FROM DIGESTION TO ULTRA-DIGESTION

A screeening of all the possibilities to reach the limits of sludge carbon conversion to biogas

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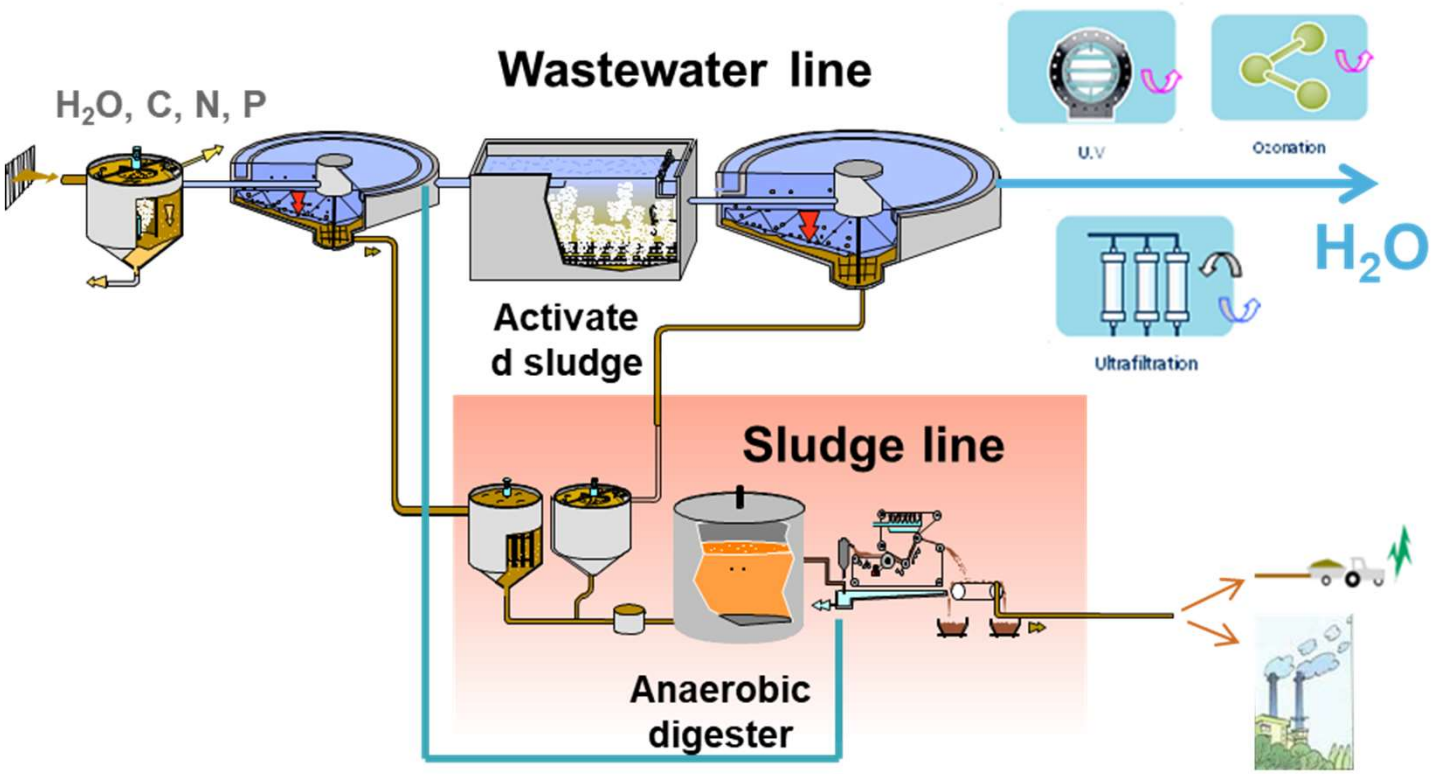
Sommaire

