World water works

Zero Energy / Energy Positive Municipal Wastewater Treatment Plant

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Presented at: Environment & Energy Conclave, Kolkata

Date: 31st August, 2012

Agenda

- Section I: INTRODUCTION
- Section II: CURRENT WWTP PRACTICES
- Section III: SIDESTREAM TREATMENT – DEMON TECHNOLOGY
- Section IV: DEVELOPMENT OF FUTURE WWTP
- Section V: CONCLUSIONS

Introduction

- Treatment of municipal wastewater has mainly been an energy demand vs. energy production. (Aerobic Treatment)
- Treatment of certain industrial wastewater allows for energy production vs. energy demand. (Anaerobic Treatment)
- WWTP can consume up to 30% of cities energy for providing drinking water and treating wastewater.
- More and more stringent regulations requires more and more energy to treat wastewater. Nitrification / Denitrification (electrical & carbon requirements)
- Energy opportunity from 3,800 m^3/day is 30 kW of electricity.

Energy in WWTP

- **BOD Removal:** Organics →CO2

  Medium Energy Demand: 1.0 kg Oxygen / kg $BOD_{removed}$

- **Nitrogen Removal:**

  a. Nitrification: Ammonia-N → NO3

  High Energy Demand: 4.57 kg Oxygen / kg $Ammonia_{removed}$

  b. Denitrification – NO3 → N2

- **Introduction of DEMON for Nitrogen Removal:** **60% Less Energy**
- **Anaerobic Sludge Digestion:** **Energy Produced**

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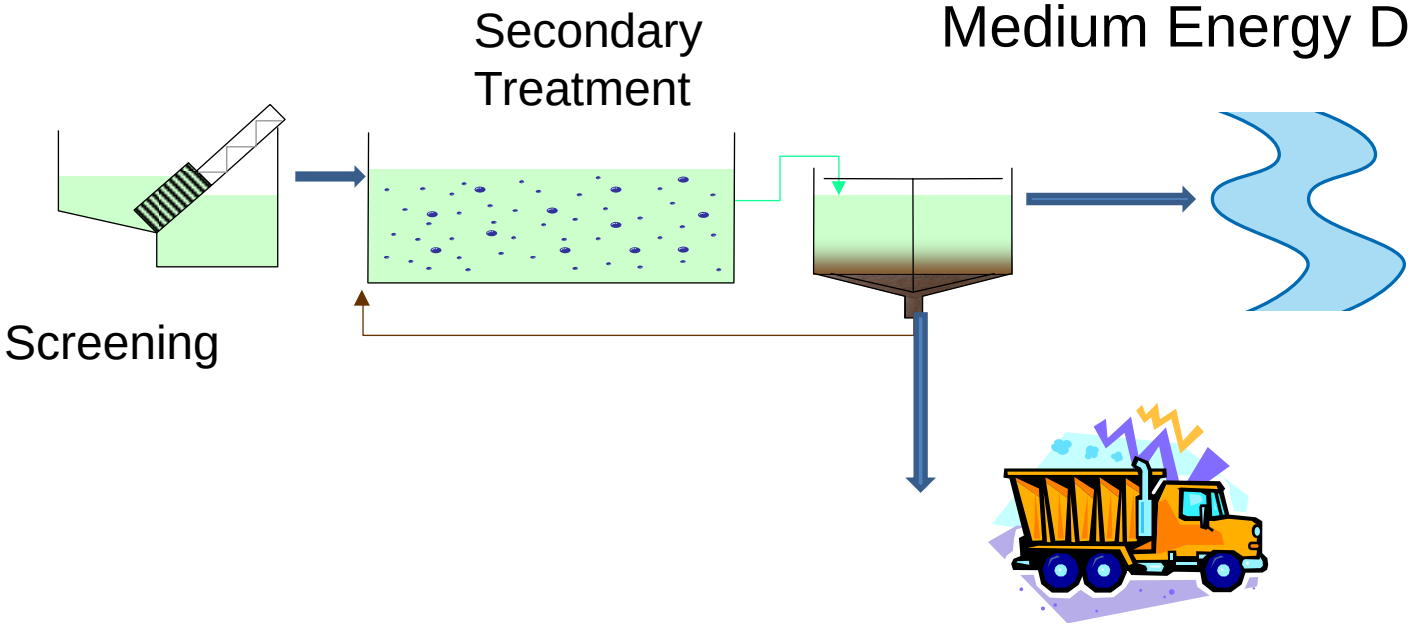
Section IV: CONCLUSIONS

