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**Biogas Research- & Consulting Group
IFA-Tulln, Institute for Environmental Biotechnology**



Competence Centers for
Excellent Technologies

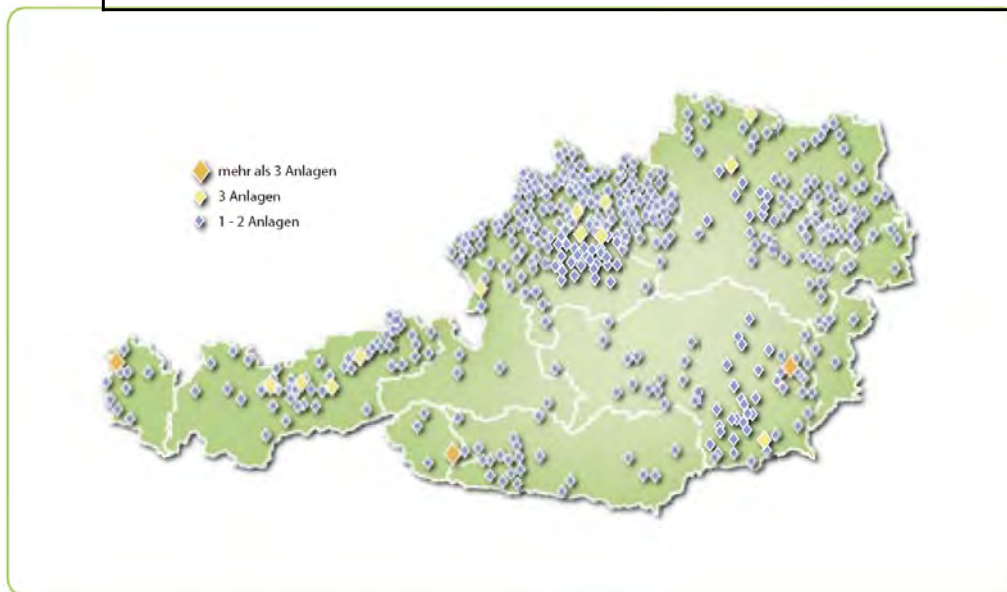
Industrial Organic By- Products For Local Energy Production

Roland Kirchmayr



Biogasplants in Austria

Pre-treatment: Food, Pharma, Industrie ⁽¹⁾	25
Sewage Sludge Treatment ⁽¹⁾	134
Magnum-Plants: Biowaste-Treatment ⁽²⁾	6
Agricultural Biogas Plants under Operation ⁽³⁾	294
Eco-Electricity-Biogasplants ⁽⁴⁾	340



