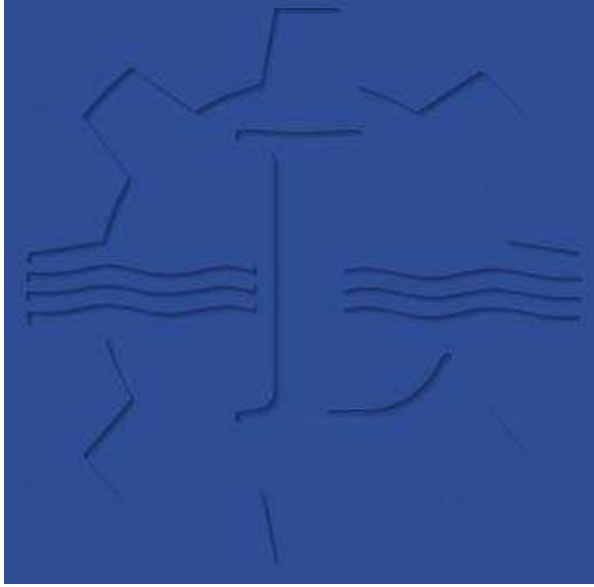
Landustrie

DeSaR-project

Ir. Brendo Meulman

Introduction

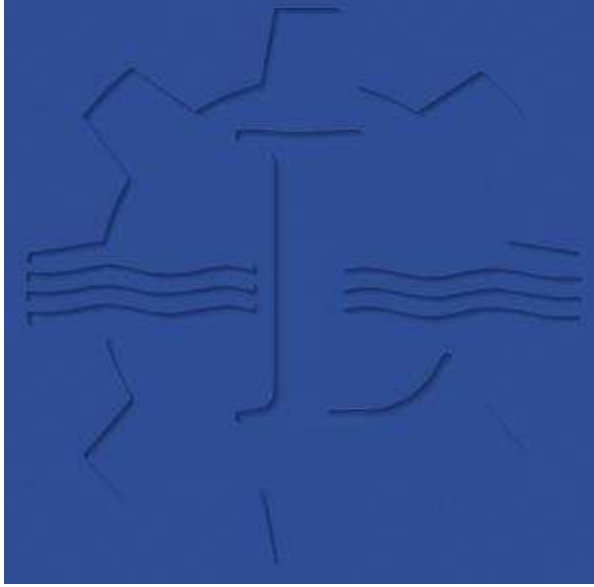
- **DeSaR: Decentral Sanitation and Reuse**



Introduction

- DeSaR: Decentral Sanitation and Reuse

- **Demonstration DeSaR-project**



Partners

- Landustrie Sneek BV
- Wageningen Universiteit
- Roediger VHT GmbH
- Woningstichting De Wieren
- Woningstichting Patrimonium
- Gemeente Sneek

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Separation at source

- **Black water (toilet water):**
  - Difficult degradable organic material
  - High nutrient concentration
  - Hormones and medicine traces
- **Grey water**
  - Easily degradable organic material
  - High temperature
  - Heavy metals (below irrigation standards)
  - Low salt concentration (irrigation)

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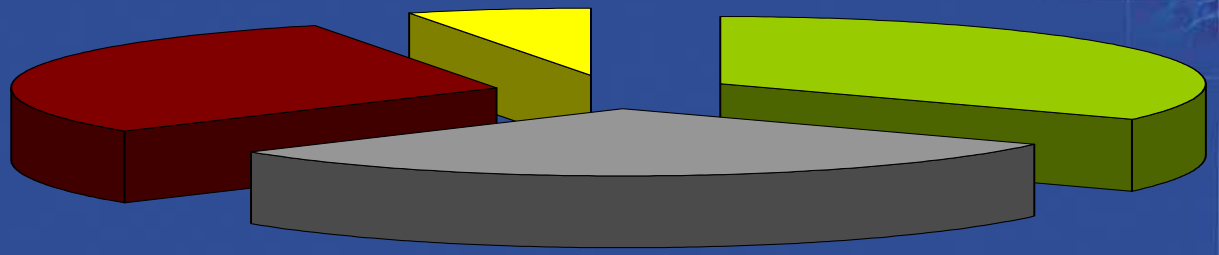
COD