Typical WWTP Layout – Secondary Treatment – 1.0

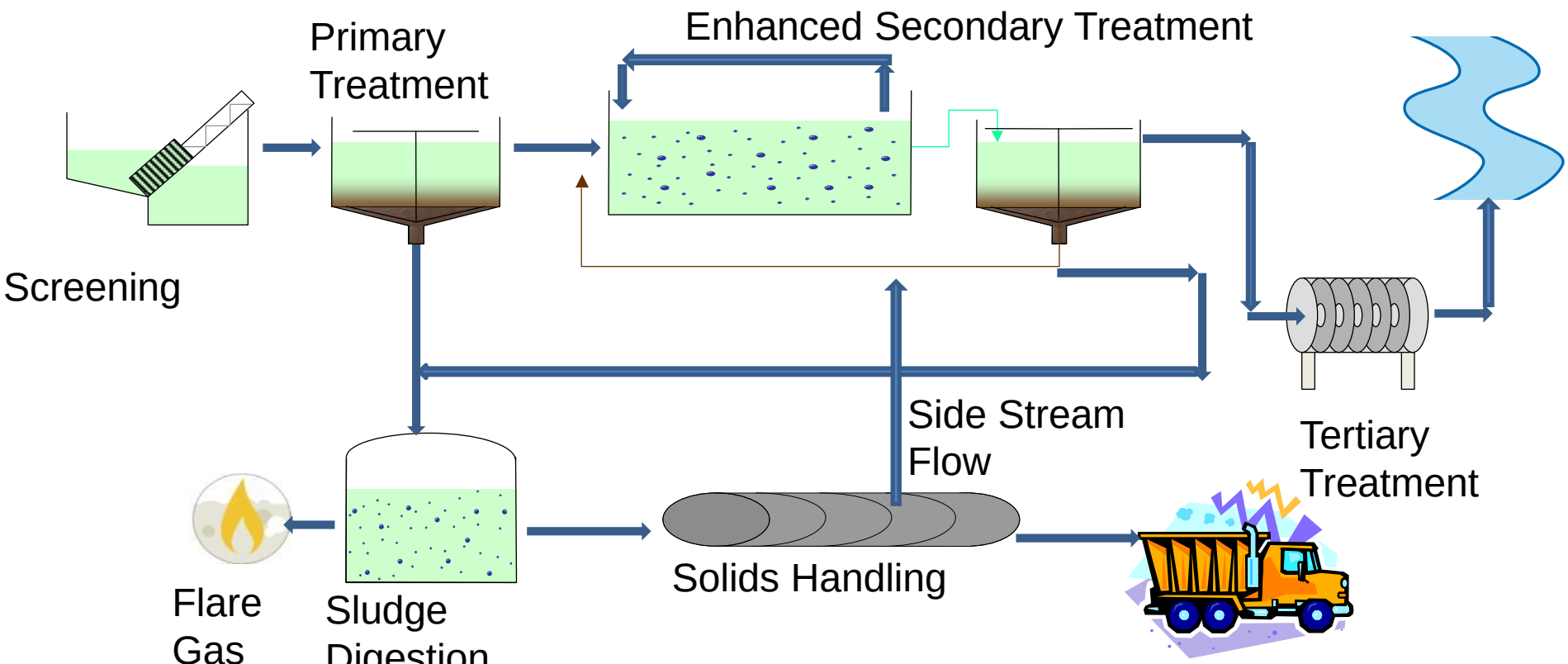
95% BOD Removal

95% TSS Removal

Medium Energy Demand



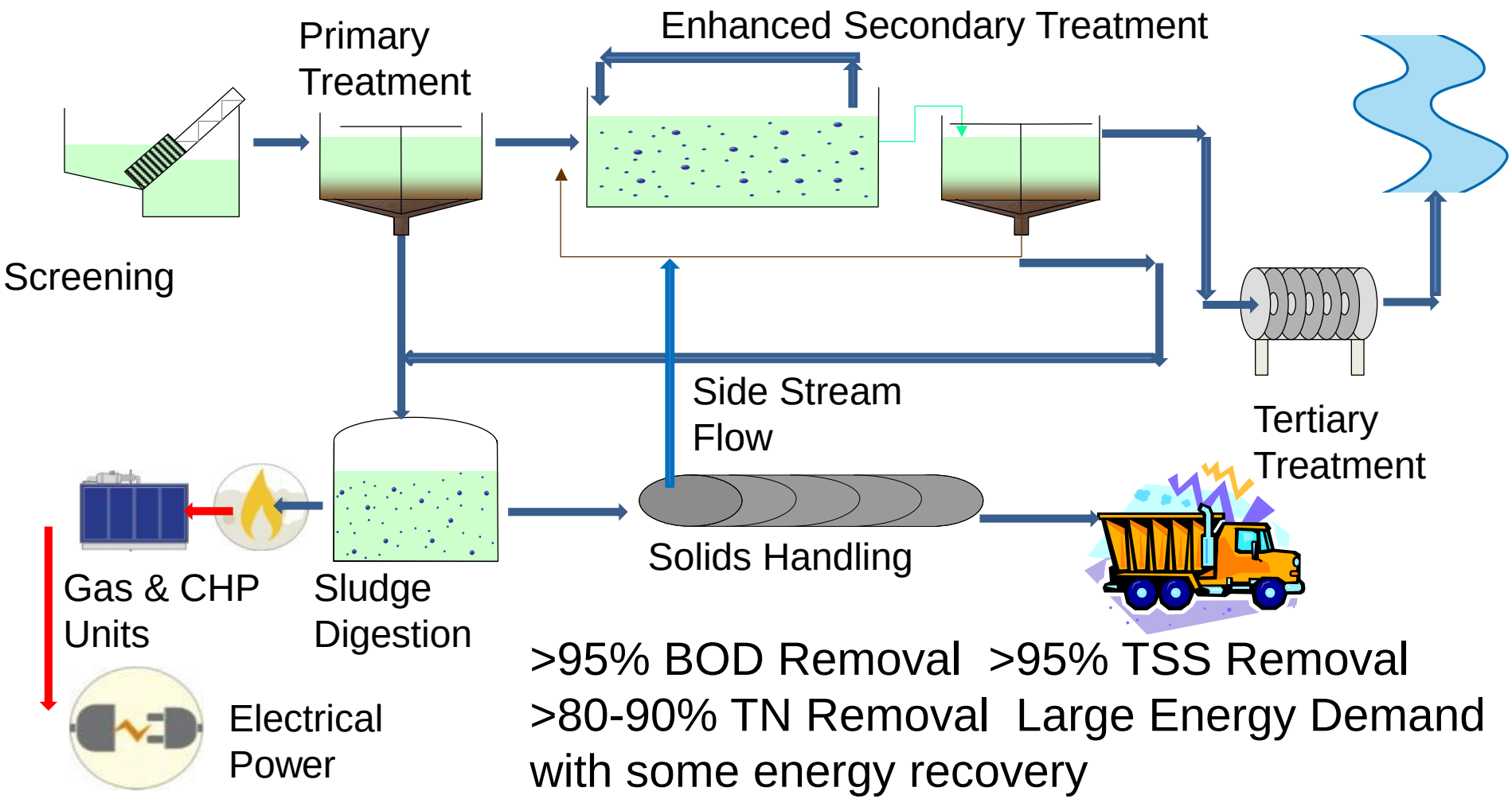
Typical WWTP Layout – Enhanced Treatment – 2.0



>95% BOD Removal >95% TSS Removal

>80-90% TN Removal Large Energy Demand

Typical WWTP Layout – Enhanced Treatment – 3.0



>95% BOD Removal >95% TSS Removal
>80-90% TN Removal Large Energy Demand with some energy recovery

