AR-HES-B – Energy storage, production and recovery of valuable substances in wastewater treatment plants

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Waste water treatment plants (WWTP) Current status

- > **1800 WWTPs in Austria**
- **20% of energy demand** of municipalities for WWTPs
- Energy demand ca. **40 kWh per inhabitant and year**

- Missing link to gas or district heating grids → no motivation for surplus production of **biogas from WWTP**
- Flaring of biogas AND avoidance of produced too much biogas

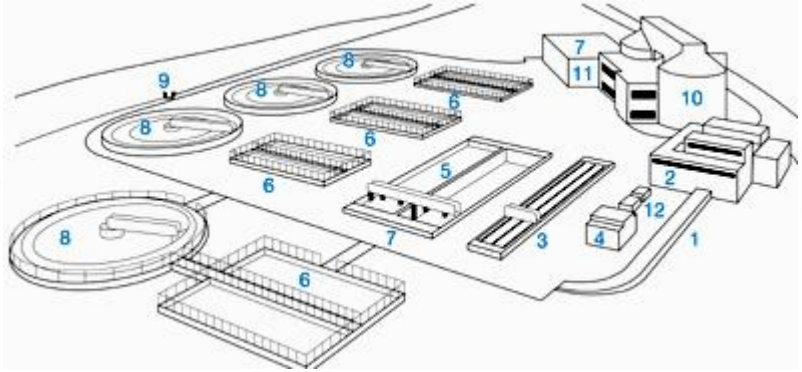
- High **energy demand for removal** of C and NH_3
- High **energy demand for NH_3-production** (e.g. for fertilizer: Haber-Bosch-Synthesis requires 1-2% of world energy demand)

