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ECOMONDO
Progettiamo un mondo migliore.

LIFE project EN/IT/000345 Decentralized innovative treatment of ammonium-rich urban wastewater

Energy and carbon audit and efficiency in urban water cycle: towards standard methods and verified practice

An integrated assessment for sustainable nitrogen removal from industrial wastewater by decentralized biological processes

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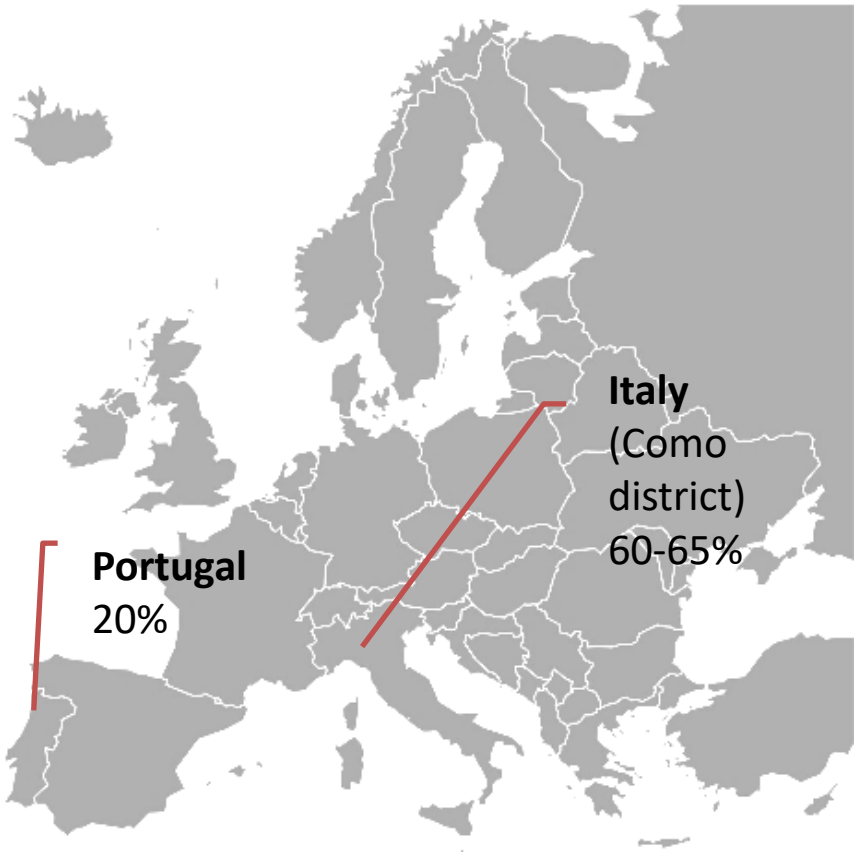
BACKGROUND
Global growth of Digital Textile Printing (DTP)

Digital textile printing growth in the last 15 years:



Average in Europe:
25%

BACKGROUND
Global growth of Digital Textile Printing (DTP)

Como textile industrial district:

In 10 years, DTP grew from 2% of total production to the current 60-65% (estimated to reach 85% within five years).

In the Como district, DTP is one of the responses to the difficulties in the textile sector linked to the global crisis.

