Metropolitan Water Reclamation District of Greater Chicago

Welcome to the February Edition of the 2023 M&R Seminar Series

NOTES FOR SEMINAR ATTENDEES

- Remote attendees' audio lines have been muted to minimize background noise.
- A question and answer session will follow the presentation.
- For remote attendees, Please use the "**Chat**" feature to ask a question via text to "Host."
- The presentation slides will be posted on the MWRD website after the seminar.
- This seminar has been approved by the ISPE for one PDH and pending approval by the IEPA for one TCH. Certificates will only be issued to participants who attend the entire presentation.

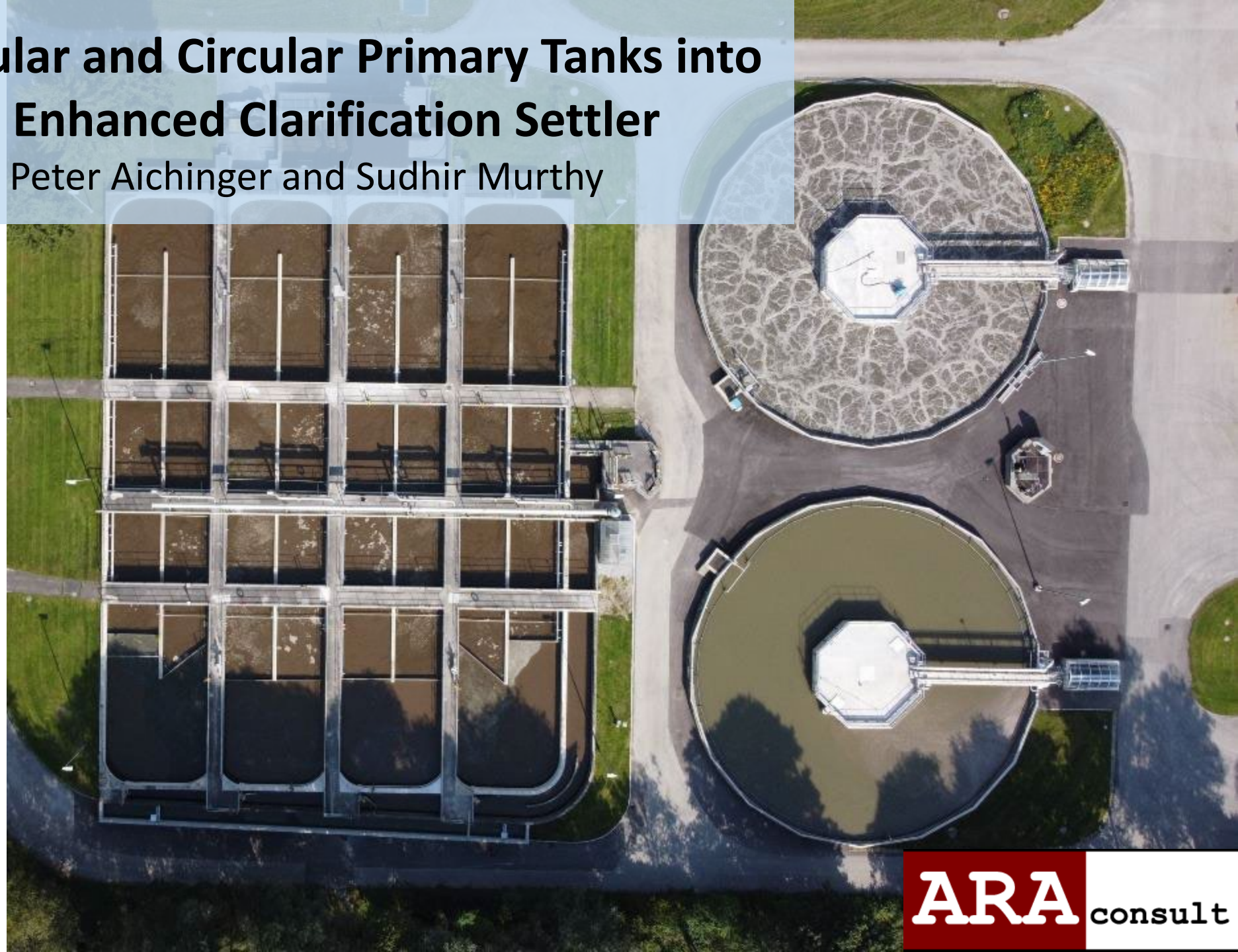
Dr. Bernhard Wett

Chief Executive Officer
ARAconsult

Dr. Bernhard Wett is Chief Executive Officer of ARAconsult, with consultancy projects in over 50 countries. His civil engineering background includes research and lecturing appointments at the University of Innsbruck, Austria. Dr. Wett's research focus is on high-strength ammonia wastewater, anaerobic digestion and energy optimization. He has contributed to developing, standardizing and distributing process intensification technologies like inDENSE, DEMON, TripleA and Biocos. He is working with Dynamita on the development of the Simulator SUMO in order to model mass- and energy-balances of these innovative technologies.

Converting Rectangular and Circular Primary Tanks into the AAA Biologically Enhanced Clarification Settler

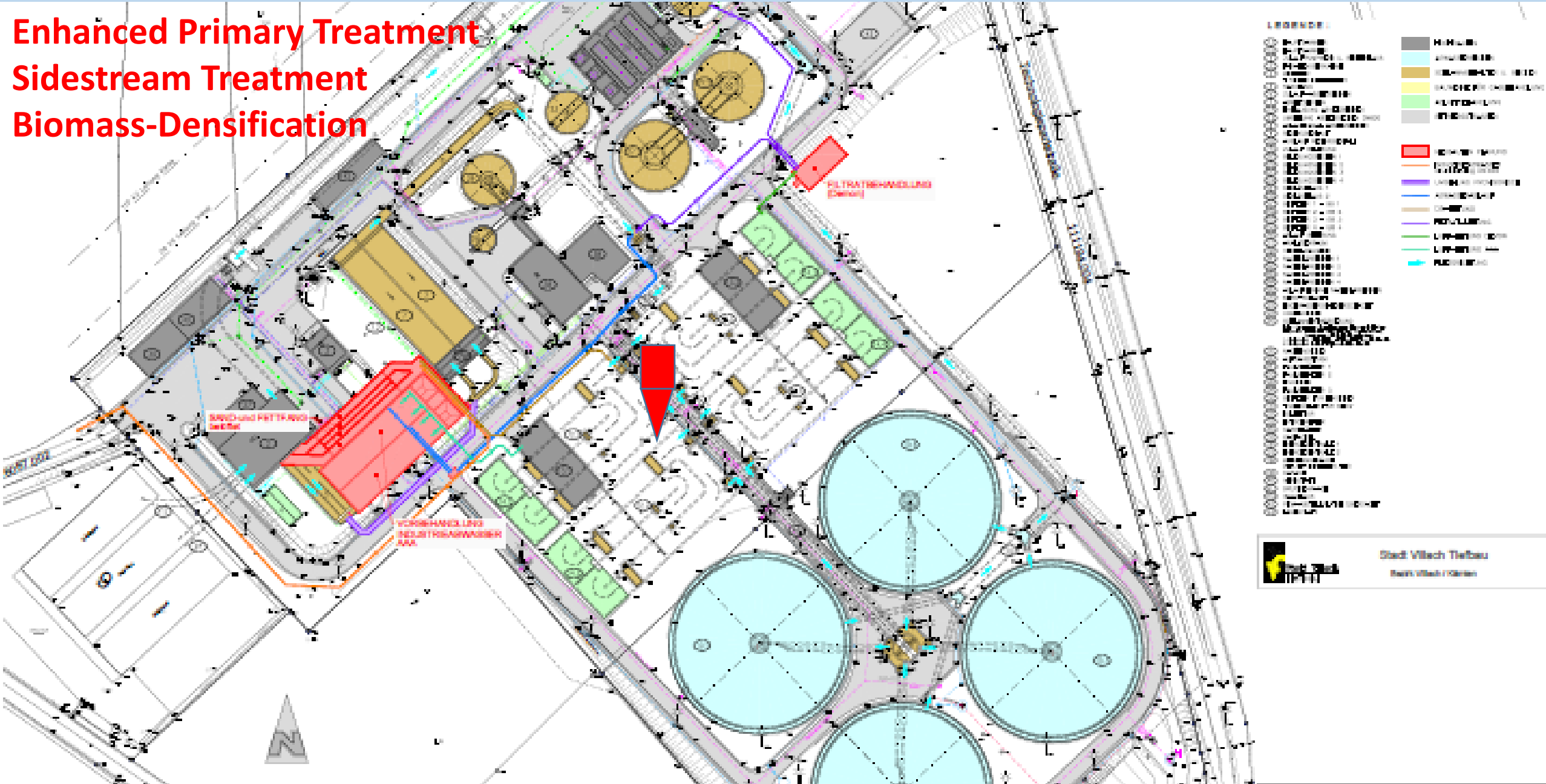
Bernhard Wett, Peter Aichinger and Sudhir Murthy