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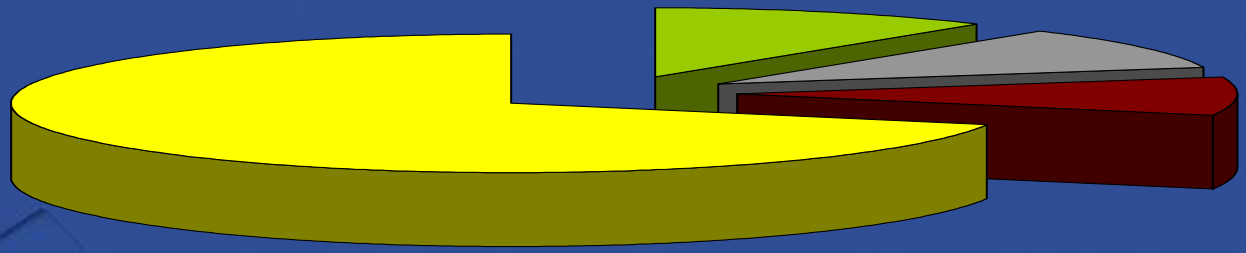

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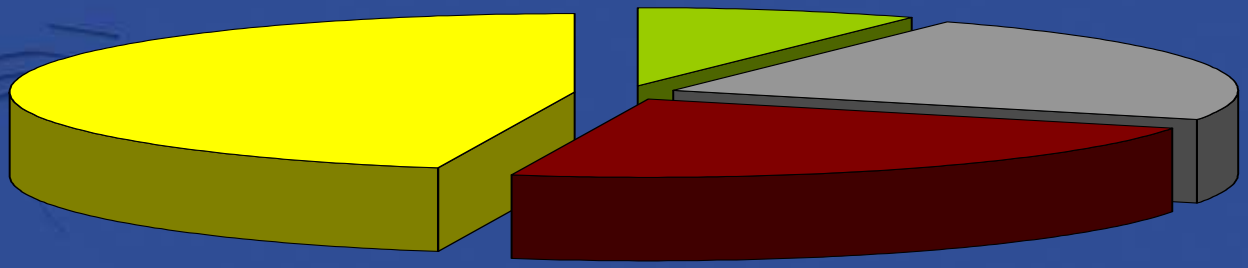