BACKGROUND
NITROGEN: a new problem

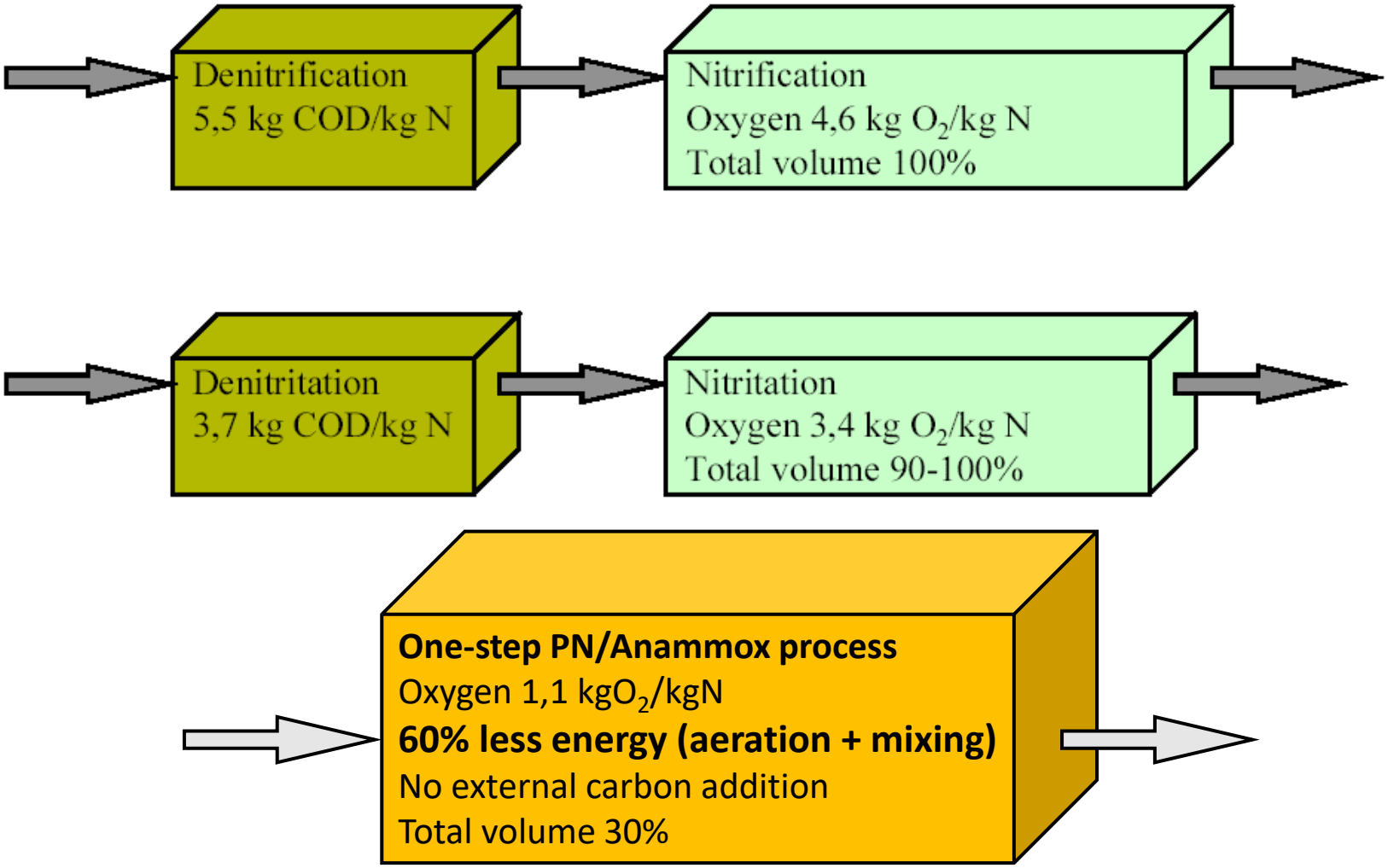
DTP has caused the emergence of new problems arising from pollution related to the printing process.

Compared to conventional printing processes:

- lower volumes of wastewater with lower COD and colour load
- higher N concentration (urea and ammonium: 150 to 600 mgN/L)
- lower COD/N ratio (about 2 gCOD/gN).

DTP is responsible of an increase of more than 200% of Nitrogen content in wastewater.

The LIFE DeNTreat technology and expected results
Cheap removal of N from N-rich wastewater



The LIFE DeNTreat technology and expected results
PN/Anammox process

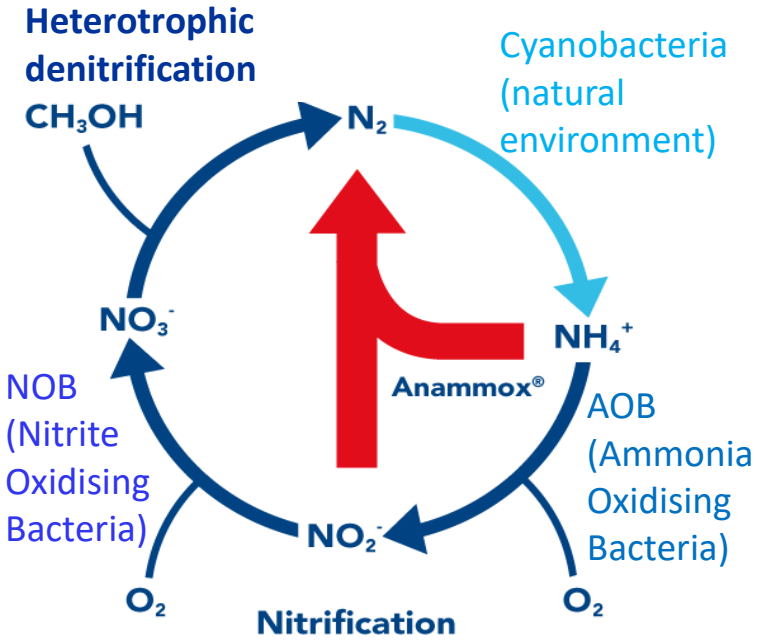
PN - Partial nitritation:

$$2NH_4^+ + 3O_2 \rightarrow 2NO_2^- + 4H^+ + 2H_2O$$

50% of N-NH_4^+ is converted

A - Anammox:

$$NH_4^+ + 1.32NO_2^- + 0.066HCO_3^- + 0.13H^+ \rightarrow 1.02N_2 + 0.26NO_3^- + 0.066CH_2O_{0.5}N_{0.15} + 2.03H_2O$$



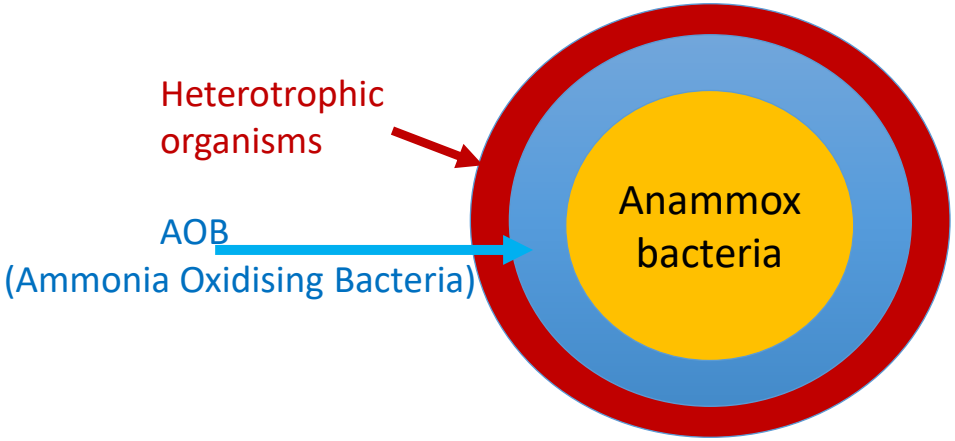
Cyanobacteria (natural environment)

NOB (Nitrite Oxidising Bacteria)

AOB (Ammonia Oxidising Bacteria)

Max conversion efficiency = **88,8%**

- ✓ Low O_2 consumption
- ✓ No external carbon dosing
- ✓ Lower sludge production