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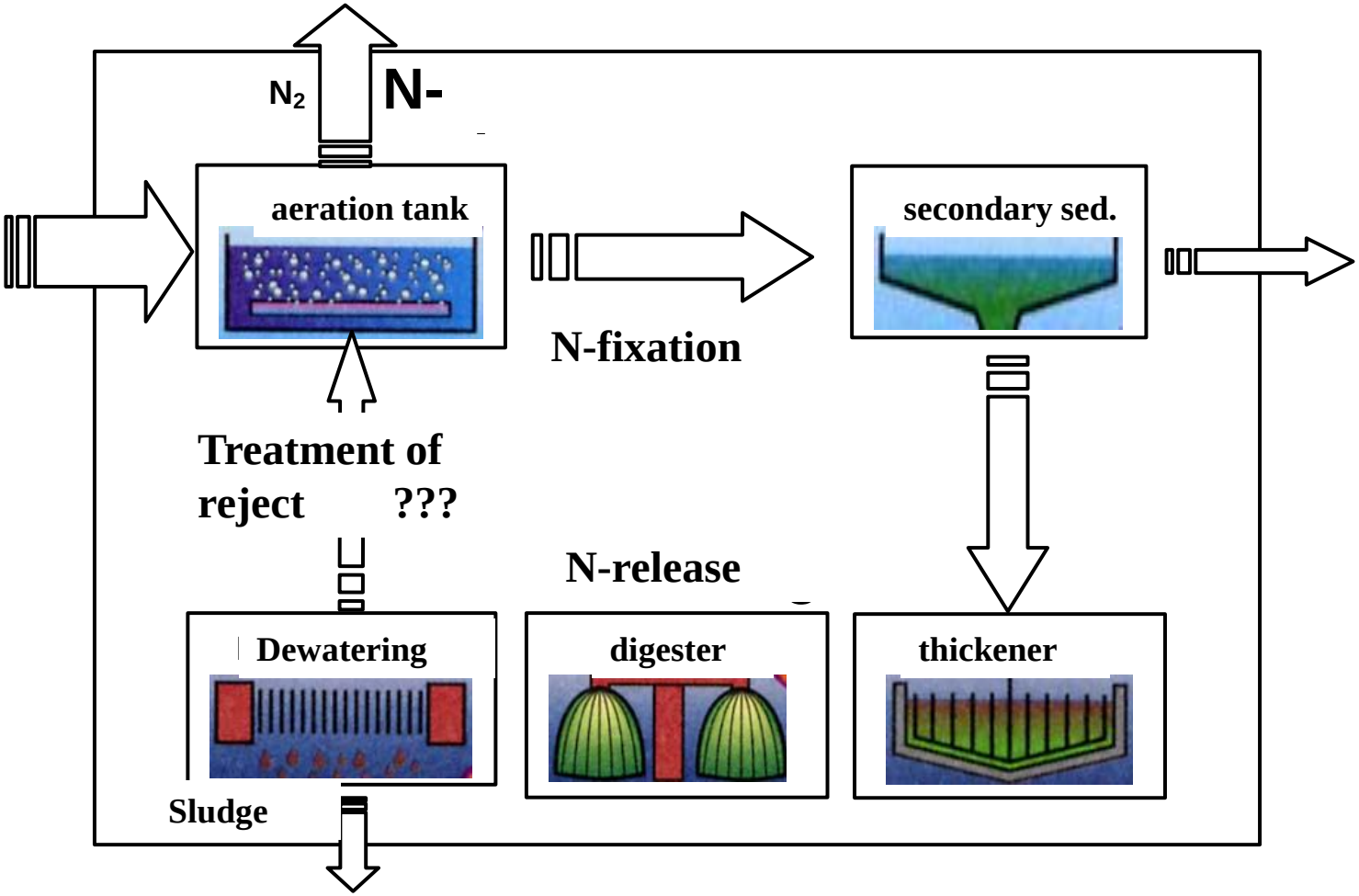
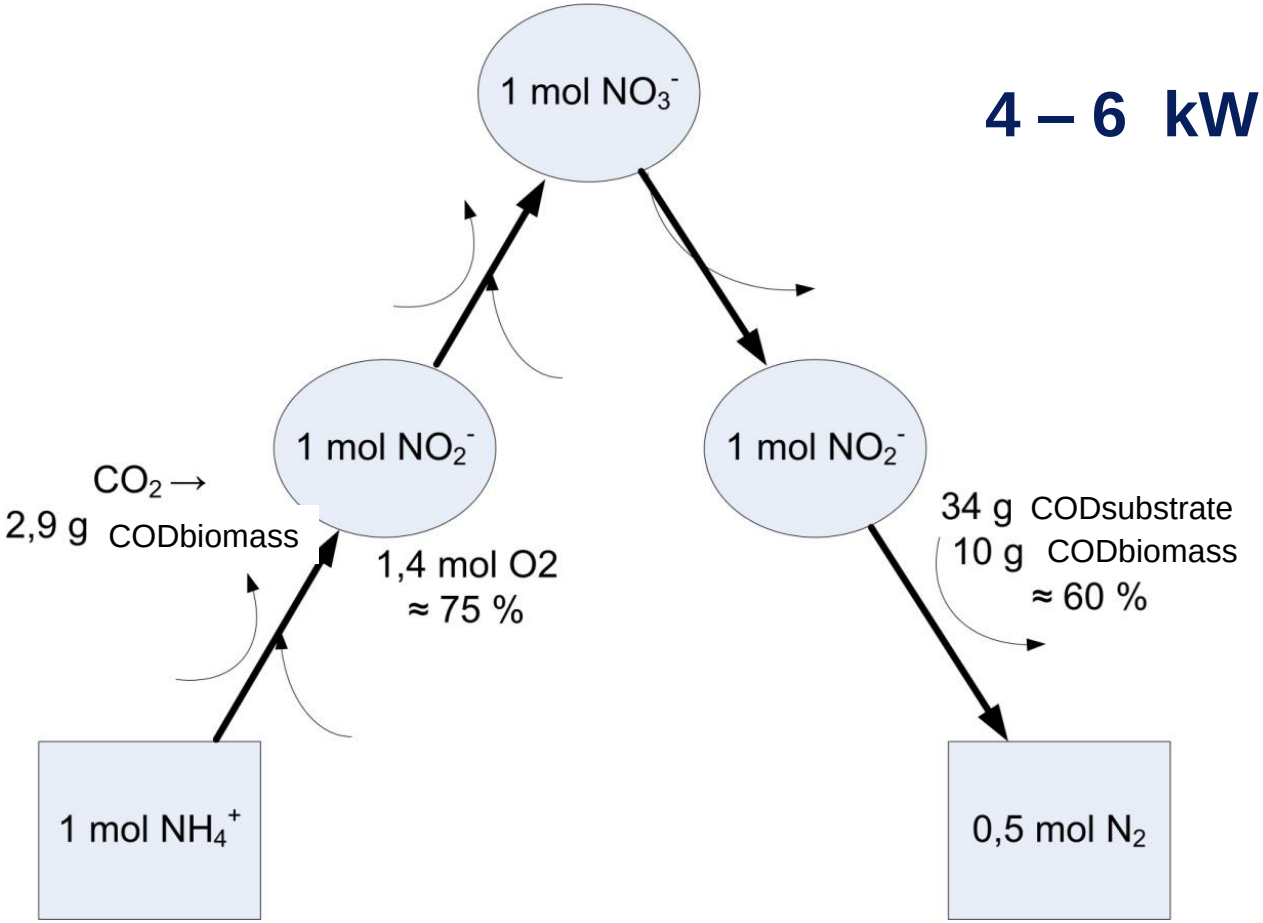
Sidestream Treatment



Side Stream's within WWTP

- Anaerobic sludge digestion is good as it reduces volume of sludge to be discharged from facility.
  - Ammonia load from side streams can make up 15 – 30% of nitrogen load to WWTP. Recycling of N through plant
  - Reduction in C/N ratio to minimize denitrification potential – thus requiring external carbon for meeting low effluent Nitrogen limits

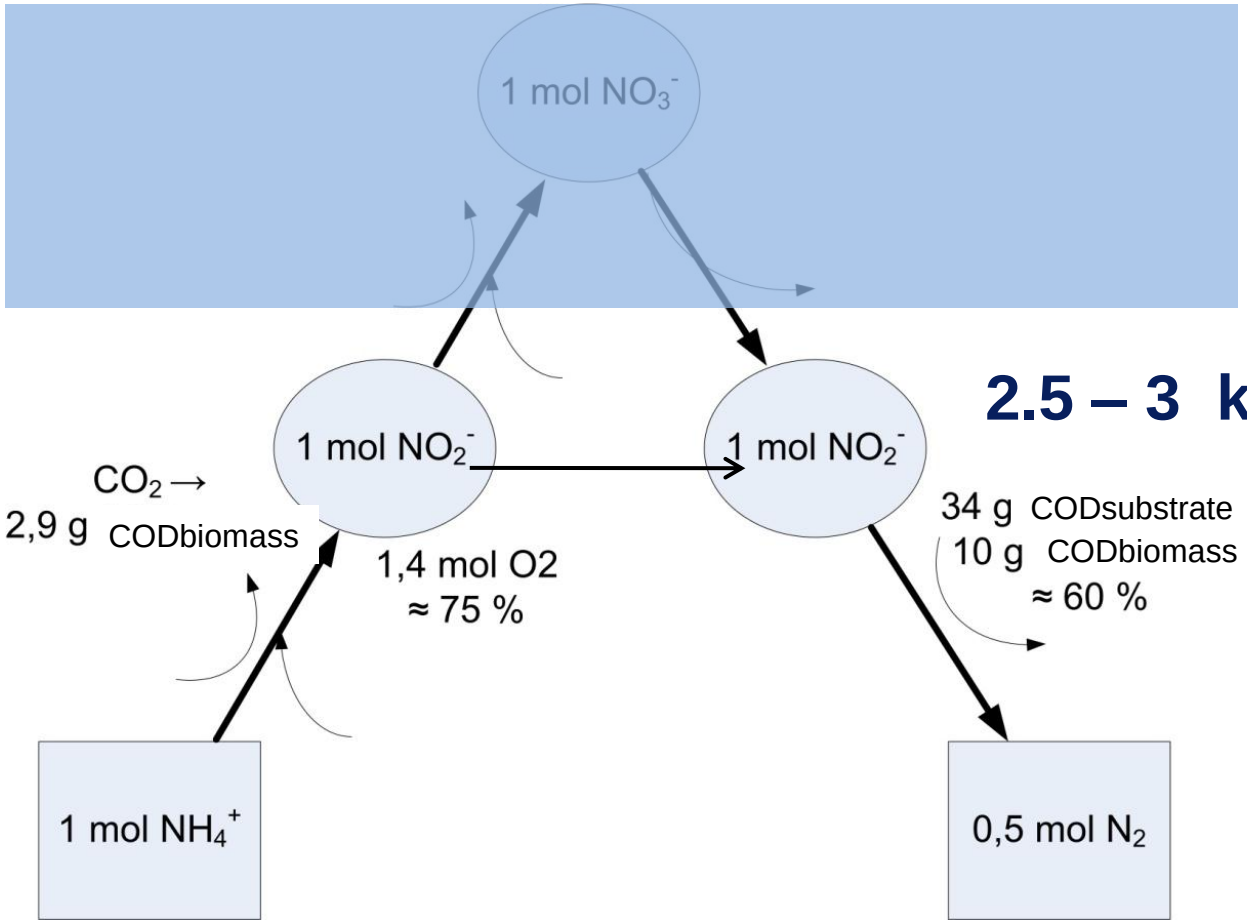
Standard Nitrification / Denitrification



