IGRC Seoul 2011
International Gas Union Research Conference

LCA of Biomethane

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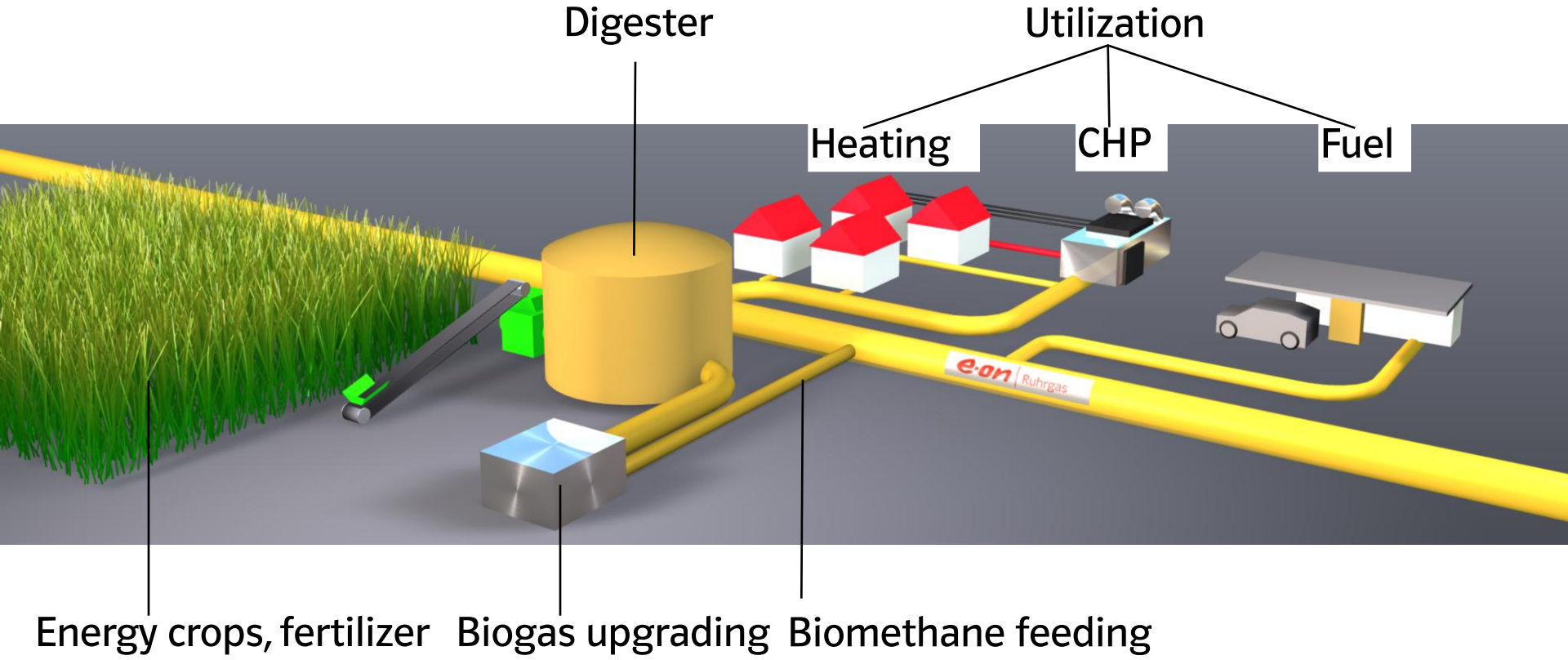
Biomethane Generation and Utilization

