



# Process optimization for minimizing the usage of water in the dairy industry

(R. Lutze, T. Weisser and N. Poertner)

Technology for Water



**ENVIROCHEMIE**

**IDF WORLD DAIRY SUMMIT 2022**

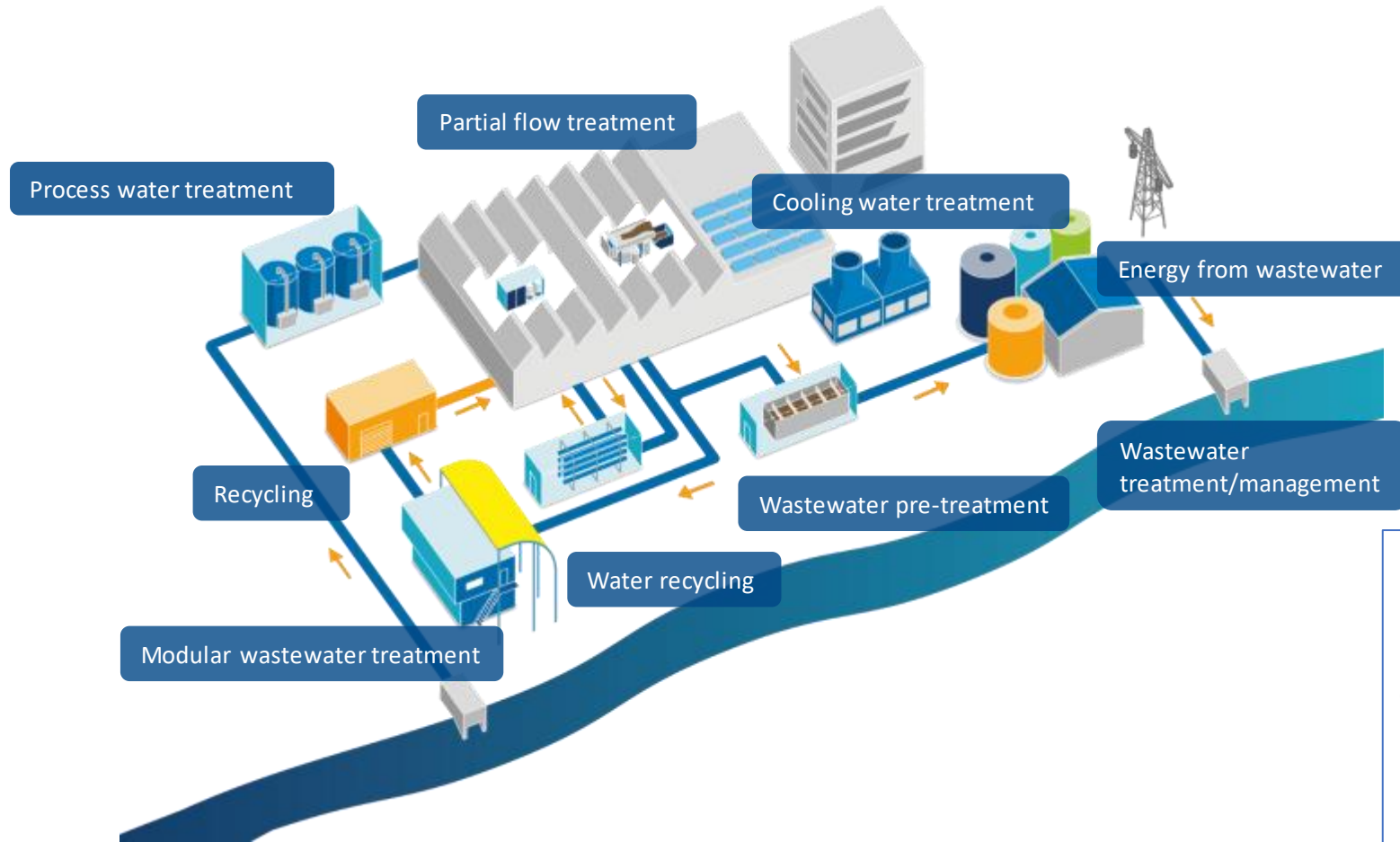
Dairy for Nutrition & Livelihood

September 12 - 15

  
**#Milkismore**



# Short introduction of our company - Water and wastewater Treatment for Industry



Technology for Water  
**ENVIROCHEMIE**

## EnviroChemie

> 45 years of experience

Total output of 225 million euros

1,000 engineers and experts

all water treatment processes in the portfolio

individually assembled plants

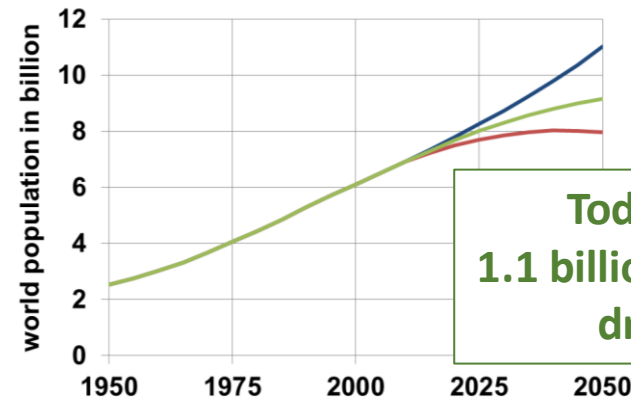
# Introduction

- Importance of efficient water use/ water reuse
  - What are the needs?
  - What are the possibilities?
  - What are the barriers?
- Project examples of succesful implementations
  - Treatment of cow water
  - end-of pipe solution
- Conclusions and outlook



# Major worldwide (water) challenges

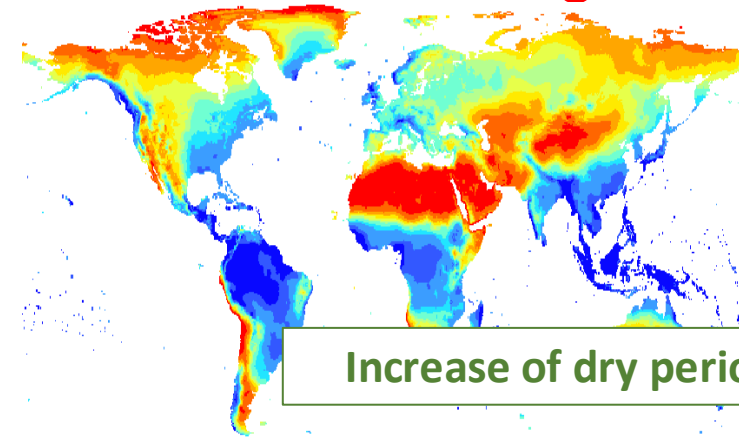
## 1. Population Growth



Today worldwide:  
1.1 billion humans without  
drinking water

[Data: UN/DESA, 2010]

## 2. Climate Change



Increase of dry periods?

[IWMI, 2013]

## 3. Urbanisation



Increase of mega cities  
with > 10 million citizens  
→ Local water stress

[Burdett & Rode, 2007, cf. Cornél and Bieker, 2013]

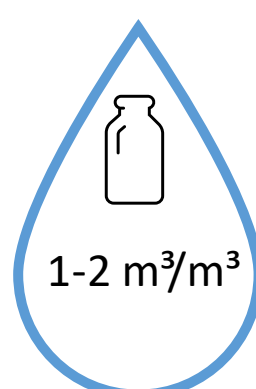
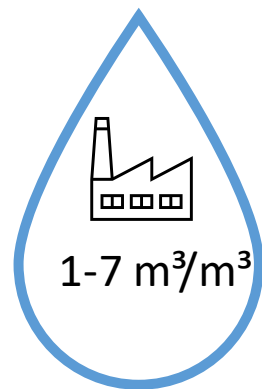
## 4. Limited Resources



Jialing/Chongqing 2006;  
[www.zeitenschrift.com/magazin/54-wasser.jp](http://www.zeitenschrift.com/magazin/54-wasser.jp)  
26.5.2013

# The dairy industry and its water needs

Water demand (in m<sup>3</sup> water per m<sup>3</sup> processed milk)



## Challenges for dairy industry

- Reduction of water footprint
- Increased water consumption due to frequent product change
- Lack of water with the necessary quality and quantity
- Water scarce regions

(Wojdalski et al., 2013)

# How to save water in dairy industry?

| Approach                                           | Amount of water saving                                                                | Complexity of water purification                                                      |
|----------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Production related water savings                   |    |    |
| Water reuse from partial streams                   |    |    |
| Water reuse from wastewater (end-of-pipe solution) |  |  |

# What are current barriers?

- Public acceptance of using recycled water
  - Society takes water for granted
  - Wasteful use
  - Resistance to use recycled water
- Cost concerns (but are these reasonable?)
  - Complex reuse solutions are mostly more costly than using „tap“ water
  - But
    - Price of water does not reflect costs of water
    - Price of water does not indicate the value of water
- Permissions
- Lack of succesful large scale implementations?





