Energy-neutral dairy chain in the Netherlands: an economic feasibility analysis

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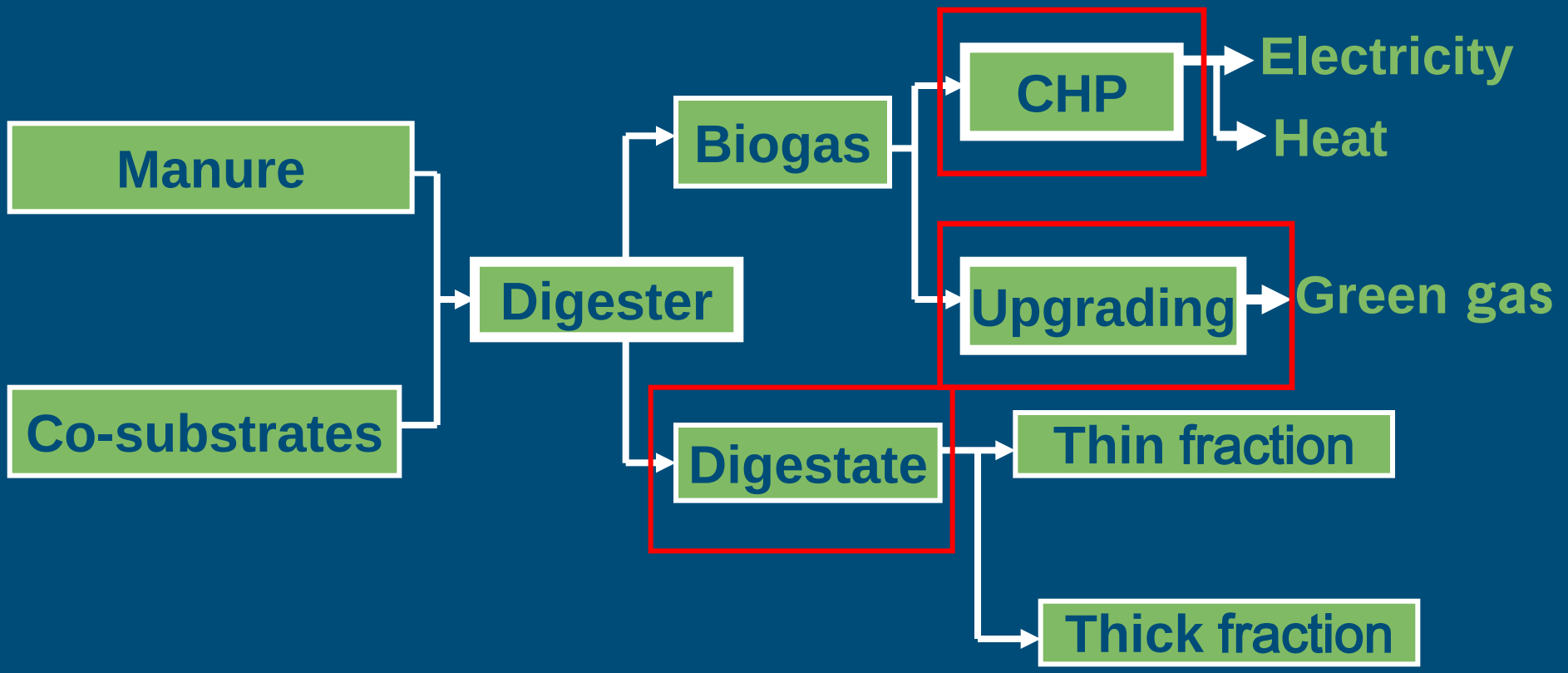
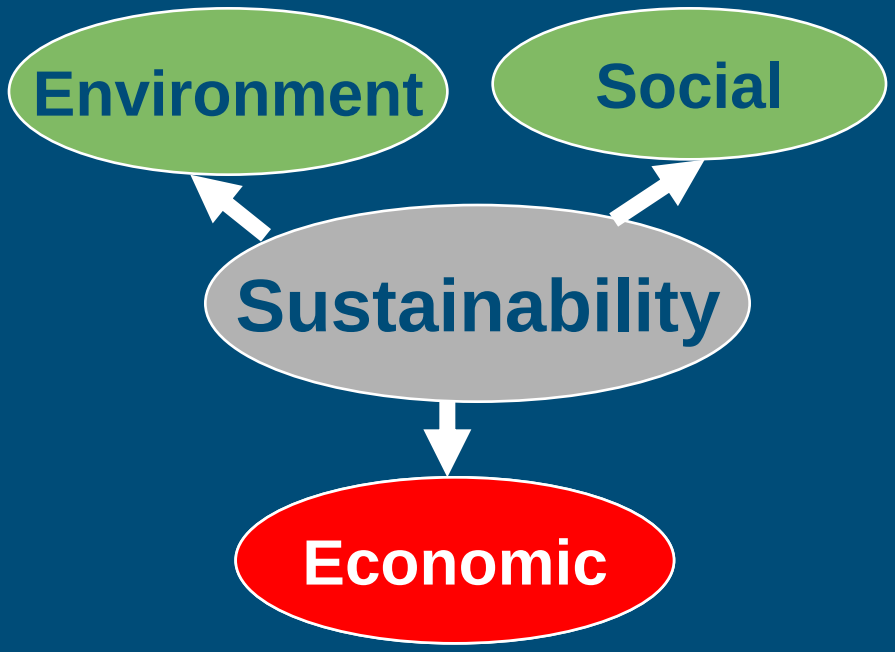
Background