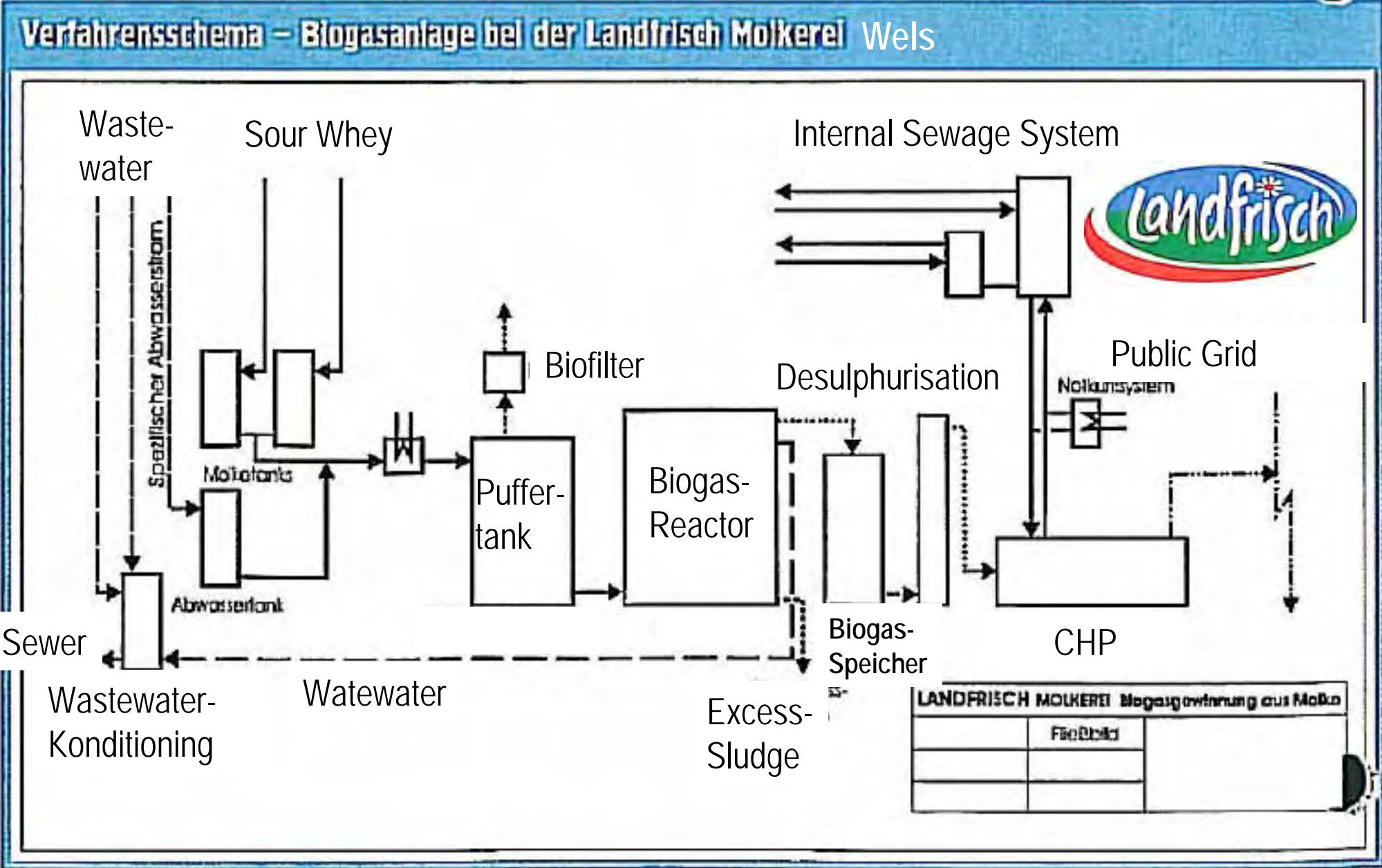
- (1) Bundesabfallwirtschaftsplan 2006 (BMLFUW)
- (2) Salzburg, Wels, Roppen, Lustenau, Markgrafneusiedl, Wien
- (3) Ökostrombericht 2008 (E-Control)
Engpassleistung: 74,94 MW,
Eingespeiste Energie 2007: 439,57 MW
- (4) Ökostrombericht 2008 (E-Control)
Engpassleistung: 90,09 MW

Other Wastes FWMP 2006 (Data 2004)

Waste group	Designations according to ÖNORM S 2100 (2005)	Amount
31	Waste of mineral origin excl. scrap metal	
312	Metallurgical slag, dross and dust	2.83 million
314	Other solid mineral waste	0.49 million
316	Mineral sludge	0.48 million
311	Spent lining, blast furnace and foundry waste	0.18 million
91	Solid municipal waste including similar commercial waste	1.20 million
11	Food, beverage, and tobacco waste	0.84 million
94	Waste from water treatment, sewage treatment and water use including industrial sewer sludge	0.70 million
57	Plastic and rubber waste incl. shredder residue	0.62 million
35	Scrap metal	0.38 million
13	Animal faeces	0.31 million
19	Other waste from processing and refinement of animal and plant products	0.30 million
12	Waste plant and animal fat products	0.27 million
18	Pulp, paper and cardboard waste	0.19 million
14	Skin and leather waste	0.12 million
51	Oxide, hydroxide, salt waste	0.12 million
	Others: glue, sealing cement and resin, textiles, sulfite liquor, medicine, drugs and washings, cosmetics, tensides, residue from detergents and cleaning agents, industrial sweepings, leachate water from waste landfills	0.15 million
Total (rounded)		9.2 million