Quelle: pixabay.com

Coventional activated sludge treatment

Sewage

Electricity



Unused C and N

Cleaned water

Quelle: https://www.stadt.sg.ch/home/

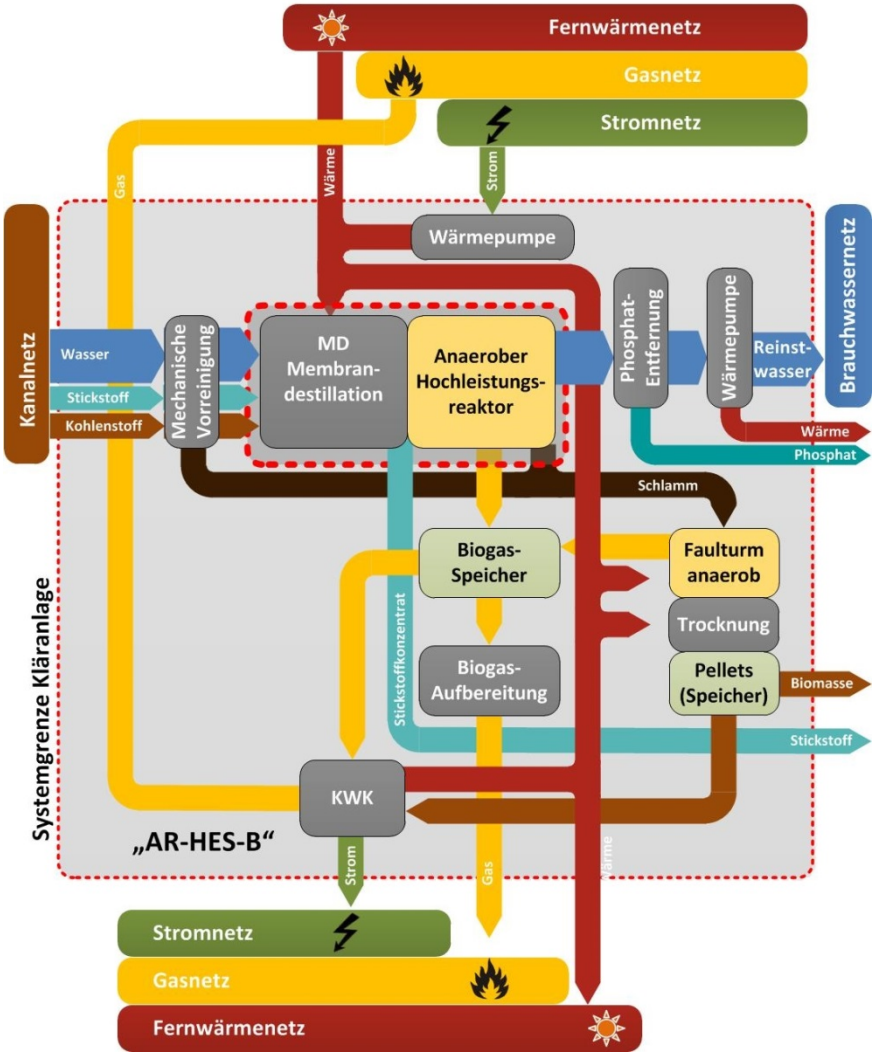
Cross-sectorial approach

Recover energy by exergetic energy use and increasing the **biogas** production

Recovery of **nutrients** and additional energy savings

Interaction with energy **grids** (gas, heat, electricity)

Conversion of energy and **storage** of energy



Sources pictures: AEE INTEC

Factors of influence

Quelle: Siyan Ren

Location WWTP

Waste heat of industries

Waste water from industries

Reconstruction and renovation

Water quality WWTP

COD concentration

Temperatures, pH-values

Legal

Energy efficiency

Amendment of waste water regulations

Energy grids

Distance WWTP to integration

Load management of grids

Guideline and Tool
www.ar-hes-b.aee-intec.at

Input
- Zulaufdaten
- Auswahl der Technologien
- Technologie-Parameter

Berechnung
- Berechnung nach Ansätzen der DWA bzw. IWA
- Bilanzierung der Wertstoffe Kohlenstoff, Stickstoff und Phosphor
- Energetische Bilanzierung

Auswertung
- Fließschemen
- Bilanzen
- Energetische, ökologische und ökonomische Bewertung

Interpretation
- Individuelle Empfehlungen an den Nutzer
- Szenarienvergleich
- Grundlage für Stakeholder-Prozess

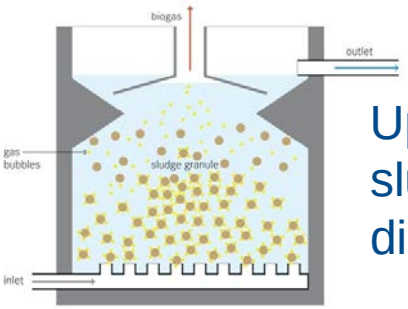
bmvit

C Schlammbehandlung				D Energieumwandlung				E Wertstoffrückgewinnung			
OK				OK				OK			
	00	Technologie			00	Technologie			00	Technologie	
1	01	Statischer Voreindicker (PS)		1	01	Biogasspeicherund Biogas Direktverkauf		1	01	MAP-Fällung Trübwasser	Z
	02	Statischer Voreindicker (ÜS)			02	BHKW	Z		02	MAP-Fällung Schlamm (AirPrex®)	Z
2	03	Maschinelle-ÜS-Eindickung			03	Biogasaufbereitung	Z		03	P-Extraktion Asche	
3	04	Faulbehälter	Z		04	Wasserstoff-Elektrolyse	Z	2	04	N-Membrandestillation Trübwasser	Z
4	05	Statischer Nacheindicker			05	Methanisierung			05	N-Strippung Trübwasser	Z