GRANULE STRUCTURE

Operation in progress at a textile digital printing factory in the Como area

demonstration plant operating with

PN/Anammox, TRL7,

processing up to 40 m^3/day of wastewater at

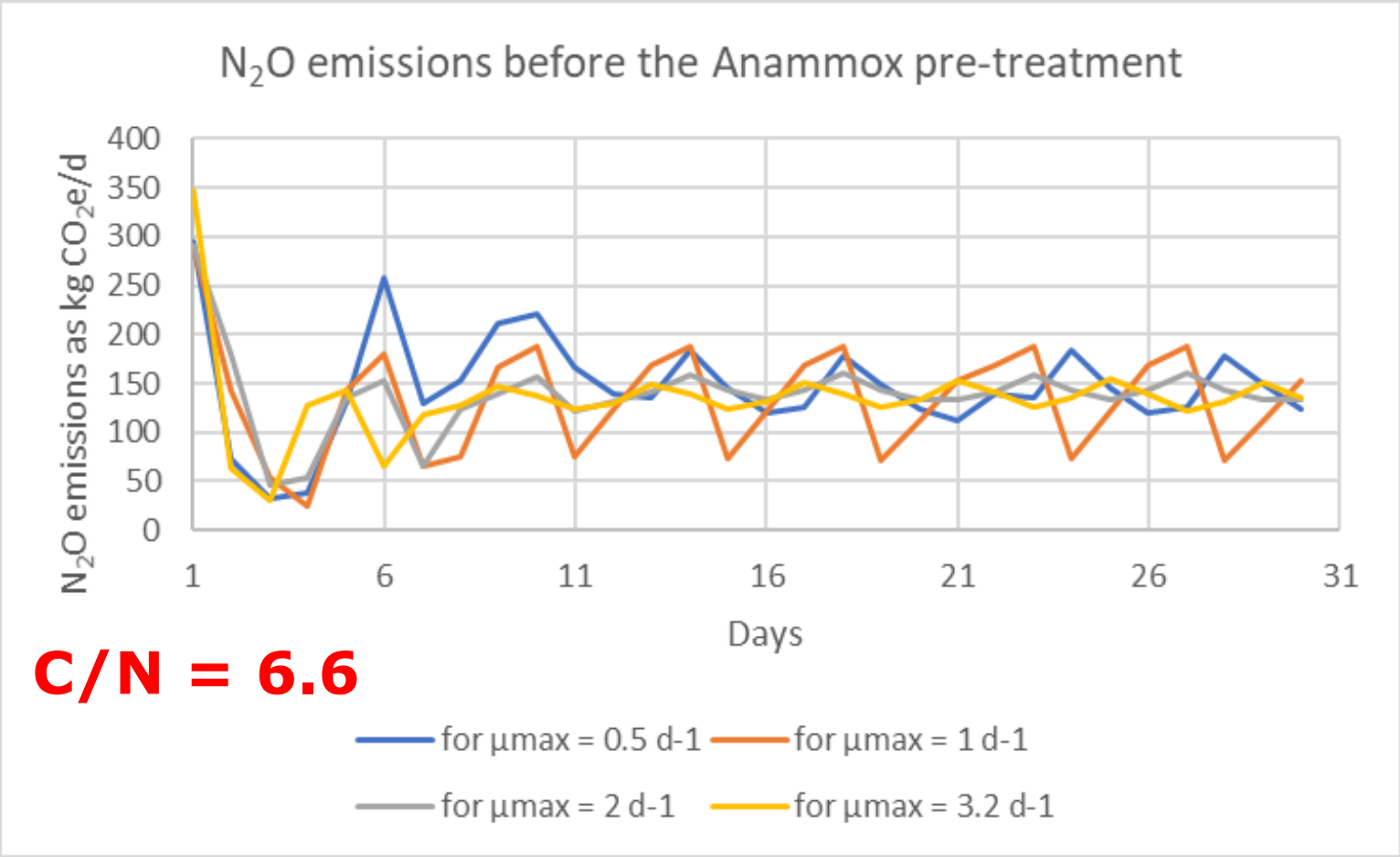
SCR (Stamperia Cassina Rizzardi)

After the project the demo-plant will be installed from time to time in the companies interested in adopting the new process in order to acquire knowledge and detailed specifications useful for the design and construction of the specific equipment intended for the given application.

Change of WWTP influent
after implementing FULL SCALE PN-Anammox process at SCR

Livescia influent characteristics	Situation	Scenario with PN/Anammox in operation
Flowrate (Average daily, m^3/d)	3800	3800
Total COD (mgCOD/L)	510	465
Total Kjeldahl Nitrogen (mgTKN/L)	75 – 100	35 - 50
Nitrate N (mgN/L)	1.45	1.4
pH	9.41	< 8

Change of KPI at the WWTP
after implementing FULL SCALE PN-Anammox process at SCR
results on simulations