1. Genesis of the Ultra Digestion Innovation Program
WHY?

Raw wastewater

Energy Potential

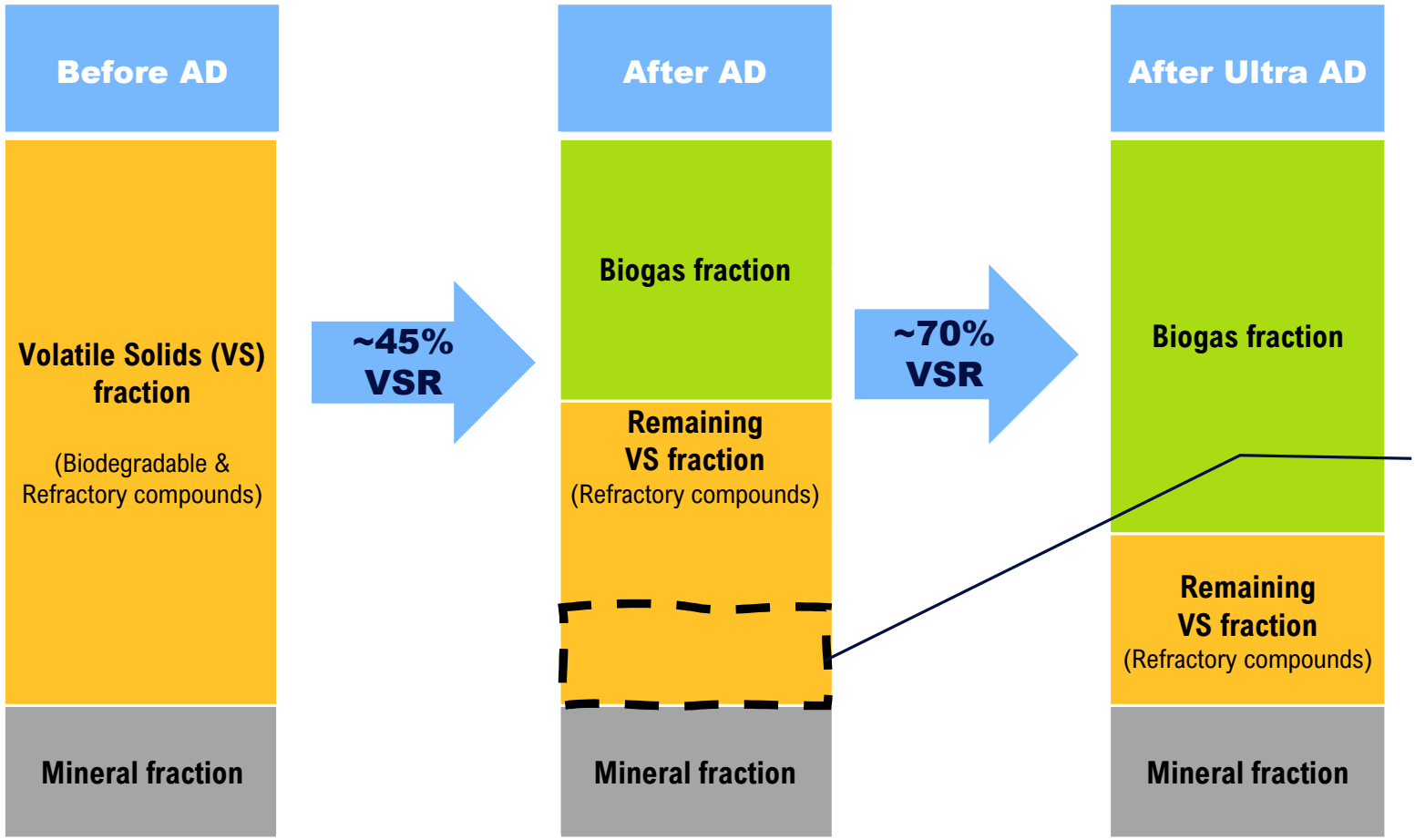
110 kWh / PE / annum



Current energy recovery
15 kWhe / PE / annum

Targeted energy recovery
