NITROUS OXIDE MEASUREMENT
IN A PILOT MABR
(Part of Watercare's efforts to reduce operational emissions)

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PRESENTATION OVERVIEW

- Background
- Pilot Project Details
- Results
- Key Learnings
- Future Work

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Background

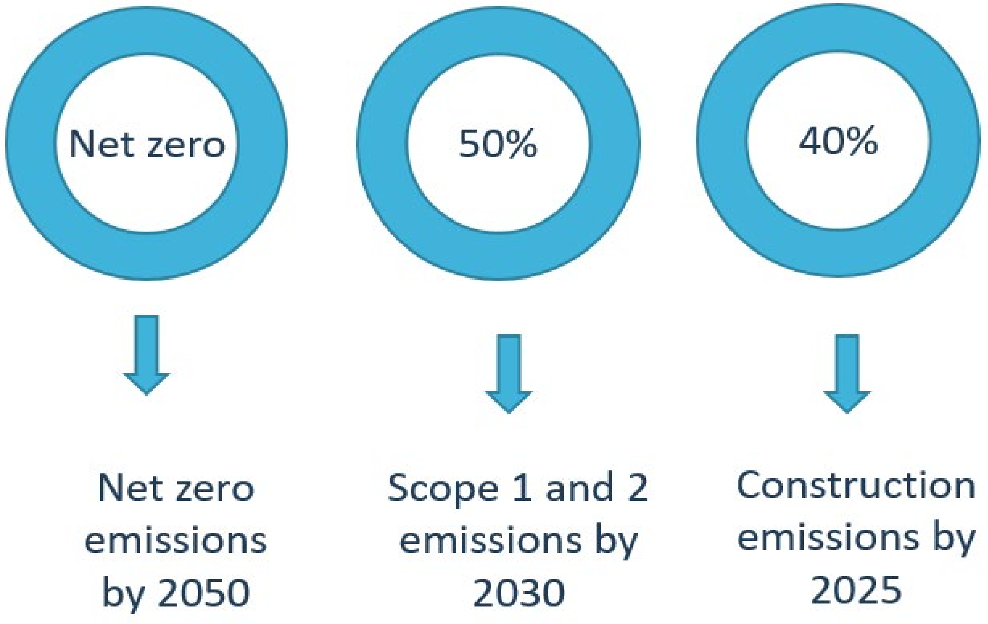
(a) GHG Emissions Targets

"The cumulative scientific evidence is unequivocal: climate change is a threat to human well being and planetary health.

Any further delay in action on adaptation and mitigation will miss a **brief and rapidly closing window of opportunity to secure a liveable and sustainable future for all**."