Process-Diagramm

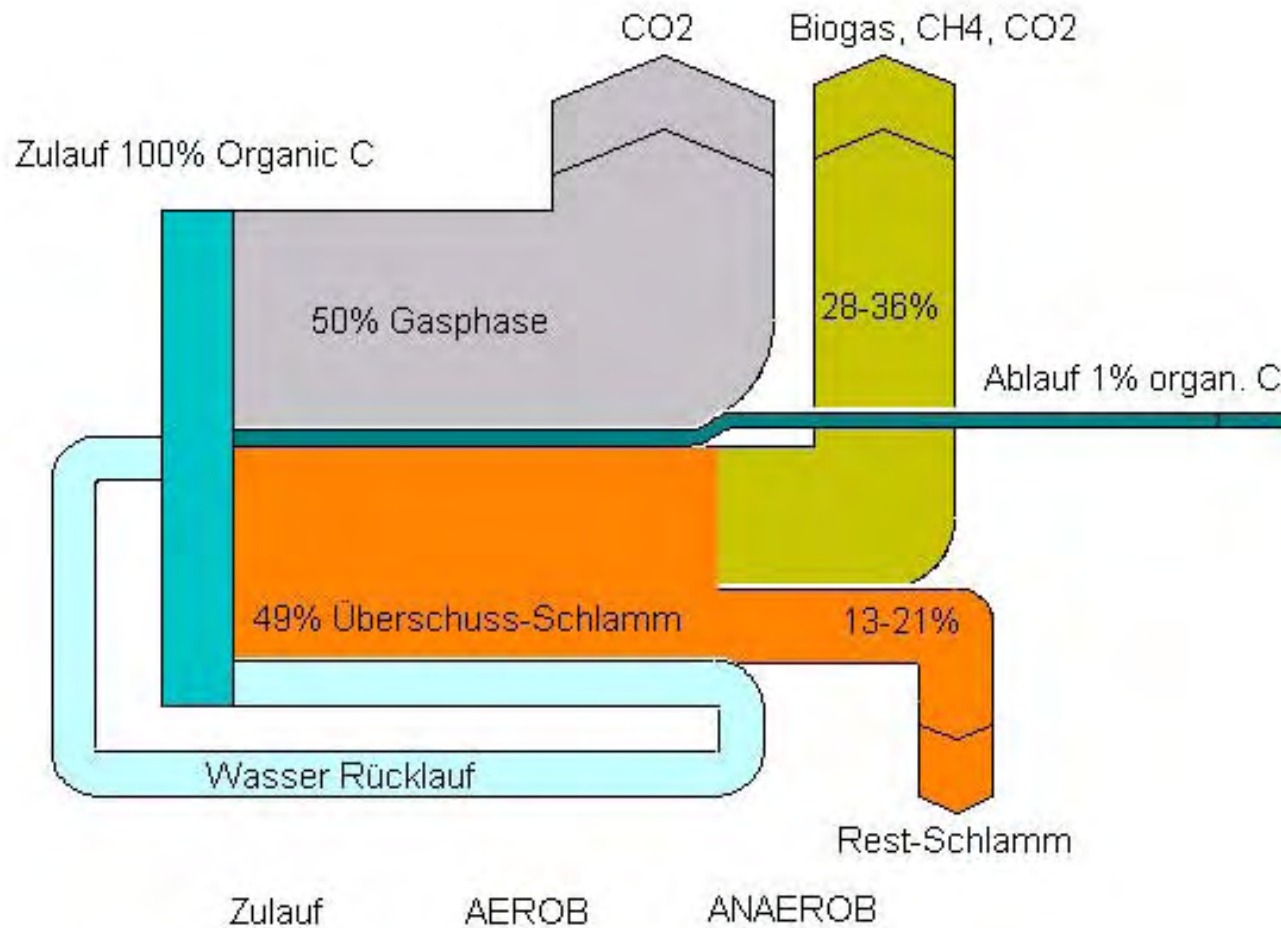
Dairy Industry – Utilization of Sour-Whey bioenergy2020+