>30 kWhe / PE / annum

1. Genesis of the Ultra Digestion Innovation Program
HOW?

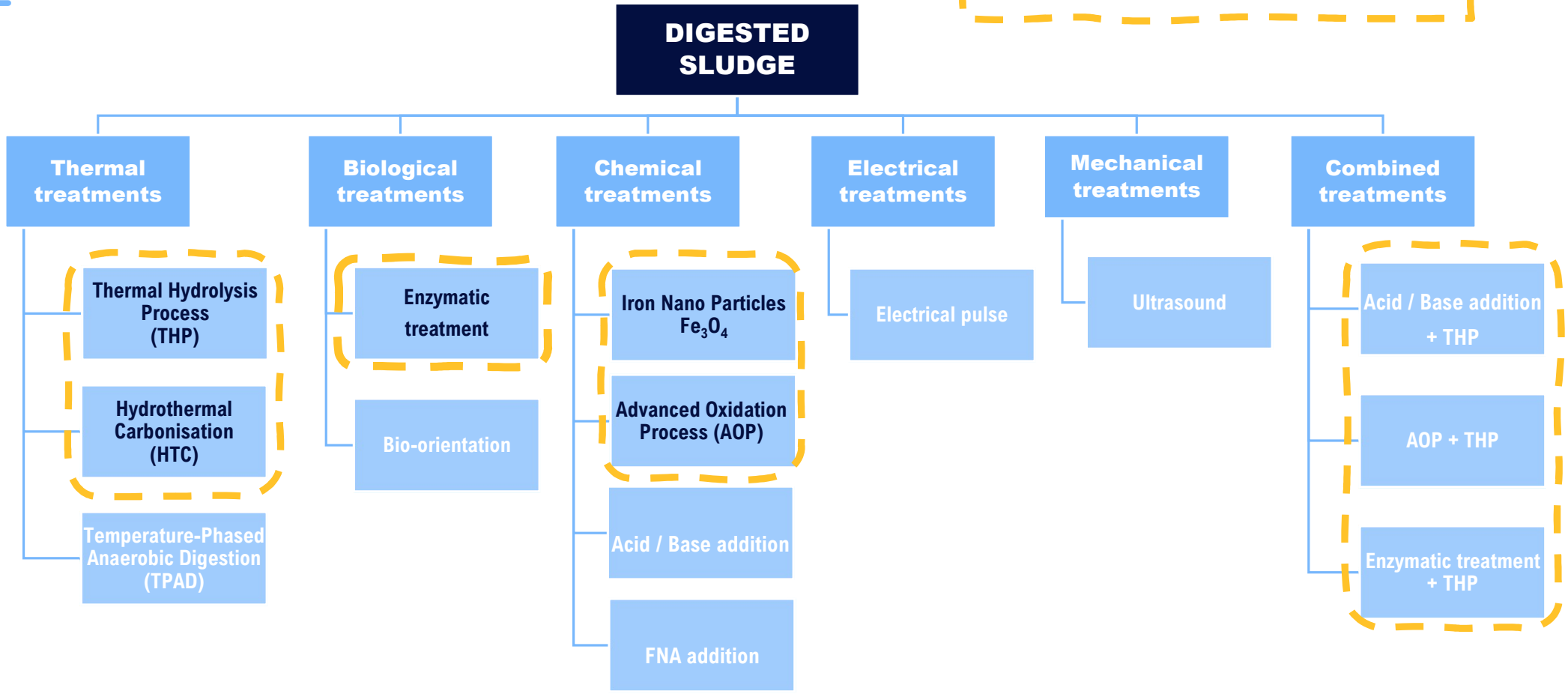


STRATEGY:

Increasing the energy production by enhancing the VSR through a post-treatment of digested sludge.