# Water reuse from partial streams

Purification of cow water  
to drinking water quality

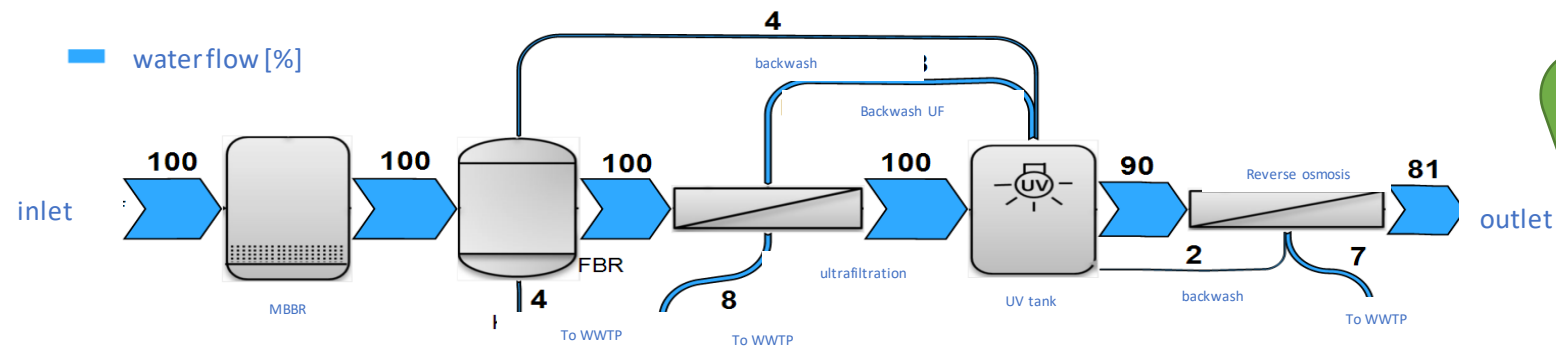
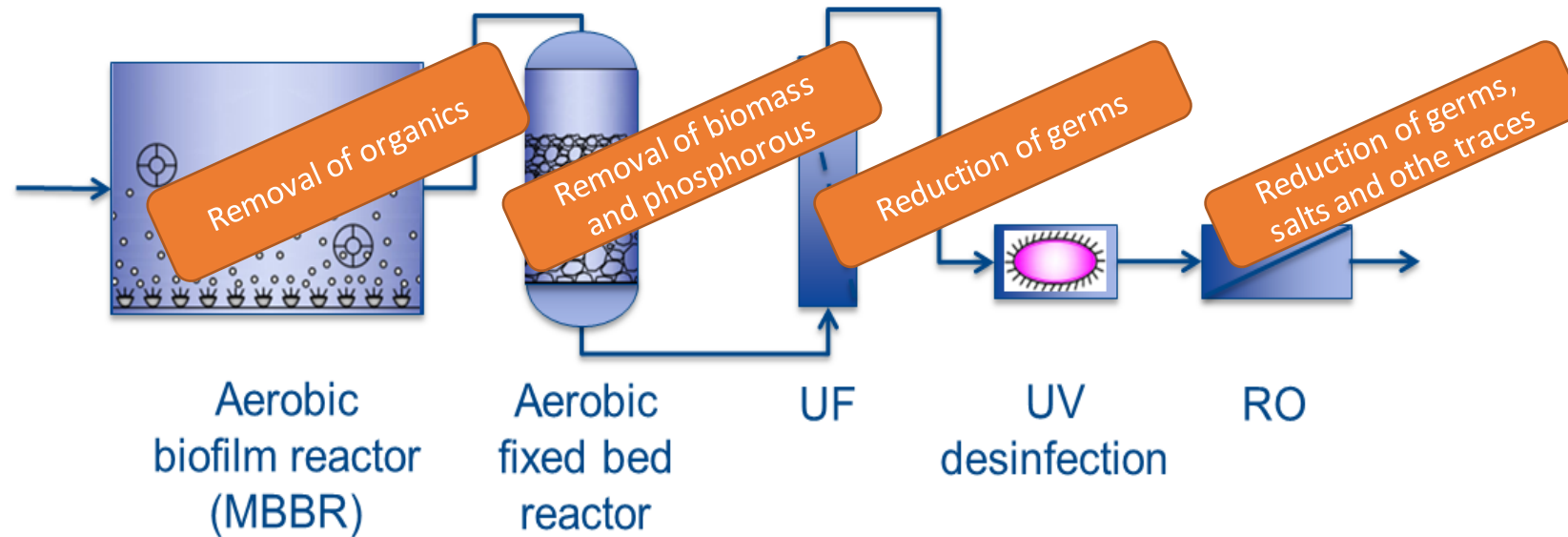