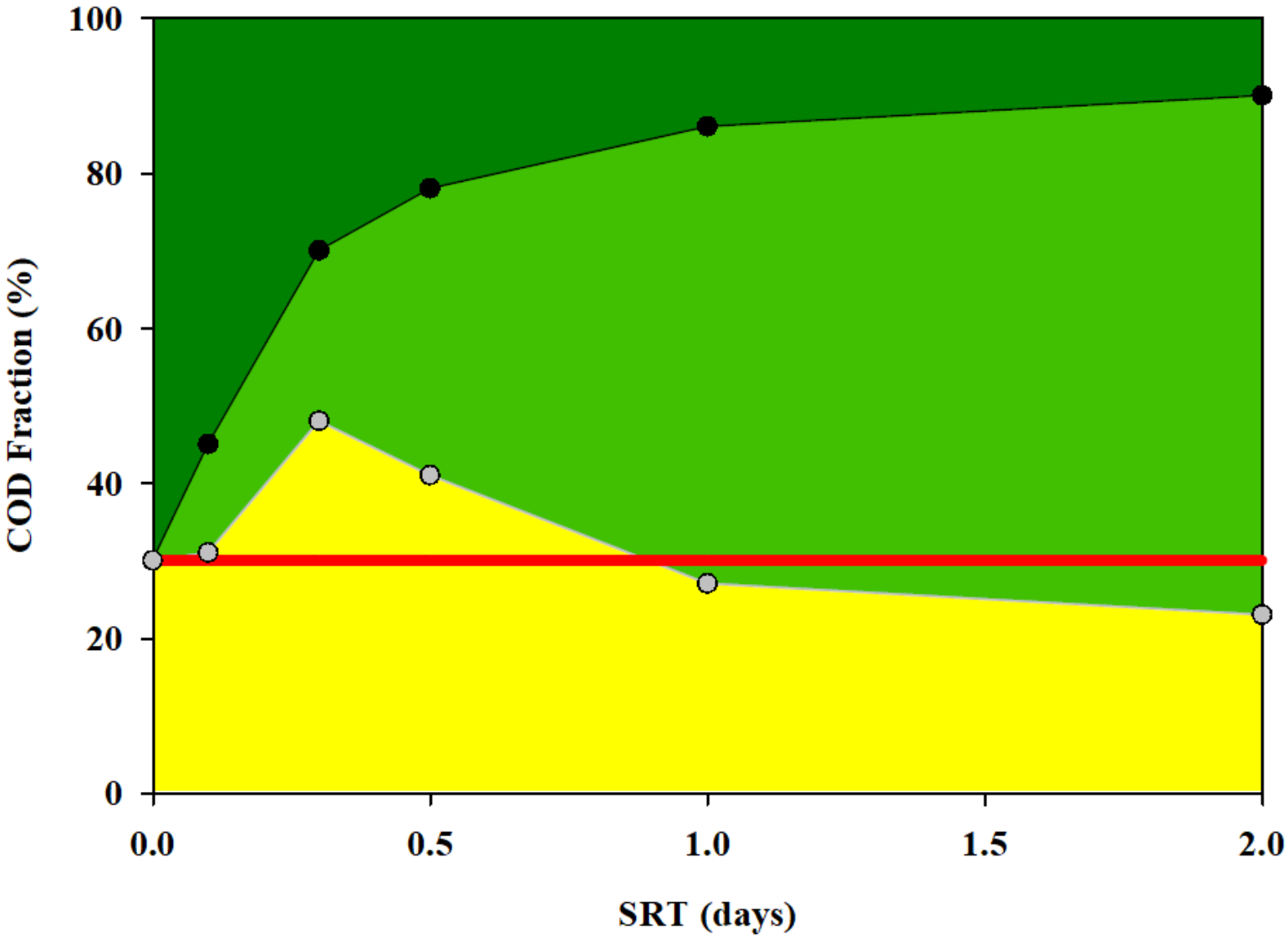
ARA consult

Intro: design challenge – 50% capacity increase

Enhanced Primary Treatment
Sidestream Treatment
Biomass-Densification



Intro: bio-sorption approach

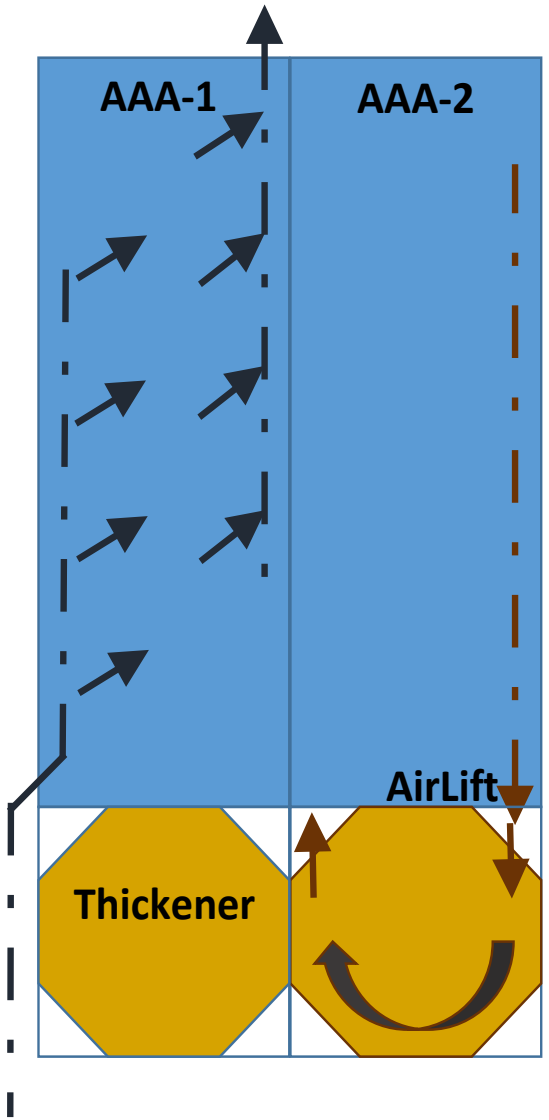


(—) represents assumed 30% COD removal by primary sedimentation; effluent COD; COD oxidized; COD captured as WAS.

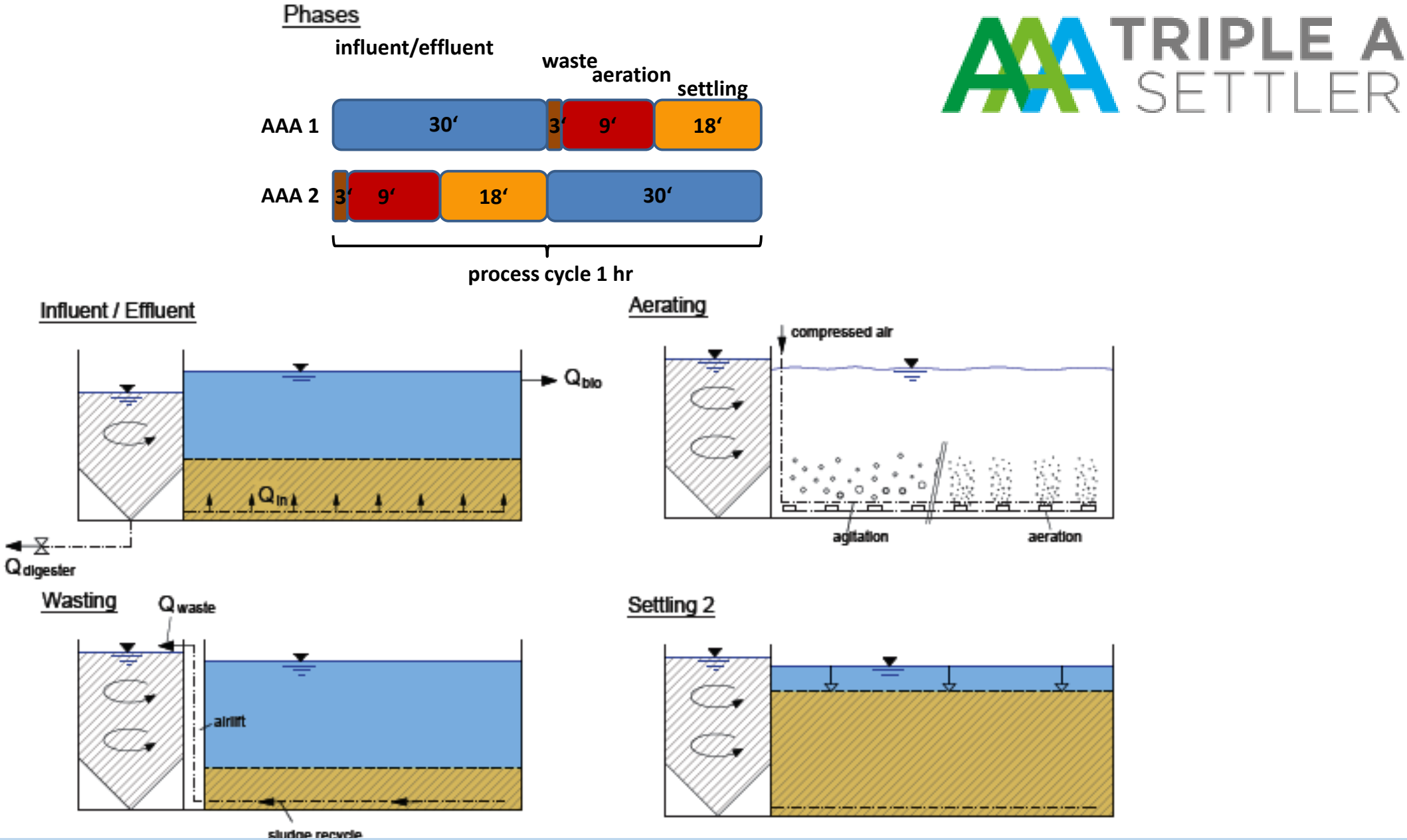
Figure provided by M. Miller and data adopted from Jimenez et al. (2015).

Alternating Activated Adsorption

Alternating feed/withdraw-cycle (const. water-level) spans half the time and a waste/react/settle cycle that spans the other half