2. Technology mapping

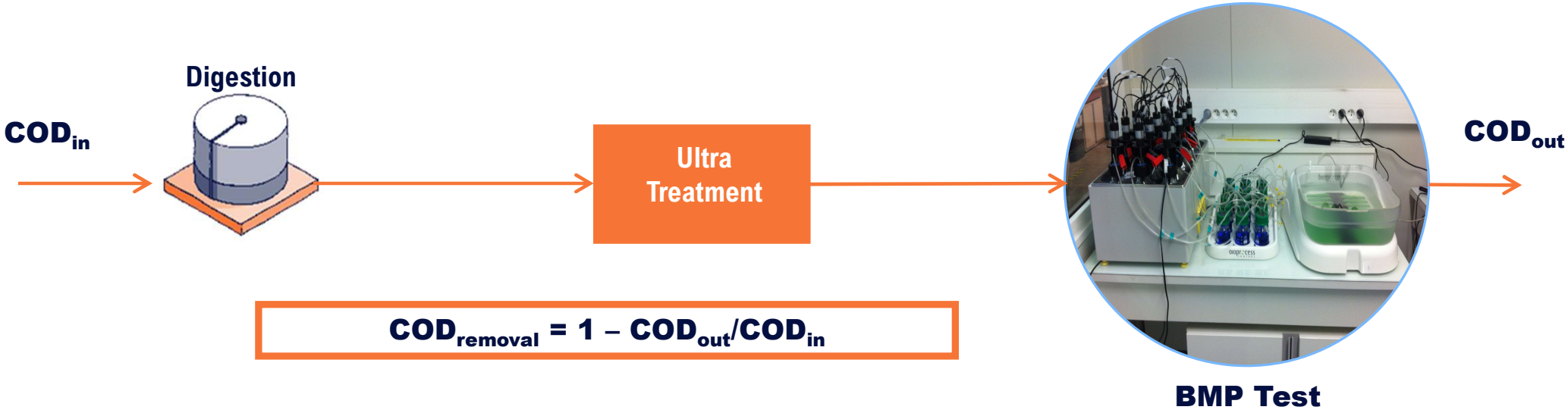
SELECTION CRITERIA:
CAPEX + OPEX + TRL + PERFORMANCE



3. Materials & Methods

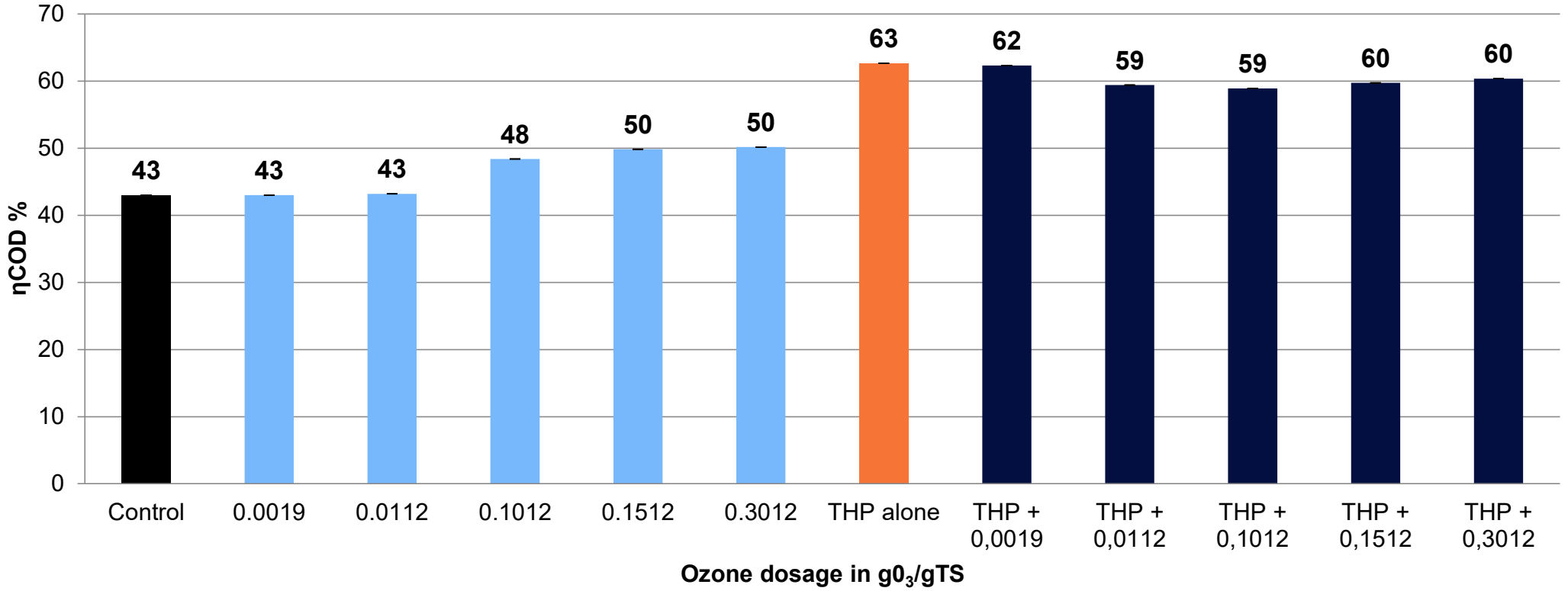
TECHNOLOGY SCREENING

- **Substrate & Inoculum:** digested sludge from a WWTP located in the Paris metropolitan area.
- **Biochemical Methane Potential (BMP) tests** carried out with the AMPTS technology from Bioprocess Control.
- **Baseline (raw sludge)** established for every batch of tests using the WWTP raw sludge (primary and secondary sludge at a 50:50 ratio)
- **COD measurement** used instead of VS to better account for VS solubilisation