4 – 6 kW hr-kg N

$$NH_3 + 1.8915\ O_2 + 1.06\ CH_3OH \longrightarrow 0.078\ C_5H_7O_2N + 0.461\ N_2 + 3.347\ H_2O + 0.67\ CO_2$$

Nitritation – Denitritation

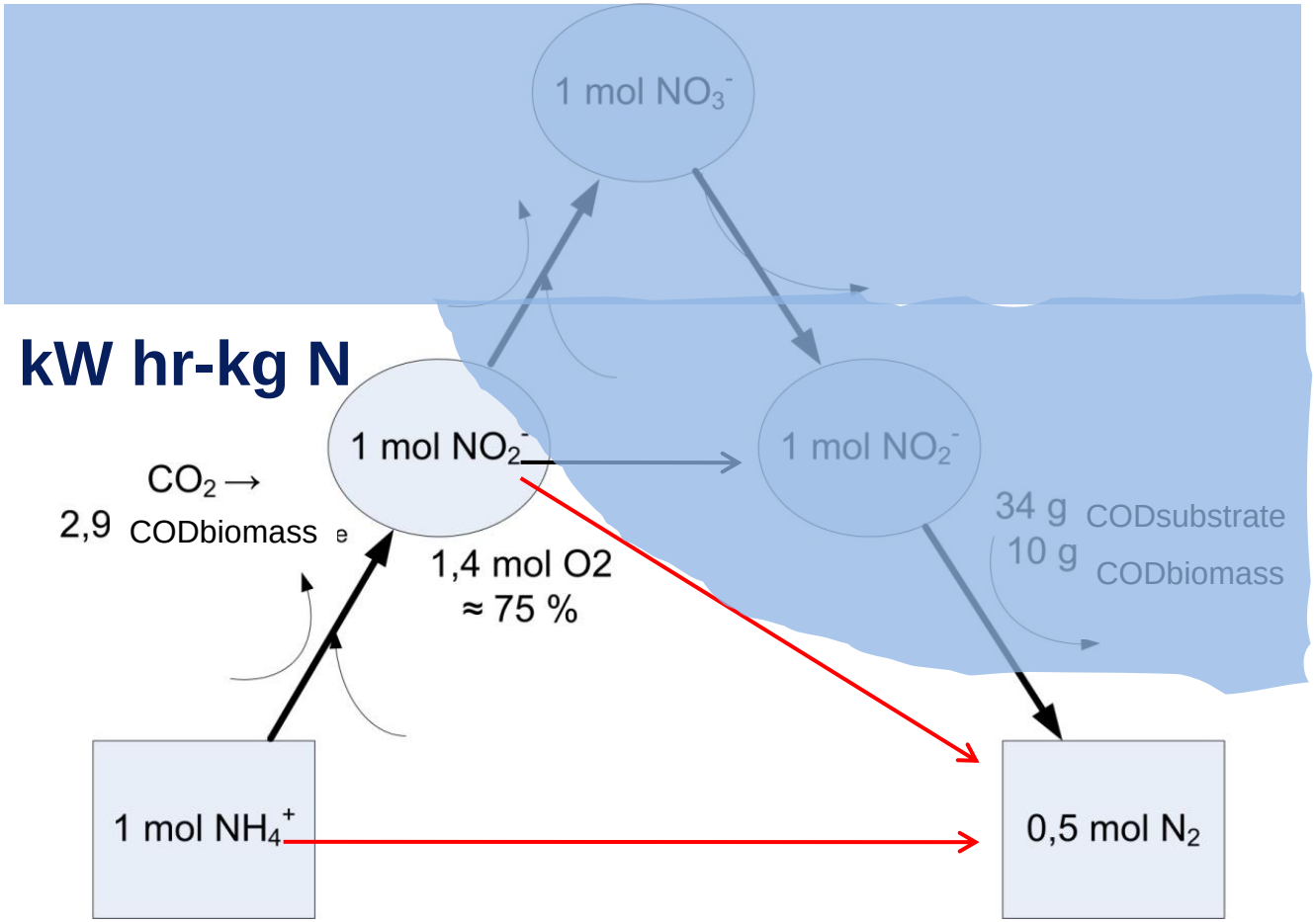


2.5 – 3 kW hr-kg N

$$NH_3 + 1.441\ O_2 + 0.66\ CH_3OH \longrightarrow 0.052\ C_5H_7O_2N + 0.474\ N_2 + 2.638\ H_2O + 0.4\ CO_2$$

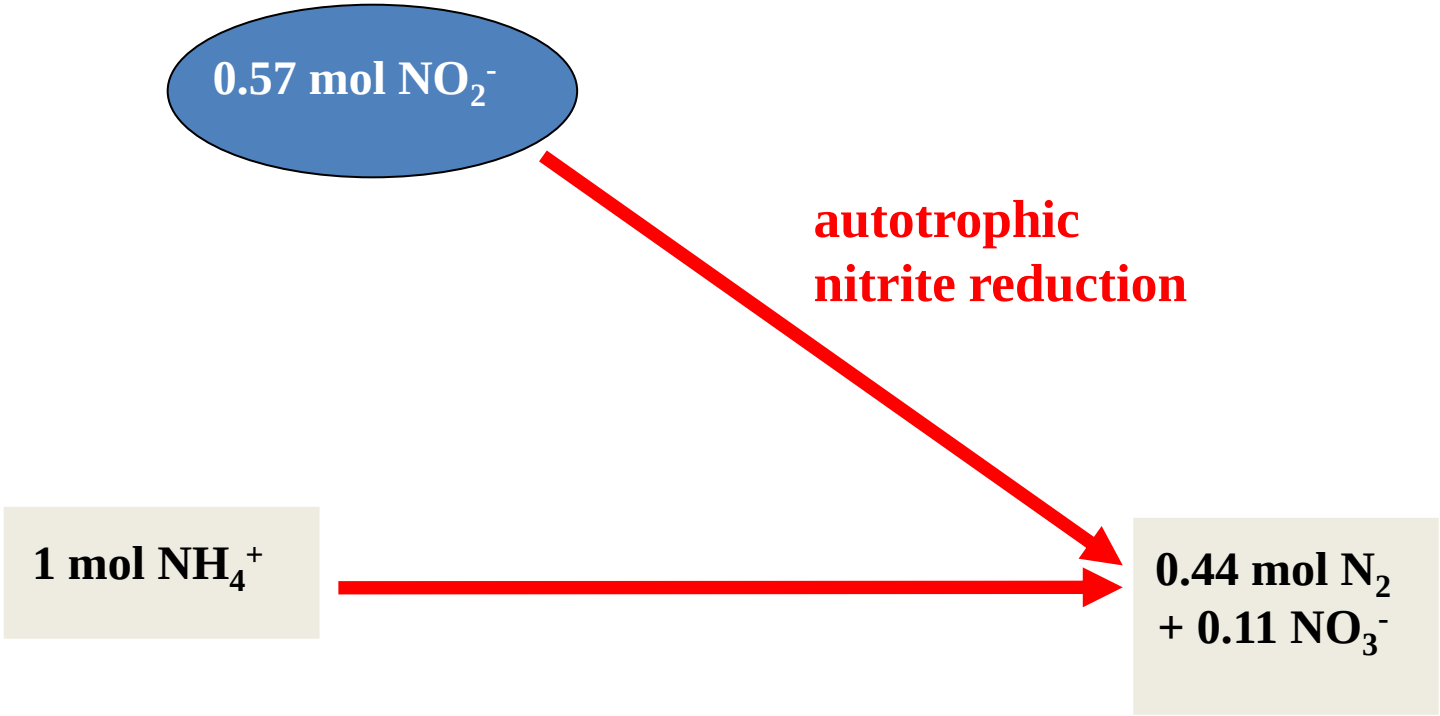
Nitratation – Nitritation-Deammonification – Anammox Process

