WCRE

IRES 2016 Poster Exhibition

10th International Renewable Energy Storage Conference

EUROSOLAR
The European Association for Renewable Energy

Wastewater Treatment Plants as a Municipal Contribution to Provide System Services and Storage Capacities in the Future Energy Market

Background & approach of arrivee

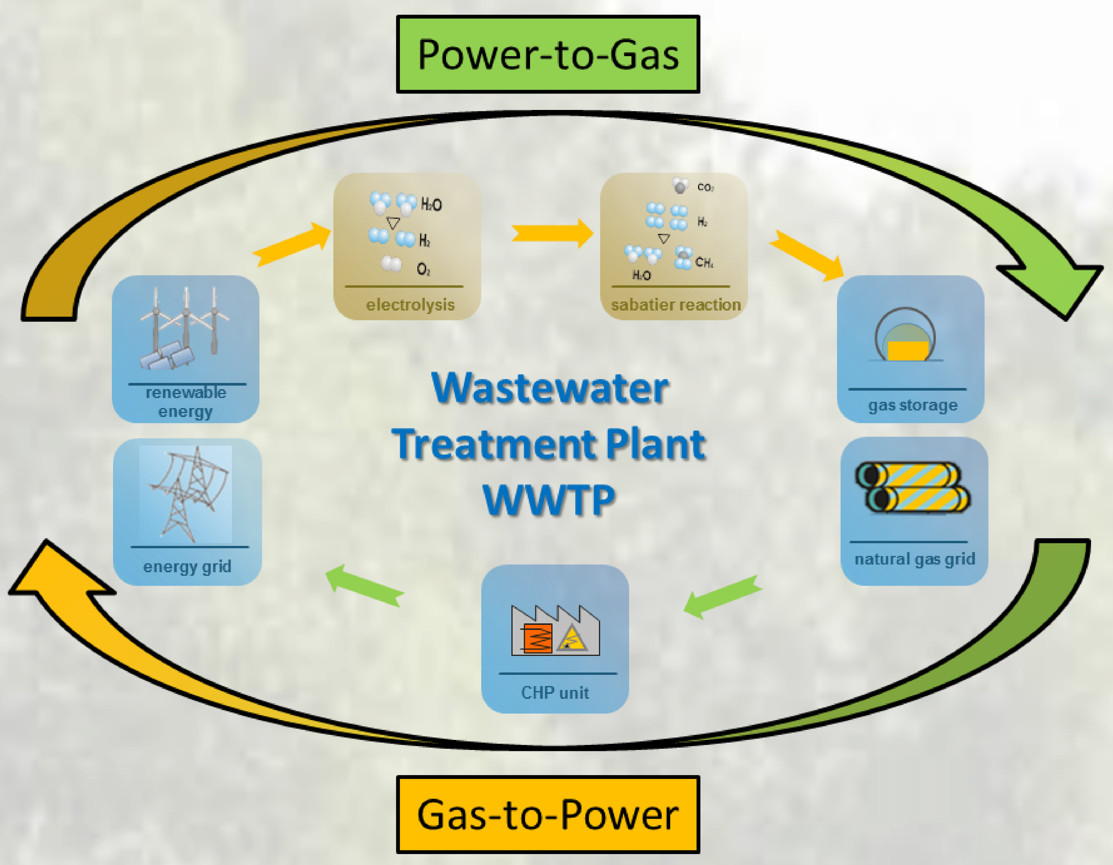


Figure 1: Upgrading of WWTP to Power-to-Gas-to-Power

Background

- Integration of renewable energy sources and storage options in the frame of energy system transition.
- Increasing part of **renewable energy production** (2015: 32,5%) of the German energy mix leads to an increasing need of **flexibility** to compensate severely fluctuating power generation.
- Regional water management is able to provide storage capacities and power generation to take part in the German energy transition.

Approach

- Integration of widely available wastewater treatment plants (WWTP) with anaerobic sludge digestion into an optimized control reserve and storage concept to counterbalance those new challenges and take a more active part in energy grids.