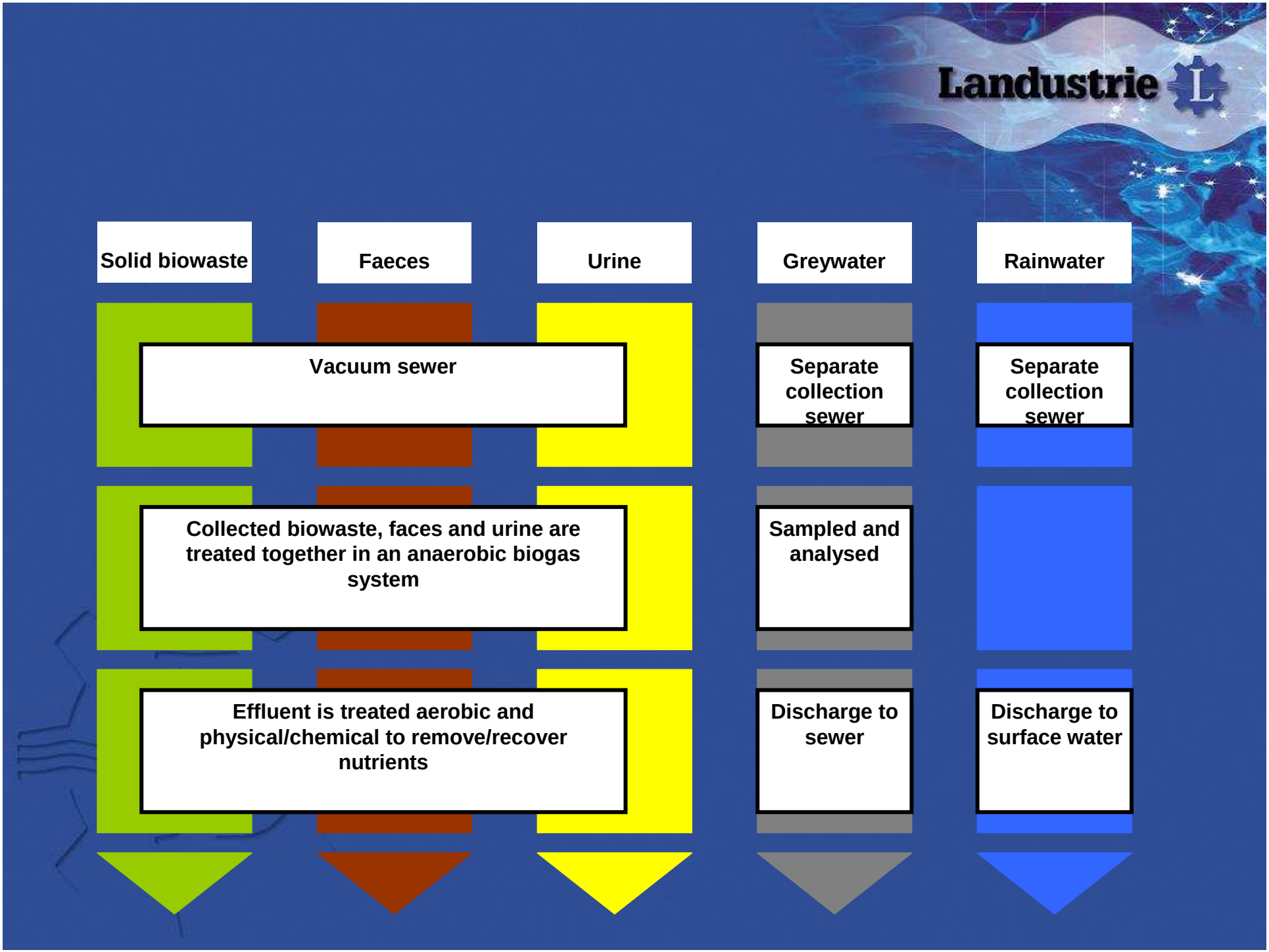
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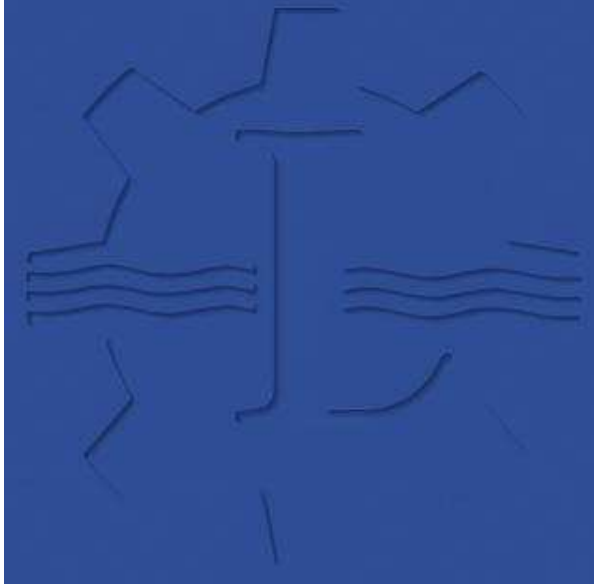
Solid biowaste
Faeces
Urine
Greywater
Rainwater
Vacuum sewer
Separate collection sewer
Separate collection sewer
Collected biowaste, faces and urine are treated together in an anaerobic biogas system
Sampled and analysed
Effluent is treated aerobic and physical/chemical to remove/recover nutrients
Discharge to sewer
Discharge to surface water

How to get a concentrated organic fraction?