1 – 1.75 kW hr-kg N



$$NH_3 + 0.806O_2 + 0.066\ CO_2 \rightarrow 0.0132\ C_5H_7O_2N + 0.44\ N_2 + 0.106\ HNO_3 + 2.638\ H_2O$$

DEamMONification



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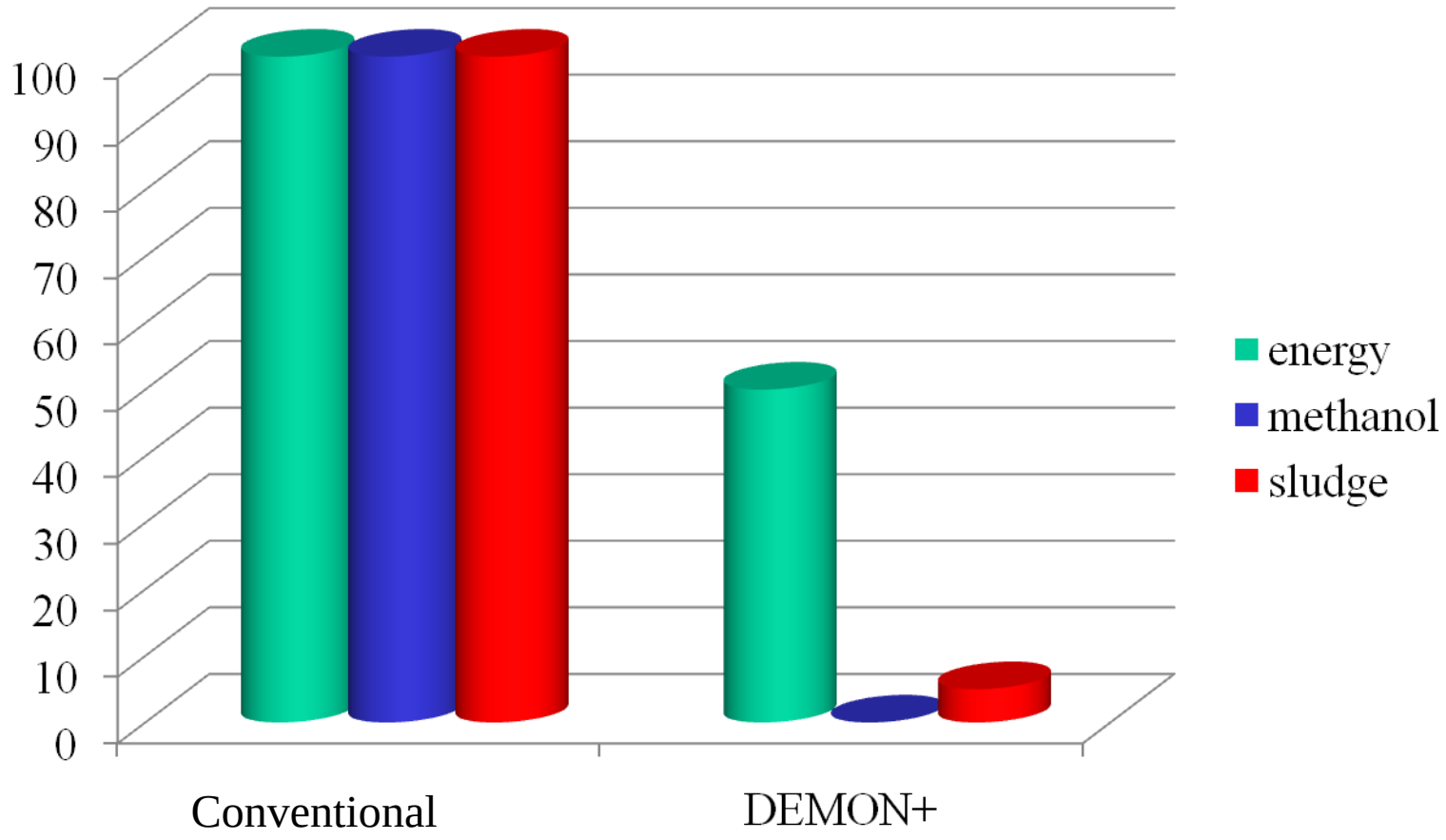
Comparison of Consumables