# Project overview

- Objective
  - Treatment of cow water to drinking water quality
  - (Re-)Use of treated water in production
- Inlet concentrations
  - TOC 10- 35 mg/L
  - Nitrogens up to 5 mg/L
  - Phosphorous < 0,5 mg/L
- Requirements of treated water
  - No germs and harmful chemicals in treated water
  - TOC < 0.2 mg/L
  - El. Conductivity < 5  $\mu$ S/cm

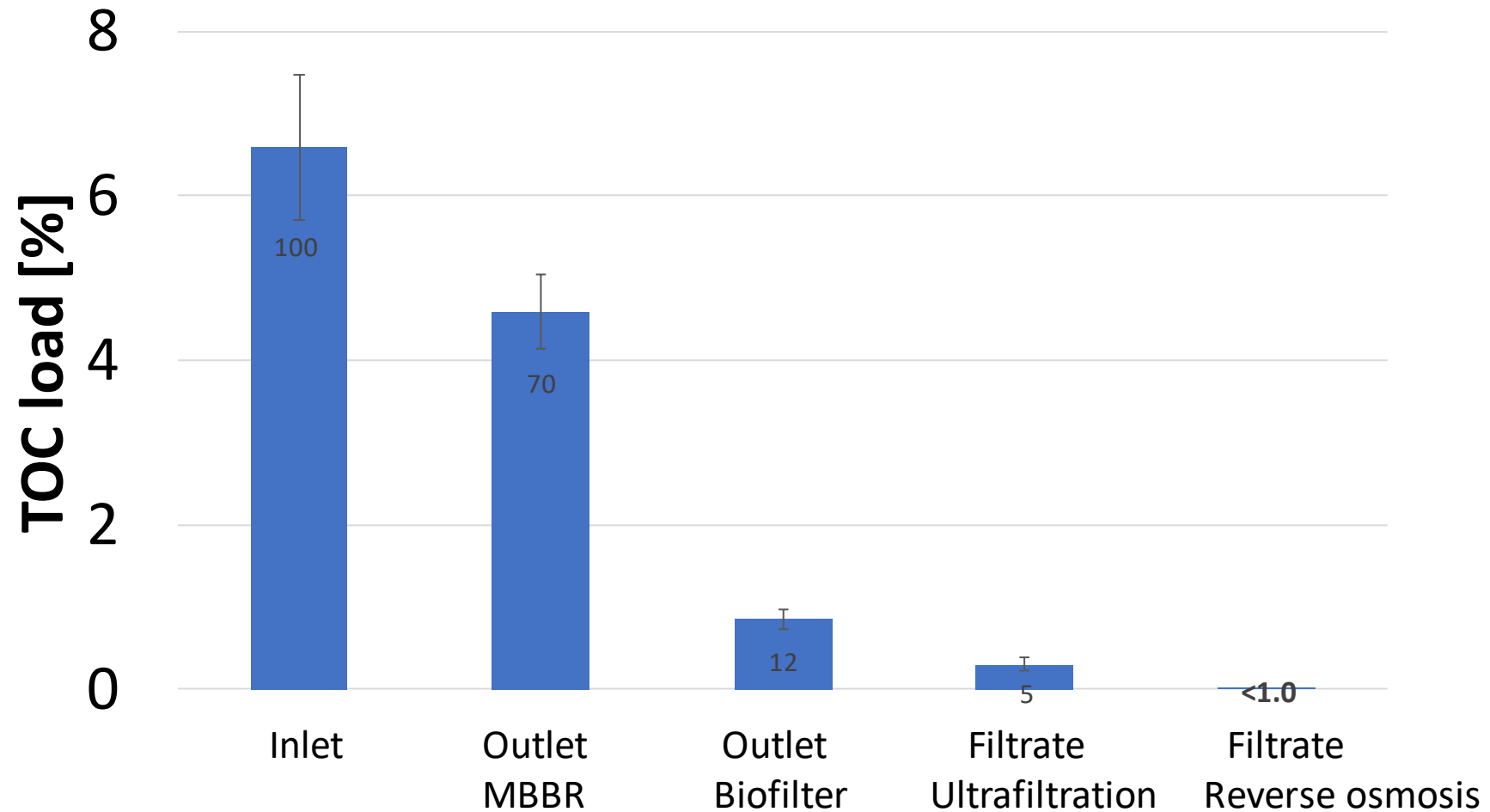


# Multi-barrier approach as treatment concept



**> 80% of  
water reused**

# TOC removal





# Benefits

- Highly efficient and operationally safe
  - Low wastewater because of high overall conversion factor (85%)
  - Low energy consumption
- 
- > 200,000 m<sup>3</sup>/a water saved at Arla (implemented in 2018 & 2021)
  - > 600,000 m<sup>3</sup>/a water savable at DMK (current research project)
  - Payback within 3 years





# Water reuse from waste water

Example from a brewery



# Project Overview

## Objective

- Conversion of process waste to biomethane
- Improvement of carbon footprint
- Recycling of water (=water for brewing)
- Reduction of emissions



## Solutions

- Anaerobic wastewater treatment (Biomar® Clearfleau® AD)
- Membrane biological treatment (Biomar® OMB)
- Reverse osmosis (Envopur®)





# Process Performance

Biomar® Clearfleau® AD



487 m<sup>3</sup>/d washwater + trub/yeast  
18,500 kg COD/d  
**387 Nm<sup>3</sup>/h Biogas (55% CH<sub>4</sub>)  
for grid injection**



