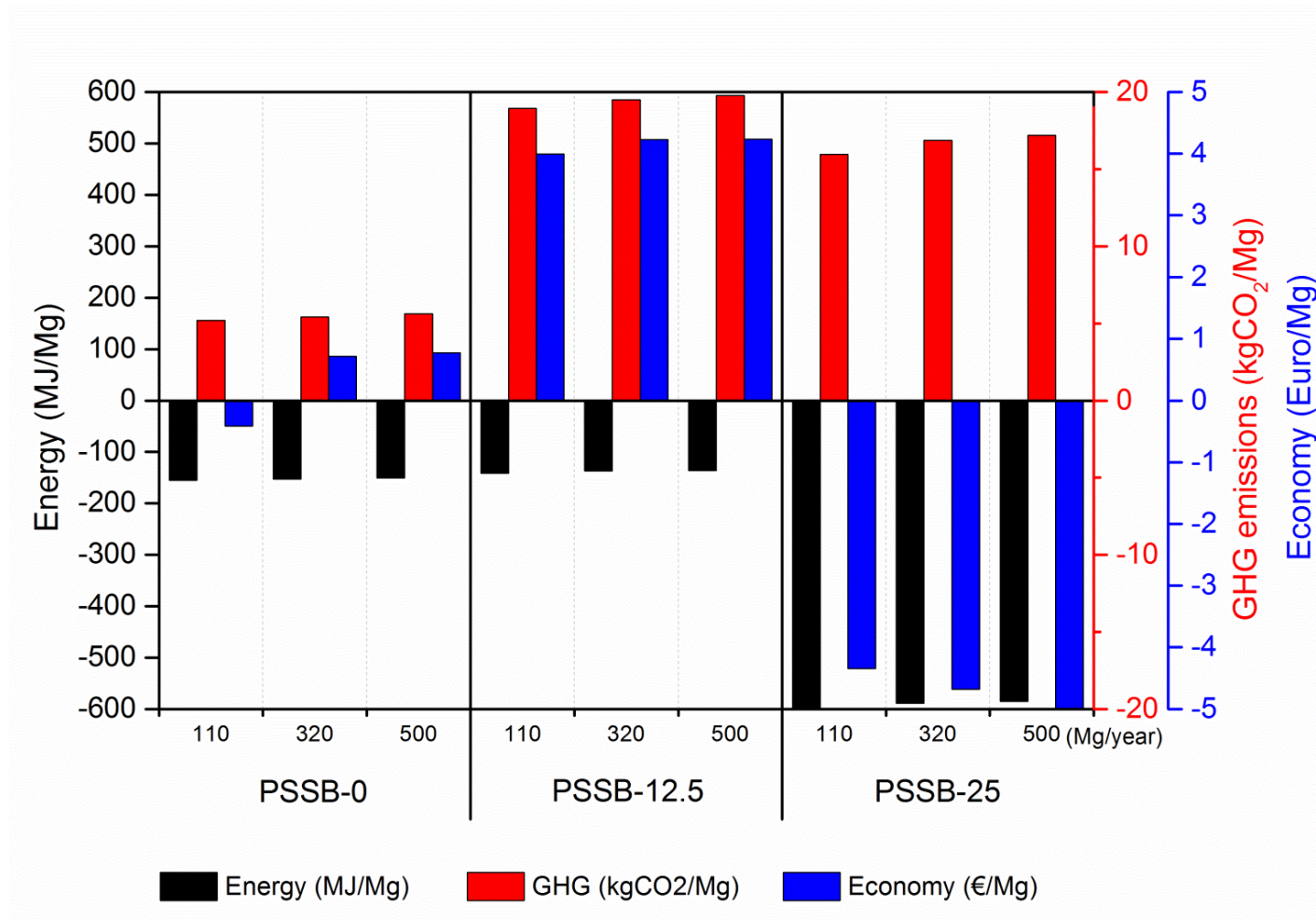
Cost contribution and scale 12½% sugar beet



Large scale biogas plant in DK based on manure and upgrading biogas to grid (BioChain case)