- Vacuum toilets are used, they flush with 1L water and 100L of air. Reduction of 36L*p*p*d water, is 25% of total water consumption



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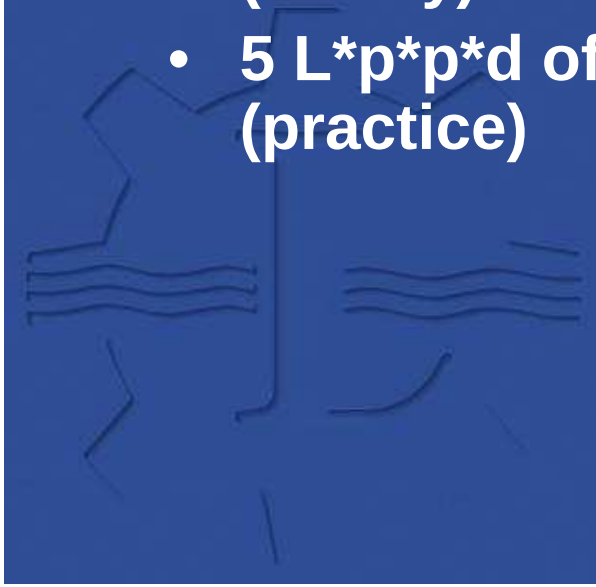
- **7 L*p*p*d of concentrated toilet water is produced (theory)**
- **5 L*p*p*d of concentrated toilet water is produced (practice)**



Concentrated toilet water characteristics

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Parameter ($g * L^{-1}$)	Influent $UASB_{st}$
COD_{tot}	16,1
COD_f	4,1
COD_p	12,0
VFA	1,4
TN	1,8
NH_4-N	1,2
Ptotal	0,24
PO_4-P	0,085

UASB-septic tank

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	Black water (HRT = 15 days)	Concentrated Black water (HRT = 30 days)	Concentrated Black water (HRT = 30 days)	Concentrated Black Water (HRT=30 days)	
CODt infl	5,5	12,8	12,8	16,1	16,1
COD (%)	90 – 93	61	78	87	93
COD_{ss} (%)	-	88	94	95	98
$COD_{col + sol}$ (%)		n.d	n.d	67	71
Temp (^oC)	tropical	15	25	Not heated (20±2 ^0C)	35
Methanisation rate	n.d	n.d	n.d	60%	76%
CH_4-production (L/day/capita)	12 - 15	6,4	14,5	13	19,5