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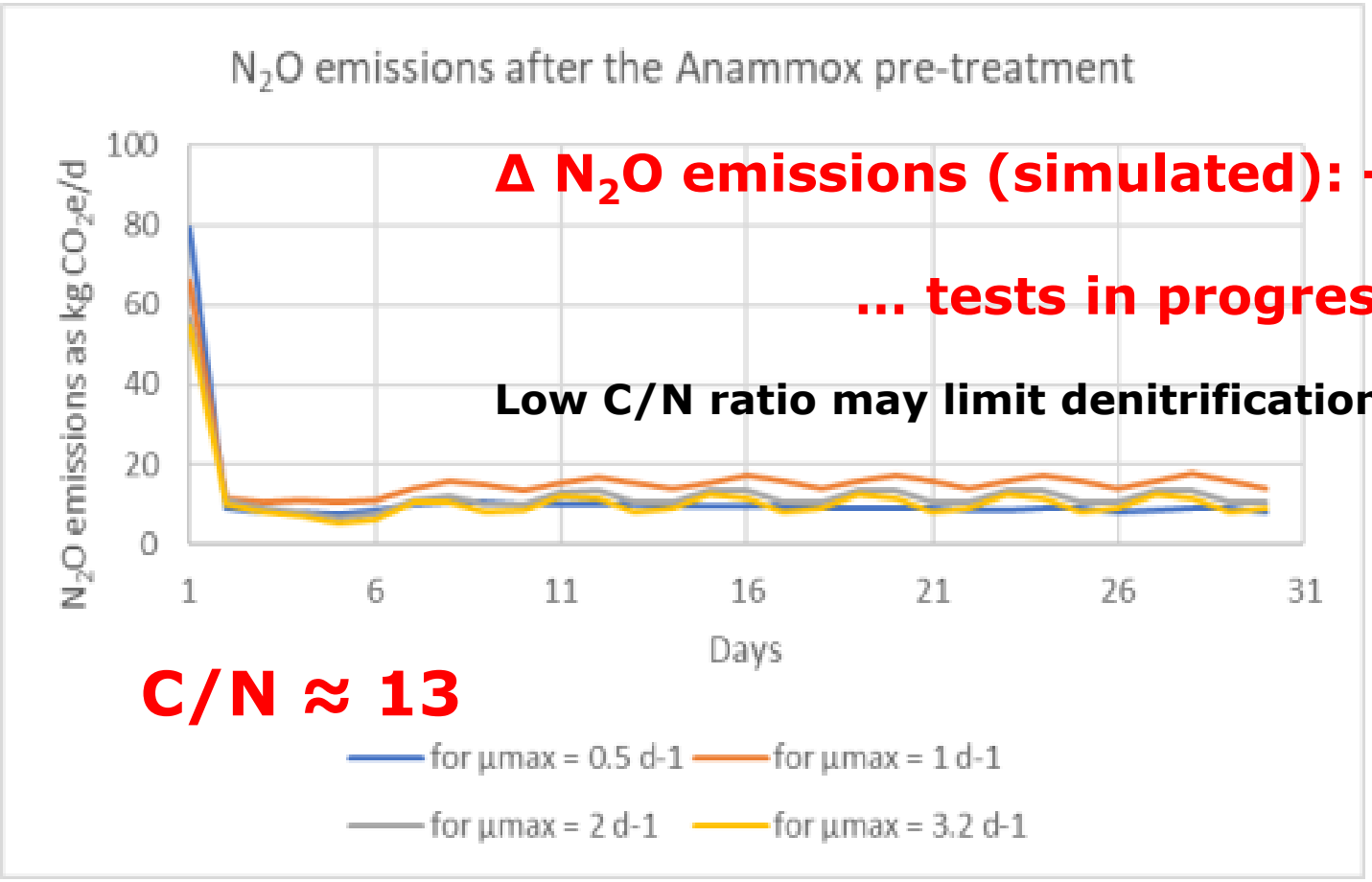


Δ N_2O emissions (simulated): - 80%

… tests in progress…

Low C/N ratio may limit denitrification

C/N ≈ 13

Change of KPI at the WWTP
after implementing FULL SCALE PN-Anammox process at SCR
results on simulations

	LIFE DeNTreat project demonstration plant (40 m^3/d) effect on total discharge	Full treatment of the wastewater from SCR factory (1200 m^3/d)
Energy	-2%	-15%
GHG emissions	-6% su N_2O	To be determined depending on operational conditions
Chemicals	-4%	-100%
Sludge	-3%	-25%

Change of KPI at the WWTP after implementing FULL SCALE PN-Anammox process at SCR results from simulations

Categories	WWTP before Anammox		WWTP after Anammox		Difference
	(€/h)	(€/m^3)	(€/h)	(€/m^3)	%
Power	10.68	0.08	7.17	0.047	- 41.25
Chemicals	46.71	0.31	1.26	0.008	- 97.4
Liquid sludge handling	5.85	0.04	2.99	0.02	- 50
Total cost of treatment	63.24	0.43	11.42	0.075	- 82.5