IPCC Sixth Assessment Report, 2022

Watercare Commitments



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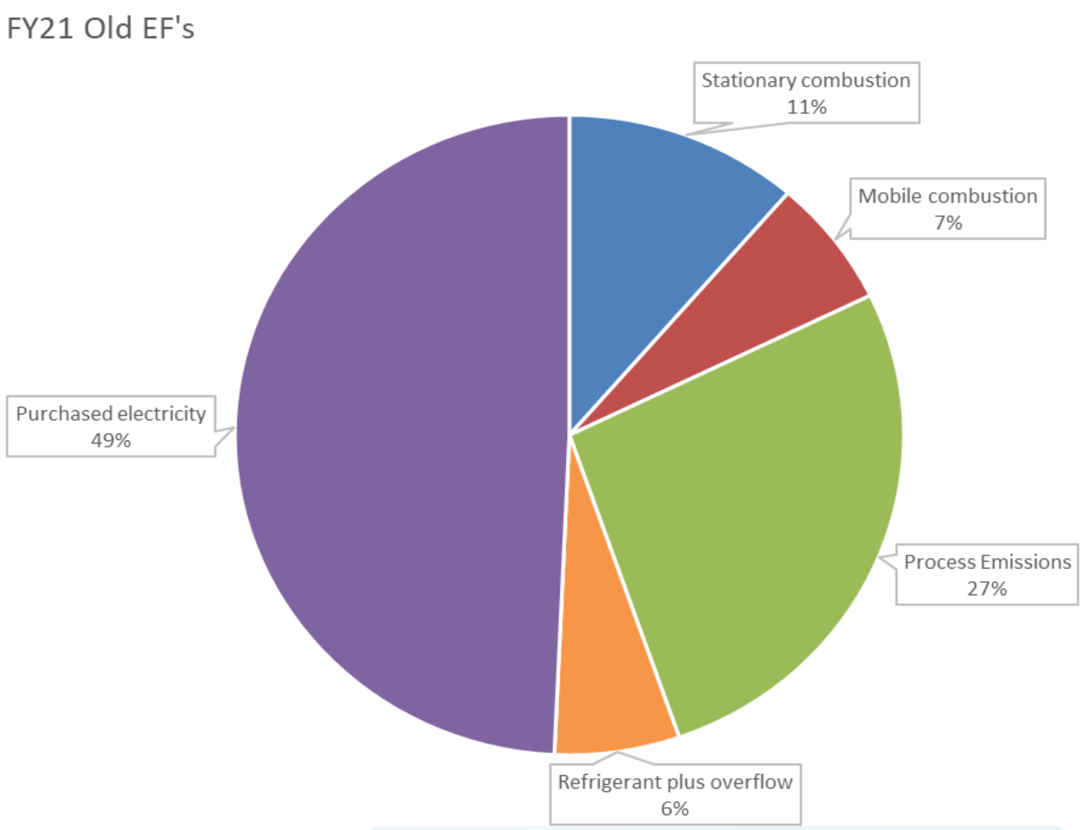
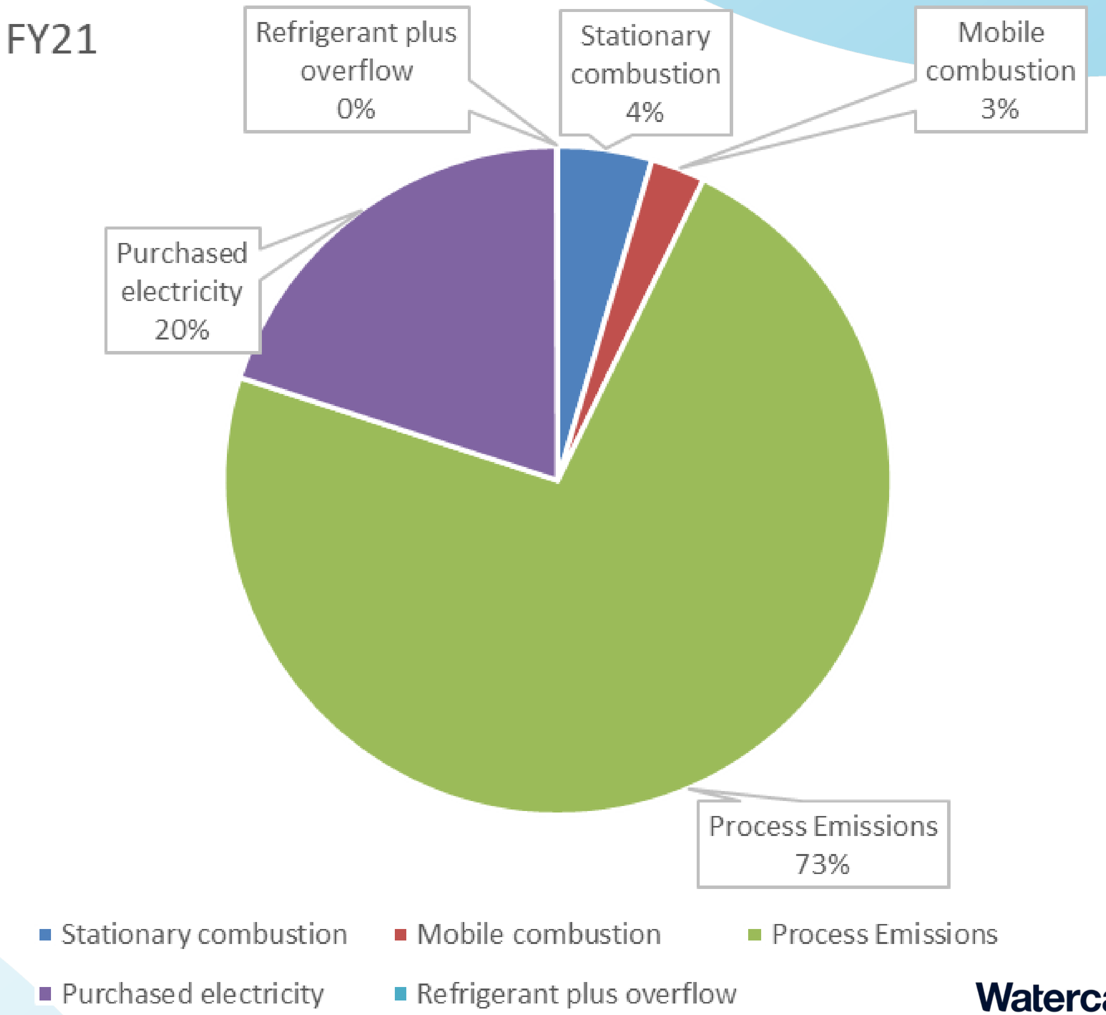
Background