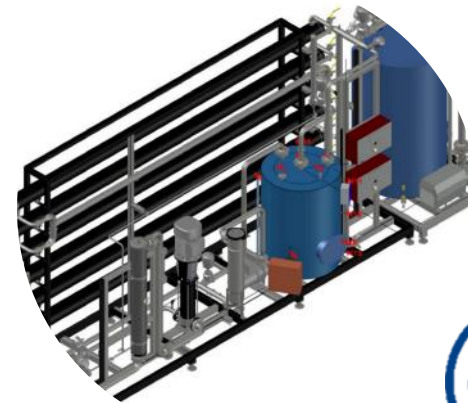
Biomar® OMB



Clean water for discharge  
COD < 50 mg/l

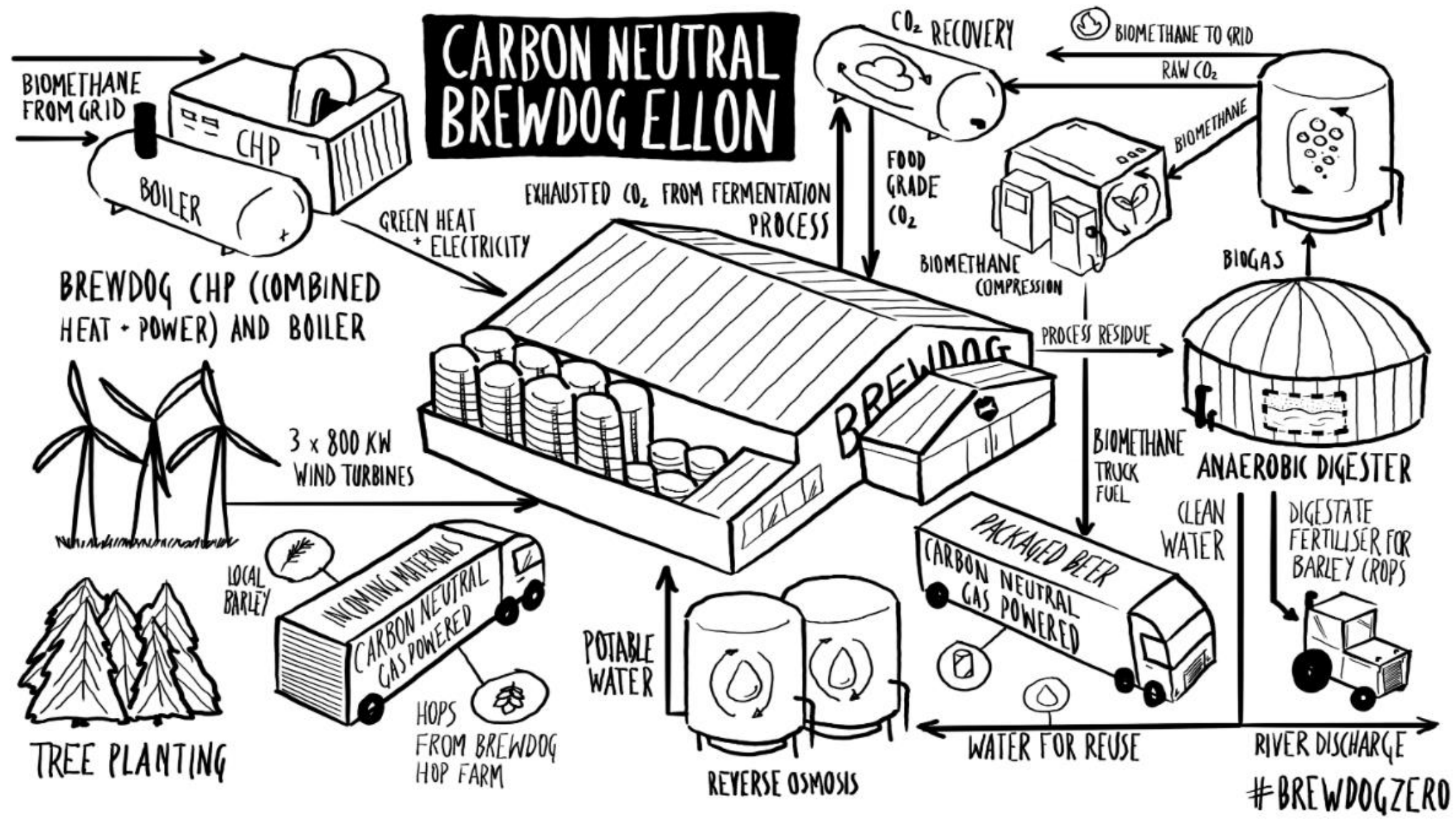


Envopur® Reverse Osmosis



**Water for brewing**  
Up to 240 m<sup>3</sup>/d  
(Water in / Beer ratio  
1.91:1)





# CARBON NEUTRAL BREWDOG ELLON

BIOMETHANE FROM GRID  
CHP  
BOILER

BREWDOG CHP (COMBINED HEAT + POWER) AND BOILER



3 x 800 KW WIND TURBINES



TREE PLANTING



LOCAL BARLEY

HOPS FROM BREWDOG HOP FARM

EXHAUSTED CO<sub>2</sub> FROM FERMENTATION PROCESS



CO<sub>2</sub> RECOVERY

FOOD GRADE CO<sub>2</sub>

BIOMETHANE COMPRESSION

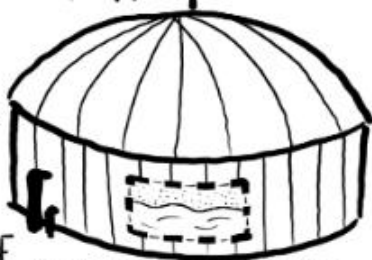