Feed/withdraw in AAA-1 while waste/react/settle in AAA-2

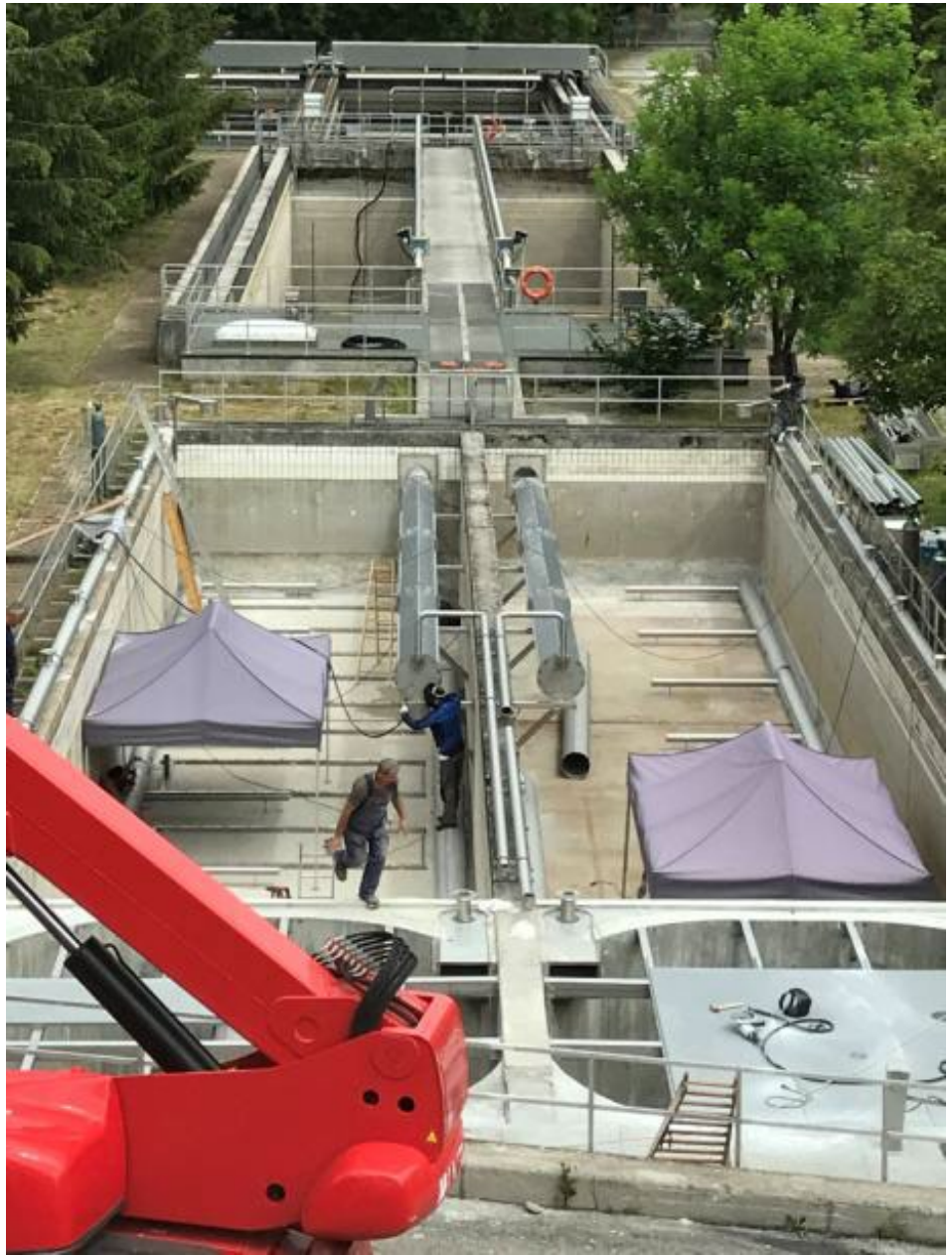


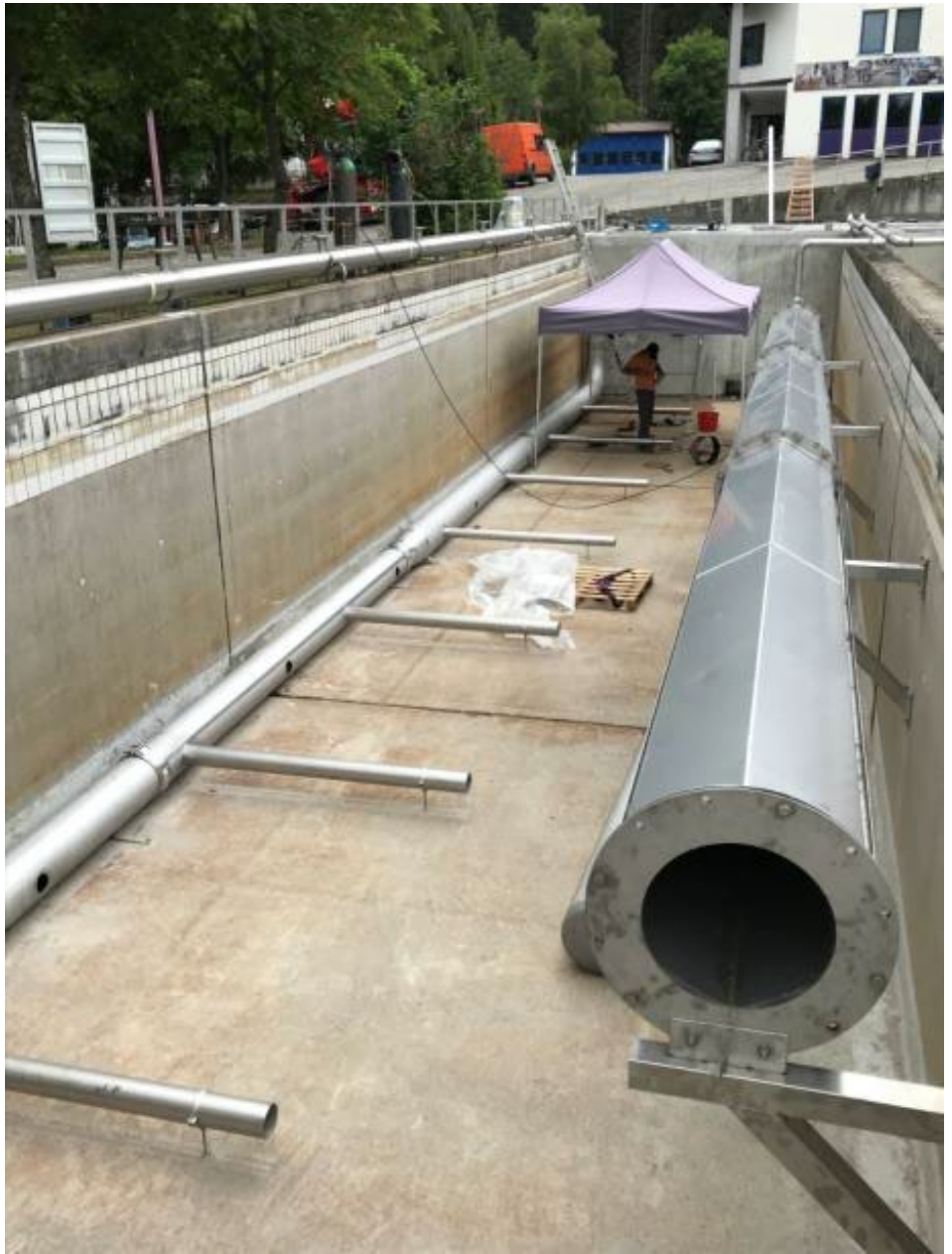
Schematic cross-section of one AAA-lane showing all process phases of an operation cycle – Air-driven without mechanical equipment like pumps, scrapers or mixers

Conversion of rectangular PT: WWTP Alta Badia

Retrofit of the sludge-hopper-zone into AAA-thickener

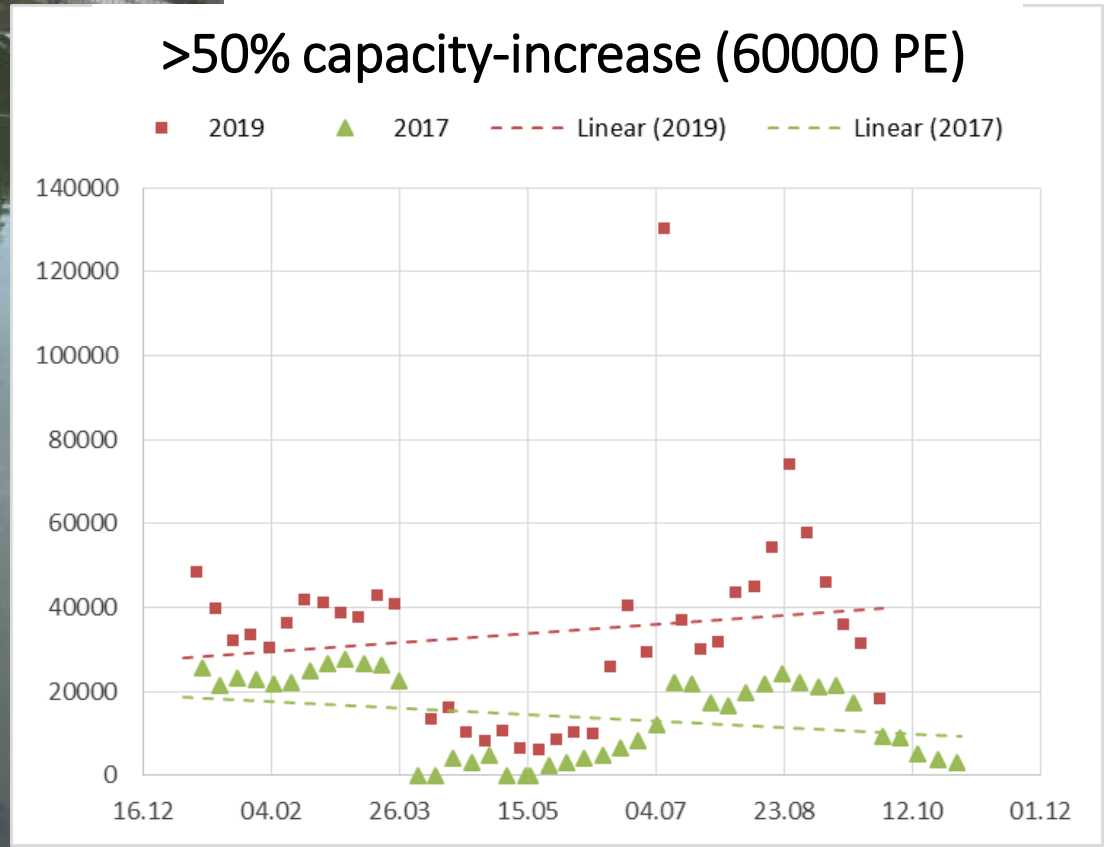
Conversion of rectangular PT: WWTP Alta Badia