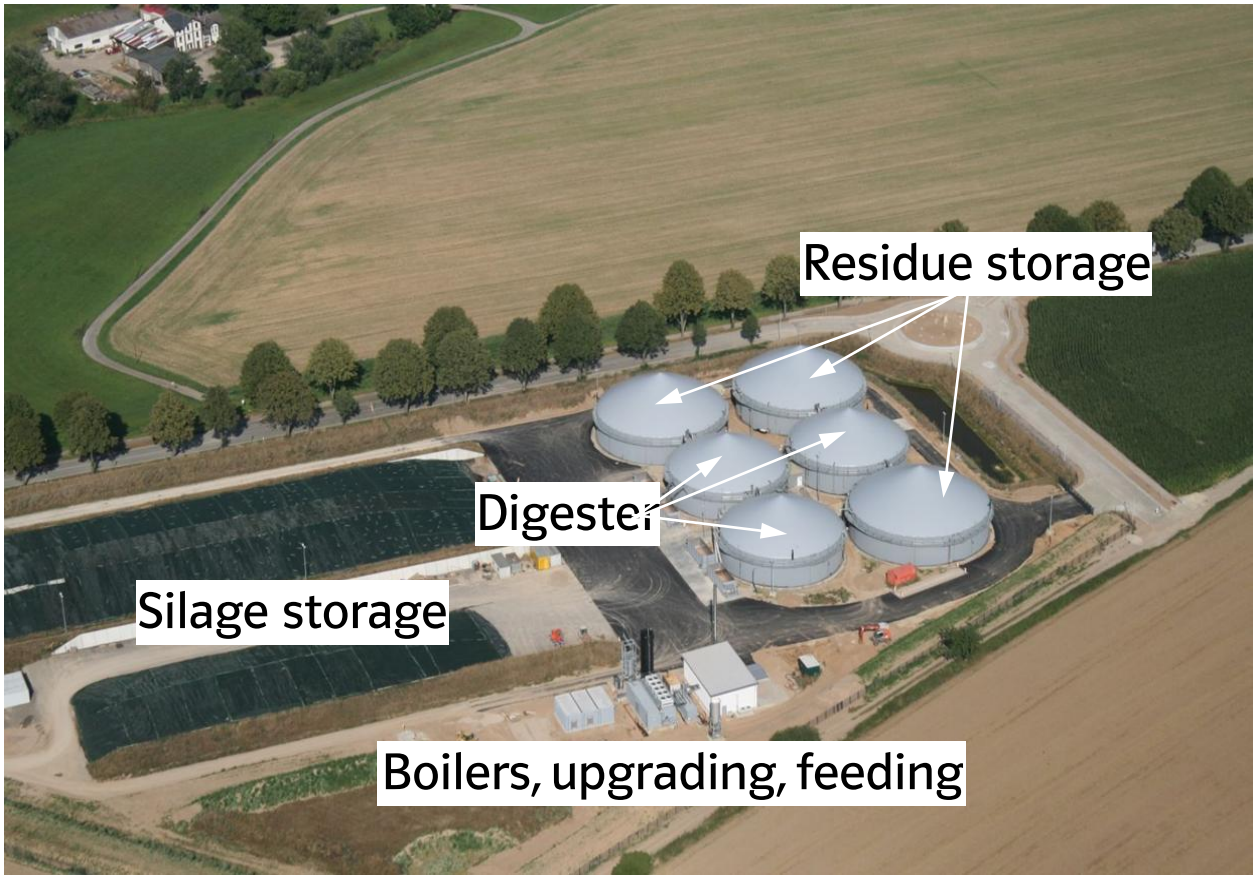


→ Biomethane - ideal renewable energy carrier for feeding into the natural gas pipelines

Biomethane Feeding Plants Germany/E.ON

- 46 in operation
  ➔ total 32.500 Nm3/h
- 65 under construction
  ➔ total 43.500 Nm3/h
- 11 E.ON plants in Germany
  ➔ **7500 Nm³/h by end 2011**
  Plant under consideration:
  Einbeck, commissioning 09/2009

Biomethane Plant in Einbeck



- Nominal capacity 500 m³/h,
- Substrates – energy crops
- Upgrading – amine gas treating

- Renewable process heat – biogas and/or wood chips
- Electricity – public net

LCA Objectives

- Calculation of GHG emissions and cumulative energy demand CED
- Provision of reliable data for certification and public relations
- Detection of possible ‘weak points’, further plant optimization