Aerobic versus Anaerobic

Aerobic Wastewater Treatment, Anaerobic Sludge Treatment

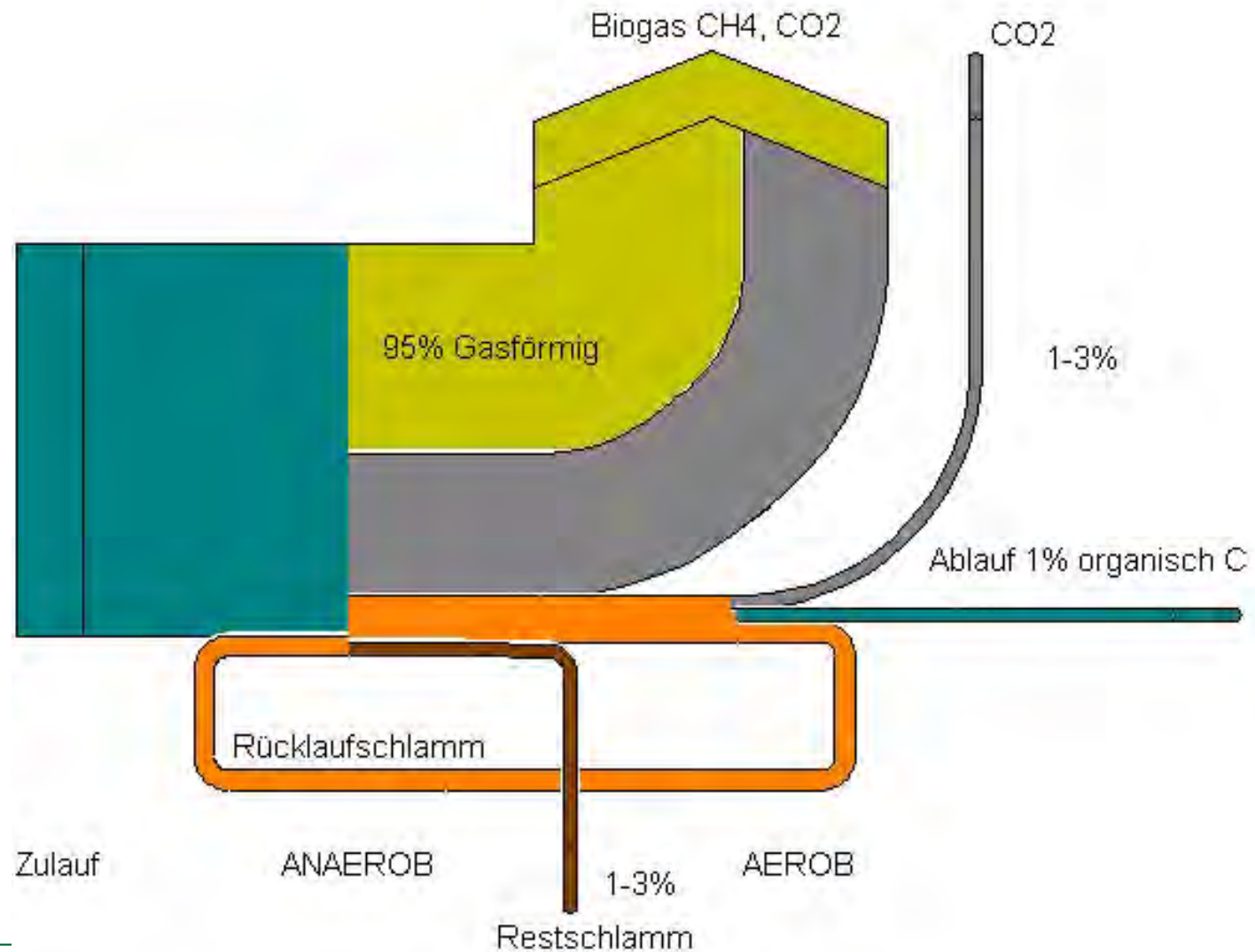
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Aerob versus Anaerob

Anaerobic Pre-Treatment, Aerobic Polishing

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Dairy Industry

Treatment of Sour Whey



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- Substrate
 - Sour Whey: 180 m³/d
 - Rinsing Water: 180 m³/d
- Gas utilization
 - Elektric: 500 kW (30% of Demand)
 - Thermic: 580 kW (40% of Demand)



Biofuel-Production: Biodiesel

Input 300,000 t/a Vegetable Oil; 100,000 t/a Used Oil

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By-Products:

1. Destillation-Residue from Glycerine-Treatment	8,000 t/a
2. Schlime from Pre-Treatment of Primary Product	26,300 t/a
3. Wastewater (low WWA) from Glycerine-Treatment	7,800 t/a
4. Glycerine Tech	2,000 t/a
5. Wastewater Pre-Treatment Used Cooking Oils	16,000 t/a