(b) Operational Emissions





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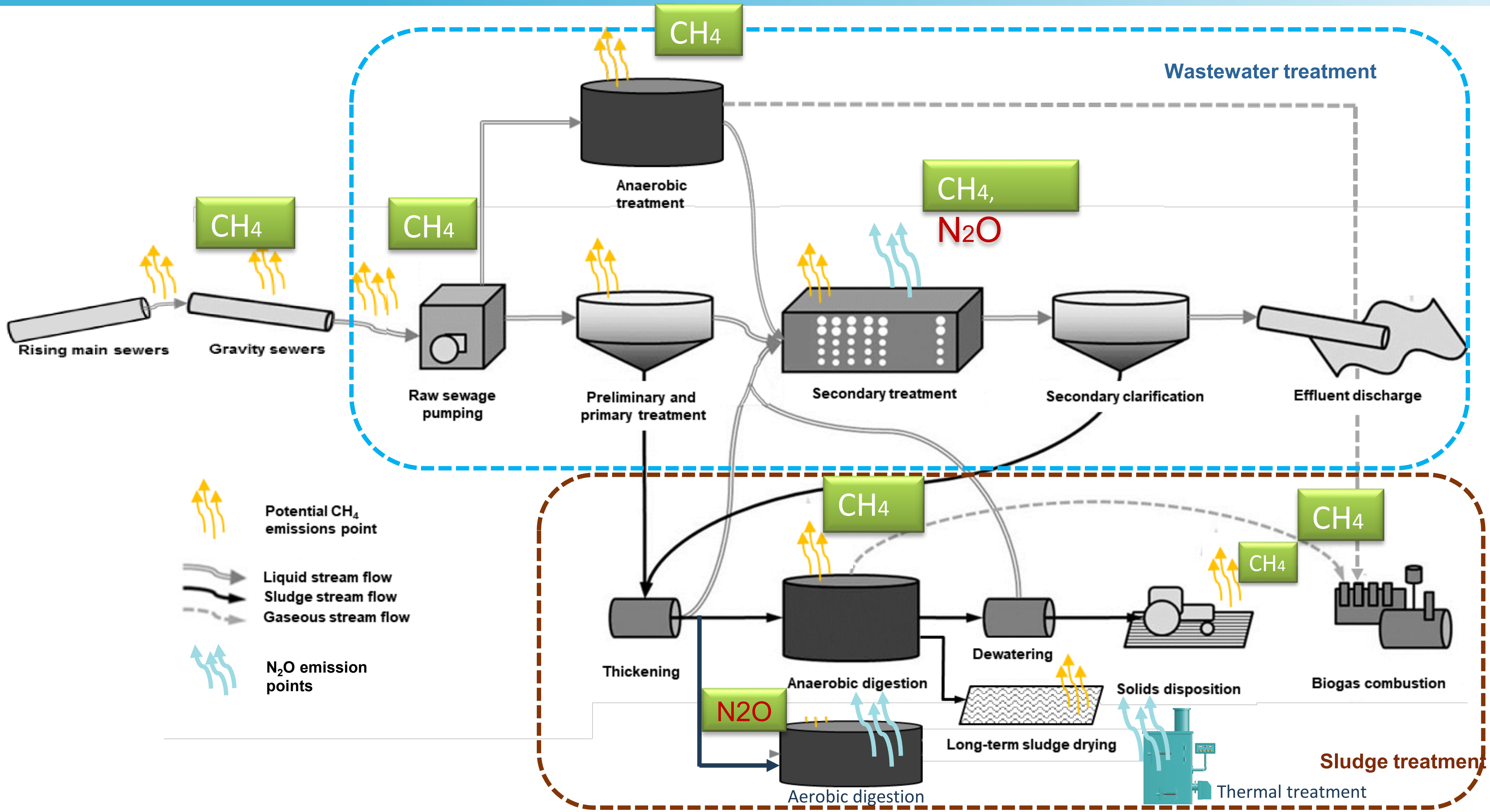
Background