- Environmental legislation on renewable energy
  - Share of renewable energy 20% by 2020
  - Energy saving and improvement of 30% in 2020
  - Less GHG emissions, 30% in 2020
- Growing interest in the anaerobic digestion of organic waste
- Manure residues a major source of environmental pollution

Anaerobic digestion



Energy-neutral dairy chain



- Initiatives at sector level
- By 2020, the dairy chain aims for energy-neutral production
- Total energy consumption in the dairy chain 60 PJ
- 17 PJ green gas to be produced from co-digestion
  - *Towards a sustainable dairy chain*

This paper

- Assess the profitability and associated risks of green gas production (17 PJ) by the dairy chain

Develop:

- Business models and their likelihood
- Simulation model
  - *Technical & financial data: 23 operating biogas plants in NL*

Business models: Green gas

- Two business models
  - Stand alone (4-5 million m3)
  - Central upgrading (5-6 million m3)
- Green gas one of the energy transition paths of the Ministry Of Economic Affairs
- Ambitions to substitute natural gas with green gas:
  - 8-12% in 2020
  - 15-20% in 2030 and
  - 50% in 2050

Data: Descriptive statistics (n=23)

	Small scale (n = 4)		Farm scale (n = 17)		Large scale (n = 2)	
	Mean	SD	Mean	SD	Mean	SD
Biogas yield (m^3/ton)	150	26	118	26	98	16
Methane (%)	57	1	58	4	57	1
Engine efficiency (%)	36	4	35	2	36	1
Price maize (€/ton)	27	5	30	6	31	1
Price grass silage (€/ton)	20	1	23	6	n.a	n.a

Model assumptions

- Stochastic variables:
  - Biogas yield
  - Upgrading efficiency
  - Investment cost
  - Feedstock prices
- Deterministic variables:
  - Digestate production and disposal cost
  - Operating and maintenance cost
  - Fixed costs
  - Output price (*New subsidy levels for 2009 € 58.3 ct./m^3*)

Results (1)

Technical results of business models

Item	Stand alone		Central upgrading	
	Mean	SD	Mean	SD
Green gas (million m^3/year)	4.50		5.50	
Total feedstocks (1000 ton)	62	17	69	20
Digestate (1000 ton)	49	14	55	15
Thin fraction (1000 ton)	42	12	46	13
Thick fraction (1000 ton)	7	2	8	2