COD mass balance

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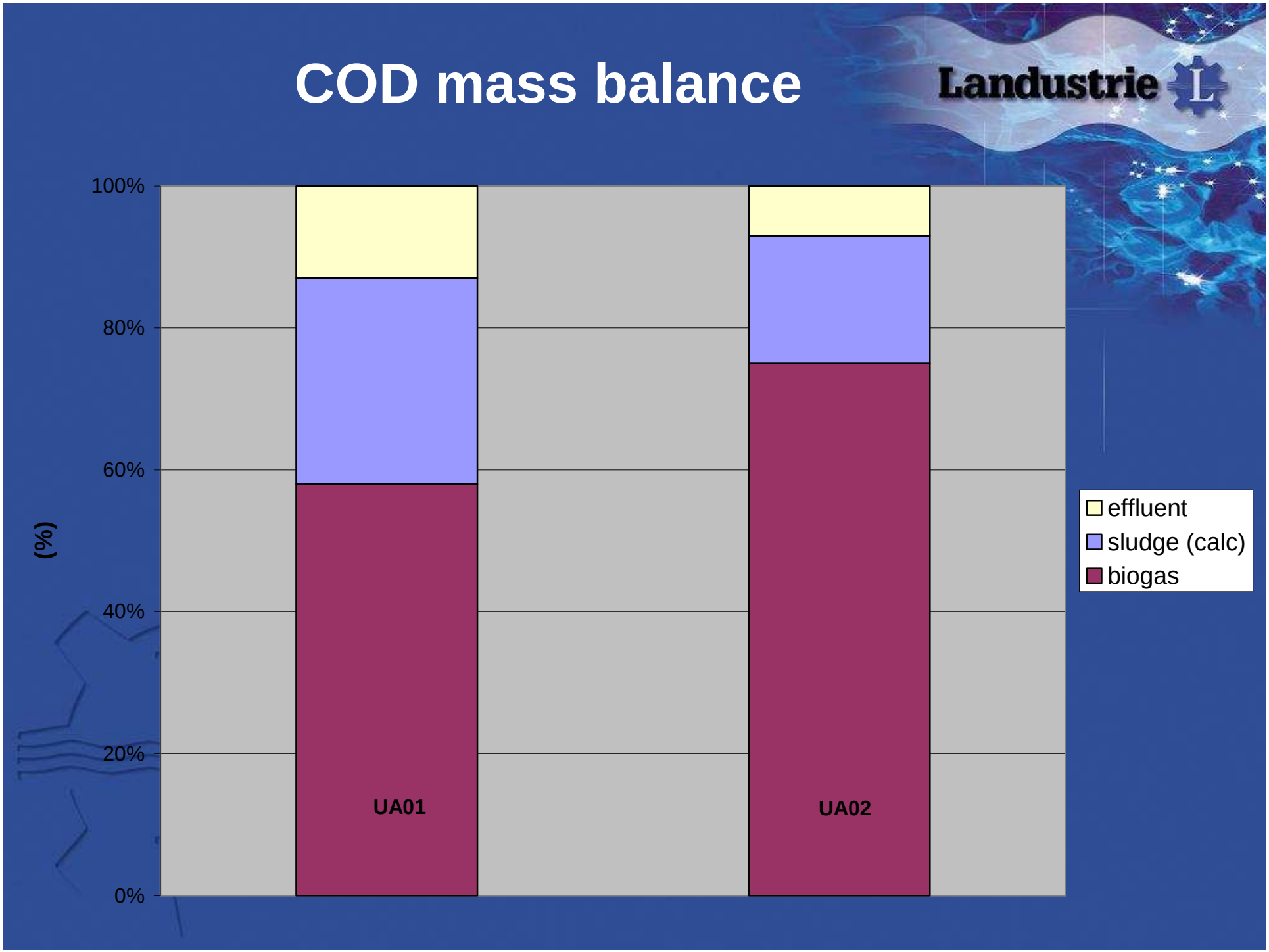


Energy production

Houses	1000	
Inhabitants	2300	
Blackwater + kitchen waste production	13,8	$m^3 * d^{-1}$
CODt conc	20	g COD * L^{-1}
CODt load	276	kg COD_t * d^{-1}
Temp reactor	25	^{O}C
HRT*	9	days
Methanisation rate*	60	%
Biogas production	58	m^3 CH_4 * d^{-1}
CHP efficiency	85	%
Heat prod (60%)	12,3	kW_{ther}
Elec prod (40%)	8,2	kW_{elec}

$Energy_{therm}$ consumption

Temp difference	5	^{O}C
Volume reactor	125	m^3
Surface reactor wall	140	m^2
Heating efficiency	75	%
Isolation	2,5	$w / m^2 * K$
Energy loss of reactor	0,3	kW
Energy for heating influent	5,1	kW
Total energy (heat)	5,4	kW_{ther}