(c) WHERE THE EMISSIONS COME FROM



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Background

(d) Watercare Emissions Strategy

- Develop reduction roadmap
- Monitor emissions from existing processes to establish baseline
- Investigate technology solutions to reduce emissions on new assets
- Develop mitigation strategies to reduce emissions on new and existing WWTP's

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Pilot Project Details

(a) Membrane Aerated Bioreactor – why pilot for N2O

- MABR claimed to have lower N2O emissions than other “high rate” processes
- Good environment to test equipment and learn how to use it
- Pilot infrastructure already established and equipment already running

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Pilot Project Details

(b) Goals

- Establish an emissions factor for hybrid MABR
- Look for cause and effect in data sets
- Learn how to use measurement equipment and how to manage data
- Learn about what can be applied to full scale measurements

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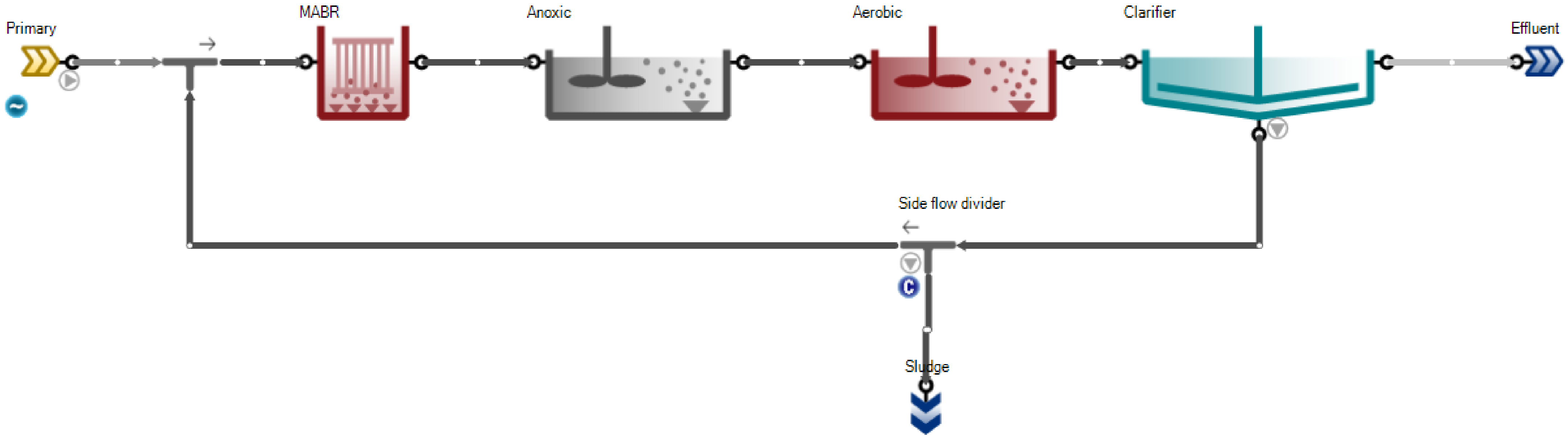
PILOT PROJECT DETAILS
(c) Reactor layout