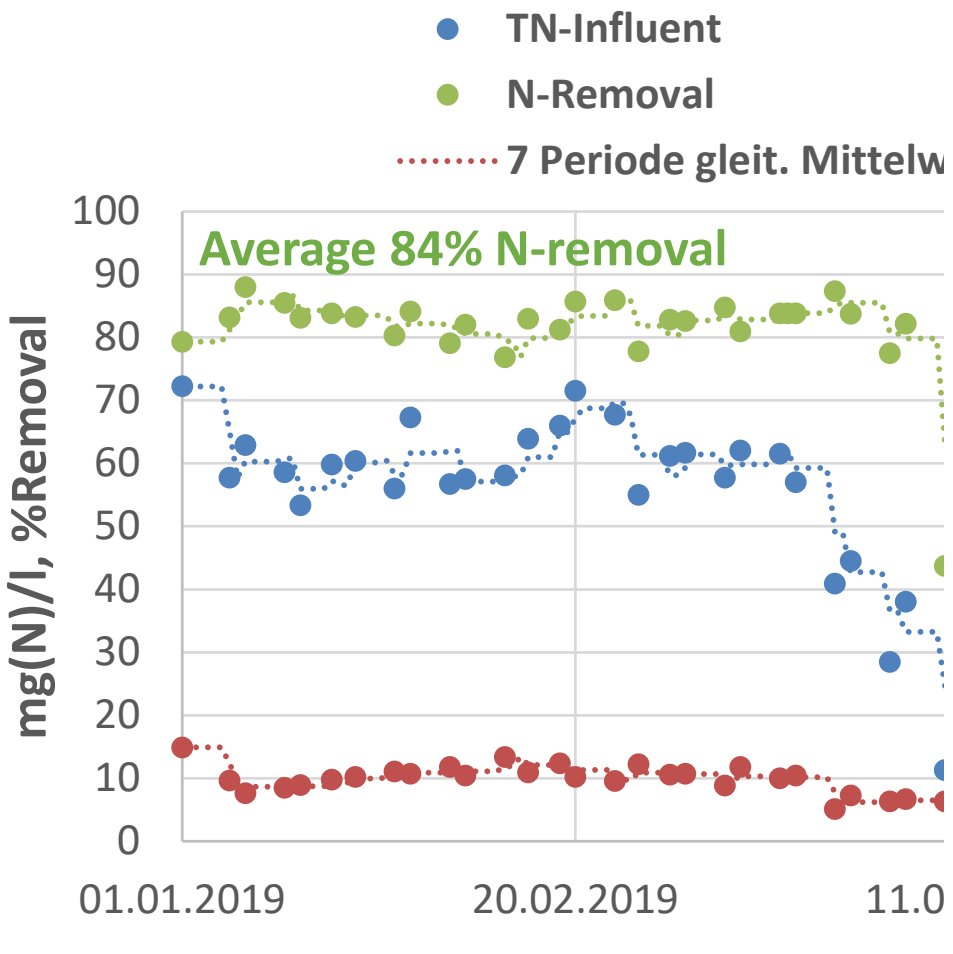


Conversion of rectangular PT: WWTP Alta Badia

TRIPLE A SETTLER



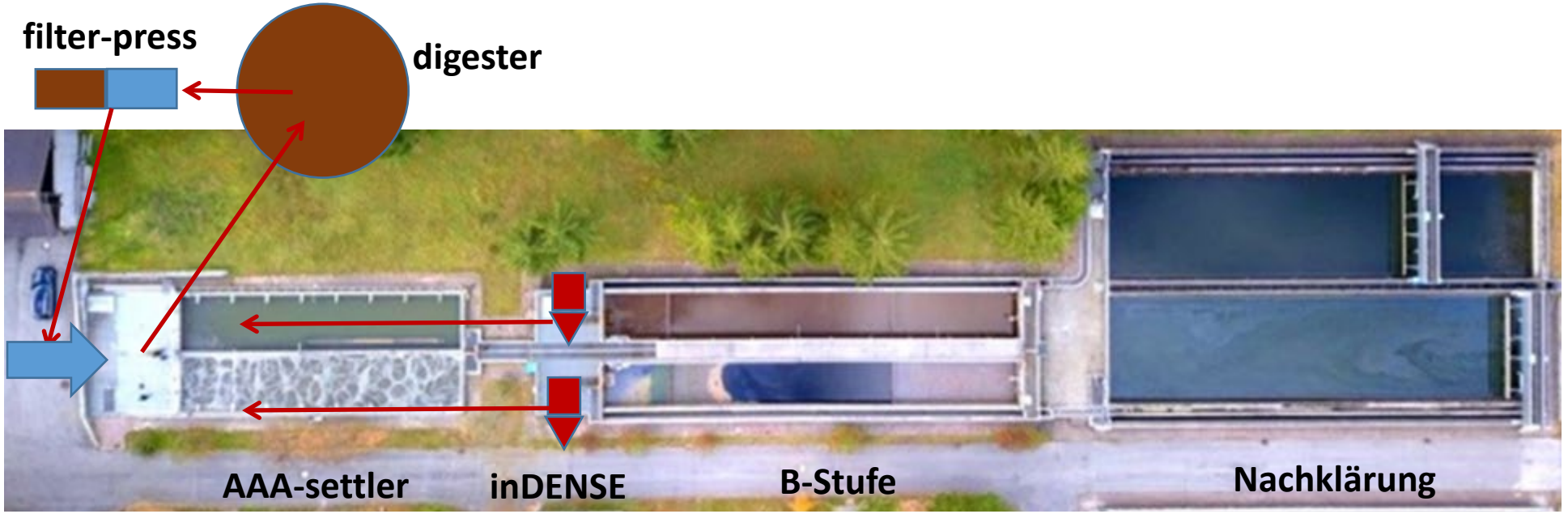
Conversion of rectangular PT: WWTP Alta Badia



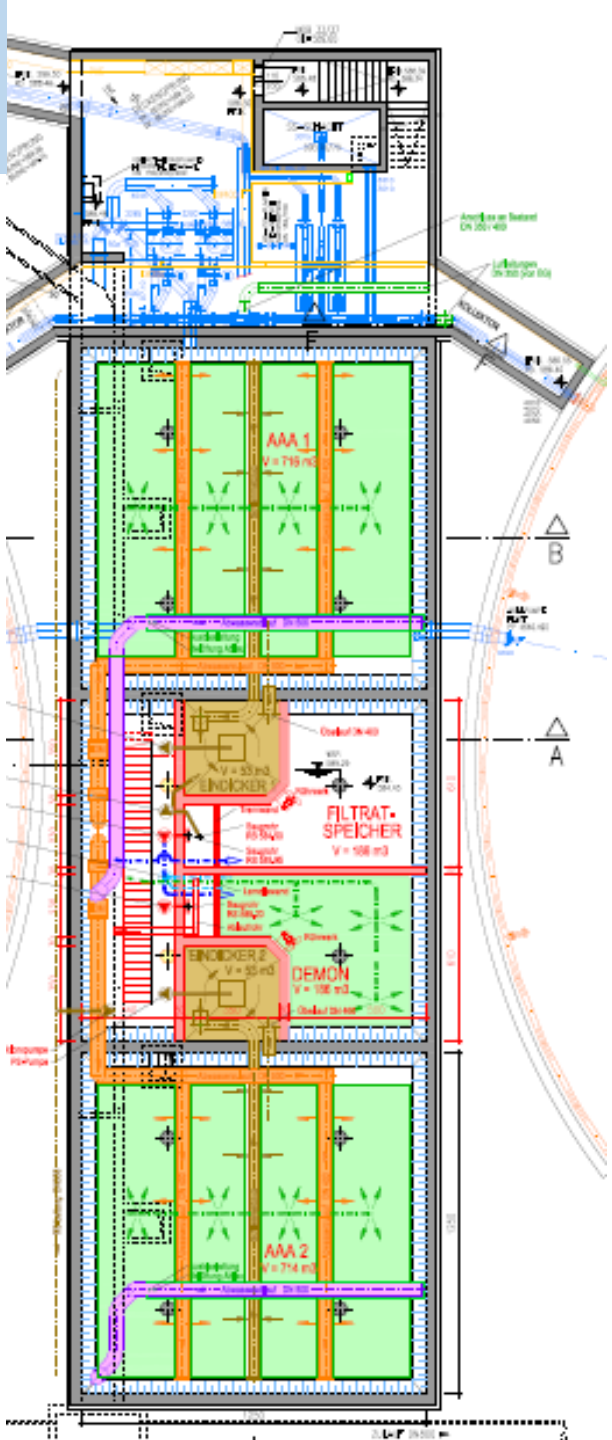
Conversion of rectangular PT: WWTP Alta Badia

inDENSE - SVI-improvement for

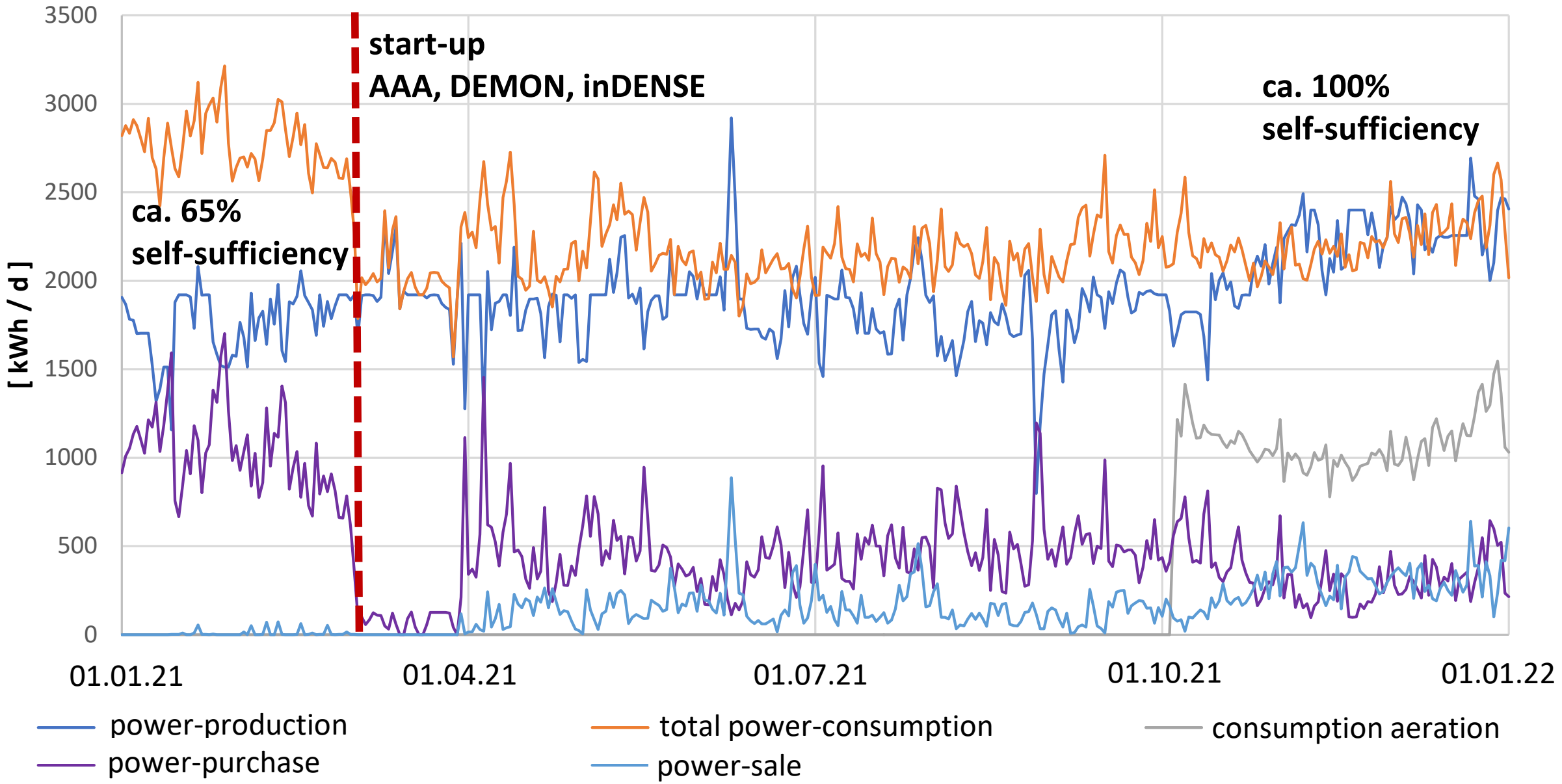
- high biomass concentration (6-7 gMLSS/L) in B-stage
- co-thickening of A- and B-stage in AAA