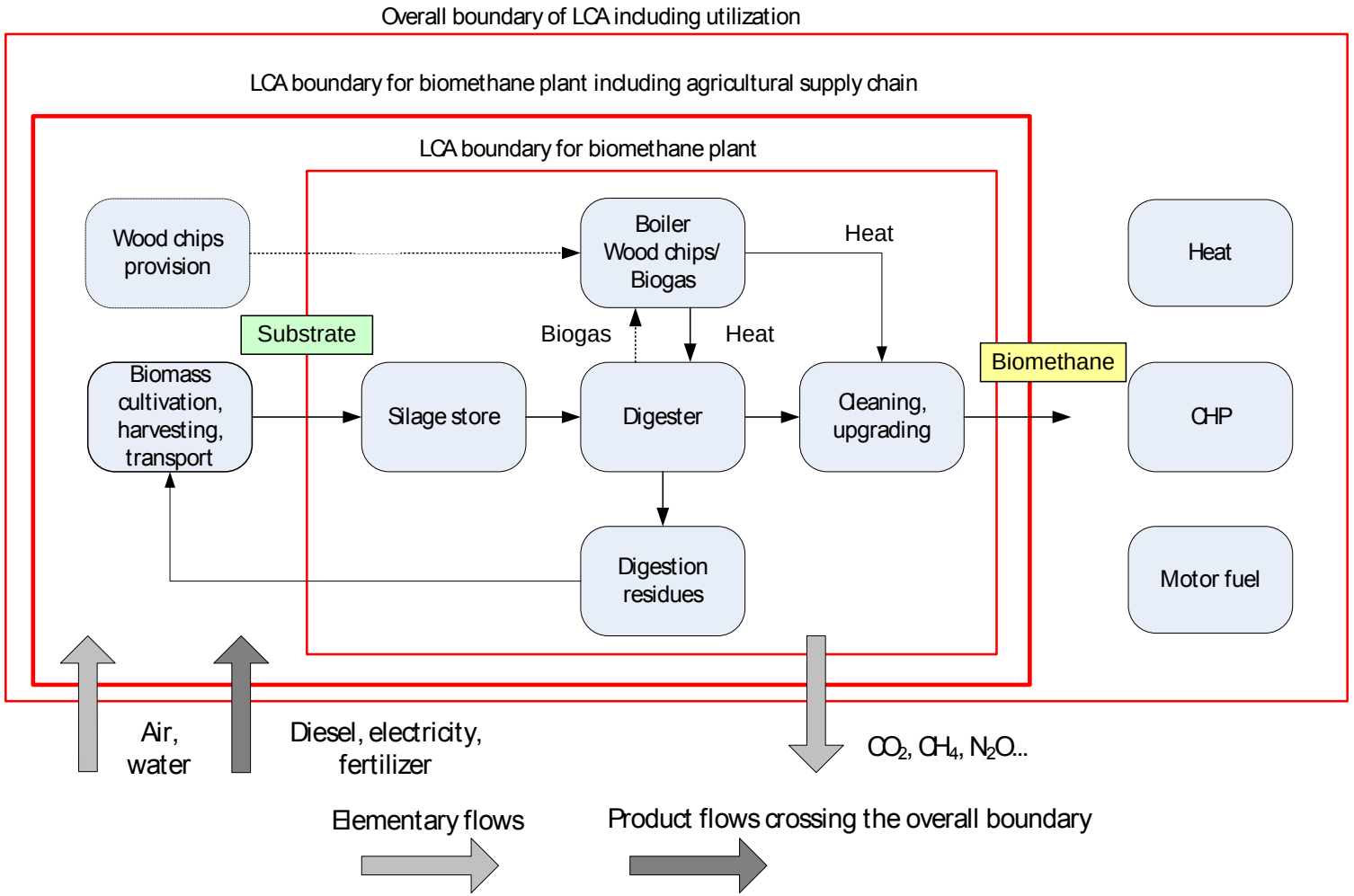
LCA Data Basis

- Process data report – primary own data
- Energy feeding measurement – primary external data
- Agricultural upstream data – secondary external data, experience data
- Basic properties (fertilizer, diesel, methane…) – primary data bases

LCA Exclusions

- Land use change – not relevant in Germany
- Plant construction and decommission – only marginal effect