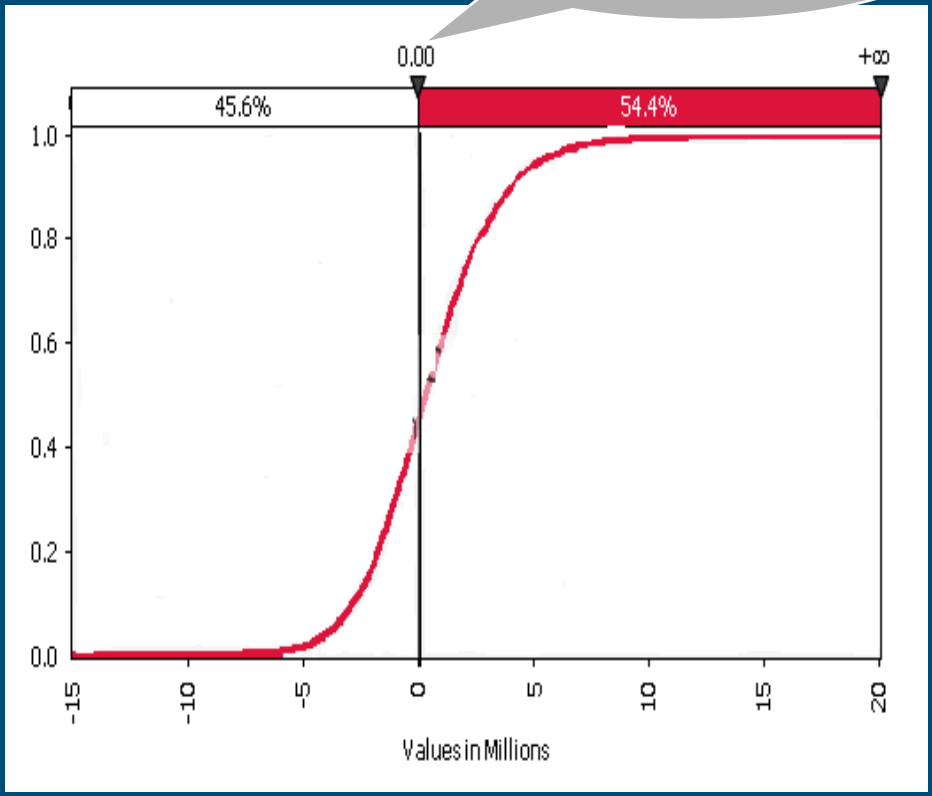
Results (2)

Simulation results of business models (€ million)

	Stand alone	Central upgrading
Total investment	3.60	4.00
Operating profit:		
Mean	0.26	0.31
90% confidence interval	-0.33-0.95	-0.36-1.00
NPV:		
Mean	0.48	0.68
90% confidence interval	-3.75-5.28	-3.95-5.90

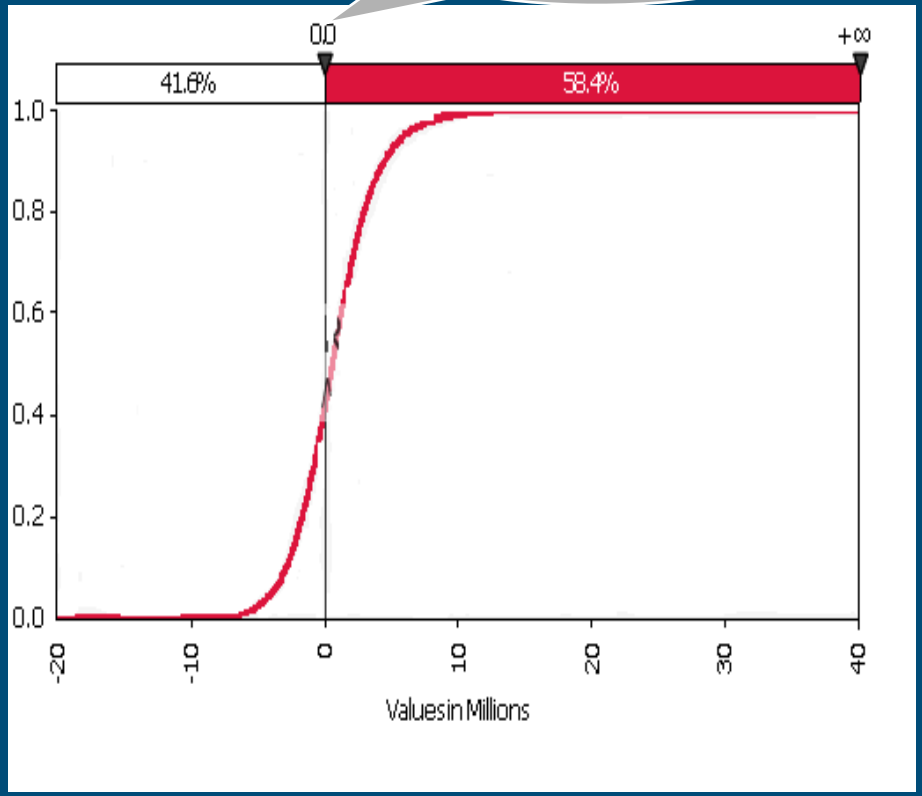
Results (3) Cumulative distribution function

P (NPV < 0)= 0.46



NPV of stand alone

P (NPV < 0)= 0.42



NPV of central upgrading

Conclusions

- Risk analysis more informative to decision makers
- More than 50% chance of economic success for both models
- A total of 109 plants needed
- 8.5% of the total amount of cattle manure will be processed

Discussion…

- Operationalization of the initiative:
  - Availability of feedstocks
  - Location of digesters
  - Availability of subsidy
- Integrated sustainability assessment (economic, environmental and social aspect)

Thank you!!