

VARIOLYTICS

Making the invisible visible

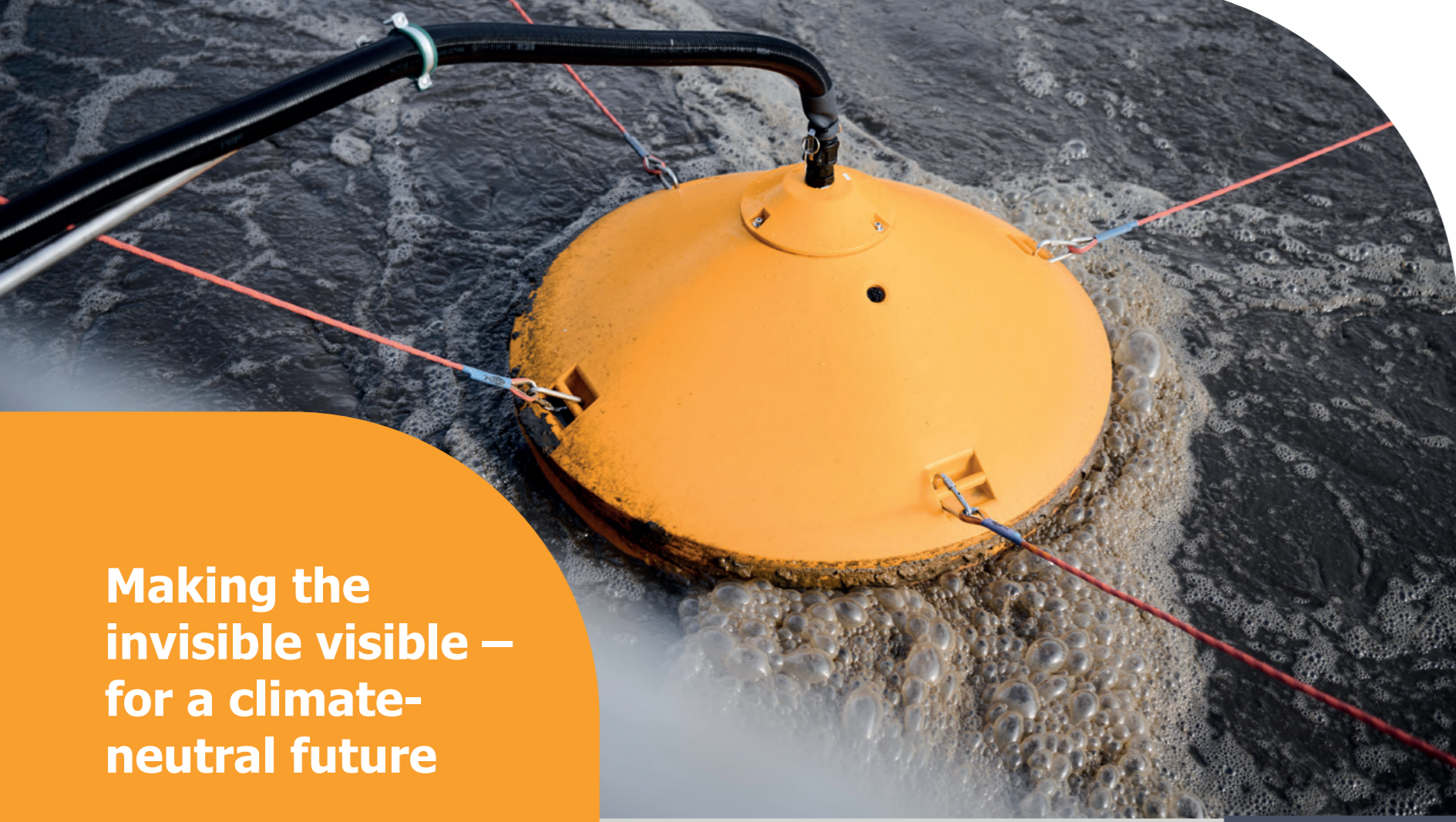
Measure  
Understand  
Optimize



**Make emissions visible.**  
**Enable precise, data-driven  
process control**

With EmiCo lite & EmiCo Insight –  
Integrated measurement and analytics solution  
for optimized wastewater treatment





# Making the invisible visible – for a climate-neutral future

Understand when your plant generates emissions and how to reduce them effectively.

Measurement system and analytics platform for wastewater treatment plants



EmiCo **lite**

EmiCo **Insight**

## The Challenge

### Nitrogen removal is a climate strategy

Biological nitrogen removal is not only critical for effluent quality, it also has a major impact on the carbon footprint of a wastewater treatment plant.