1st Generation Biochain model

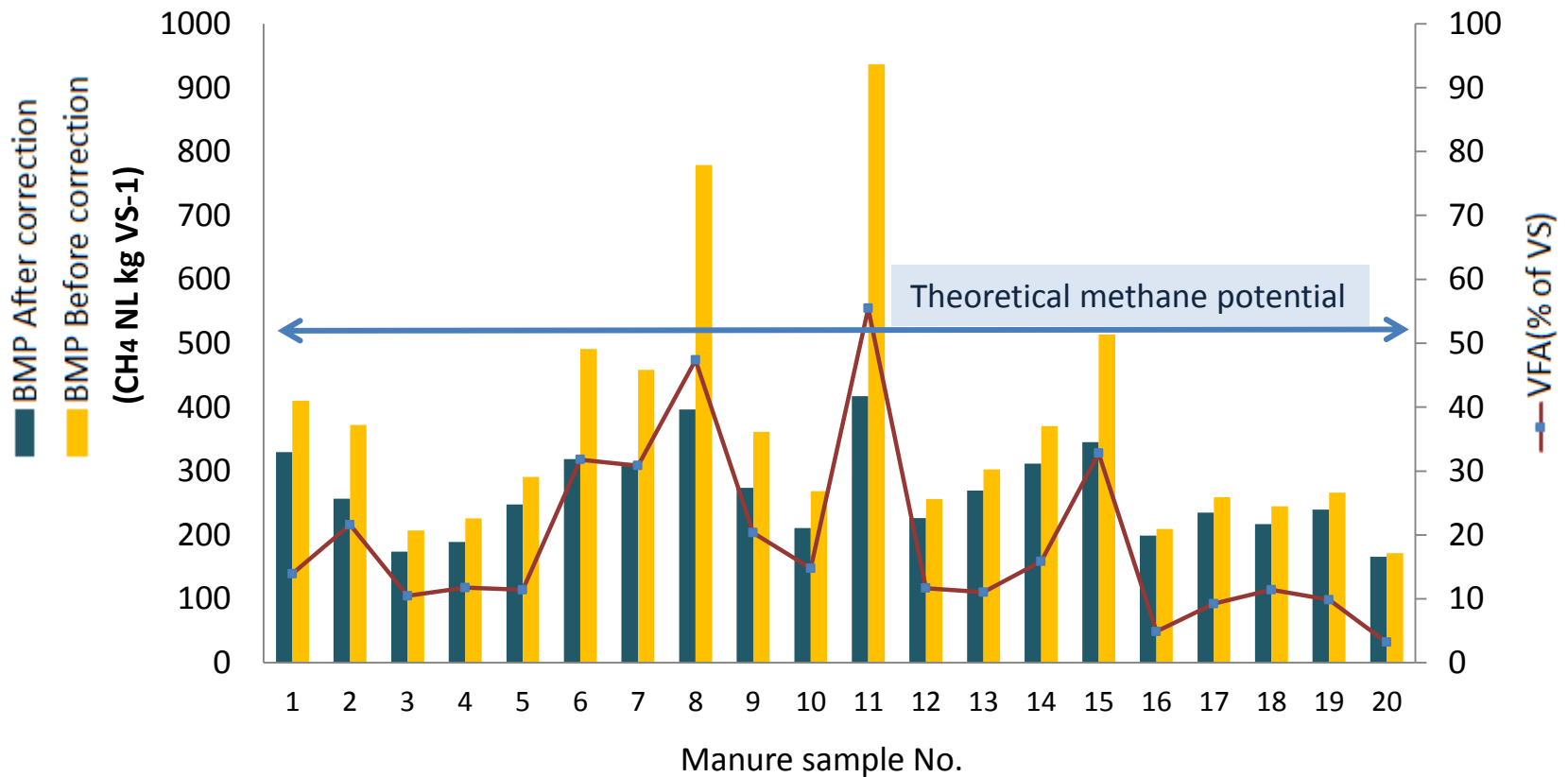


Economics results from sugar beet case study

- Profitability is significantly increased when adding 12½ % sugar beet to the manure input
- For a large plant the upgrade of natural gas to the grid is a profitable option
- The income of the biogas plant in the case is dominated by the biogas support payments
- Economies of scale is found for size of biogas plant capital cost but increasing transport costs of inputs tend to limit the benefit of scale
- Positive scale effects only dominate the net result for pure manure (no sugar beets – due to transport and handling costs)

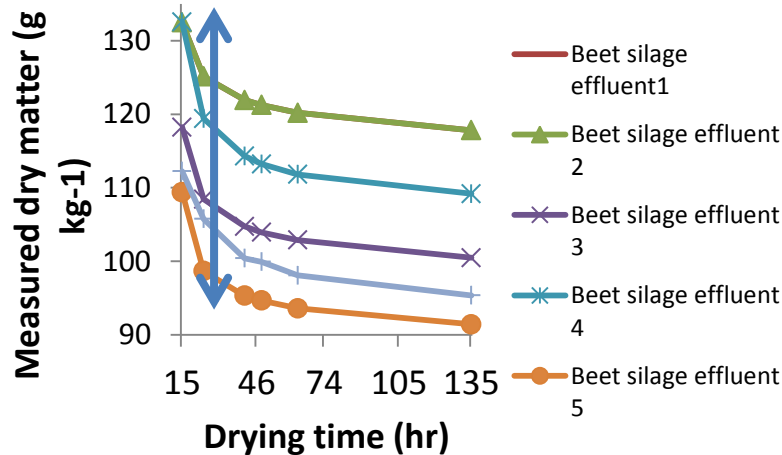
New method to characterise biomass

Overestimated VS based methane potentials



Organic matter (Volatile solids) is determined as the amount of DM (oven drying 105°C, APHA) emitted when heating the DM at 500°C