4. Results

Advanced Oxidation Processes – Ozone dosing

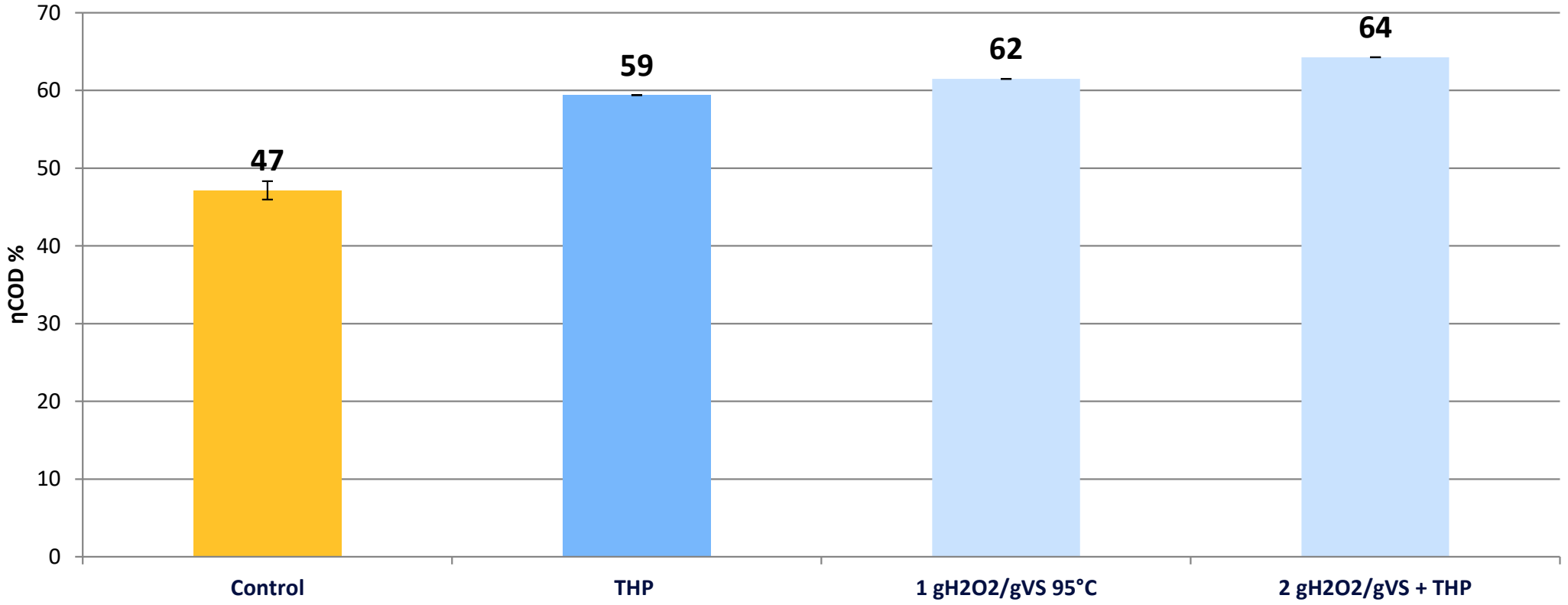


ηCOD % O_3 up to +16% | ηCOD % O_3 < ηCOD % THP | ηCOD % THP + O_3 < ηCOD % with THP

Difficult to dose, less efficient than THP treatment and seems to degrade bioavailable carbon

4. Results

Advanced Oxidation Processes – H_2O_2

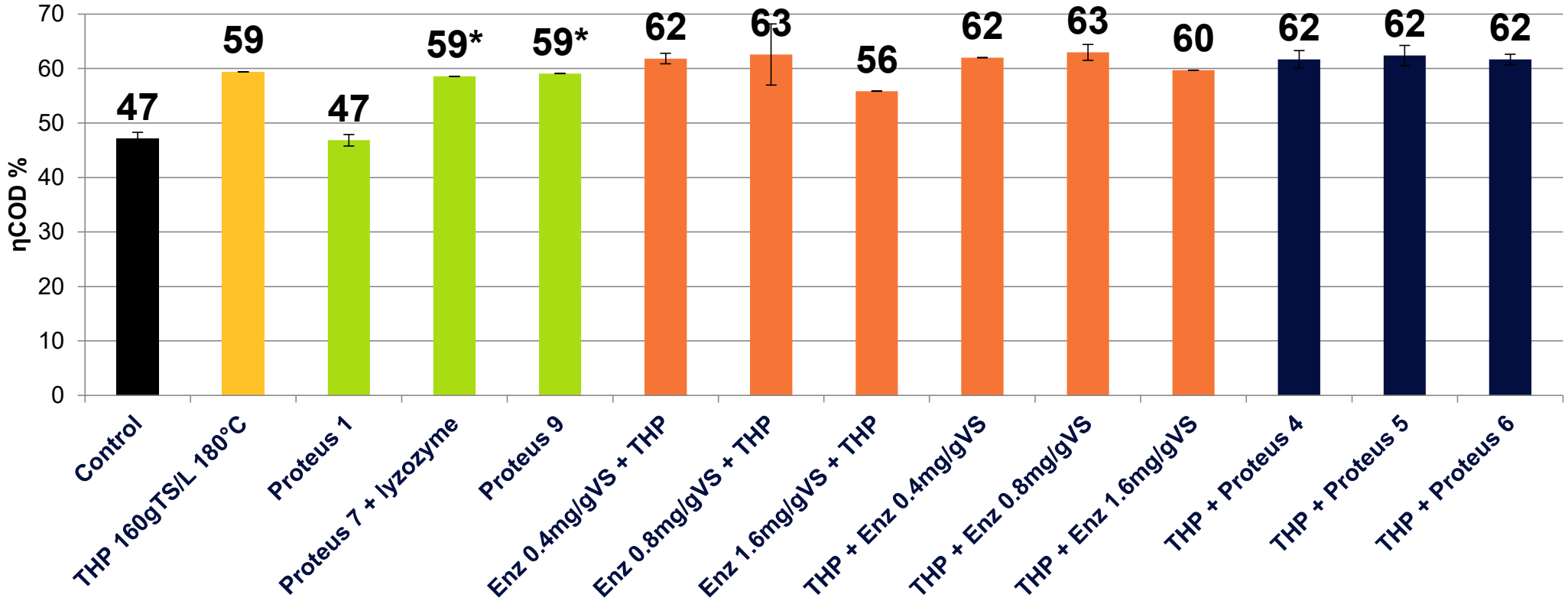


ηCOD % H_2O_2 up to +36%

H_2O_2 dosage renders the process uneconomical & not significantly different from THP