Nitrous oxide (N<sub>2</sub>O) is formed as an intermediate product and has a global warming potential around 273 times higher than CO<sub>2</sub>.

# 50%

Up to 50% less CO<sub>2</sub>e through data-driven plant operation

## What operational data reveals

- N<sub>2</sub>O can account for a significant share of total emissions
- Emissions occur during process instability and impaired nitrogen removal
- Even small deviations can have a major impact

## The real problem

- Emissions remain invisible during operation
- Process conditions are not linked to emissions
- Optimization happens without direct feedback

Anyone who considers nitrogen only as an effluent parameter **misses valuable optimization potential**

## The Solution

One system – two components

### EmiCo lite

EmiCo lite (hardware)

- > Measures real emissions directly in the process
- > Installation in under 2 hours
- > Maintenance effort below 1 hour per year

### EmiCo Insight

EmiCo Insight (software)

- > Cloud-based solution
- > Makes emissions understandable and actionable

Only the combination of hardware and software enables true process understanding.

## The key difference

Emissions become a controllable process signal.

## Why this matters

N<sub>2</sub>O is not just an emission – it is an early warning signal for process instability

Emission = diagnostic tool + control parameter

## How the system works From measurement to optimization



### EmiCo lite – measure

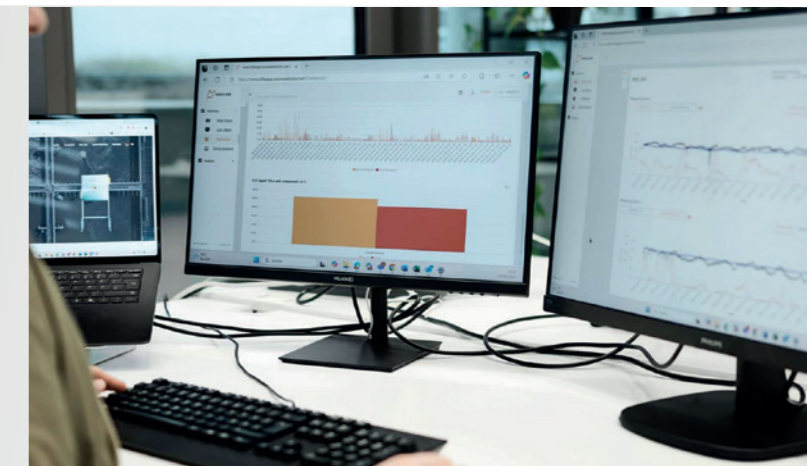
- Continuous off-gas monitoring
- Direct measurement within the process
- Real data instead of model-based estimates

measure

### EmiCo Insight – understand

- Links emissions with process data
- Analyzes biological interactions
- Identifies emission drivers