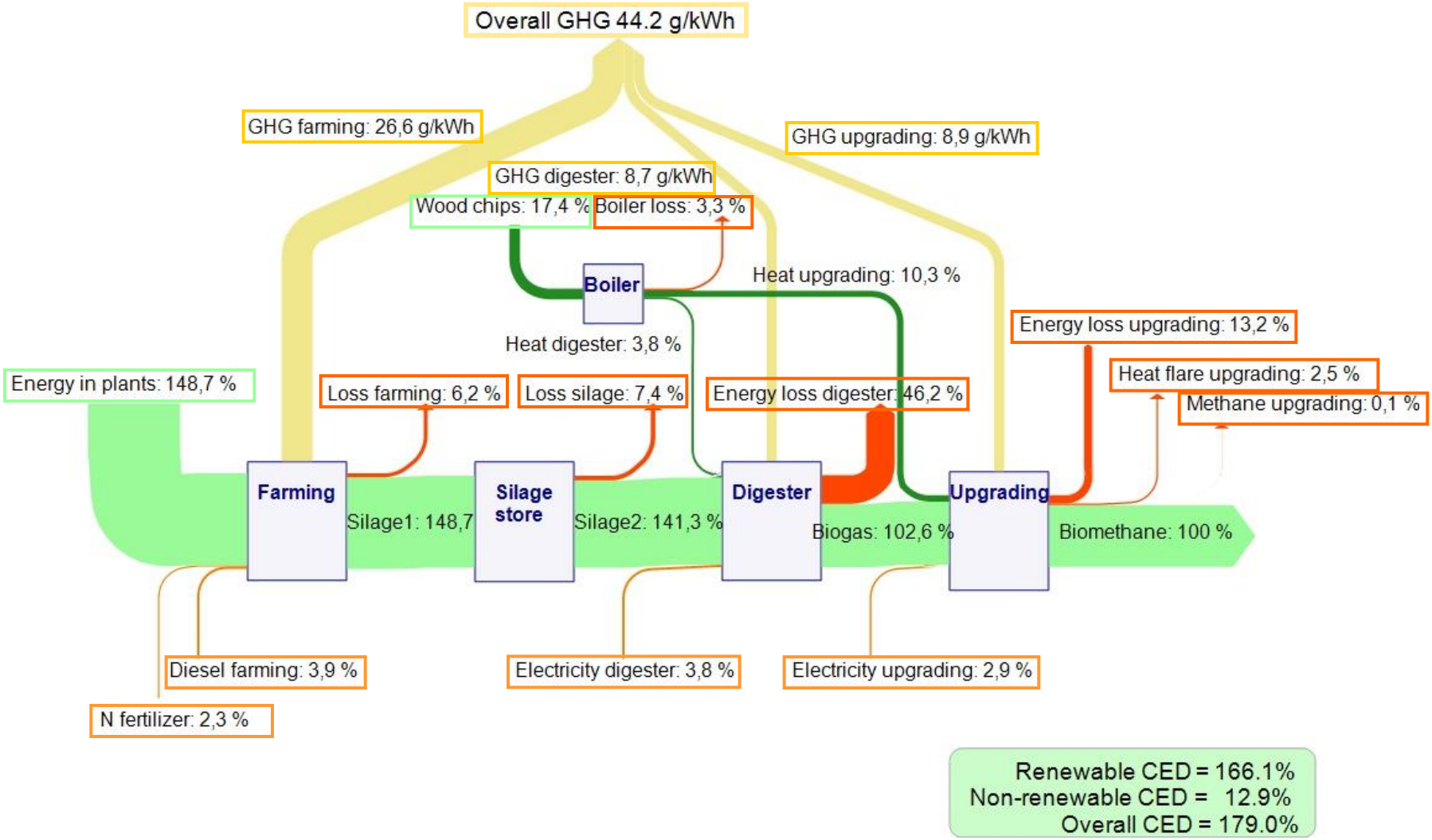
Basic Processes of the Biomethane Plant in Einbeck