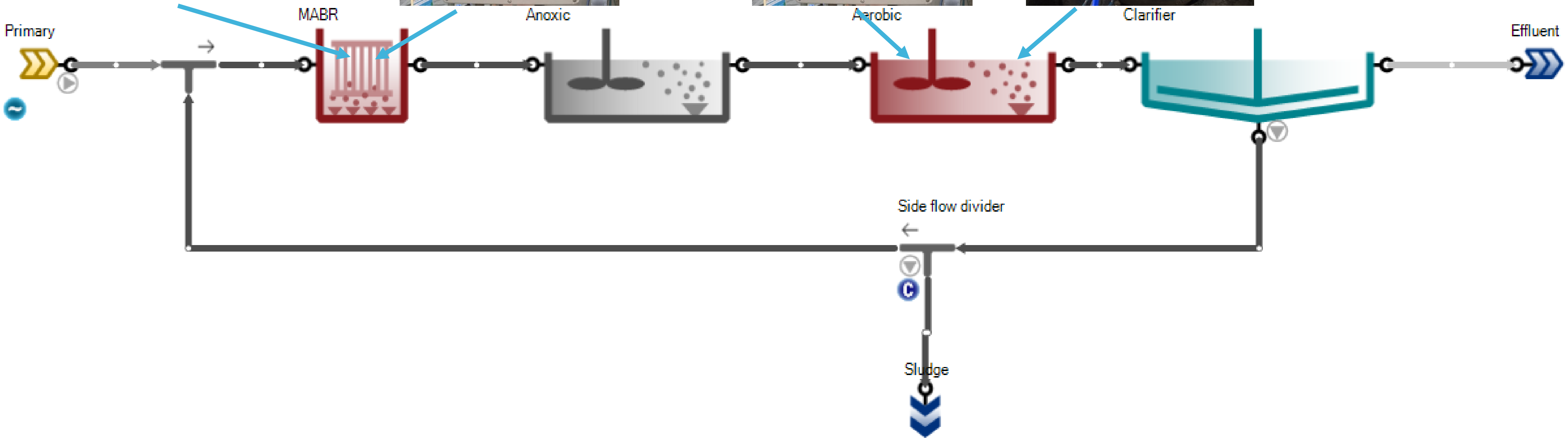
PILOT PROJECT DETAILS
(d) N2O Monitoring Equipment