Without SBR PN-Anammox

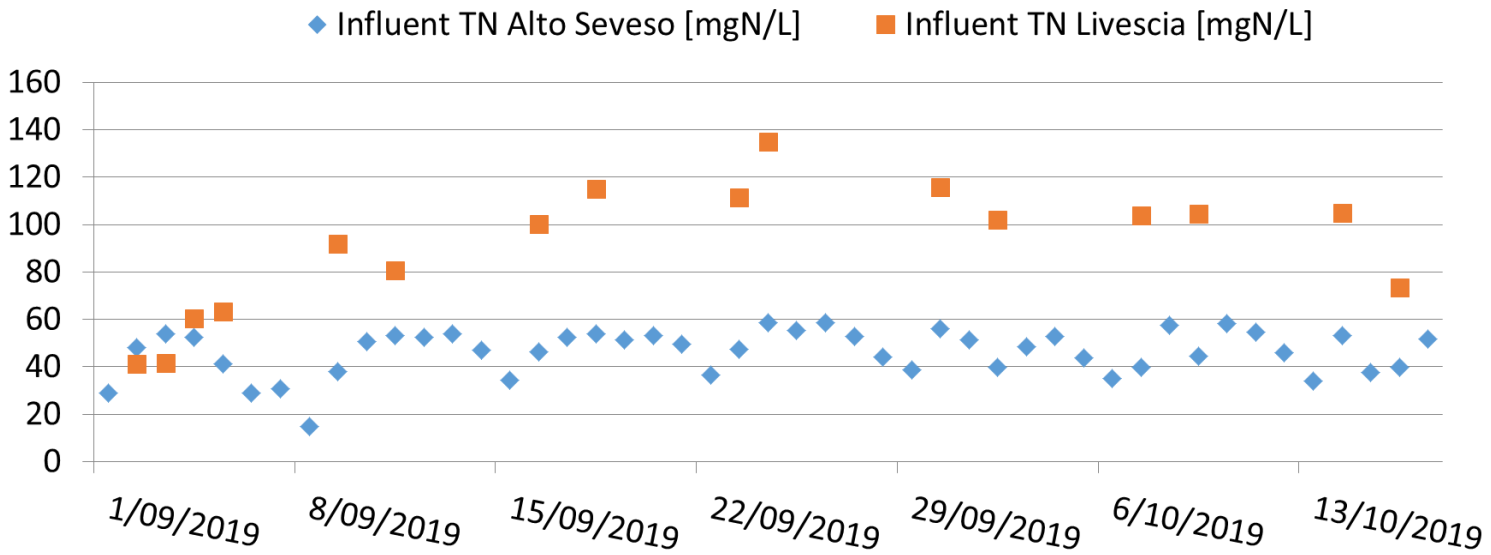
0.500 kWh/m^3

With SBR PN-Anammox

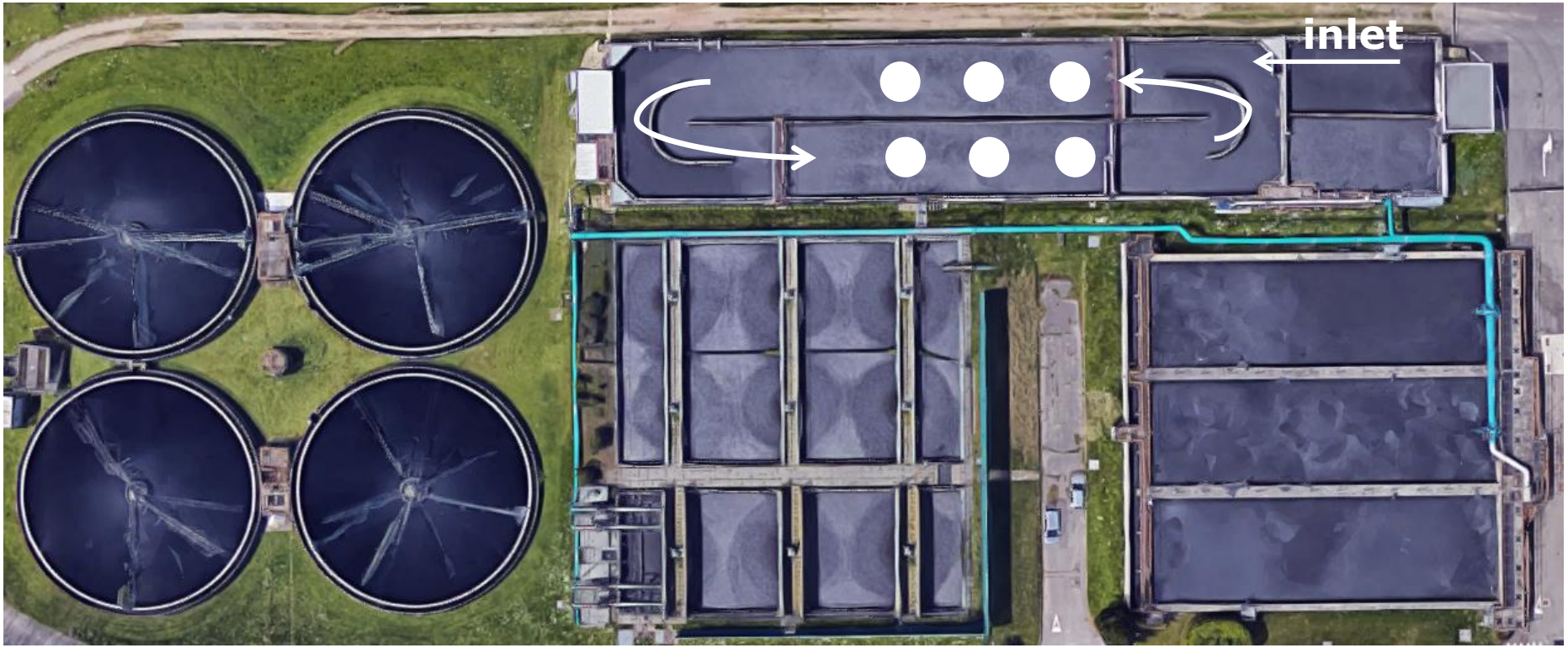
0.335 kWh/m^3

N_2O measurements at Alto Seveso