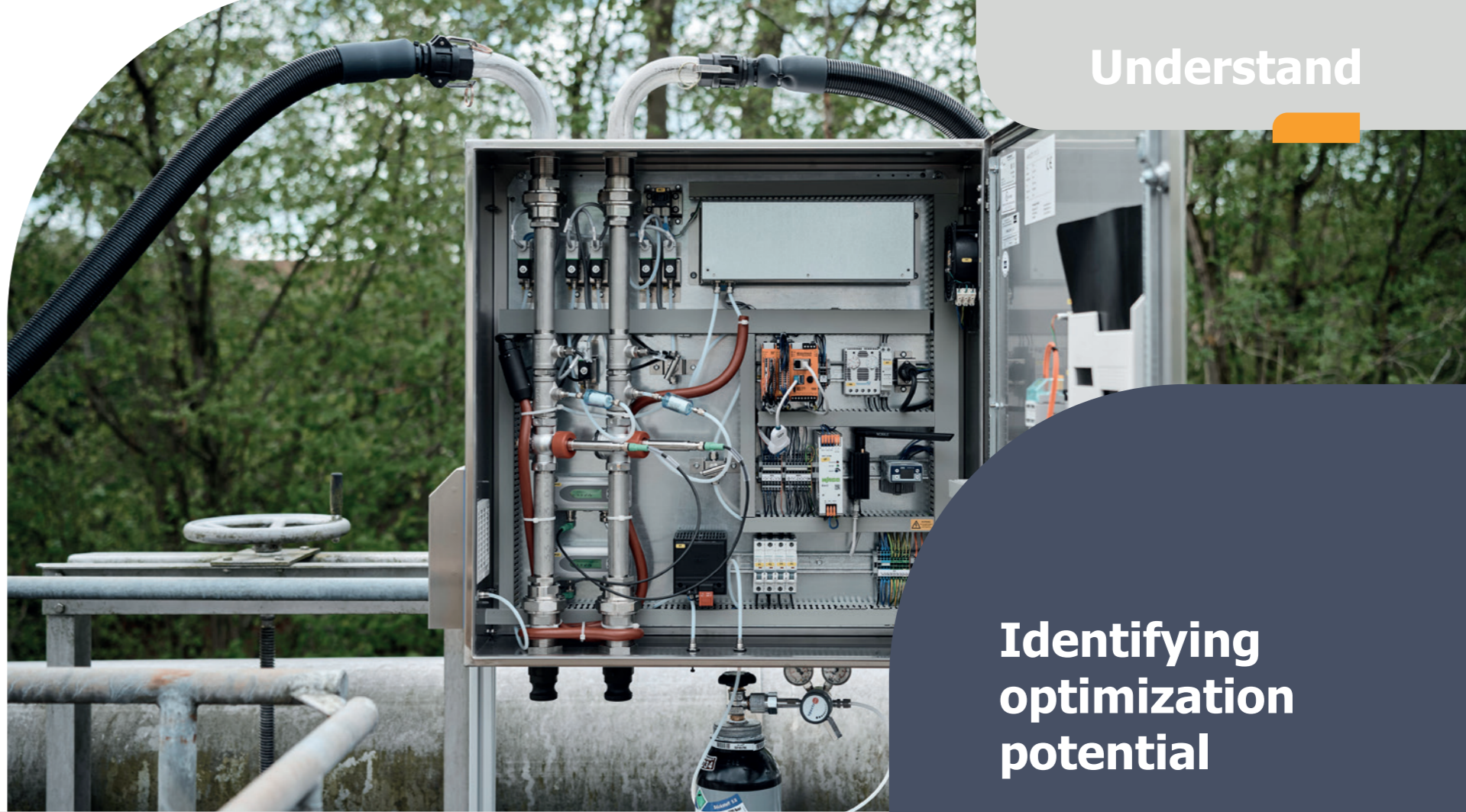
understand



### EmiCo Insight – optimize

- Classifies “good” and “bad” operating states
- Derives concrete actions
- Enables continuous improvement

optimize



## What the data really shows

**Emissions reflect the actual process behavior**

## Identifying optimization potential

Shock loads lead to:

- $\text{NH}_4^+$  peaks
- Unstable nitrification
- Increased  $\text{N}_2\text{O}$  formation
- Poorer effluent quality

Stable operation enables:

- Consistent inflow
- Optimized aeration
- Complete denitrification
- Improved effluent quality

## Key insight

Emissions occur whenever the biological reaction chain is incomplete:

- Incomplete nitrification
- Incomplete denitrification
- Disrupted process transitions