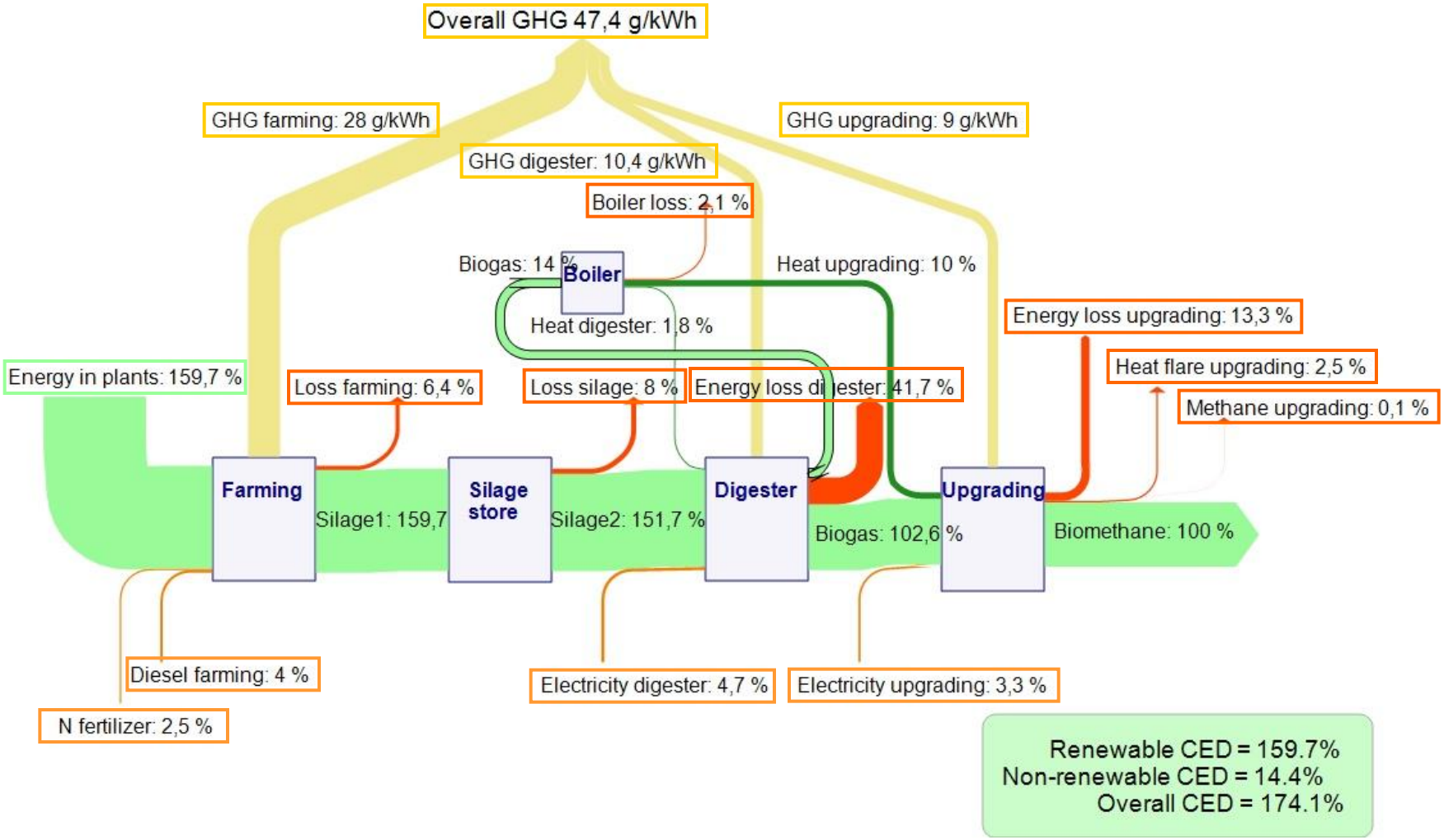
Inventories

	Biogas heating		Wood heating	
	CED	GHG	CED	GHG
	%	g/kWh	%	g/kWh
Substrates energy input, LHV	159,66%	0,00	148,69%	0,00
Diesel: farming, transport	3,97%	11,81	3,89%	11,52
N-fertilizer - residual fossil part	2,02%	9,15	1,88%	8,48
N2O emissions: 0.6% of N applied	-	6,33	-	5,86
Plant protectants	0,42%	0,72	0,42%	0,71
Electricity digester	4,72%	10,44	3,82%	8,46
Heat digester	-	-	4,64%	0,29
Overall methane emissions 0.1%	-	1,80	-	1,80
Electricity upgrading	3,25%	7,18	2,86%	6,32
Heat upgrading - amine regeneration	-	-	12,74%	0,78
Total	**174,05%**	**47,43**	**178,93%**	**44,22**