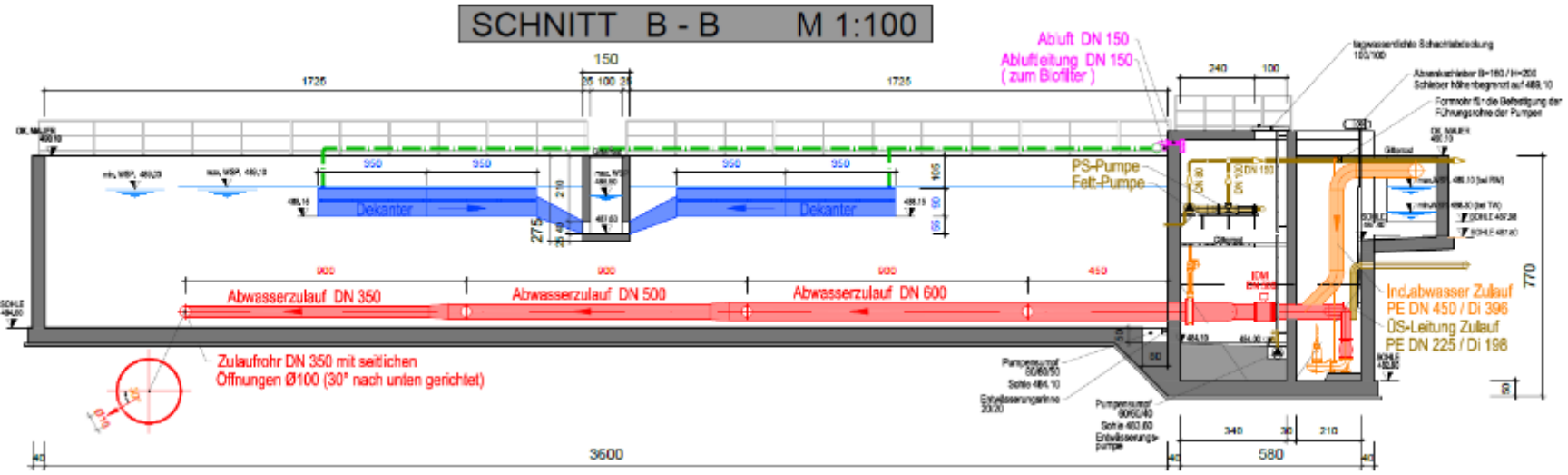
Conversion of square-tanks: WWTP Zirl, 17 MLD



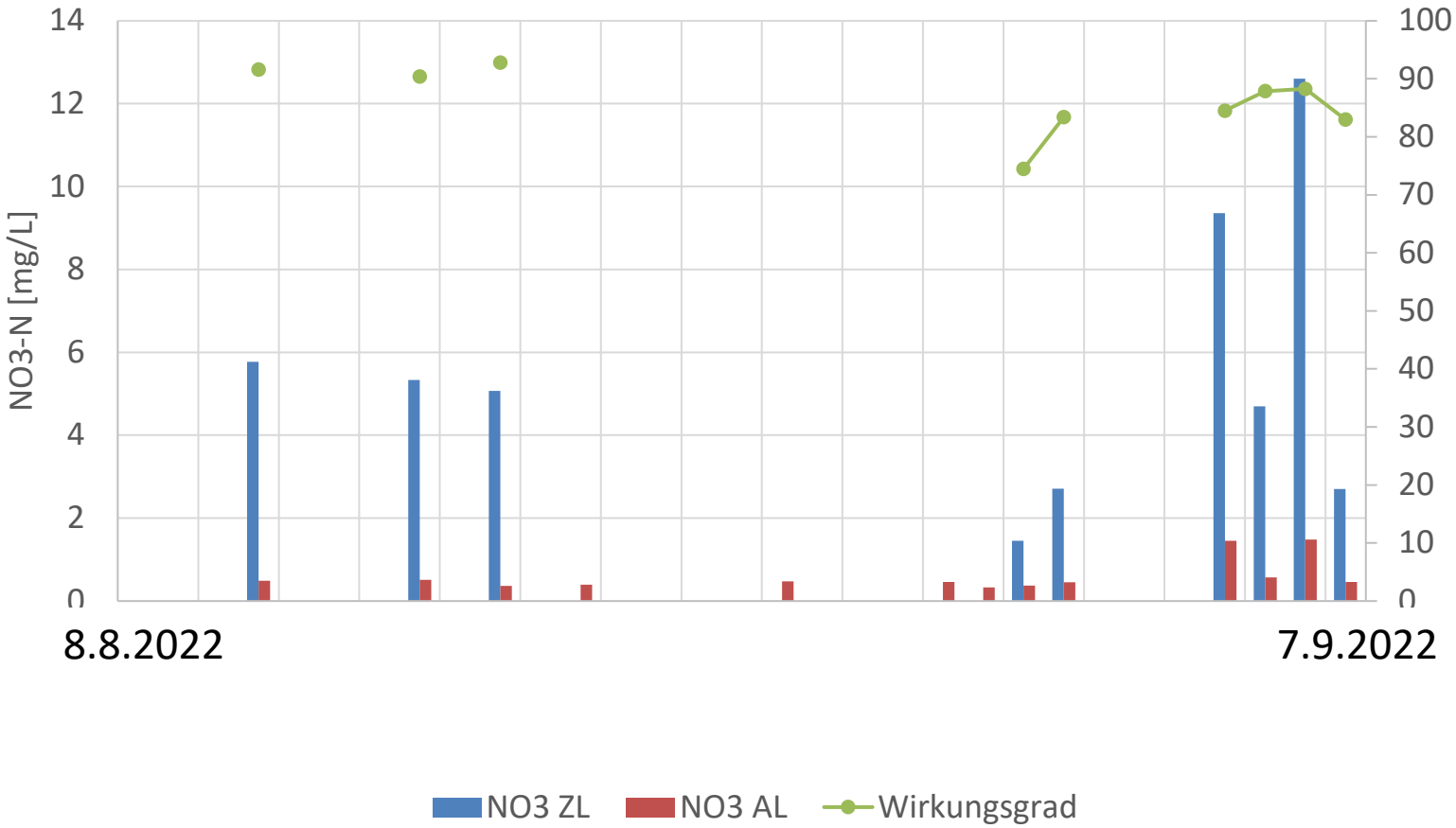
Energy balance: WWTP Zirl, 17 MLD



Construction of rectangular AAA-tanks: WWTP Villach, 27 MLD



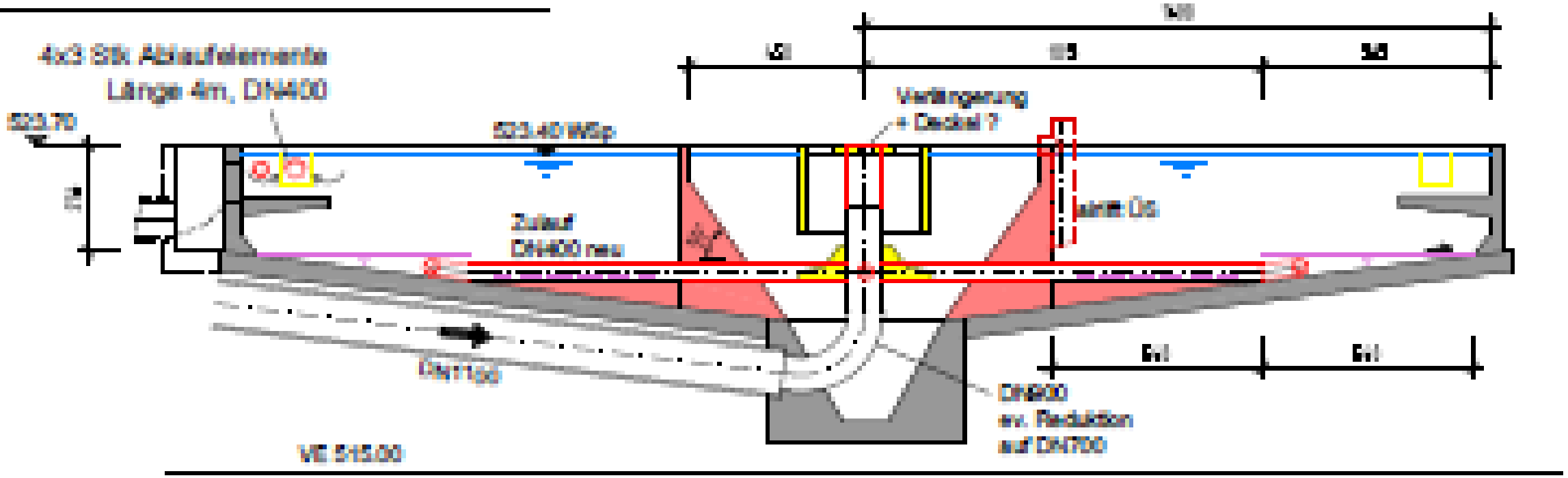
WWTP Villach, 27 MLD
Nitrate removal from semiconductor industry