C/N = 5.08 (3-months average)



N_2O measurements at Alto Seveso



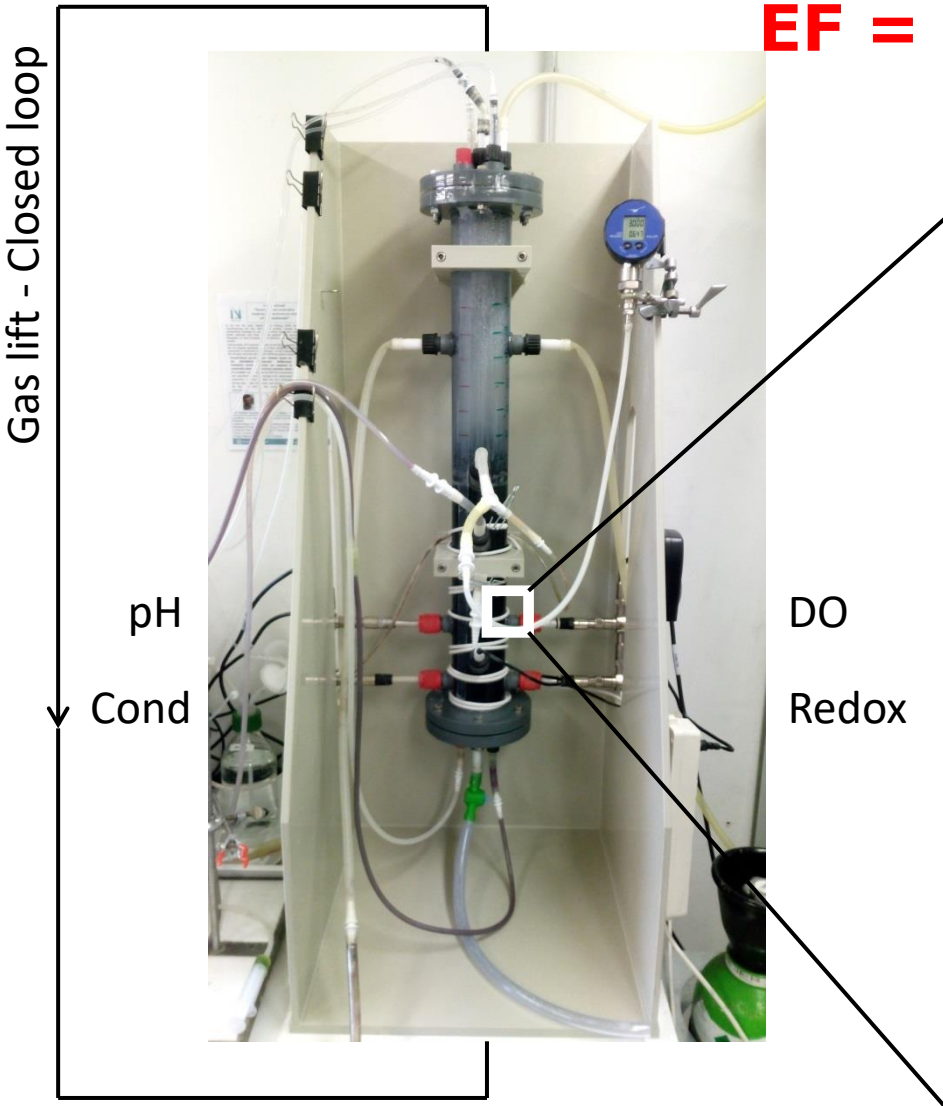
DO: from 0.3 (close to inlet) and 0.9 mg/L (end of aeration)