BIOGAS



BIOMETHANE TO GRID

RAW CO<sub>2</sub>



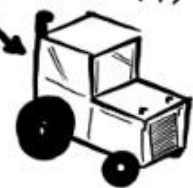
ANAEROBIC DIGESTER

PROCESS RESIDUE

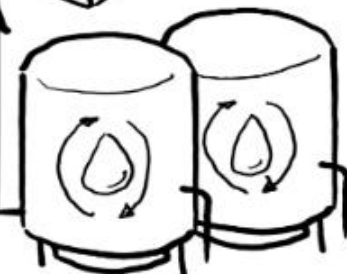
BIOMETHANE TRUCK FUEL

CLEAN WATER

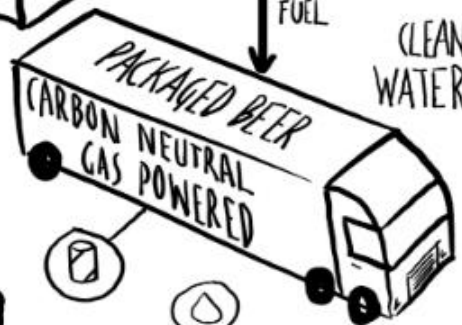
DIGESTATE FERTILISER FOR BARLEY CROPS



POTABLE WATER



REVERSE OSMOSIS



WATER FOR REUSE

RIVER DISCHARGE

#BREWDOGZERO



# Benefits

- Over 40% reduction of water usage
- 140% site self sufficient in biomethane
- 87% CO2 self sufficient
- Removal of 8600 vehicle movements
- 80 tonnes of quality digestate per week
- Payback within 3 years