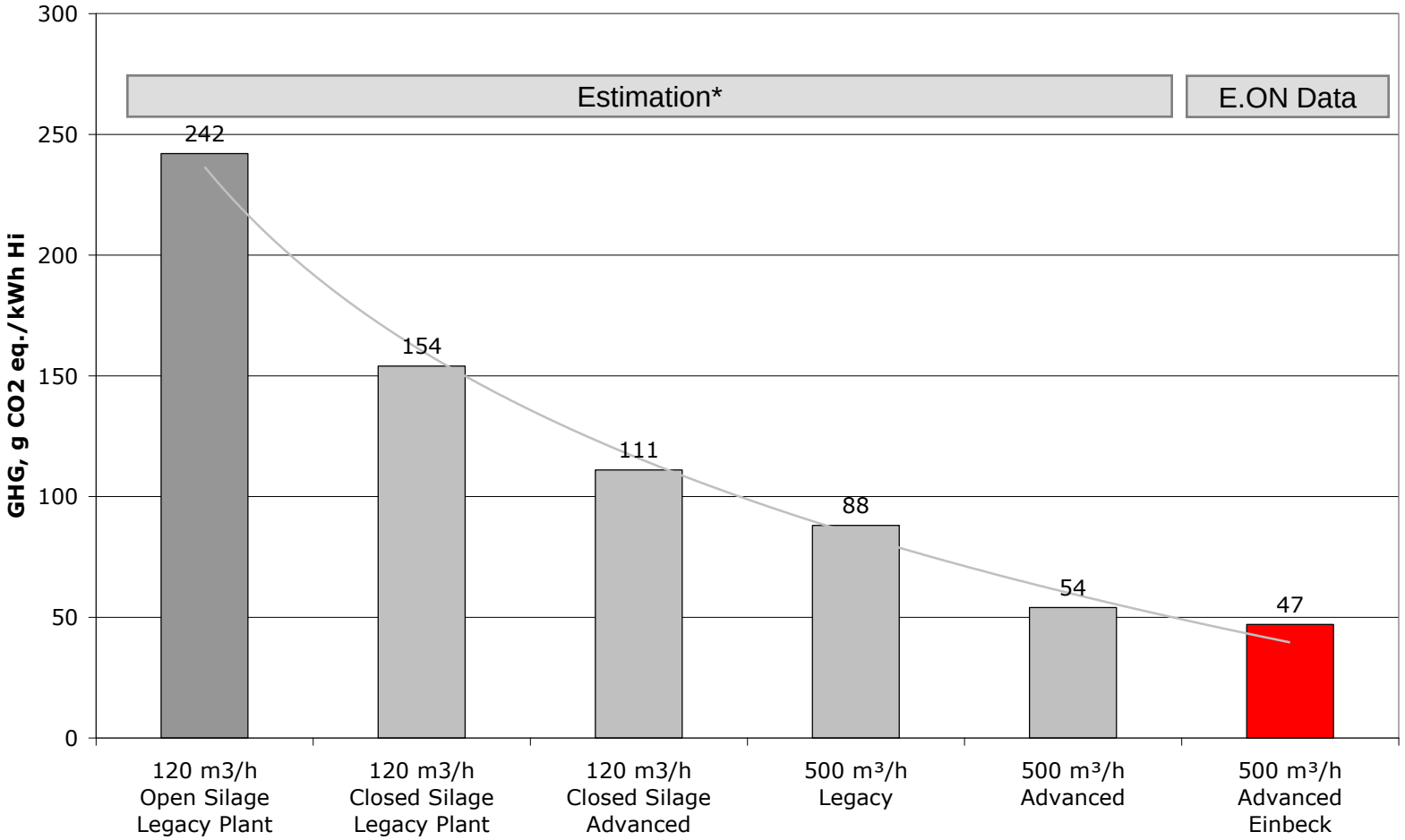
Results – Energy/GHG Flow Diagram for Wood Heating