Conversion of circular tanks: WWTP Strass, 250000 PE

TRIPLE A SETTLER

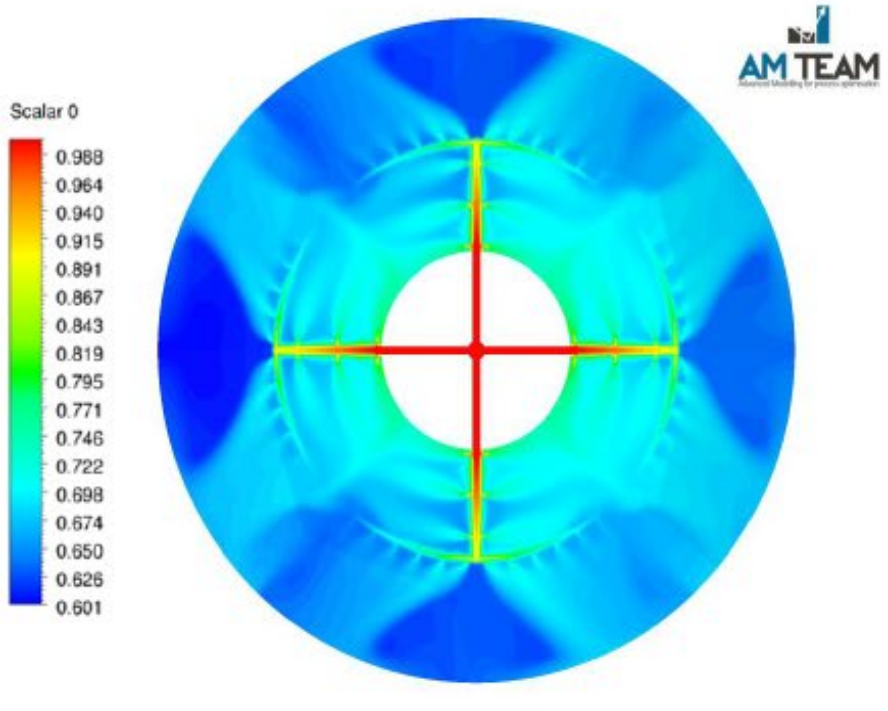
SCHNITT ZULAUFLEITUNG M 1: 200



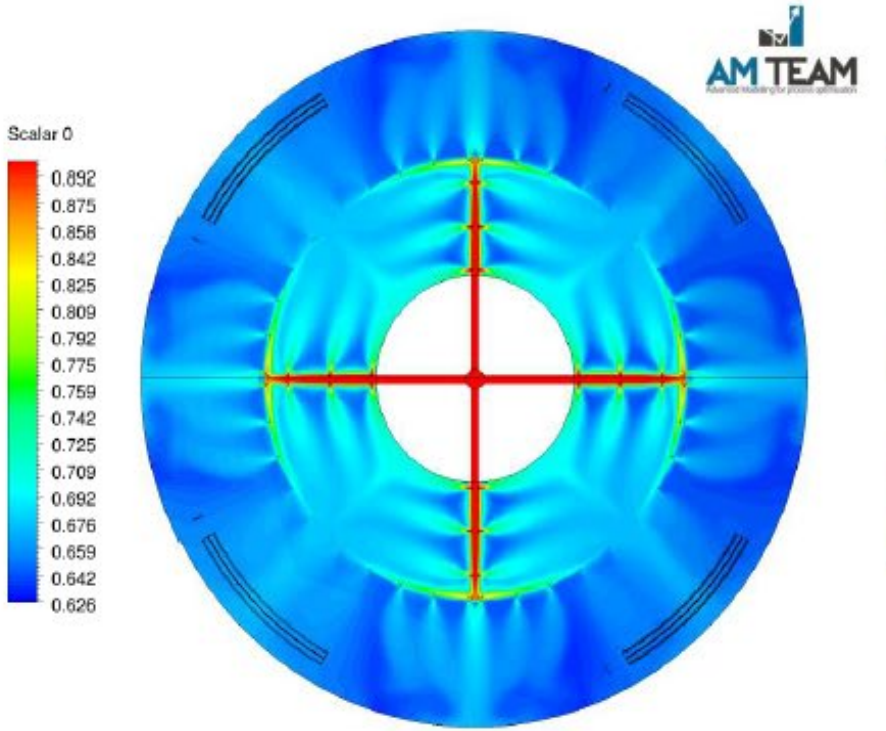
CFD-modeling of influent distribution

AM TEAM
Advanced Modeling for process optimisation

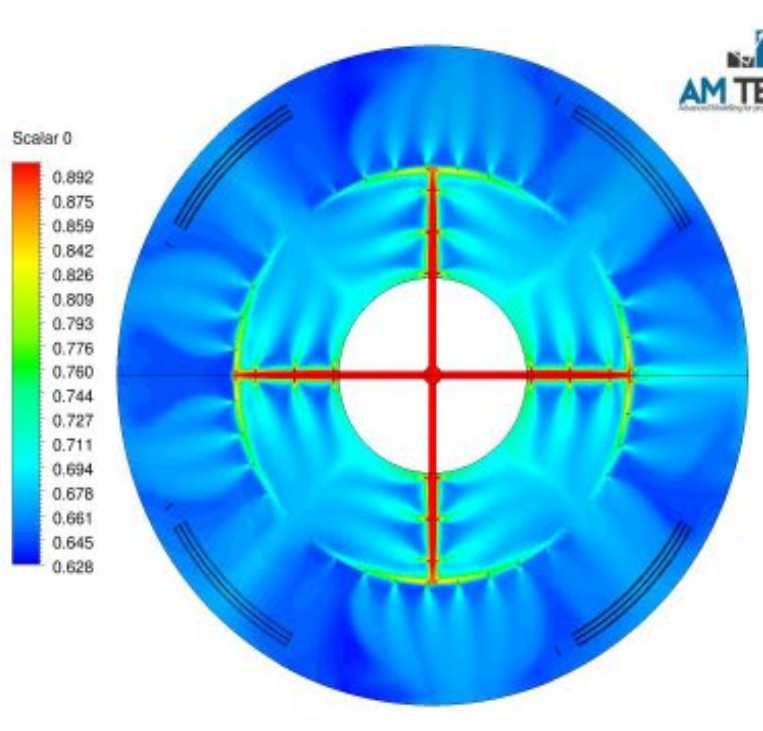
Base Case



Scenario 1



Scenario 2



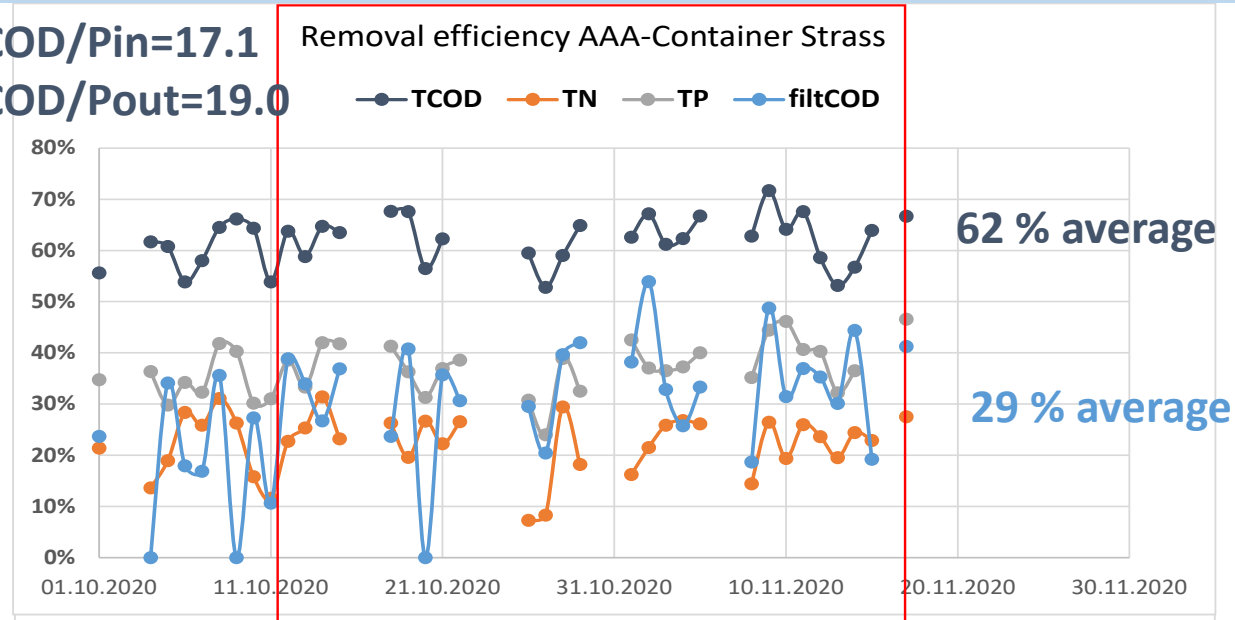
Potential four dead zones → More equally distributed

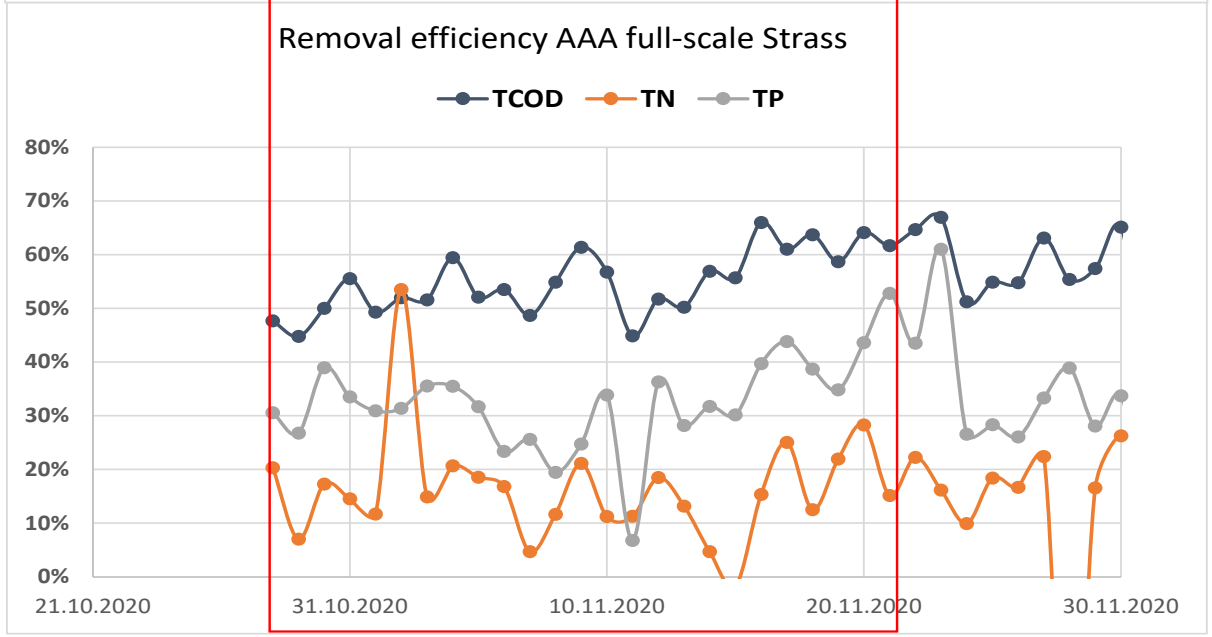
Conversion of circular tanks: WWTP Strass, 250000 PE