4. Results

Enzymatic treatment

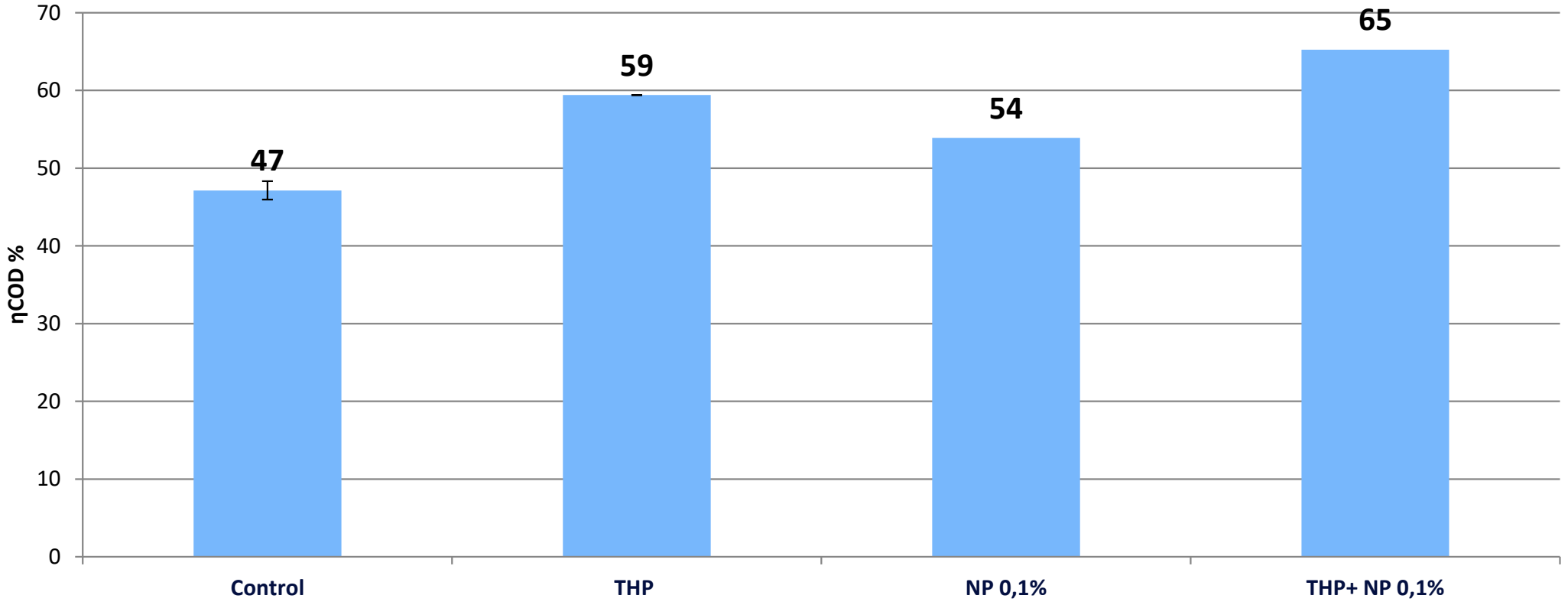


*(*) 59% as a theoretical maximum but **52%** expected at industrial scale.*

ηCOD % enzymatic treatment up to +11%, lower than performance obtained with THP.
No significant impact of enzymatic treatment of thermally hydrolysed sludge

4. Results

Iron Nano Particles (Magnetite - Fe_3O_4) – Diameter: 7 nm – BMP_4



ηCOD % magnetite up to +12% on thermally treated sludge and *+15% on digested sludge*