The DEMON®-Process

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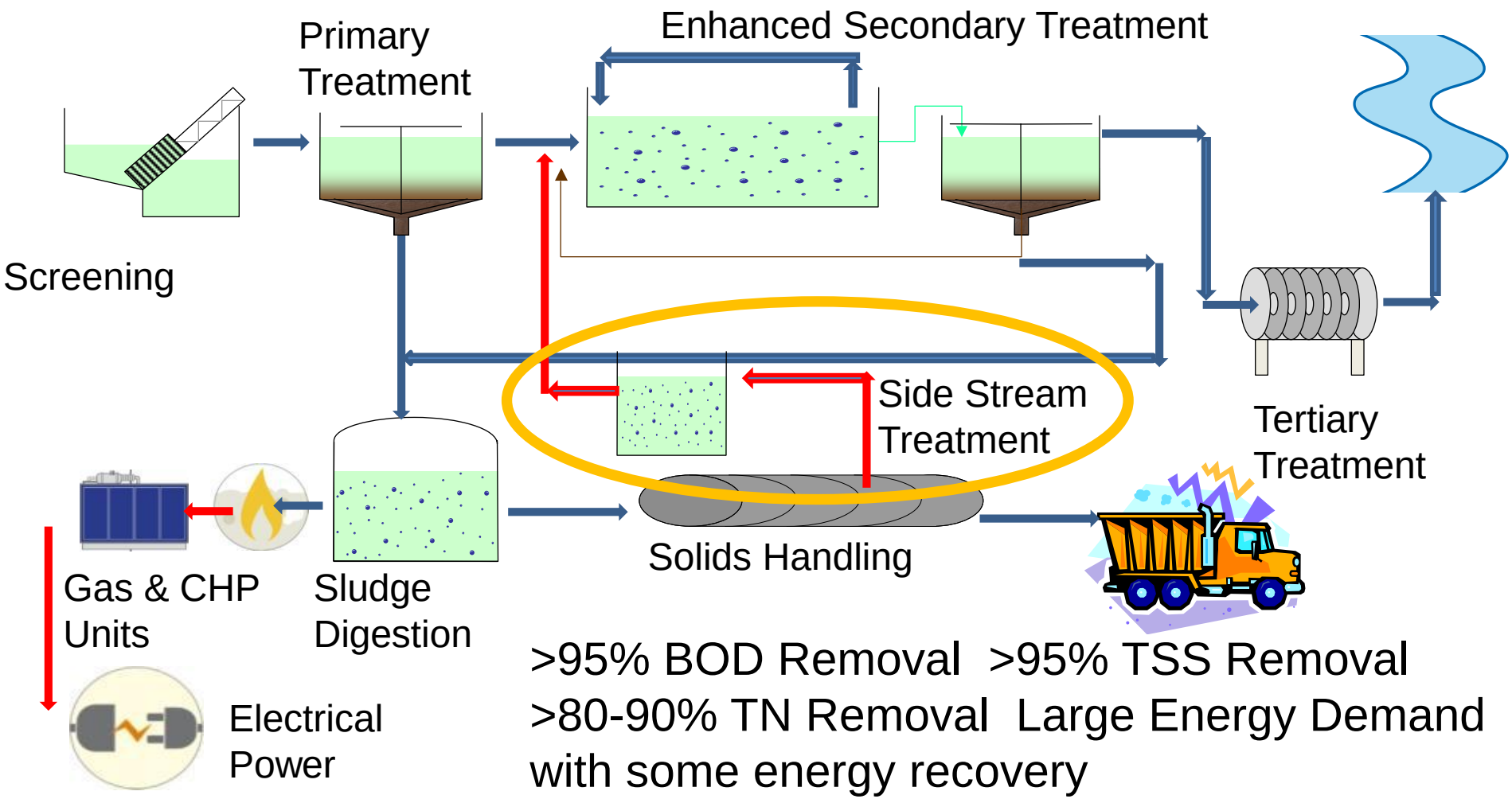
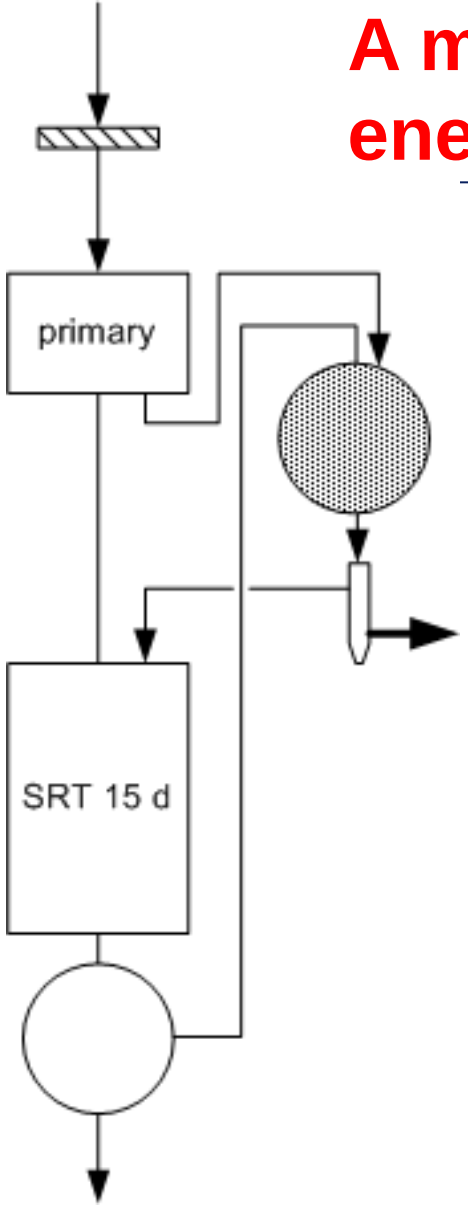
Typical WWTP Layout – Enhanced Treatment – 3.1

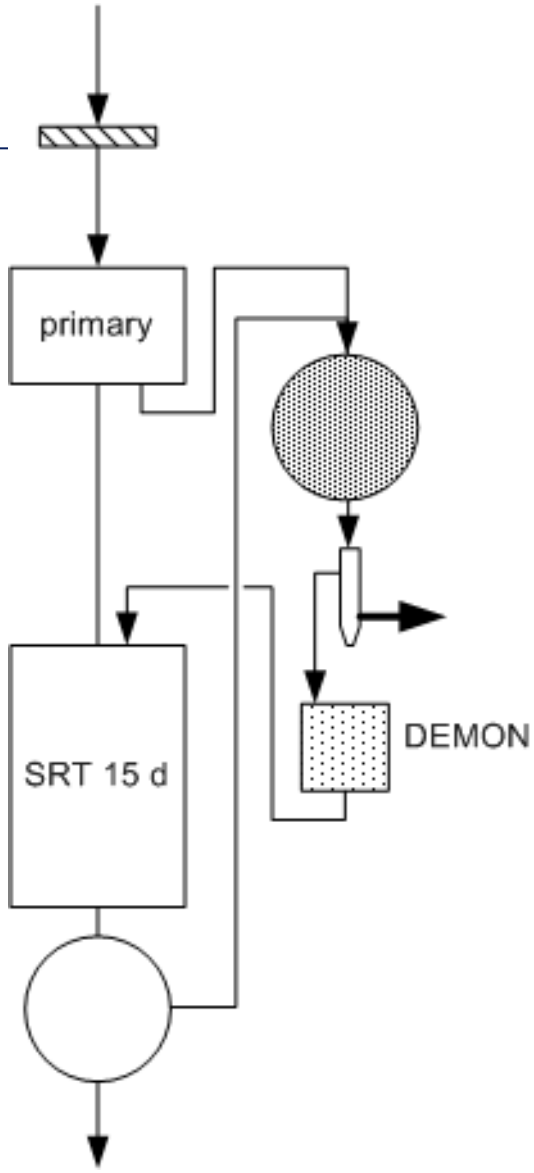


>95% BOD Removal >95% TSS Removal
>80-90% TN Removal Large Energy Demand with some energy recovery

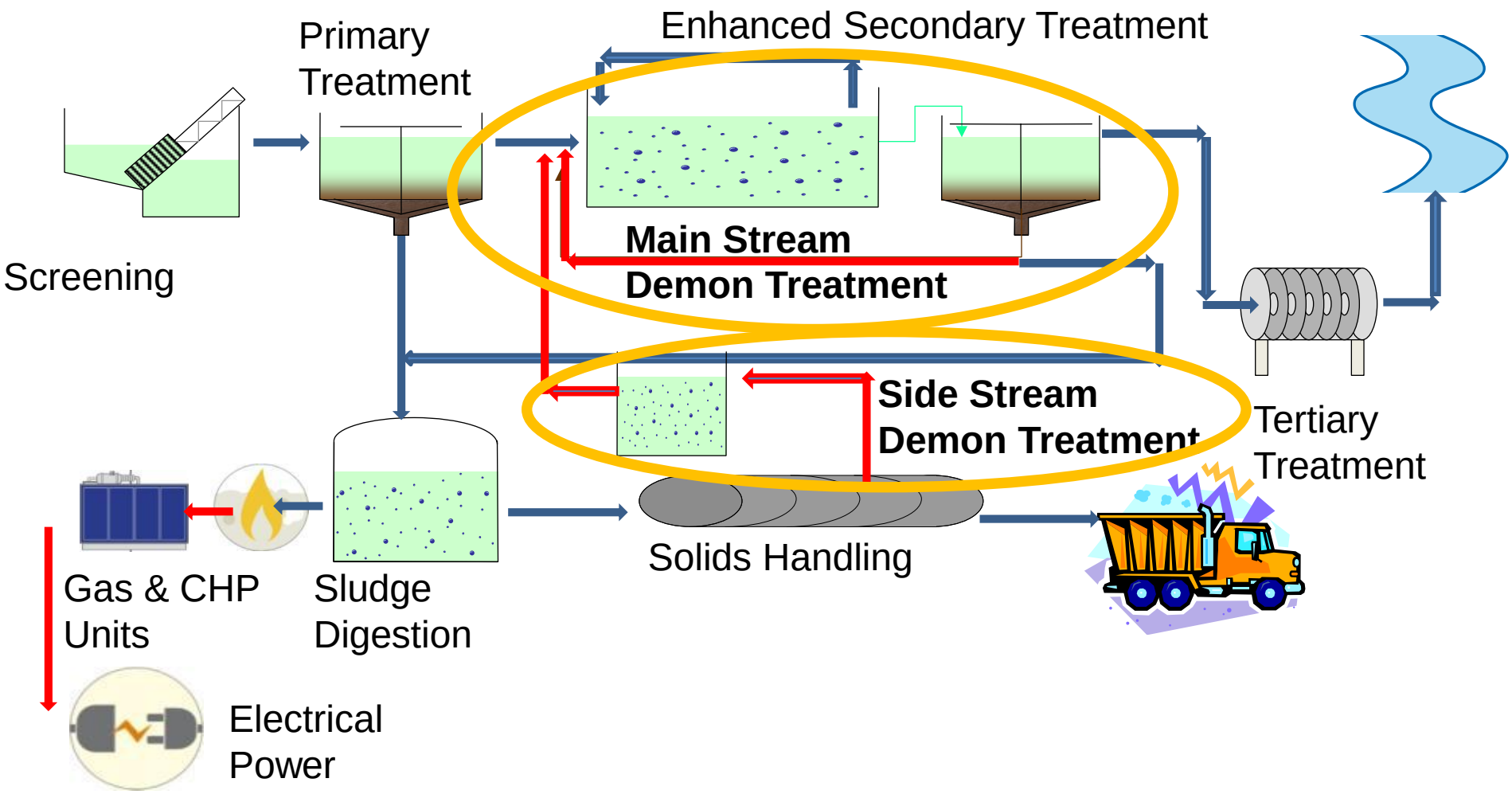
A major step towards an energy self-sufficient WWTP