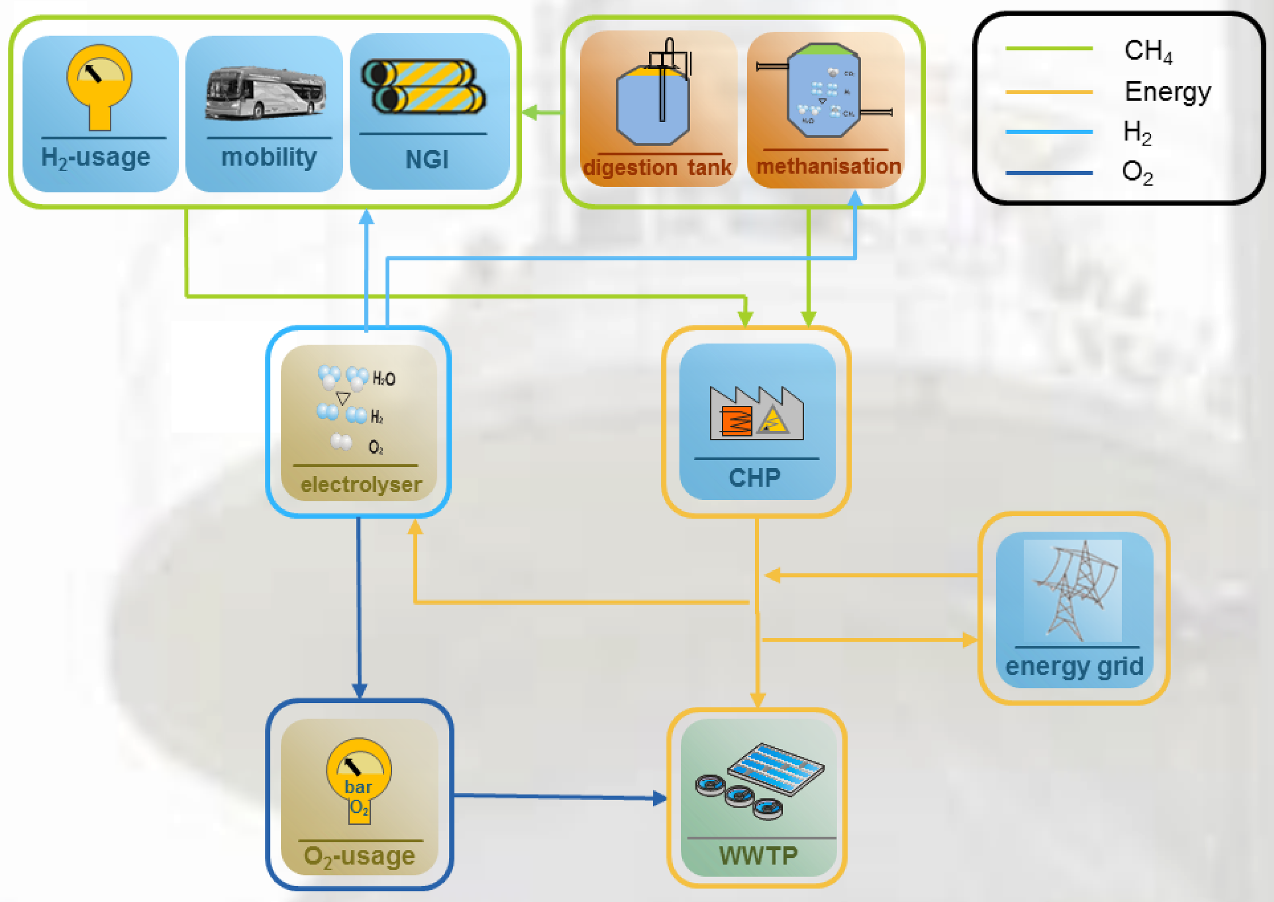


Figure 2: Example plant concept on WWTPs, shown: biological methanisation in an external reactor