24hr : Standard method

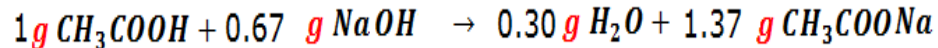


Drying causes loss of volatile organic component:

- Slurry: Organic acids
- Slurry and ensiled organic matter: Organic acids and alcohols

Adding a base:

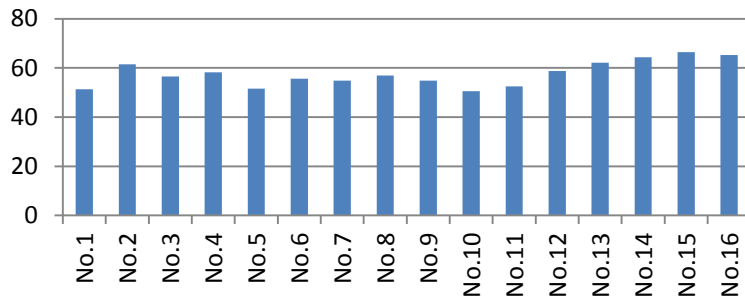
- Reduce emission of organic acids
- Problem crystal water formation
- Problem: Don't affect alcohol volatilization



	ash g/kg	ash g/kg
	Standard method	Increasing pH
Silage 1	44,5	81,0
Silage 2	45,6	72,5
Silage 3	58,5	96,9
Silage 4	41,0	76,2
Silage 5	51,0	67,3

We suggest COD- based methane potentials for silage biomass

TBMP of (CH₄ m³/ton)

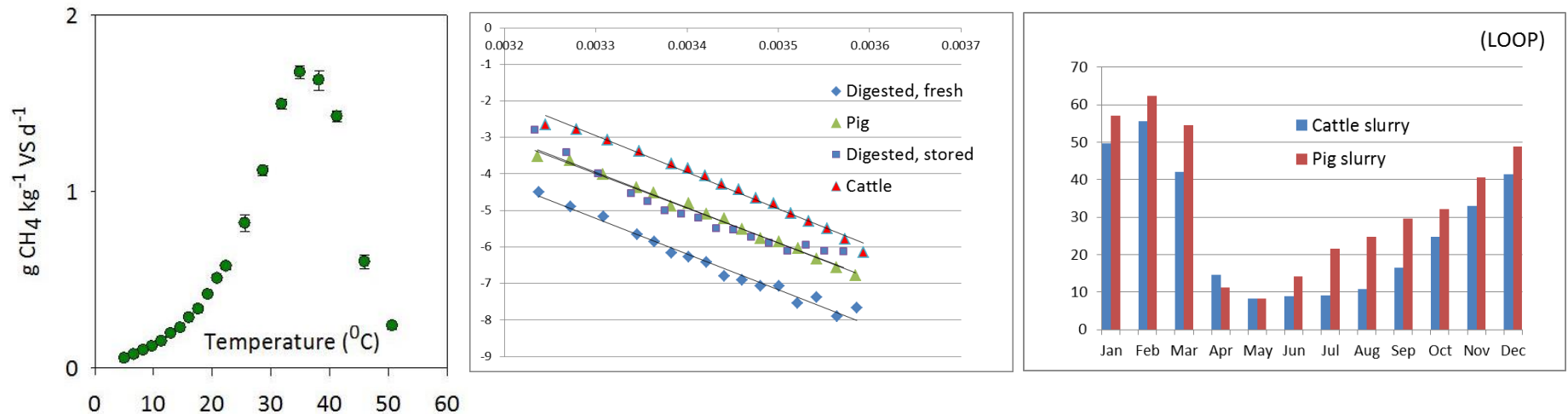


	Theoretical BMP (VS based) CH ₄ NL/g VS-1	Theoretical BMP (COD based) CH ₄ NL/COD g	g COD/g VS
VFA	0.37	0.35	1,07
protein	0.50	0.35	1,42
Carbohydrate	0.41	0.35	1,19
Lipid	1.01	0.35	2,90
Ethanol	0.73	0.35	2,09

Using COD, Theoretical BMP can be assessed
 The problem is that samples need to be diluted much,
 and due to sample heterogeneity the result may not reflect
 manure composition

GHG emission model

- document effects of AD for GHG inventory
- CH₄ emissions during storage of digestate:
 - new Arrhenius parameters, VS composition



- N₂O emissions from field-applied digestate:
 - derived from VS/water potential relationships

Conclusion

Joint model development: Efficient training of inter faculty PhD and Post doc

New interrelated models for assessing biomass management (Chain approach) –value chain

New methods to characterise biomass

New model for assessing GHG emission as affected by biogas digestion

Collaboration with international partners