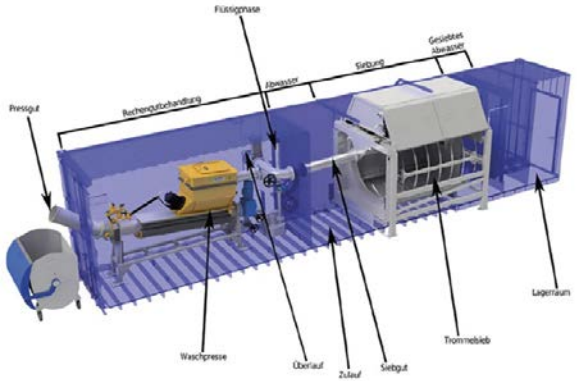
Sources pictures: AEE INTEC

Main results from AR-HES-B calculation

- With new water purification technologies (e.g. ammonium recovery) and primary treatment
  - 10-20% electricity saving,
  - 20-30% more biogas yield
- Recovery of valuable resources (fertilizer) with stripping, membrane distillation or MAP-precipitation
  - Amount of product for medium sized WWTP: 50,5 kg/d $(NH_4)_2SO_4/d$



Upflow anaerobic sludge blanket digestion (UASB)



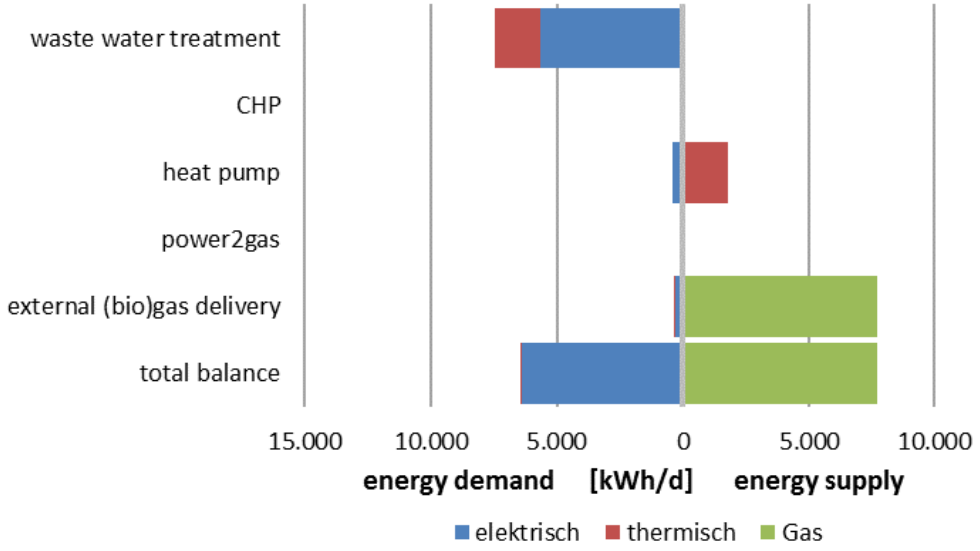
Very fine sieve

Membrane distillation

Sources pictures:
Tilley, E. et.al. (2014)
AEE INTEC
Huber

Main results from AR-HES-B calculation

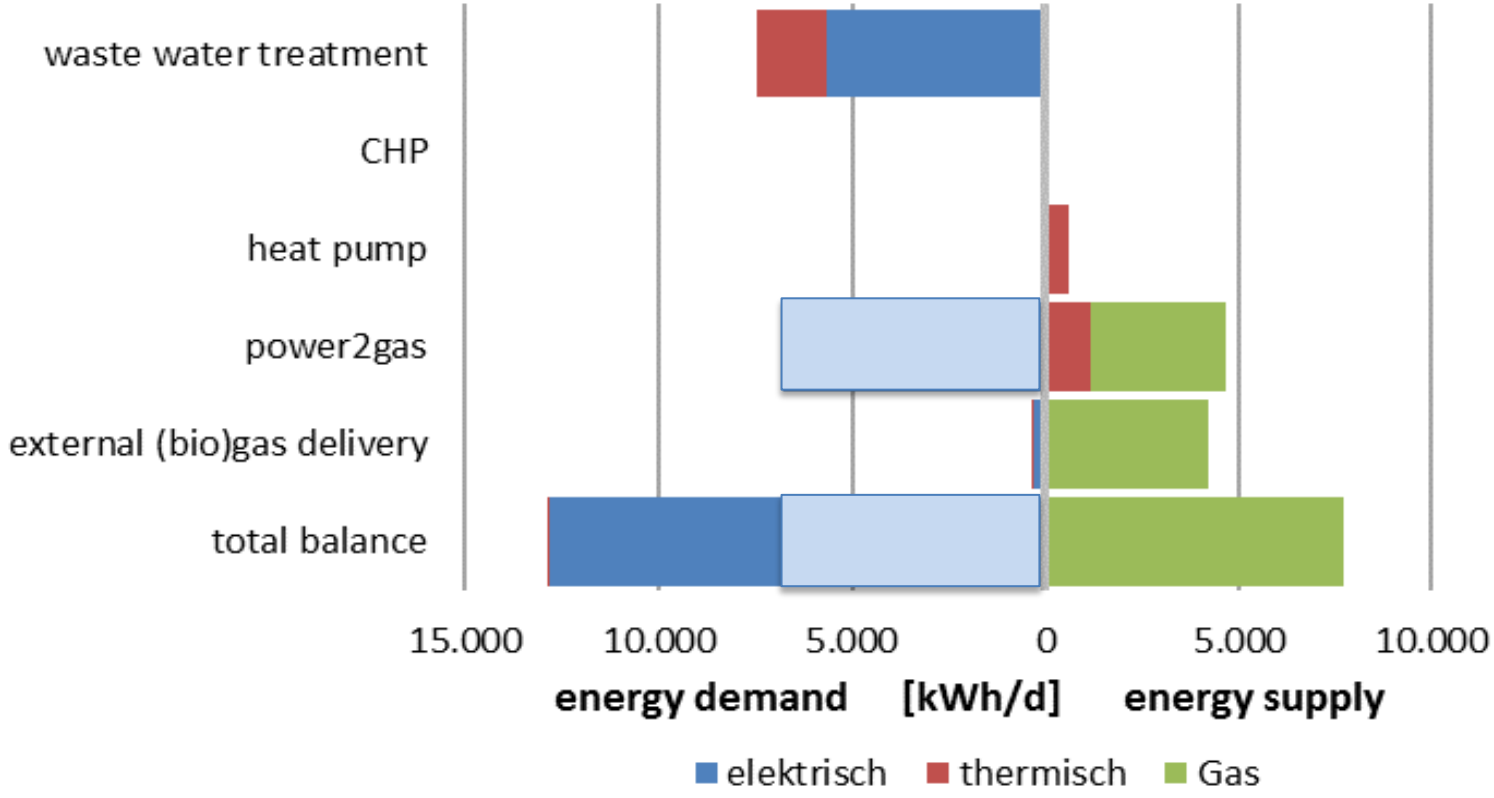
- Maximizing the yield of biogas in combination with CHP and heat integration to district heating system
- Exergetic use of biogas – additional purification of biogas to grid quality
  - COD content of feed *4,800 kg/d*
  - Energy biogas ***1.44 kWh/kgCODfeed → 288 kW***
- Heat pump – utilization of the thermal energy in waste water for own usage



Sources pictures: AEE INTEC

Main results from AR-HES-B calculation

- Power – to – Gas: 45-55% efficiency by conversion of electricity to methane



Sources pictures: AEE INTEC

Best practice realization - WWTP of a small town - planned for 2019

- Expansion of the WWTP with new biogas plant
- Maximizing the biogas yield and biogas piping to nearby district heating gas-boiler
- Usage of biogas for covering the heating demand (appr. 250 kW)
- Integration of a heat pump (waste water as source) for heating the biogas plant
- Energetic Renovation of existing buildings and low heating system

Sources pictures: AEE INTEC

Herzlichen Dank an die Förderungsstellen und Projektkonsortium

Sources pictures: AEE INTEC

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IDEA TO ACTION