$Q_{\text{Gärrest}} \sim 12 \text{ t/h}$
Abwasser-
Behandlung

Supply of ~75% of Energy-Demand



$Q_{\text{Substrat}} = \sim 13.6 \text{ t/h}$

$Q_{\text{TS}} = 2.1 \text{ t/h}$

$Q_{\text{CSB}} = 3800 \text{ kg/h (280 kg CSB/m}^3\text{)}$



$Q_{\text{Biogas}} = 1700 \text{ Nm}^3\text{/h}$

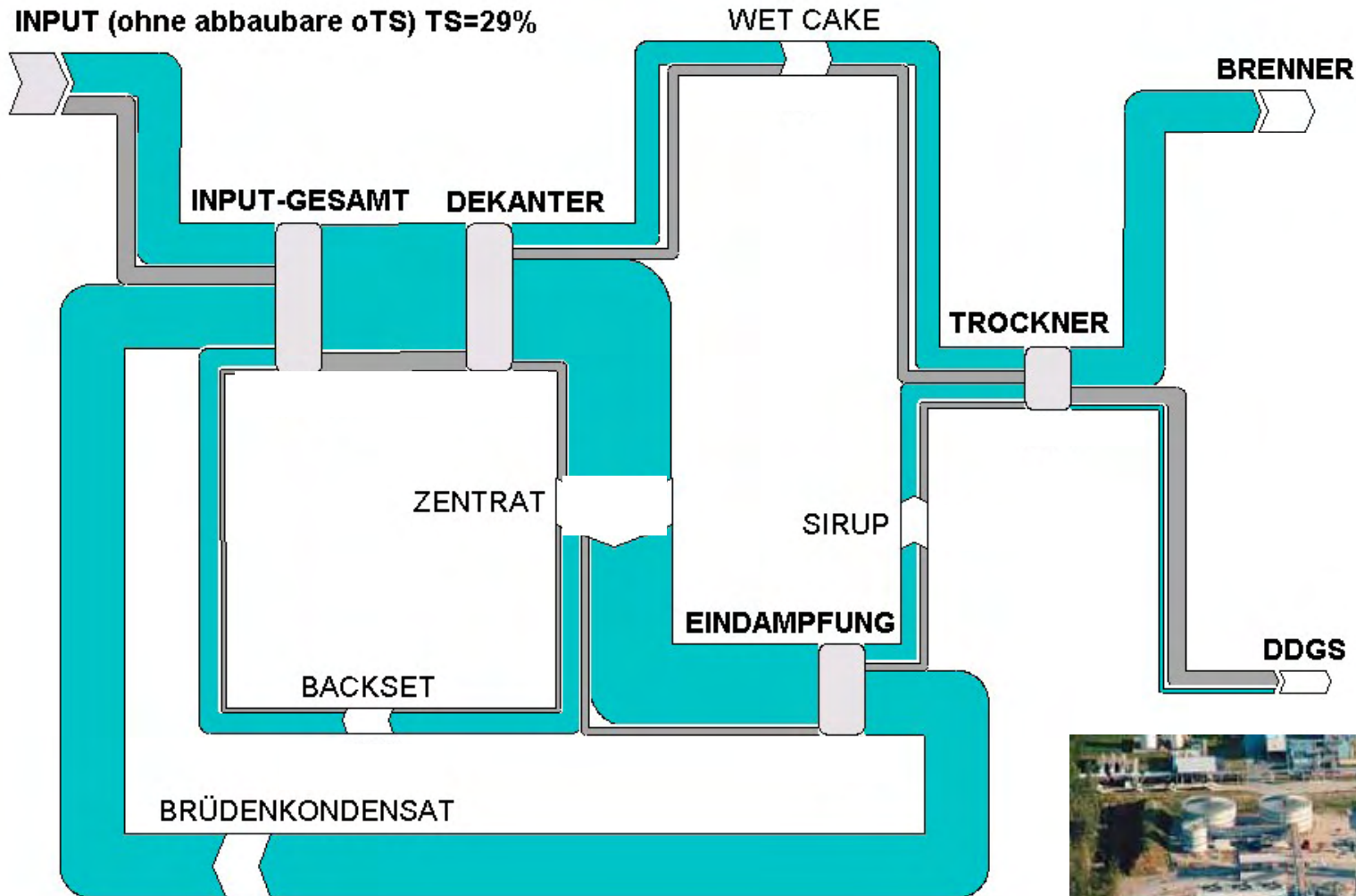
$Q_{\text{CH}_4} = 800 \text{ kg/h}$

$\text{CH}_4 = 63\%$



Option:
 $P_{\text{el}} \sim 4.3 \text{ MW}_{\text{el}}$

Process-Scheme Bioethanol-Plant



Biogas-Potential of a Bioethanol-Plant

Extrapolation



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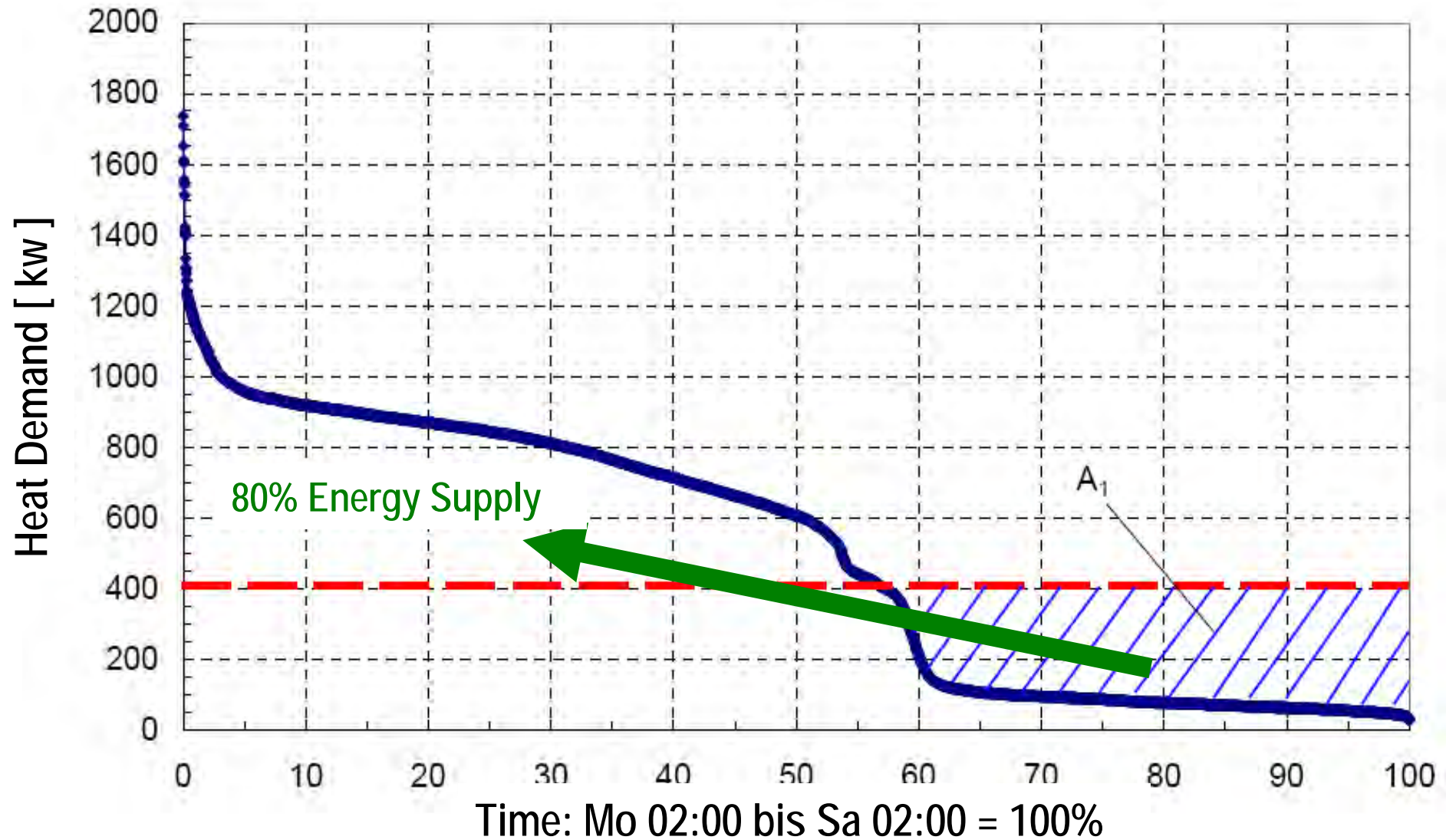
Stream	Supply Energy-Demand [%]
Stillage	119
Thin Stillage	41
Thin Stillage 50%	12
Wet cake	39
Sirup	26
Condensate	1,4

Animal By-Products in Austria

BAWP, 2004

Animal by-products	Tonnes	Recovery, disposal and location	in tonnes
Slaughter waste from animal slaughter	242,000	Animal carcass processing plants	280,000
Slaughter waste from meat processing	105,000	Biogas facilities	90,000
Bodies of animals that died natural deaths*	23,300	Composting facilities	15,500
Dairy waste from milk processing	122,000	Boiling facilities	12,500
Former food of animal origin	37,000	Incineration (left-over food from international airline flights)	1,400
Kitchen waste and leftovers	51,000	Animal by-products from milk processing (e.g., farm animal feed excl. boiling plant)	116,000
Food waste from international trade	1,400	Recovery in leather processing	27,000
Total (rounded)	582,000	Other destinations (gelatine, pet food)	28,000
		Export	12,000
		Total	582,000