Diffuser test

WWTP Strass: start-up results

filtCOD/Pin=17.1
filtCOD/Pout=19.0





Anaerobic zones and step-feed for substrate concentration gradients

PO4-P concentrations

NO3-N concentrations

3.2±0.7

0.06±0.06

3.5±0.7

0.03±0.06

8.59±3.82

0.91±0.97

7.02±3.02

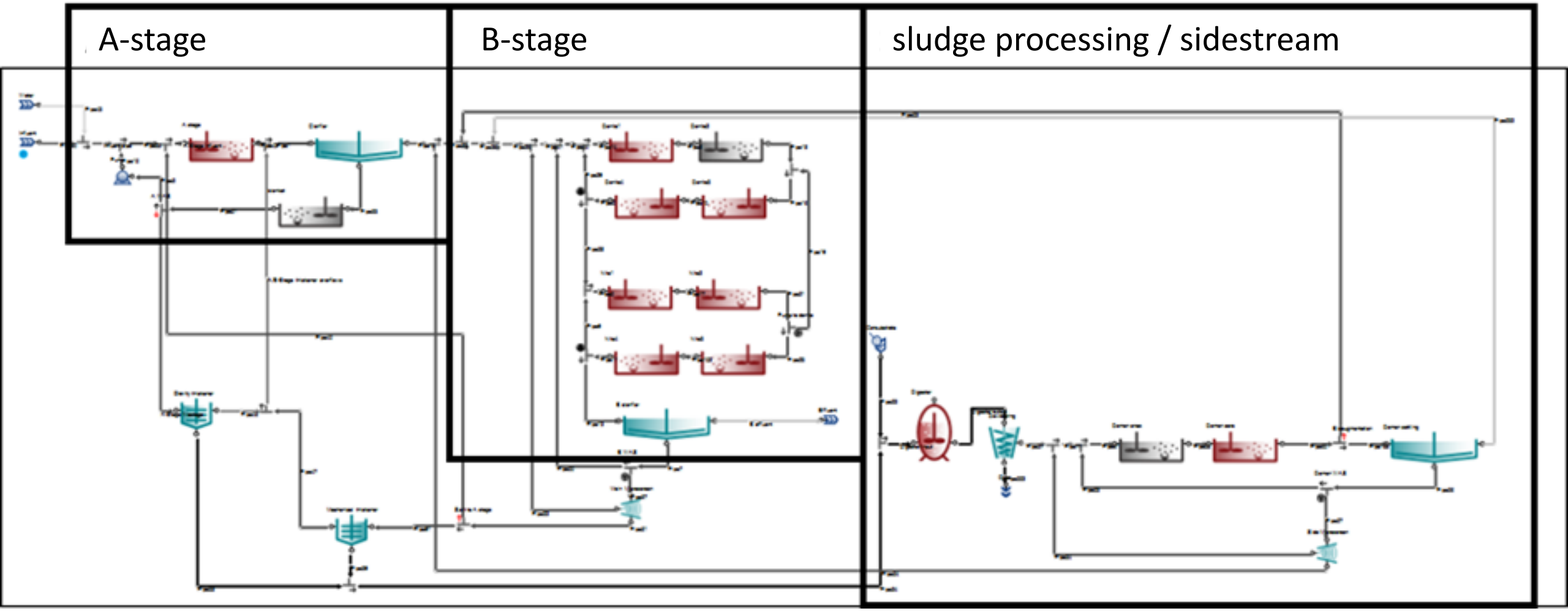
0.64±0.99

21.0±8.4

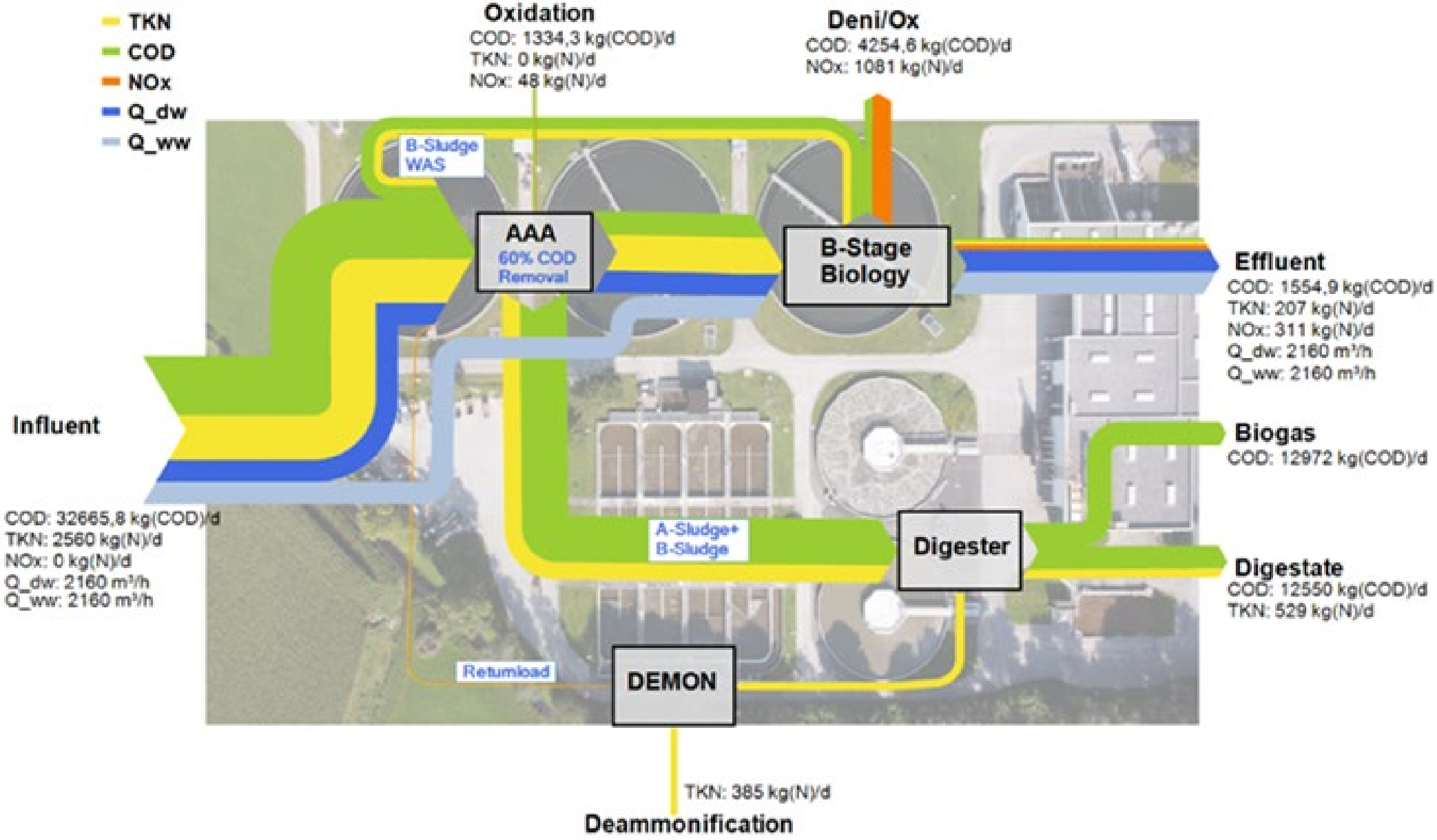
23.3±3.8

6 grabsamples July/August22 AVERG±STDIV

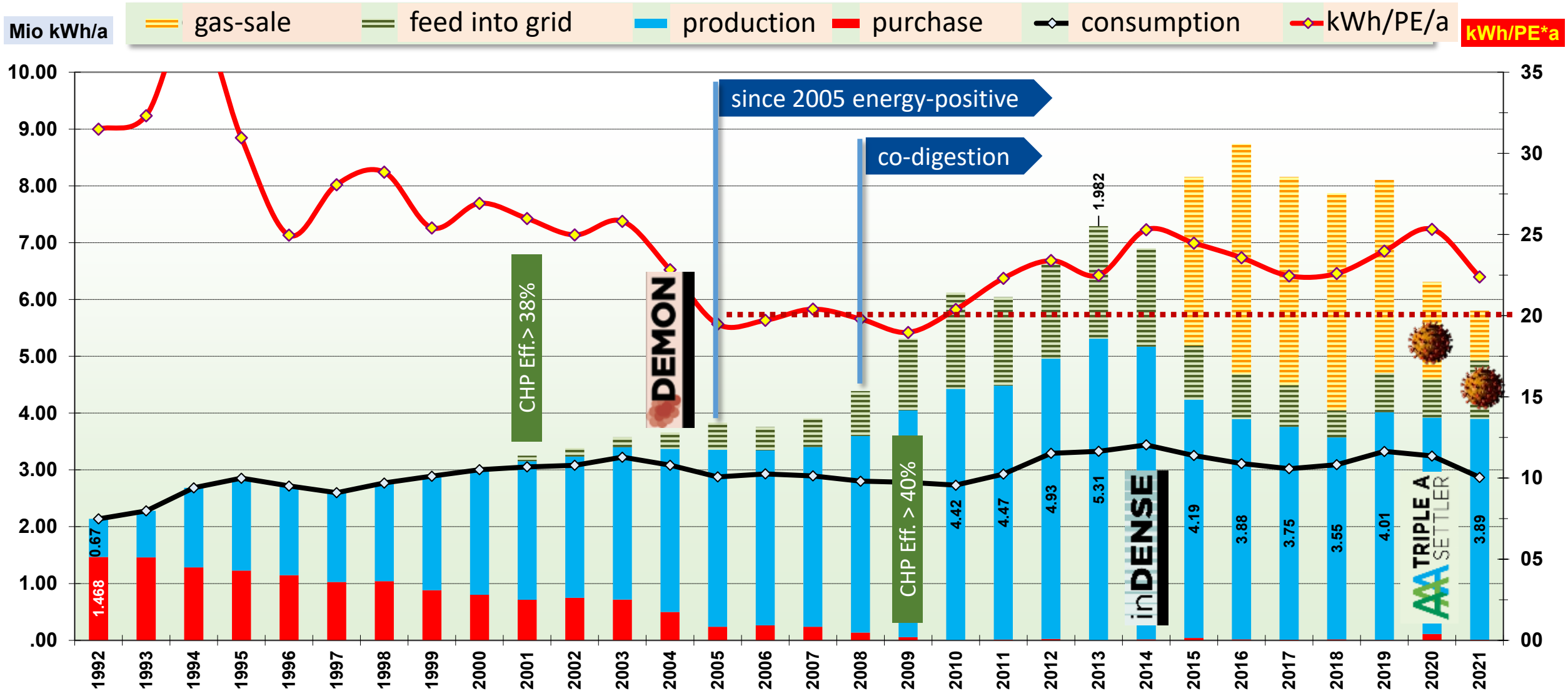
Full-plant process-modeling



WWTP Strass: mass-balance and carbon-redirection



WWTP Strass: energy-balance and –optimization over 30 years operation period



Graphik: plant manager Ch. Fimml

Conversion-steps AAA-Hallstättersee

Specific size after retrofit

Plant name	Size [PE]	Tankage [m³] A-stage B-stage Clarifier	specific [L_{VOI}/PE]	HRT [h]
Strass *AAA, DEMON* *Step-feed, AvN* *inDENSE*	Load: 250.000 PE_{COD120} Qd,DW: 34.500 m³/d Qh,WW: 4.320 m³/h	A: 4.320 B: 10.456 C: 16.800	A: 17 B: 42 C: 67	A: 3,0 B: 7,3 C: 3,9 (*)
Alta Badia *AAA, Step-feed* *AvN, inDENSE*	Load: 60.000 PE_{COD120} Qd,DW: 11.467 m³/d Qh,WW: 956 m³/h	A: 960 B: 2.400 C: 3.300	A: 16 B: 40 C: 55	A: 2,0 B: 5,0 C: 3,5 (*)
Zirl *AAA, DEMON,* *Step-feed, AvN* *inDENSE*	Load: 91.000 PE_{COD120} Qd,DW: 17.280 m³/d Qh,WW: 2.160 m³/h	A: 1450 B: 8.840 C: 10.340	A: 16 B: 97 C: 114	A: 2,0 B: 12,3 C: 4,8 (*)
Hallstätter See *AAA, Step-feed,* *AvN, inDENSE*	Load: 33.000 PE_{COD120} Qd,DW: 6300 m³/d Qh,WW: 648 m³/h	A: 696 B: 2.445 C: 2.414	A: 21 B: 74 C: 73	A: 2,5 B: 8,7 C: 3,7 (*)
Villach *AAA, DEMON, inDENSE*	Load: 250.000 PE_{COD120} Qd,DW: 66.942 m³/d Qh,WW: 7.140 m³/h	A: 2.600 (partial flow) B: 26.000 C:23.088	A: 21 B: 104 C: 92	A: 0,9 B: 9,3 C: 3,2 (*)