MABR Offgas

MABR Liquid

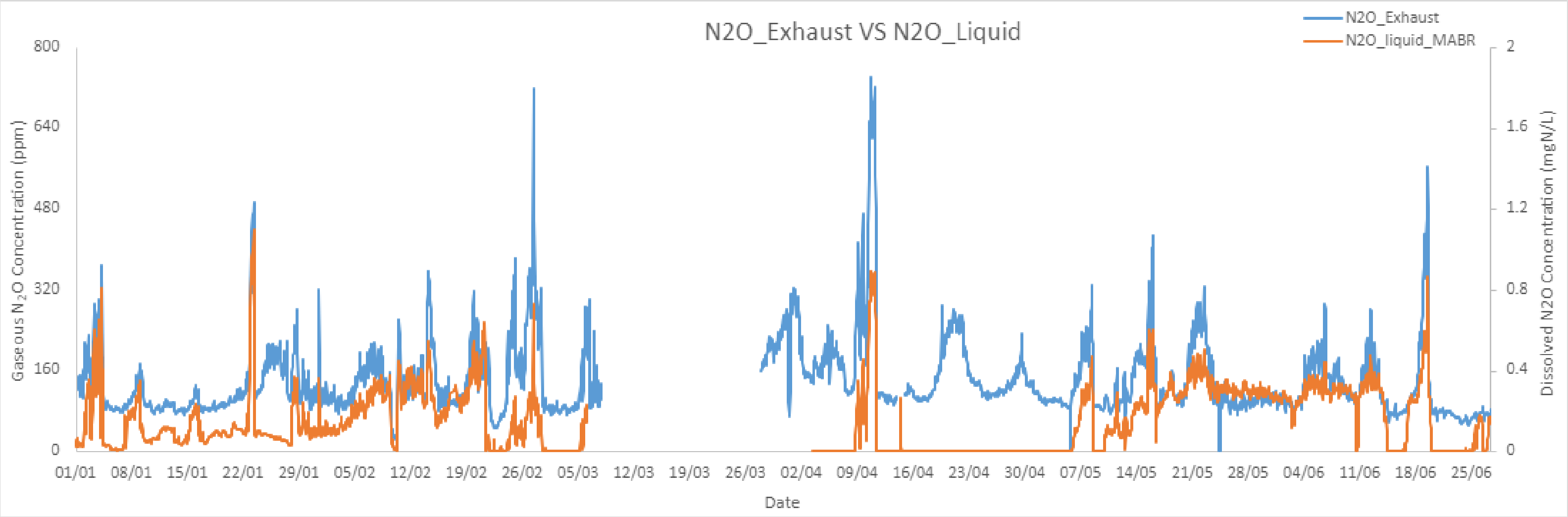
AS Liquid

AS Offgas



(i) RESULTS
Raw Measurements

Raw Measurements



Key Points:

- N2O production quite variable, even though most operating conditions are constant
- High dissolved N2O always equals higher gas phase concentrations
- When no liquid phase N2O there is still gas phase N2O

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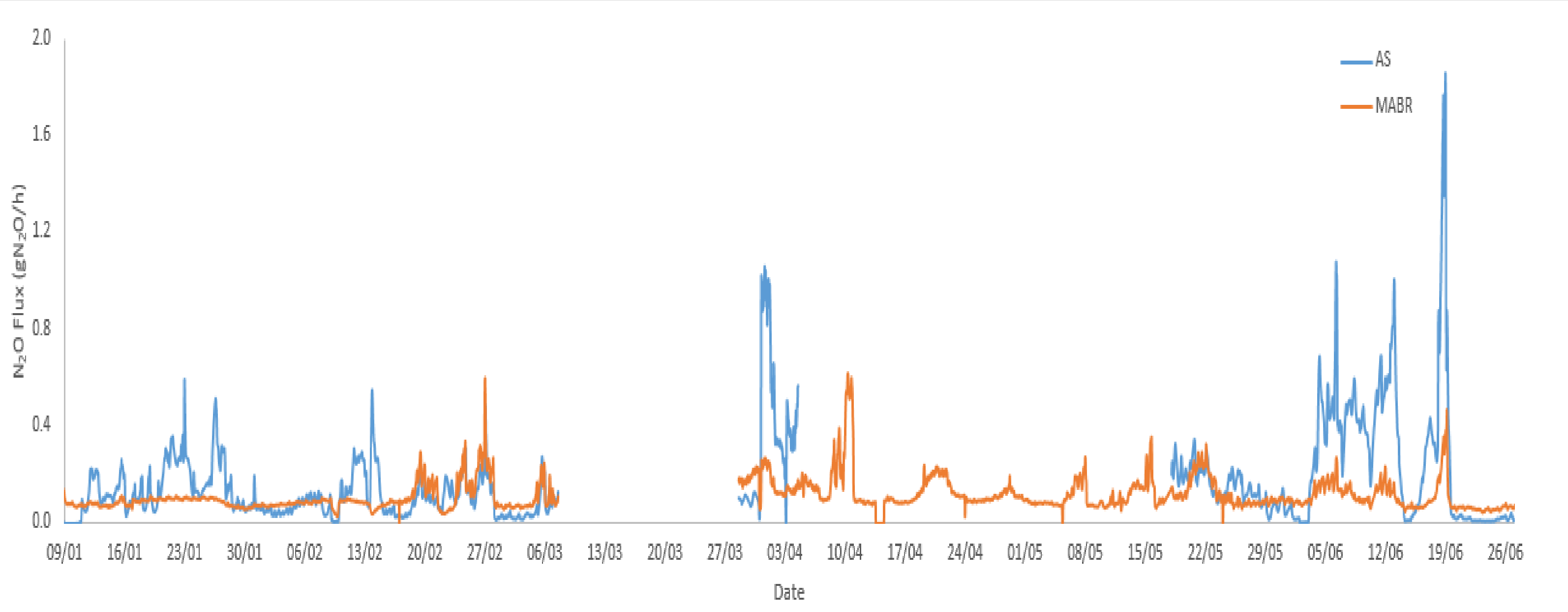
(ii) RESULTS
N2O Flux