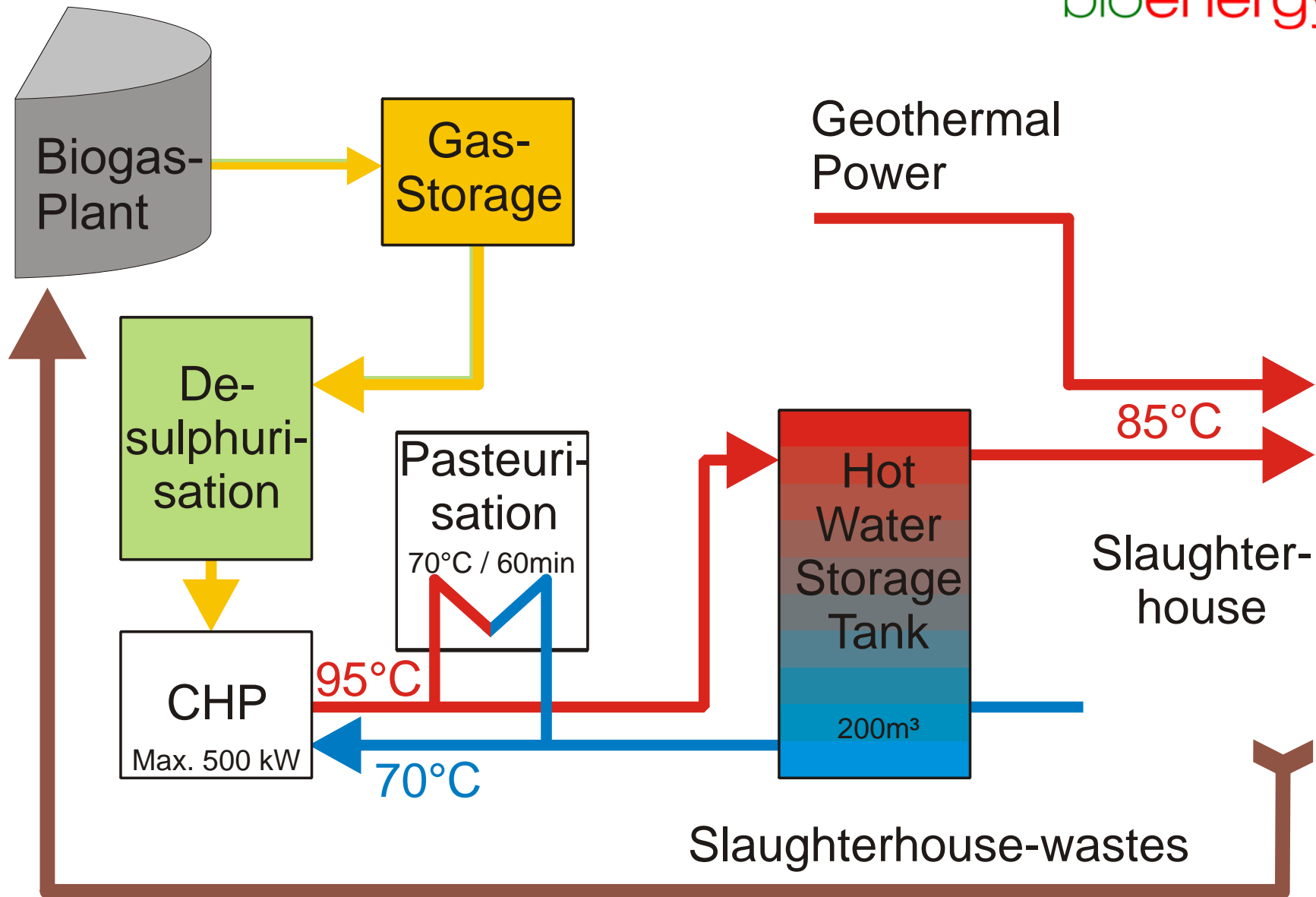
Energy-Demand Slaughterhouse



Biogas-Plant Großfurtner, St. Martin/I



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Biogas-Plant Großfurtner, St. Martin/I