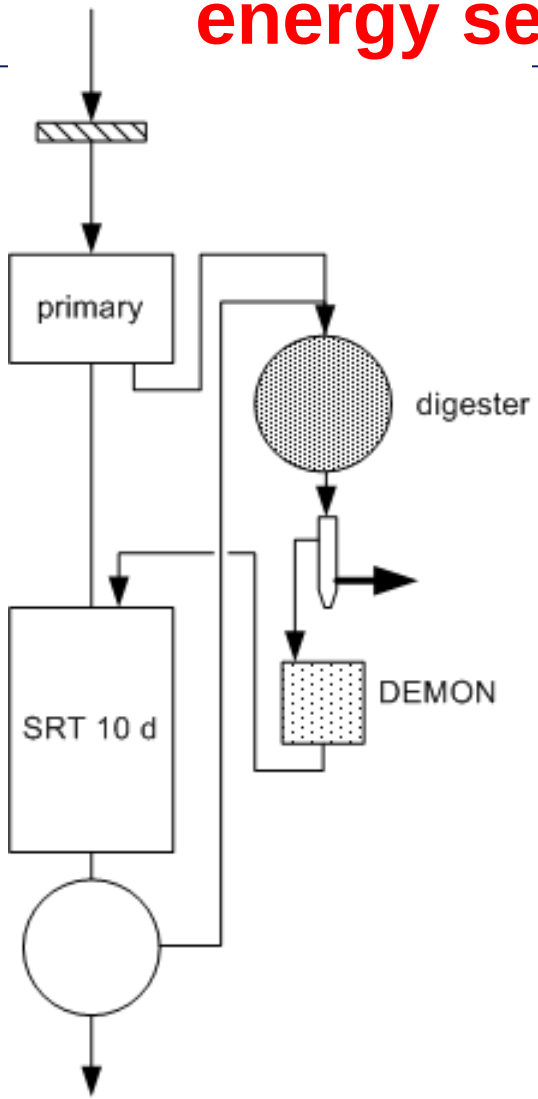
Conventional N-removal	DEMON® in side stream
Aeration +39,3 Wh /pe d	Aeration +37,2 Wh /pe d
Total +56,5 Wh /pe d	Total +54,1 Wh /pe d
Gas el. -42,0 Wh /pe d	Gas el. -42,0 Wh /pe d
Balance +14,5 Wh /pe d	Balance +12,2 Wh /pe d