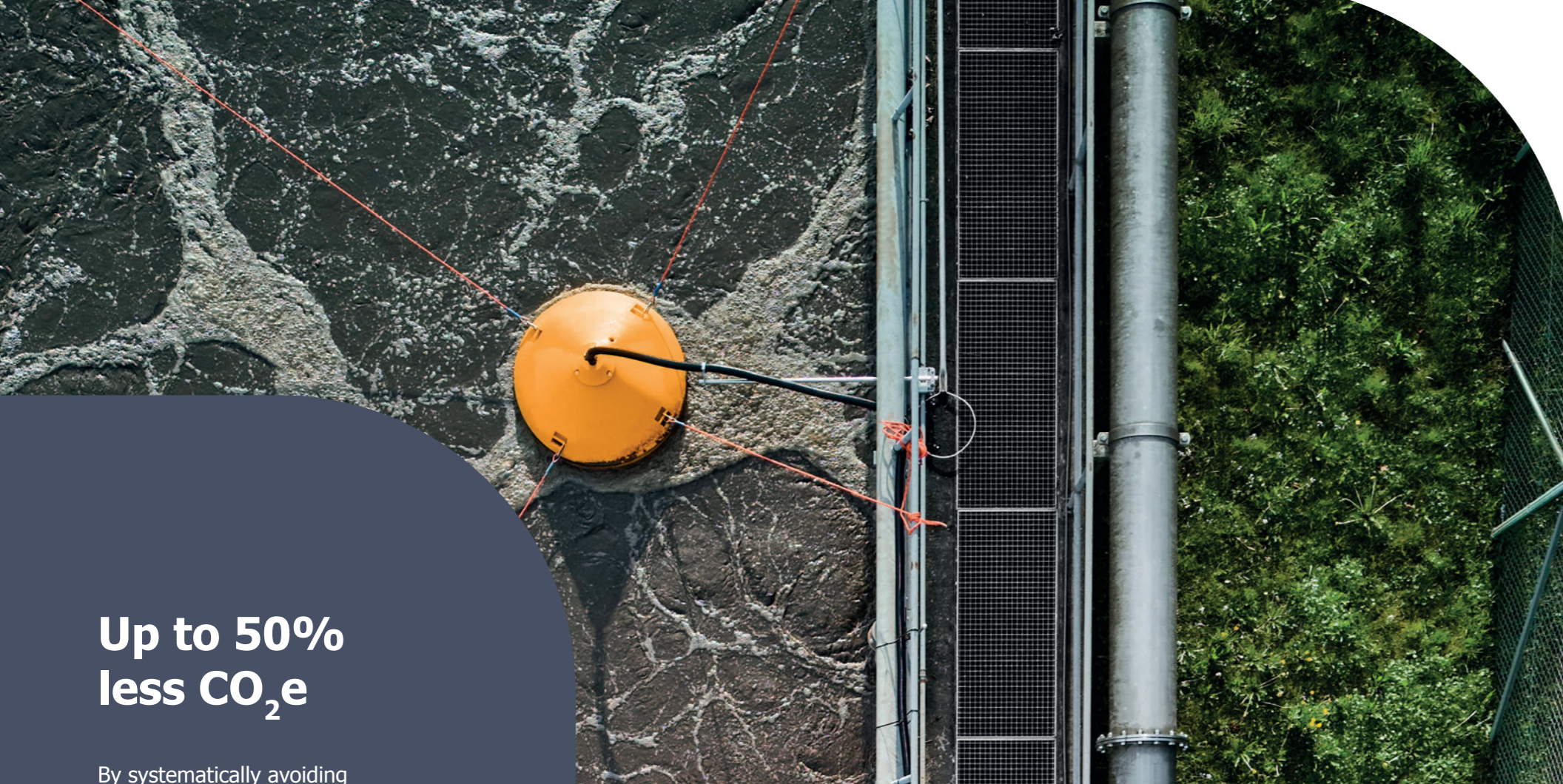
## Main drivers

- Oxygen limitation or excess oxygen
- Load peaks (e.g. nitrite and nitrate accumulation)
- Carbon deficiency (C/N ratio)
- Insufficient sludge age

**These factors directly determine emission levels**

## Why continuous monitoring matters

- Seasonal conditions strongly influence overall emissions
- Emissions occur in short-term peaks
- Average values mask real problems



## Up to 50% less CO<sub>2</sub>e

By systematically avoiding emission-intensive operating conditions, nitrogen removal is stabilized and nitrous oxide formation is reduced.

This can cut total greenhouse gas emissions in half and significantly lower the plant's carbon footprint.

## Emissions are controllable once they are visible

## How the data is processed

### Hardware

#### EmiCo **lite**

EmiCo lite measures emissions directly at the water-air interface.

#### Why off-gas measurement matters

Unlike DO-based approaches, the system measures what is actually happening biologically not just what is being supplied.

However: measurement data alone does not yet deliver optimization.

### Software

#### EmiCo **Insight**

The software enables:

- Linking operational data with emissions
- Real-time extrapolation of total emissions
- Determination of emission factors
- Identification of unfavorable operating conditions
- Concrete optimization recommendations

**Key benefit:**  
**Significant time savings through integrated analytics**



## What this enables

- Targeted process control
- Stable nitrogen removal
- Reduced emissions

## Process and energy optimization

Off-gas data also enables:

- Optimization of aeration
- Reduction of energy consumption
- Avoidance of oxygen oversupply

Savings potential of up to **20% in aeration energy consumption**

**Our approach**  
Measure | Understand | Optimize

**We turn emissions into a controllable parameter.**  
**Start your pilot project now.**

Fast installation

Real data

Clear optimization levers

### Optional: On-premise solution (alternative to cloud)

For maximum data sovereignty:



Fully offline operation



Integration via OPC UA / MODBUS



Local analytics (container-based solution)

**Full control over data and IT systems**



# Measure Understand Optimize

VARIOLYTICS

## About Variolytics

Variolytics develops technologies that make emissions visible, measurable, and controllable.

## Contact

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