Key Points:

- N2O production in AS looks higher than in MABR (given AS does less work)
- AS emissions affected by upstream dissolved N2O
- Periods where AS is a lot higher than MABR

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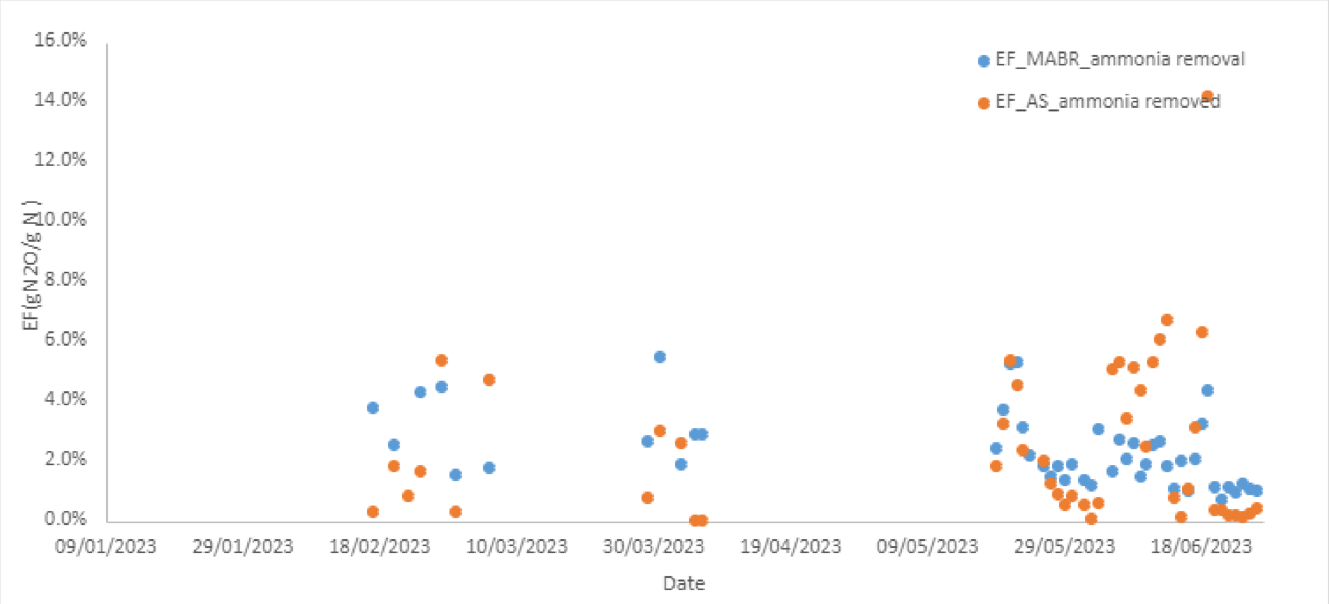
(iii) RESULTS
Emissions factors (IPCC and NGERS)



Key Points:

- Emissions factor for whole system about 2% (0.02gN2O/gN)
- MABR and AS factors are variable
- How different is the measured factor to other processes?

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KEY LEARNINGS

- Need a carrier gas in some conditions
- An understanding of mass transfer is critical
- Treat quoted emissions with caution
- Operational conditions may be more important than the process

FUTURE WORK

- ☑ Detailed cause and effect experiments undertaken
- ☑ Mechanisms for N2O in MABR and AS identified
- ☑ Mitigation strategies formulated and tested (up to 90% reduction)

- + More work with modelling needed to test scenarios
- + Full results to be published in early 2024

SUMMARY

Established our first measured emissions factor for N2O

Gained an understanding of how instrumentation works

Developed cause/effect relationships and mitigation strategies

Established that details on operational conditions are needed to understand data

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THANK YOU

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