Typical WWTP Layout – Enhanced Treatment – 3.2

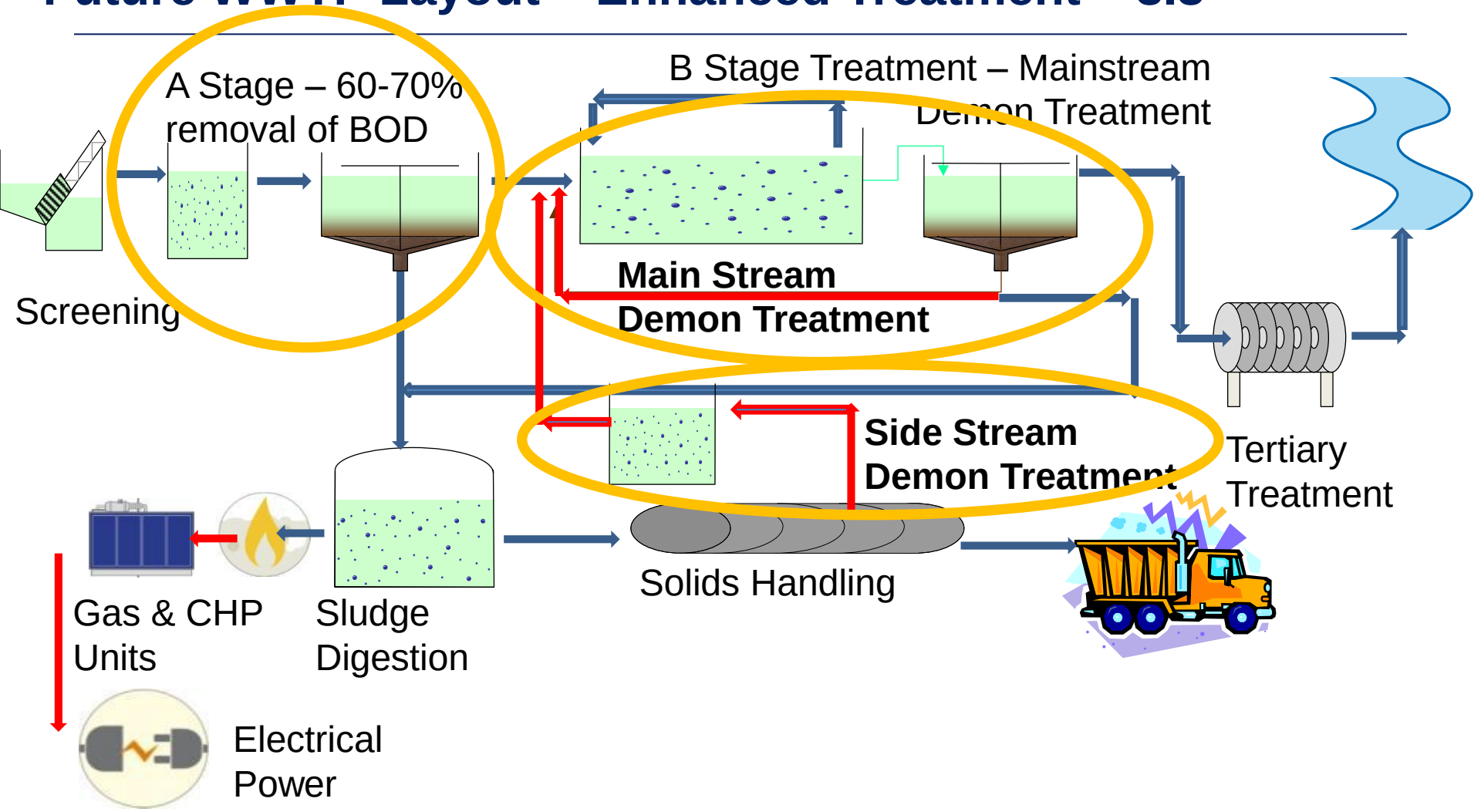


A major step towards an energy self-sufficient WWTP

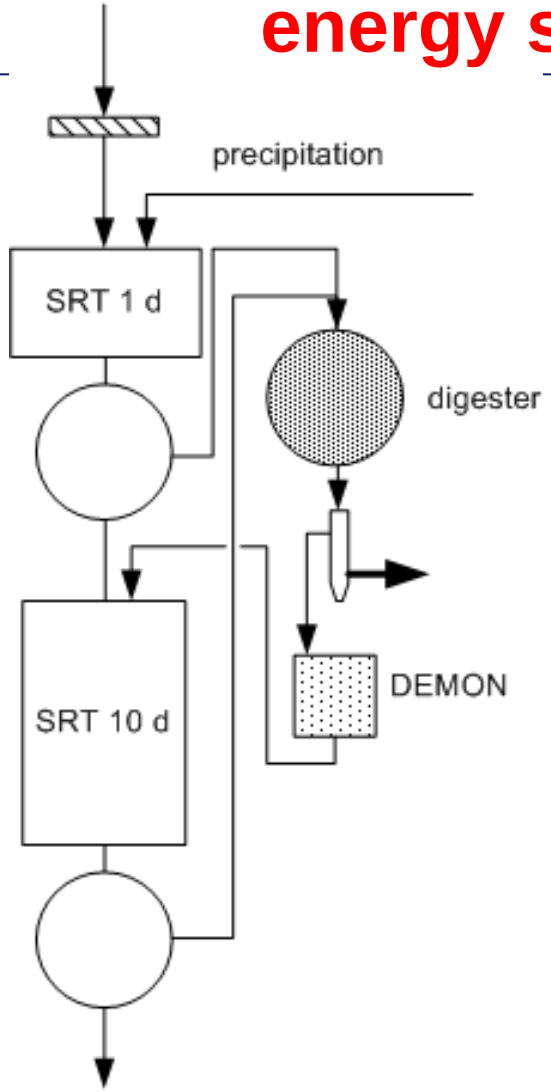


DEMON® in side- and main stream
Aeration +31,5 Wh/pe d
Total +48,4 Wh /pe d
Gas el. -42,0 Wh /pe d
Balance +6,4 Wh /pe d

Future WWTP Layout – Enhanced Treatment – 3.3

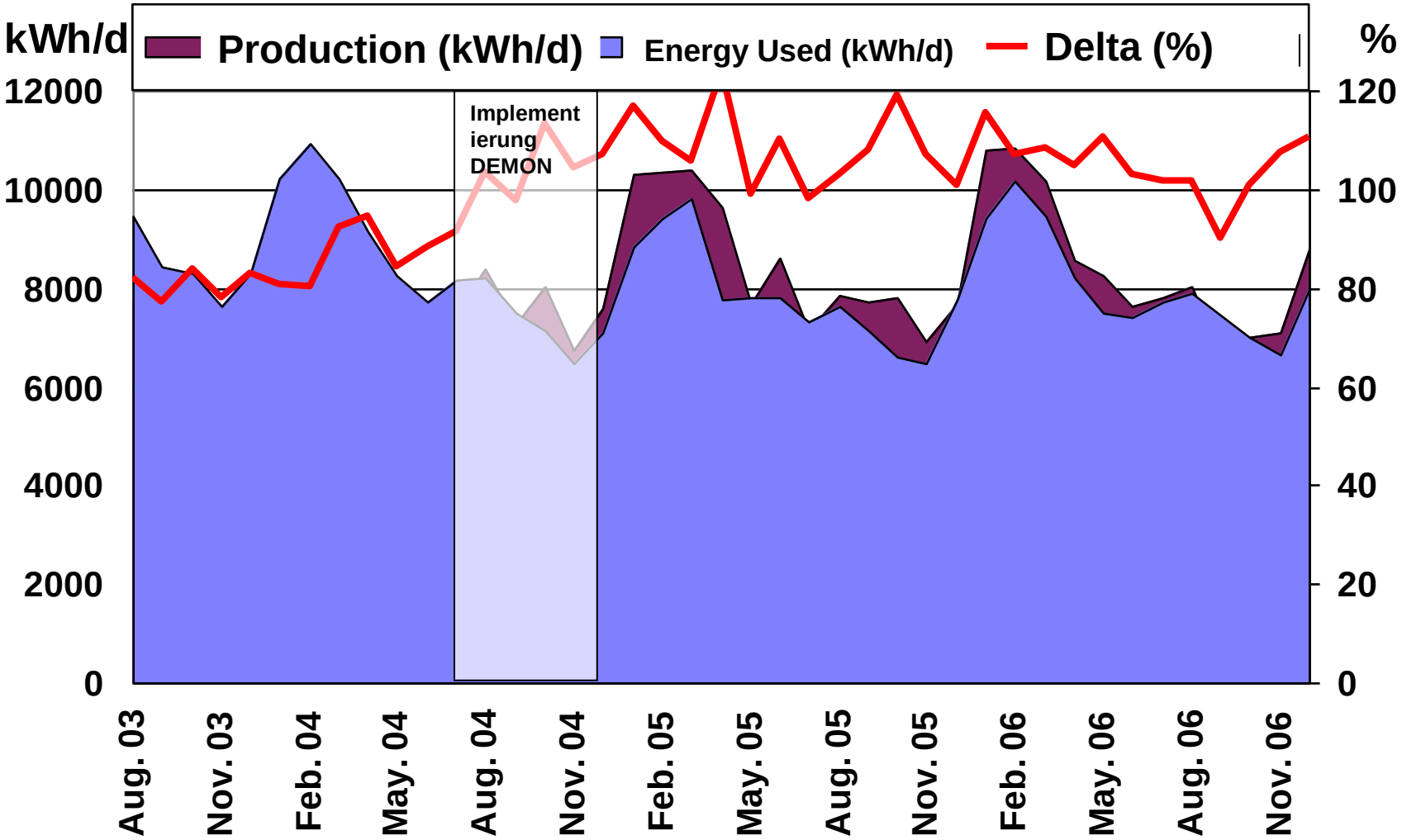


A major step towards an energy self-sufficient WWTP



High-/low loaded biology and DEMON® in side- and main stream
Aeration +16,4 Wh /pe d
Total +33,3 Wh /pe d
Gas el. -64,7 Wh /pe d
Balance -31,4Wh /pe d

Energy Balance of Strass WWTP



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Conclusions

- Current WWTP's use lots of energy for fully degrading BOD, NH3-N.
- Energy opportunity from 3,800 m^3/day is 30 kW of electricity.
- Using a re-configuration of the typical WWTP and incorporation of new processes allows us to create a energy neutral / positive WWTP in the future.

Summary of the Future of Wastewater Treatment

Conventional N-removal	DEMON® in side stream	DEMON® in side- and main stream	High-/low loaded biology and DEMON® in side- and main stream
Aeration +39,3 Wh /pe d	Aeration +37,2 Wh /pe d	Aeration +31,5 Wh/pe d	Aeration +16,4 Wh /pe d
Total +56,5 Wh /pe d	Total +54,1 Wh /pe d	Total +48,4 Wh /pe d	Total +33,3 Wh /pe d
Gas el. -42,0 Wh /pe d	Gas el. -42,0 Wh /pe d	Gas el. -42,0 Wh /pe d	Gas el. -64,7 Wh /pe d
Balance +14,5 Wh /pe d	Balance +12,2 Wh /pe d	Balance +6,4 Wh /pe d	Balance -31,4Wh /pe d

World Water Works

- US based Company Operating in India
- Innovative Technology Company
- Leading Company in DAF in US
- Leading Company in MBBR/IFAS in US
- Leading Company in DEMON in US

Thank you
Questions??

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