➔ Further exploration to confirm BMP tests launched

4. Results

Iron Nano Particles (Magnetite - Fe_3O_4) – Diameter: 7 nm – 5L CSTR

APPROACH

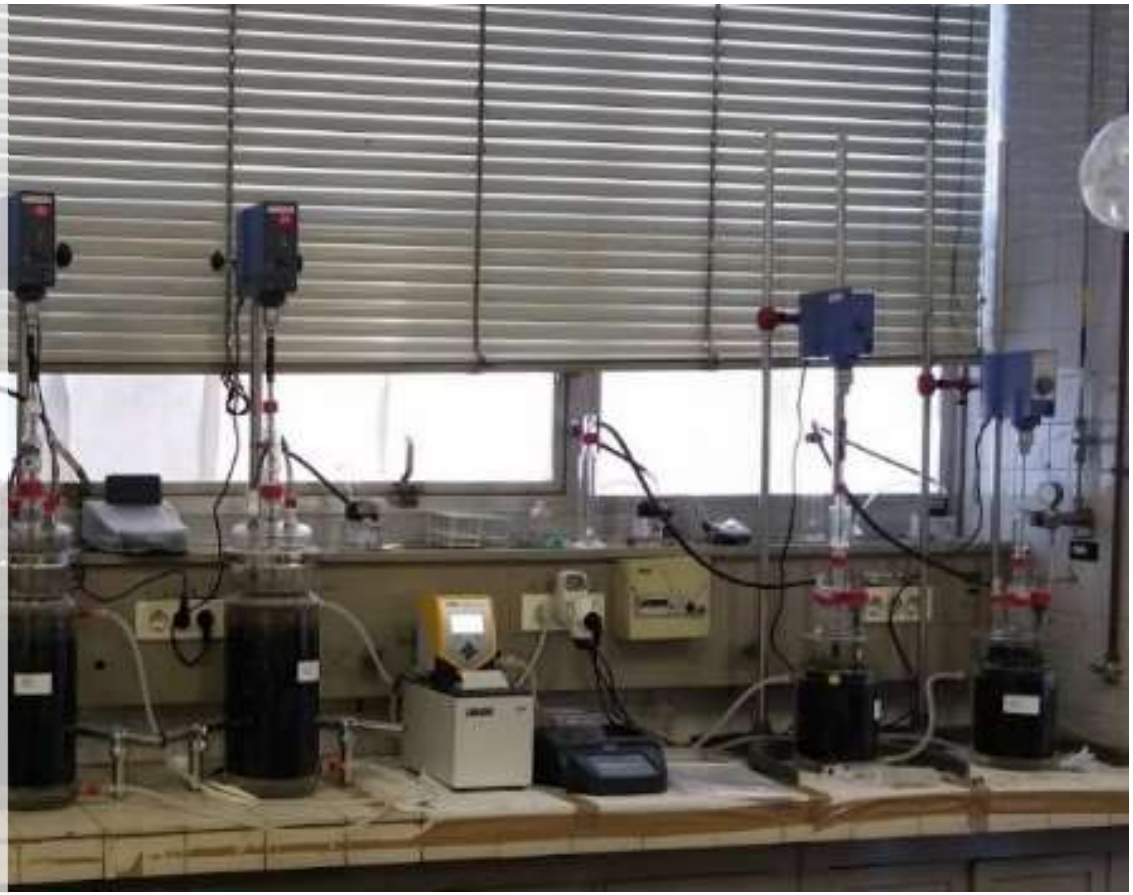
18-month continuous operation with magnetite

RESULTS

No consistency in the observed effect of magnetite with municipal sludge digestion

NanoParticles as an OPEX solution for enhancing achieved VSR :

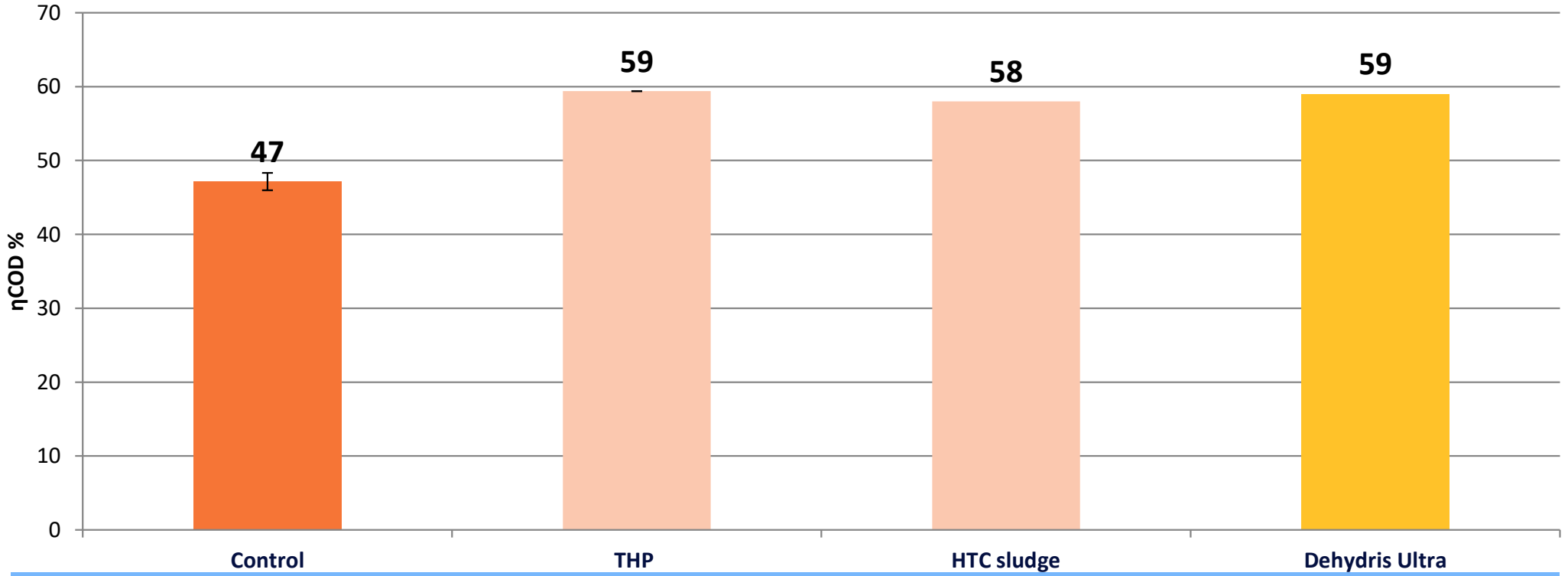
➔ *Abandoned*



4. Results

Thermal treatments

THP @165°C
HTC @185°C



ηCOD % THP / HTC up to +25%

No significant difference in performances between HTC and THP.