$Energy_{elec}$ consumption

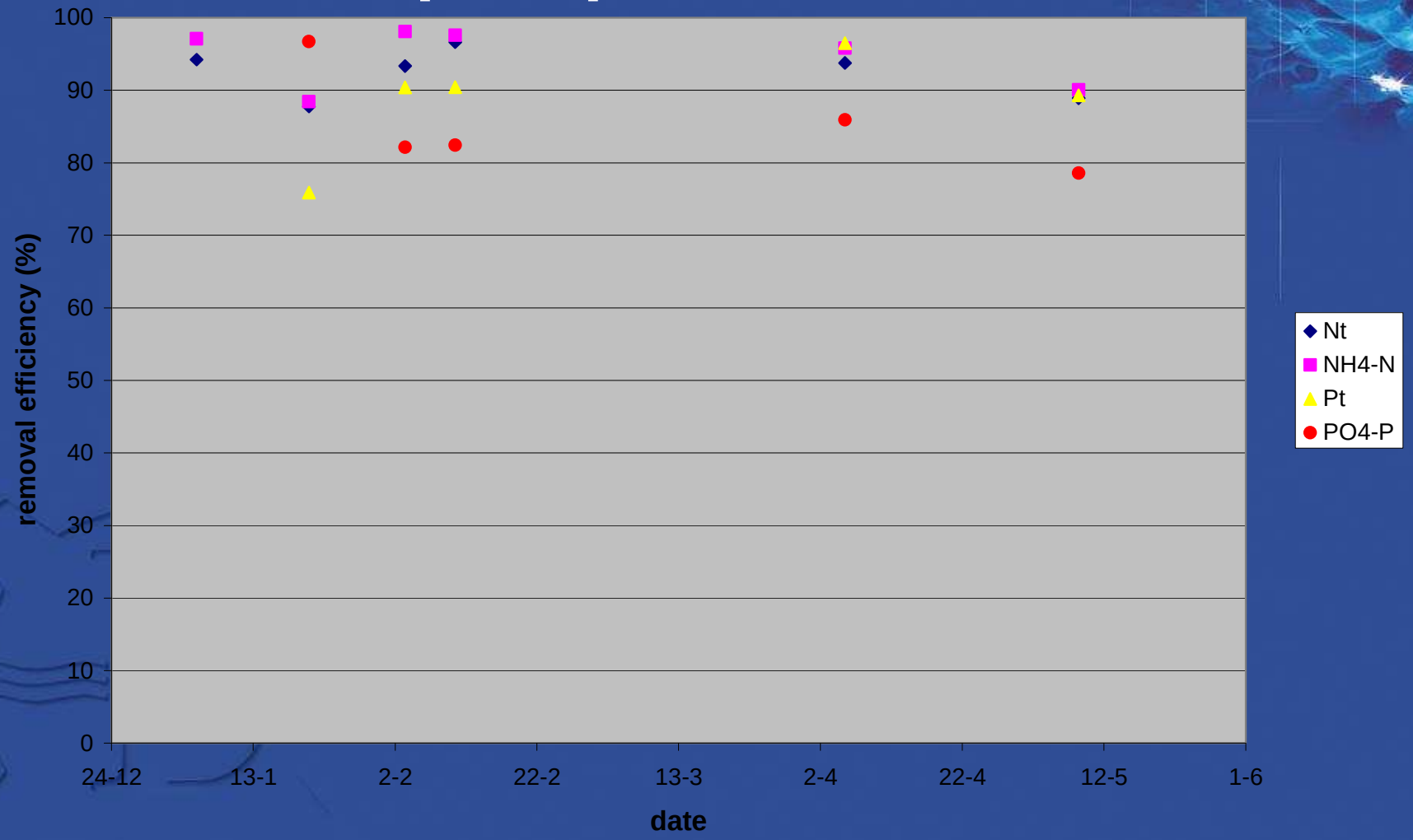
Stirrer storage vessel	0,37	kW
Influent pump	0,75	kW
Stirrer UASB	0,06	kW*
Controllers	0,1	kW
Total energy (elect)	1,3	kW_{elec}

* stirrer of 7.5kW, operating 12 minutes per day.