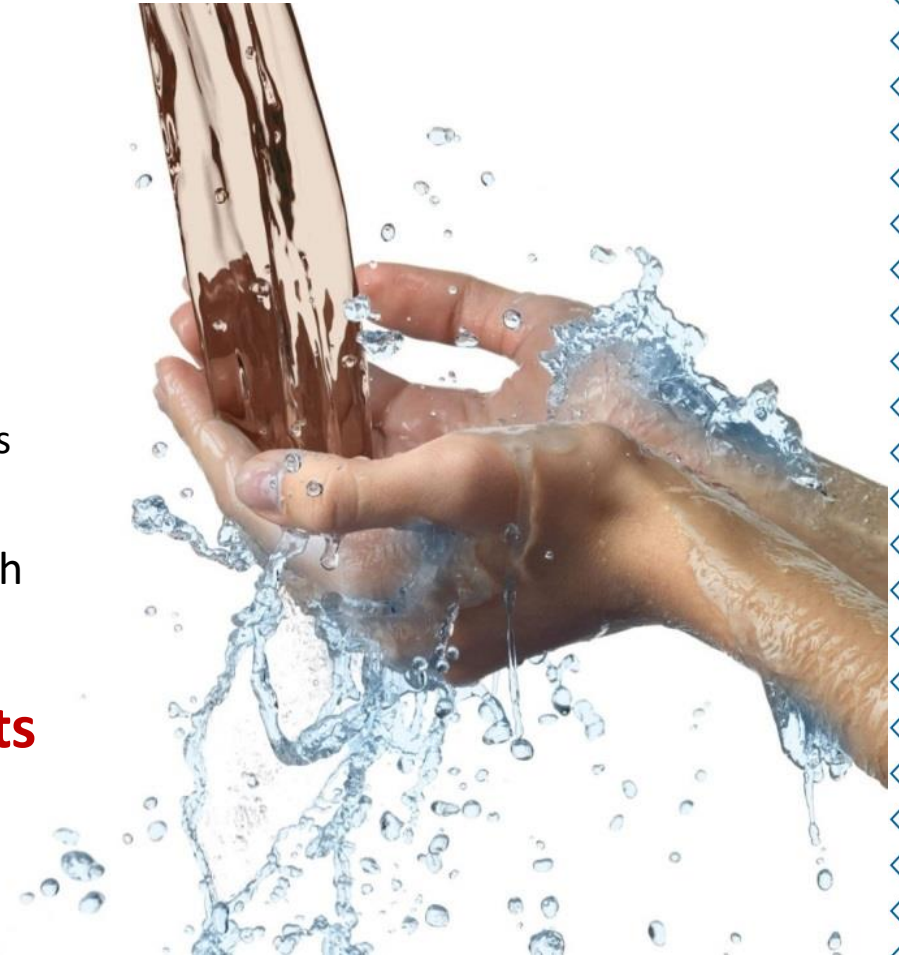
# Conclusions and outlook

# Conclusions

**The dairy industry can feed the World while conserving limited resources of energy and water!**

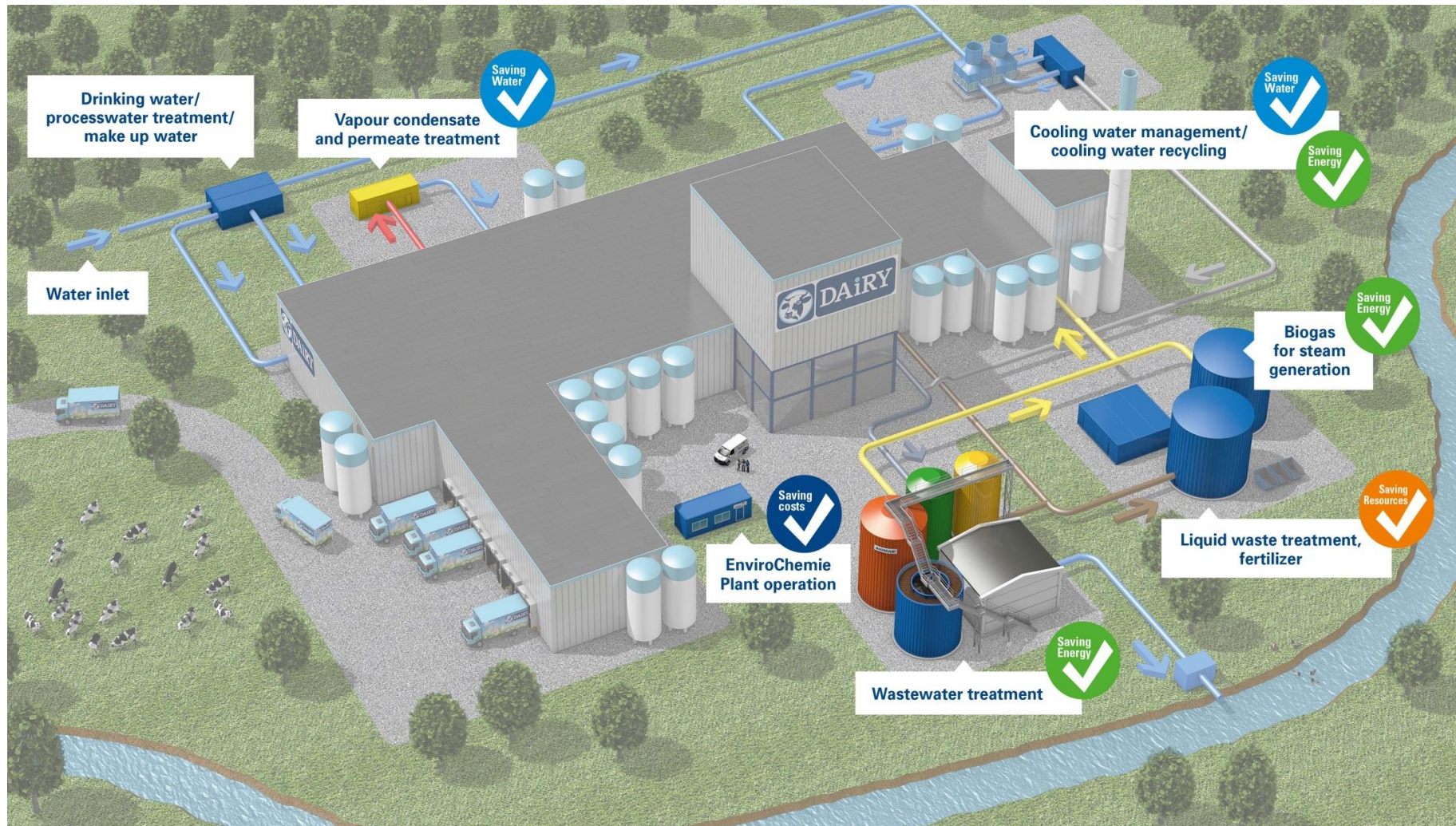
- Water reuse must always be an option
- Successful, reliable and economic feasible large scale implementations exist
- Treatments should focus a multi-barrier and fit-for-purpose approach

**We all have to work on that water is not judged by its history but by its quality!**





# Outlook – Dairy water treatment of the future







Thank you