Concepts for versatile boundary conditions

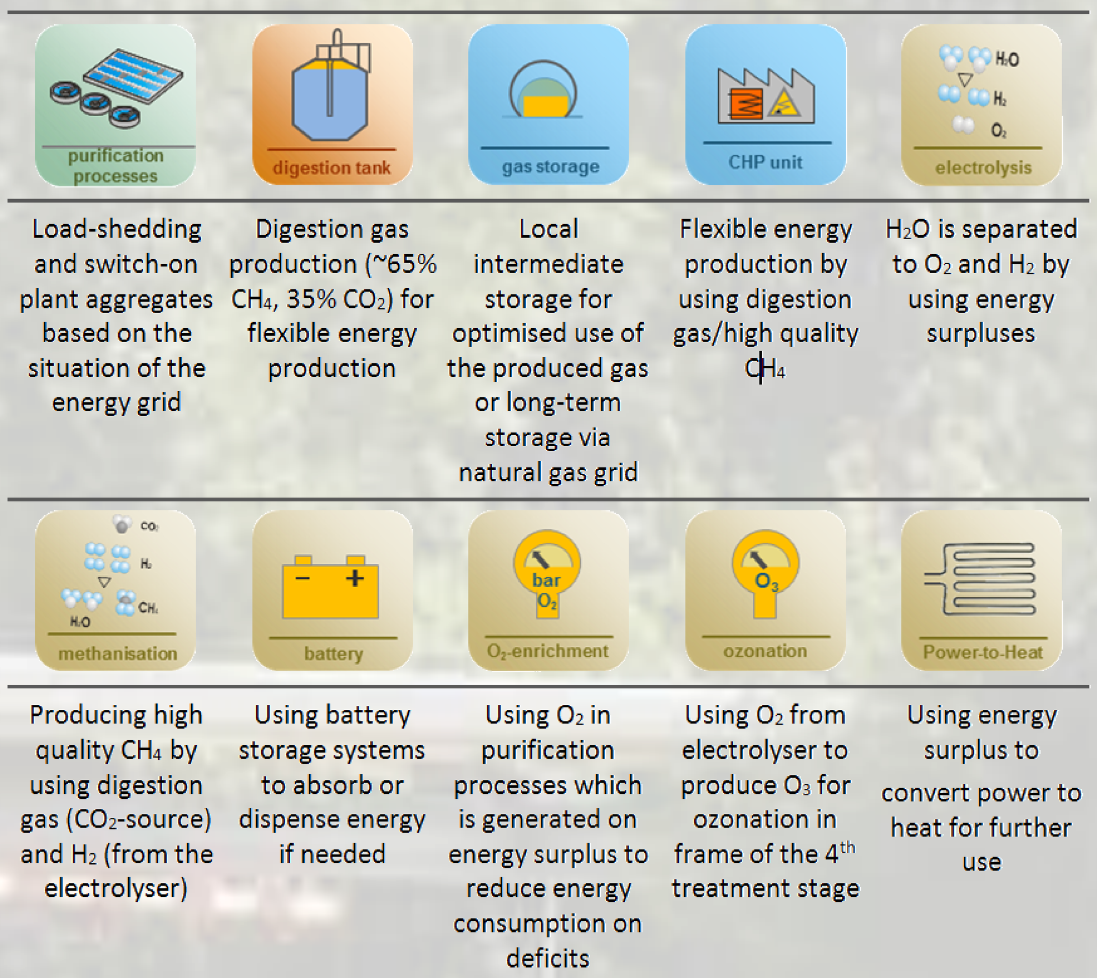


Figure 3: Possible flexibility options on WWTPs with innovative technology

Stepwise plant concept to increase flexibility

Hydrogen stage:

- Usage of H_2 and O_2 from the electrolyser
  - Feed-in of H_2 into the natural gas grid
  - Co-incineration of H_2 in the CHP units (up to 10 vol.% H_2 possible) and conversion to electricity in special H_2-CHP units

Methanisation stage:

- Processing of (high quality) methane by using CO_2 from digester gas and H_2 of electrolysis
  - Via in-situ method inside the digestion tanks
  - In an external reactor by biological processes

Providing flexibility by:

- optimised CHP usage
- adapted aggregate management
- Compressed air / PSA → Ozonation
- electrolyser

Table 1: Suitable plant concepts for WWTPs to provide system services

Concept	Electrolysis	Methanisation	Gas quality (%-CH_4)	Flexibility potential
I. Status Quo	no	no	Digester gas (65%)	low
II. compressed air vs. PSA*	no	no	Digester gas (65%)	low
III. H_2-usage	yes	no	digester gas (65%) + H_2	medium
IV. H_2-feed-in	yes	no	Digester gas (65%)	medium
V. Methanisation - in situ	yes	yes	Methane (70%+)	high
VI. Methanisation - ext. react.	yes	yes	Methane (95%+)	high
VII. Methanisation - Sab. react.	yes	yes	Methane (98%+)	high

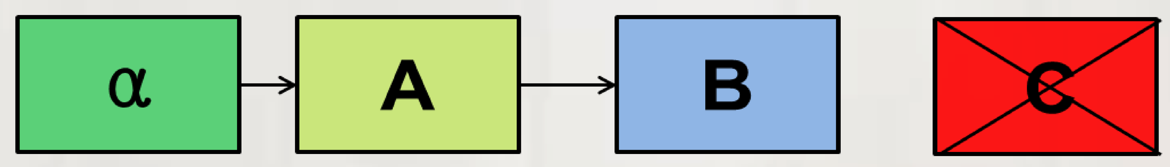
* pressure swing adsorption

Control concept to provide flexibility

Control concept

- a control concept is generated for load-shedding and switch on on-site energy consumers to provide ancillary services.
- common and new plant components are categorised and analysed by their suitability to offer maximum flexibility for the grid by using a developed algorithm (Figure 4).