Struvite precipitation

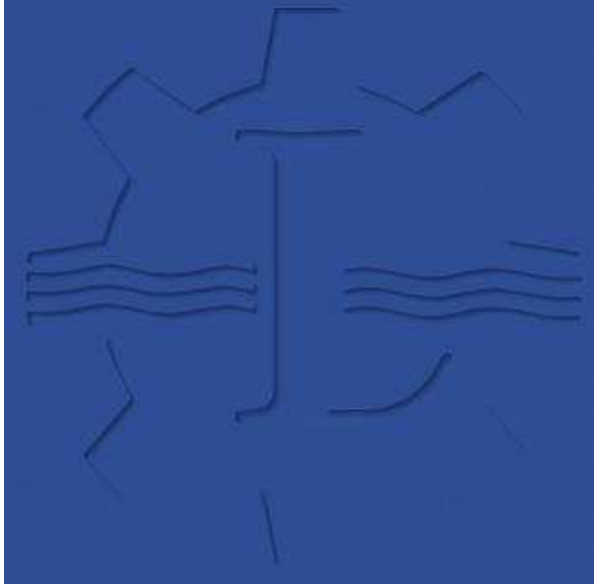
	Mg^{2+} (mg * L^{-1})	PO_4^{3-}P (mg P * L^{-1})	NH_4-N (mg N * L^{-1})
Influent	7,5	112	1100
Added	2290	2579	0
Molar ratio	1.2	1.0	1.0
Effluent	n.d	17,5	75

Removal efficiency by digestion followed by struvite precipitation



Benefits of Decentral Sanitation

- **Energy production**



Benefits of Decentral Sanitation

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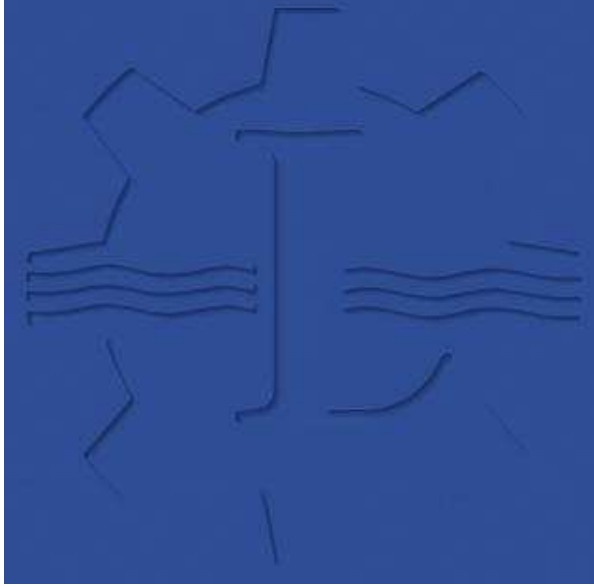
- Energy production

- **If kitchen grinder is used around 20% less solid domestic waste.**



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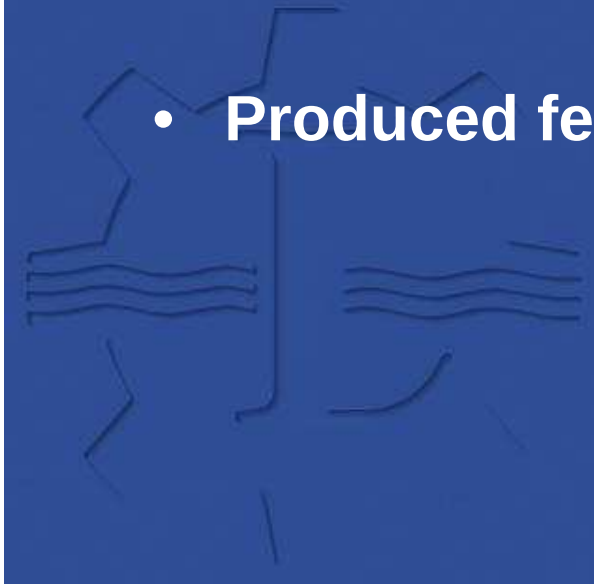
- **Produced fertilizer can have economical value**



Benefits of Decentral Sanitation

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- Energy production
- If kitchen grinder is used around 20% less solid domestic waste.
- Produced fertilizer can have economical value
- **Flexibel**

Other benefits of Decentral Sanitation

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- If it would be necessary in the future to apply more treatment steps in order to remove more or other hazardous compounds, it is cheaper to do this with separate waste streams than with a combined stream.