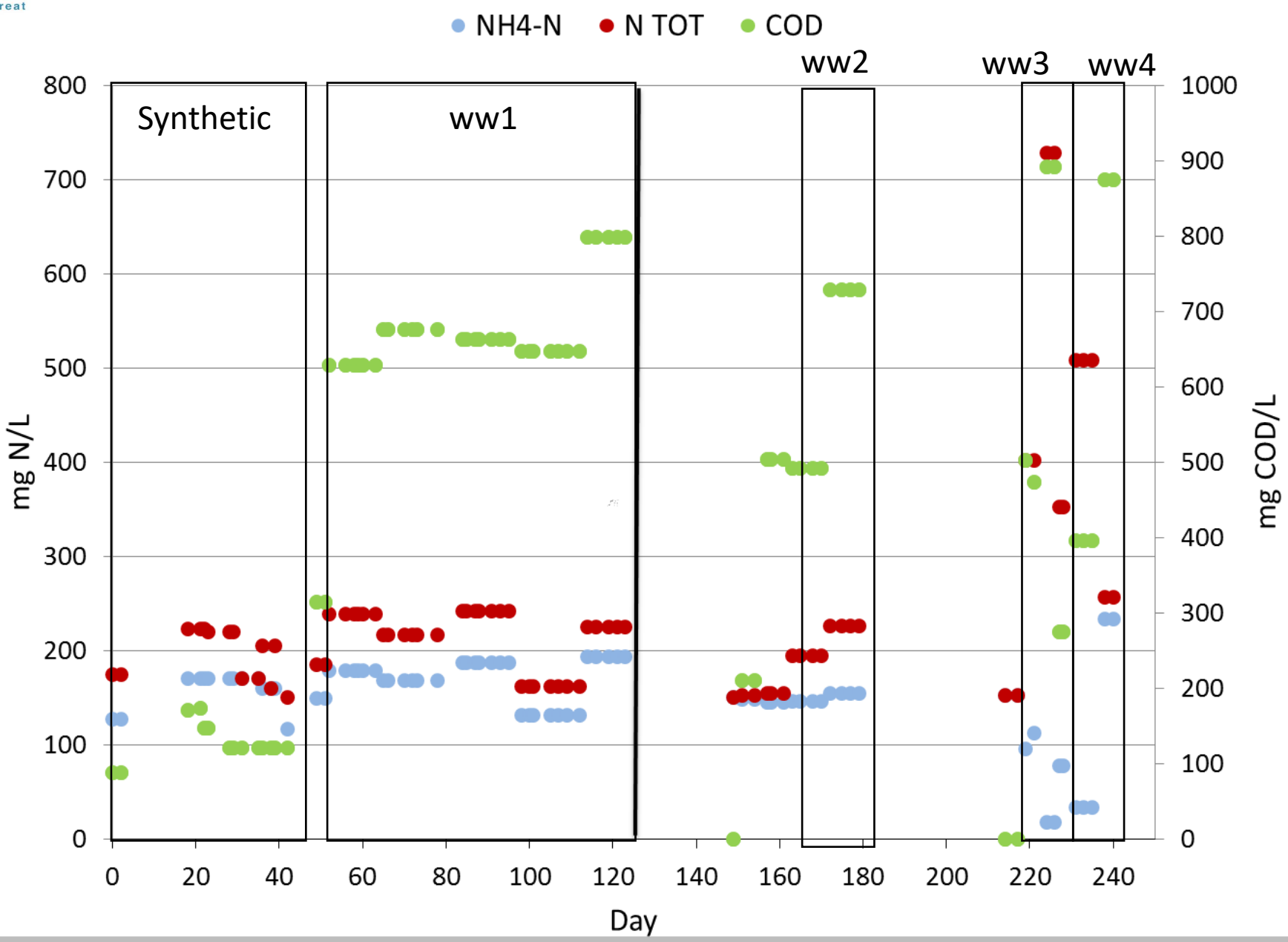
Conventional plants N_2O EF ~0.1-7%

EF = 0.55 % N-N_2O/$TN_{removed}$

N_2O emissions from PN/Anammox

EF = 0.01 % N-N_2O/$TN_{removed}$




NH4-N
N TOT
COD
Synthetic
ww1
ww2
ww3
ww4
mg N/L
mg COD/L
Day
0
100
200
300
400
500
600
700
800
900
1000
0
20
40
60
80
100
120
140
160
180
200
220
240

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