- Calculation of the range of flexibility for depending on conditions an WWTP (Figure 5)
- Optimized flexibility potential by use of available resources and infrastructure
- WWTP as flexibility service provider



Classification	Power	Usability	Example
Class α	large	at any time	CHP-unit, elektrolyzer
Class A	medium - large	trouble-free	sludge treatment (centrifuge)
Class B	low - medium	limited	blower
Class D	not usable		

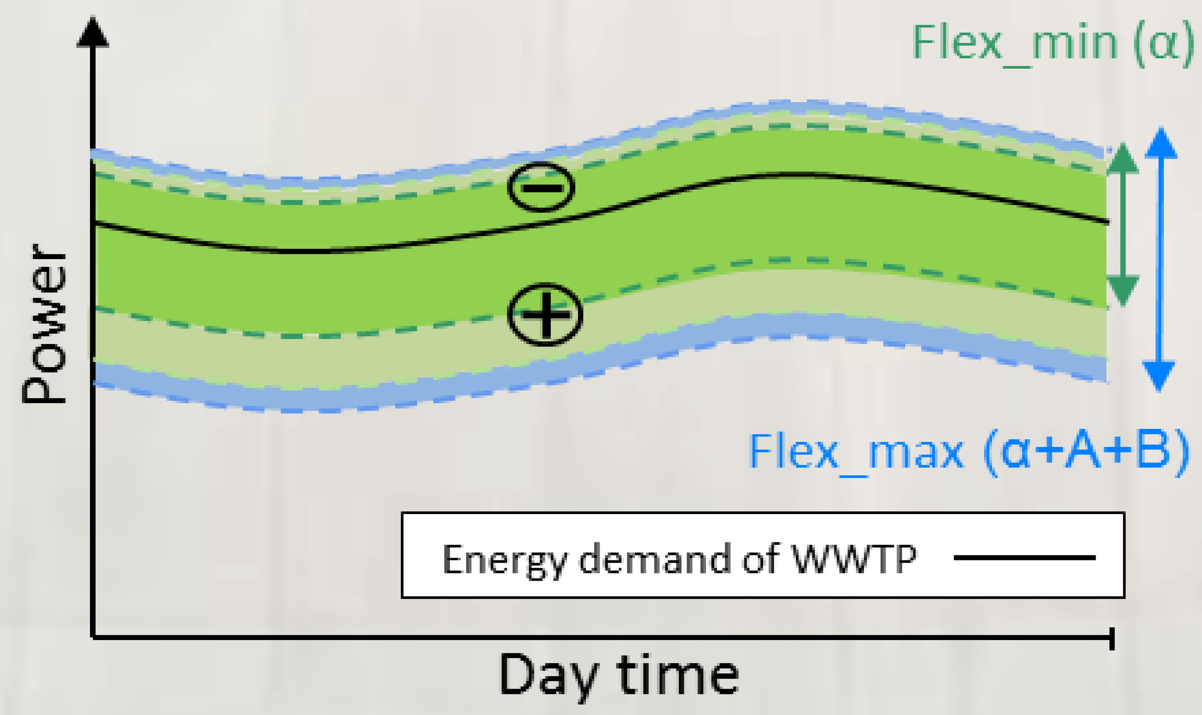


Figure 4: Control concept to provide flexibility on WWTPs by using a developed algorithm and schematic range of flexibility of WWTP

Next steps

- Side effects of those external interventions on purification processes and the effects on the local distribution grid are simulated and tested by using a mathematical model of the selected pilot WWTP and the distribution grid.
- The impacts on the transmission grid by participating in a virtual power plant are analysed and tested as well.

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Abwasserreinigungsanlagen als Regelbaustein in intelligenten Verteilnetzen mit erneuerbarer Energieerzeugung

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Sponsored by the Federal Ministry of Education and Research

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