** Qh,WW*

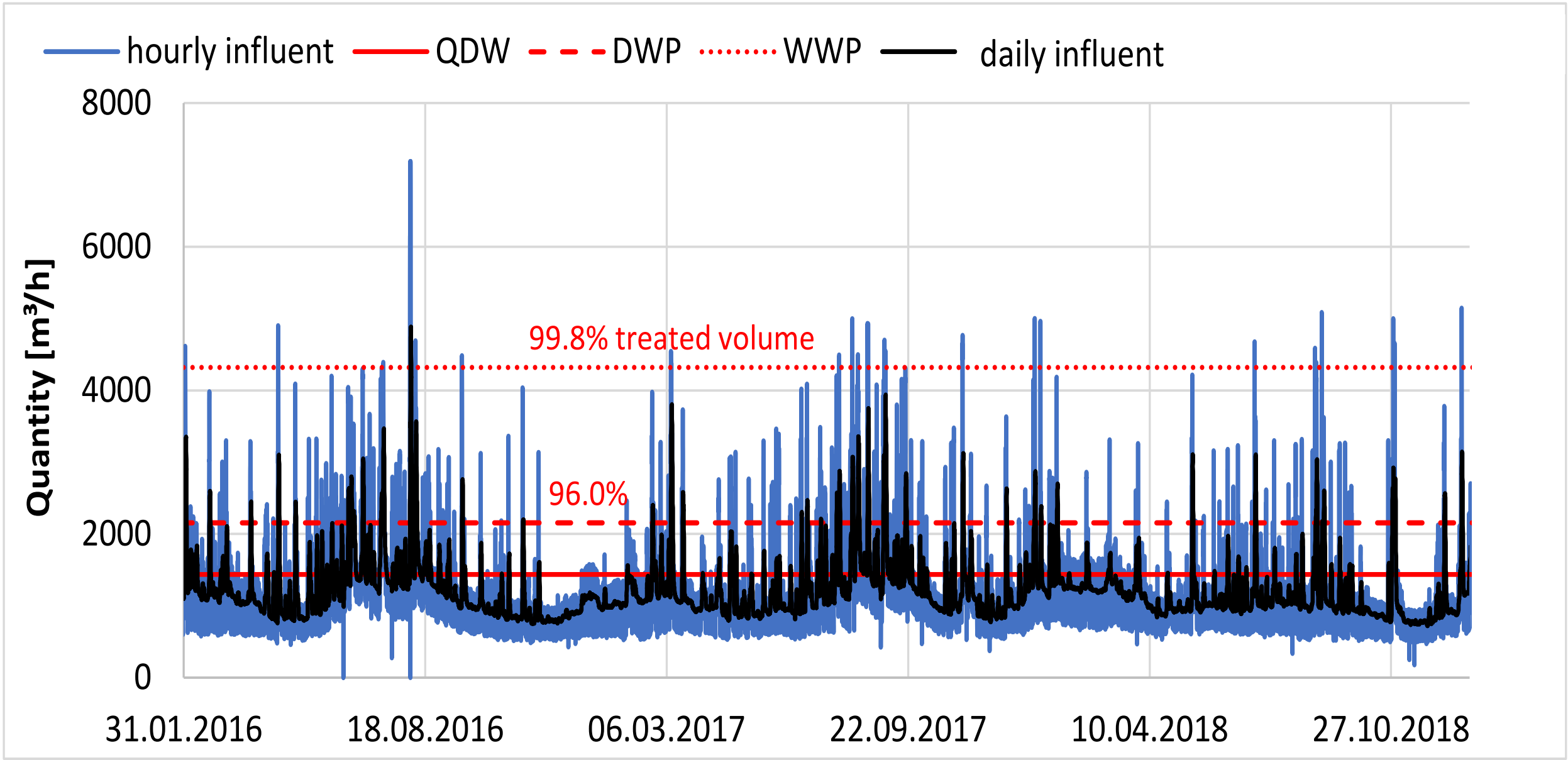
Conclusions

- Retrofitting from Primary- to AAA-settlers: Same tankage (HRT=2h) and hydraulic profile (constant level)
- Intensification case-studies with 50% capacity increase
- Energy-self-sufficient plants
- Easy maintenance – AAA without mechanical equipment

Thank you to the audience and also some **Buzz-Questions**

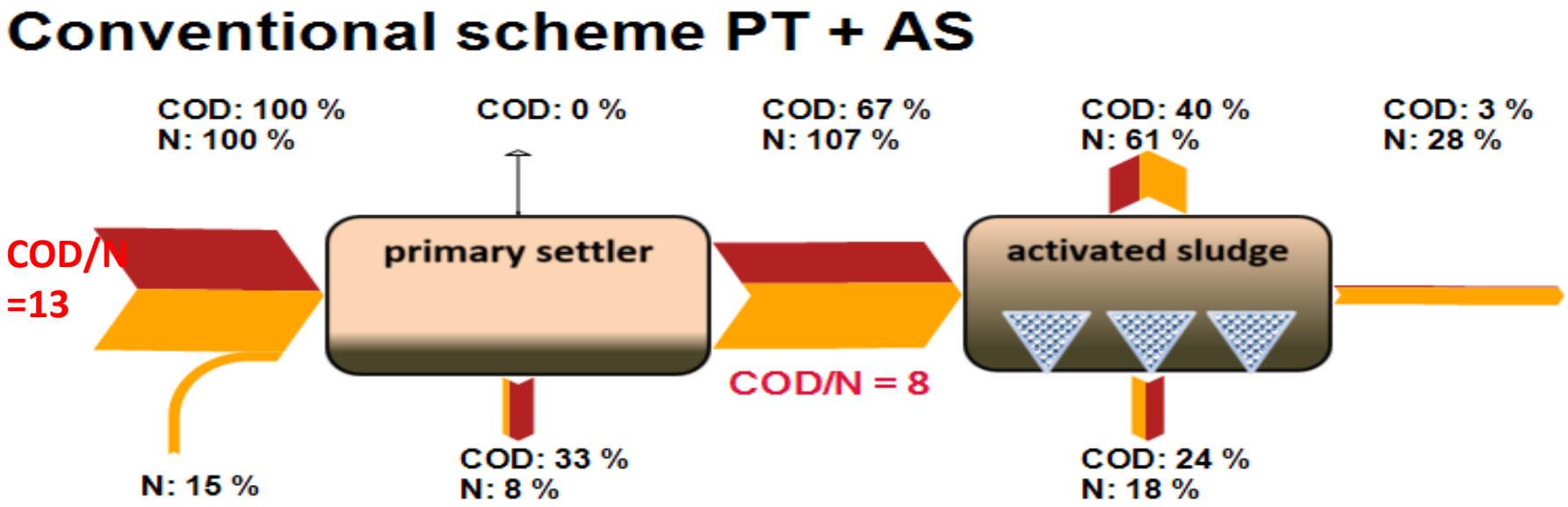
- **Does the AAA-process remind you to an HRAS- or an Contact-Stab-process?**
- **What is your opinion about the design-base for enhanced pre-treatment process?**
- **At what COD/N ratios you would apply such a process?**

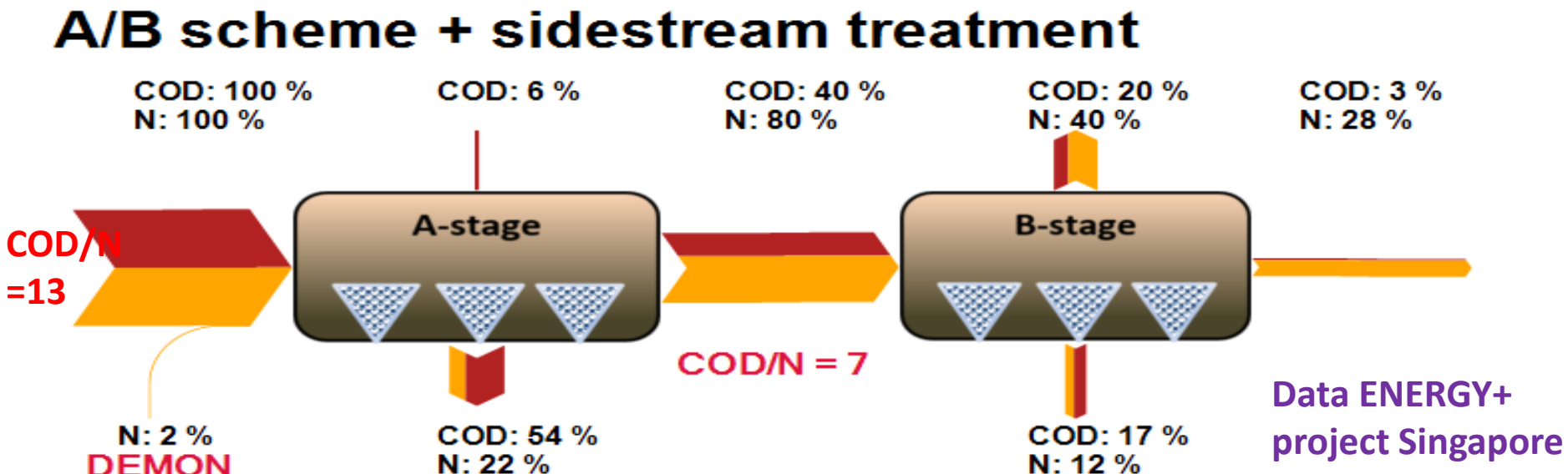
WWTP Strass: Dry weather peak design-flow



COD/N ratio

A/B configuration captures more organics and therefore more gas and return-N (compensated by sidestream process).





Improved dewaterability – A/B-plant Bludenz 110000 PE, Austria (2017)