No significant difference in performances between HTC sludge or HTC liquor (Dehydris™ Ultra)

→ digestion only occurs on solubilized COD.

Conclusions & Learnings

Technology

THP & HTC

as the core technologies to increase bioavailability of digested sludge

Positioning

THP & HTC

allow similar performances in terms of biogas production (ηCOD~60%)

Selection

HTC

allows for high dewatering performances of the cake (~ 65%DS) without polymer

Conclusions & Learnings

Up to

75%

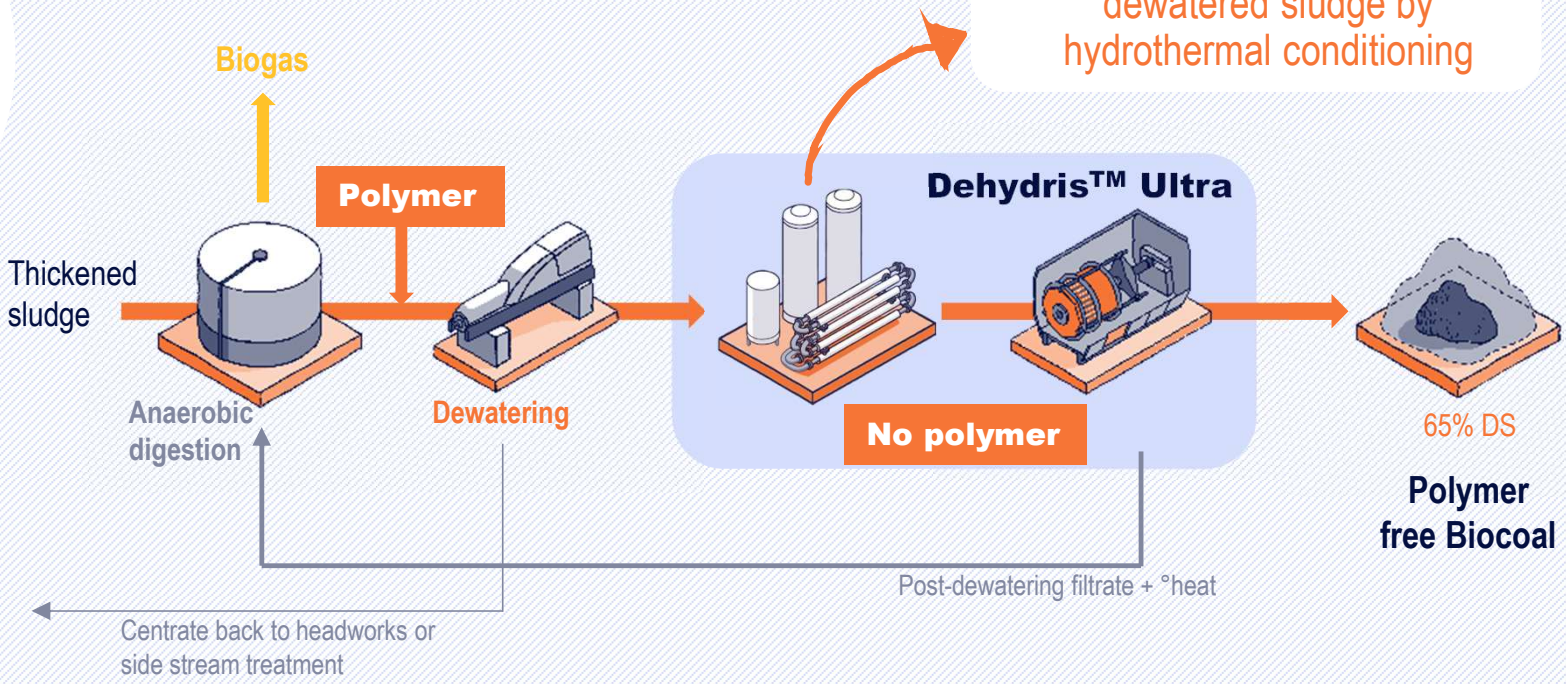
cake volume reduction

vs conventional

Synergy with digestion

100%

thermal energy self-sufficient



Destruction of the residual polymer contained in the dewatered sludge by hydrothermal conditioning

THANK YOU