Results – Energy/GHG Flow Diagram for Biogas Heating

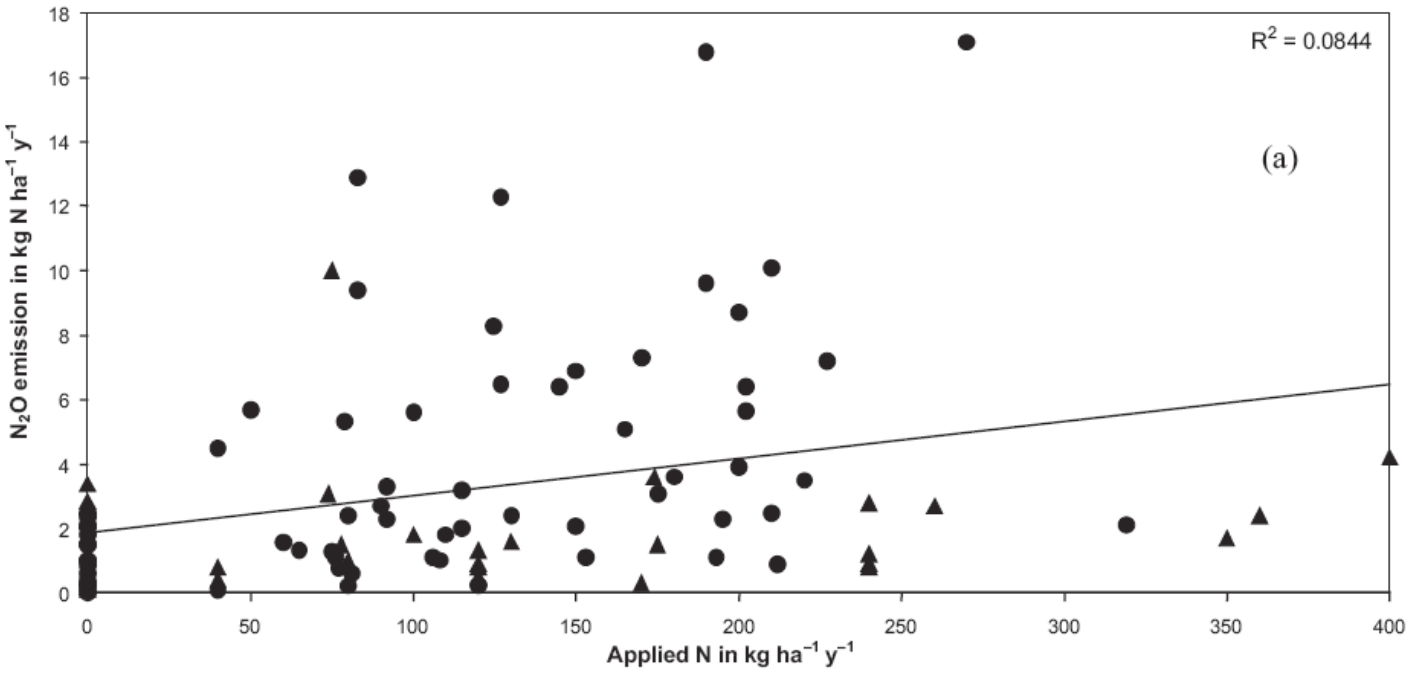


Reduction of GHG by Technical Progress



*Source: “Basis Data for GHG Inventories of Biomethane Processes”, Institute for Energy and Environment Research, Heidelberg, Internal Study, April 2008

N_2O Emissions



- Standard IPCC value of 1% too conservative
- Only weak correlation between N_2O and N revealed
- For Germany 0.6% as preliminary value assumed, further research necessary (previous overfertilization as impact factor?)

Source: „Nitrous oxide emissions from agricultural land use in Germany - a synthesis of available annual field data“
H.F.Jungkunst et al. *J. Plant Nutr. Soil Sci.* 2006, *169,* 341–351

Discussion and Conclusions

Basic prerequisite for low GHG emissions:

- Utilization of fermenter residues as fertilizer
- Minimization of silage losses
- Highly efficient upgrading technology with low electricity demand
- Industrial standard equipment and operation (process control, plant monitoring and maintenance)
- Nitrous oxide (N_2O) emissions are anticipated to disappear when overfertilization does not occur (-6 g/kWh)

Discussion and Conclusions

- In accordance with the German Sustainability Ordinance achieves biomethane from the plant in Einbeck a GHG reduction of 85%
- Further GHG reduction potential of 20 g/kWh by renewable power (-15 g/kWh) and fuel (biodiesel -5 g/kWh)
- As far as energy input is concerned achieves biomethane utilization in CHP or condensing boilers in Germany comparable GHG reduction effects

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Thank you for your attention!

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