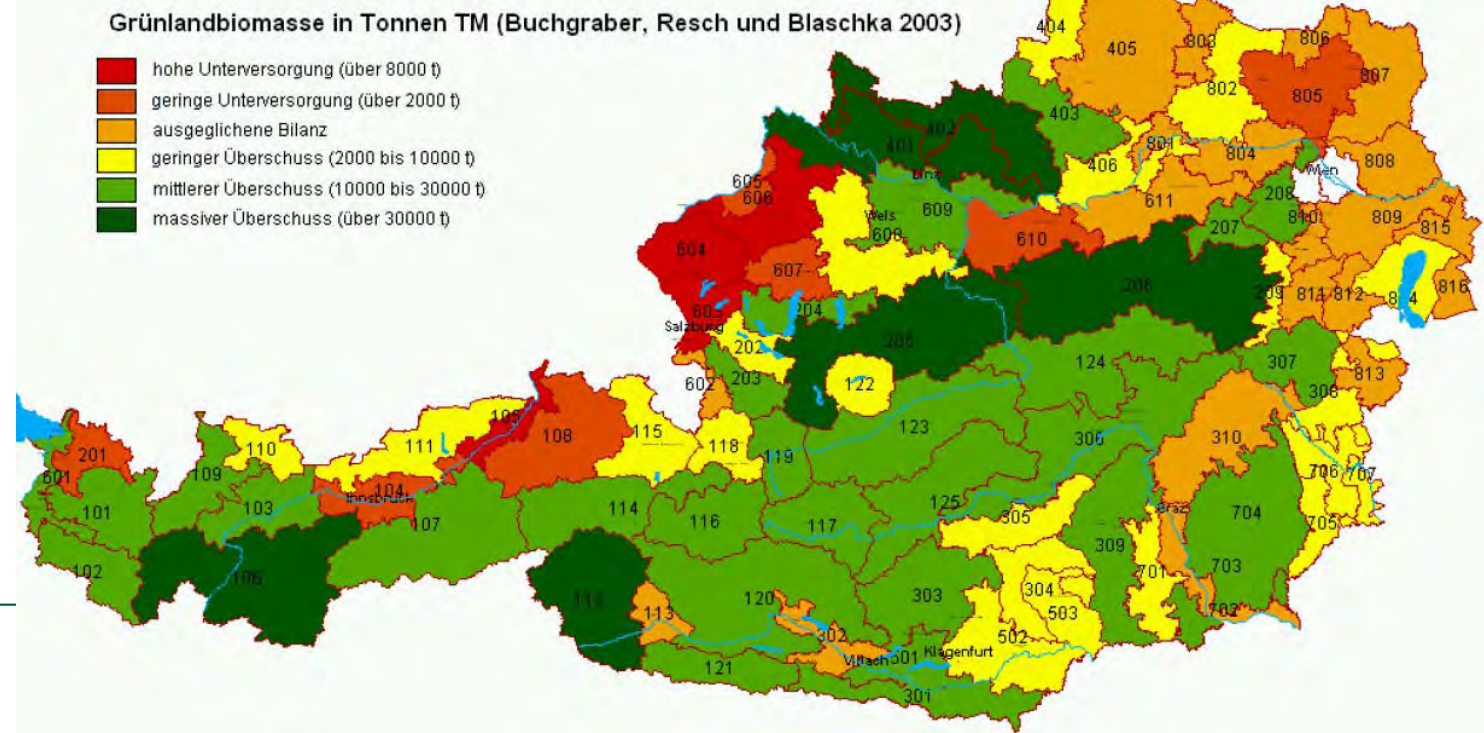


08.10.2009, Roland Kirchmayr,

Biomass-Surplus in Alpine and Pre-Alpine Regions

Buchgraber et.al., 2003

	2000	2010
	% der Grassland-Area	
Small to Medium Surplus on Biomass	42,2	53,2
Massive Surplus on Biomass	15,8	10,6
Extreme Surplus on Biomass		15,6
Total	15,8	26,2



Energy-Potential from Alpine Grassland

Kirchmayr&Pötsch 2008



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MAX	Mio m ³ Methan	MW el. ($\eta=37\%$)	MW th. ($\eta=40\%$)	MW th. ($\eta=87\%$)
Intensive Grassland	419	163	176	383
Extensive Grassland	77	30	33	71
Total Grassland	497	193	209	454
Green-Fodder	121	47	51	110
MIN	368	143	154	336
MAX	617	240	259	564

Thanks for your attention!



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