Resource recovery with algae

"Material recovery and safe reuse"

Robert Reinhardt

algen algal technology centre

robert@algen.eu

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Hello to the host

ULTIMATE

ULTIMATE aims to create economic value and increase sustainability by valorising resources within the **water cycle**. **Wastewater** is not only a reusable **resource** but also a carrier for energy and components that can be extracted, treated, stored, and reused. Drawing on "**Water Smart Industrial Symbiosis**" (WSIS) we promote wastewater recycling in various industrial settings. We have selected nine large-scale demonstration cases from the **four most important industrial sectors** in Europe:

- **AGRO-FOOD PROCESSING**
- **HEAVY CHEMICAL / PETROCHEMICAL**
- **BEVERAGES**
- **BIOTECH INDUSTRY**

TURNING WASTEWATER INTO A RESOURCE, WE WILL

Recover, refine and **reuse wastewater**,

Extract and **exploit energy**

Extract and **exploit materials**

... CONTAINED IN INDUSTRIAL WASTEWATER.

Water2REturn project

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AGRO-FOOD PROCESSING

HEAVY CHEMICAL / PETROCHEMICAL

BEVERAGES

BIOTECH INDUSTRY

Slautherhouse wastewater

TURNING WASTEWATER INTO A RESOURCE, WE WILL

Agricultural products

Recover, refine and **reuse wastewater**,

Extract and **exploit energy**

Extract and **exploit materials**

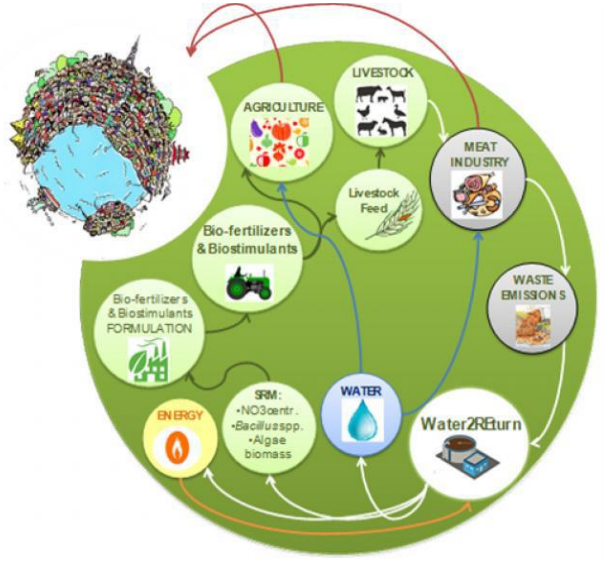
... CONTAINED IN INDUSTRIAL WASTEWATER.

Project Summary

- REcovery and REcycling of nutrients TURNing wasteWATER into added-value products for a circular economy in agriculture
- **Call:** H2020-IND-CE-2016-17
  Type of Action: Innovative Action
  GA no: 730398
  Duration: 57 months (after extension by 15 months)
  Start Date: 01 Jul 2017 **End date:** 31 Mar 2022
  Estimated Project Cost: 7,13 M€
  Requested EU Contribution: 5,9 M€
  Project Coordinator: BioAzul, Spain

Water2REturn

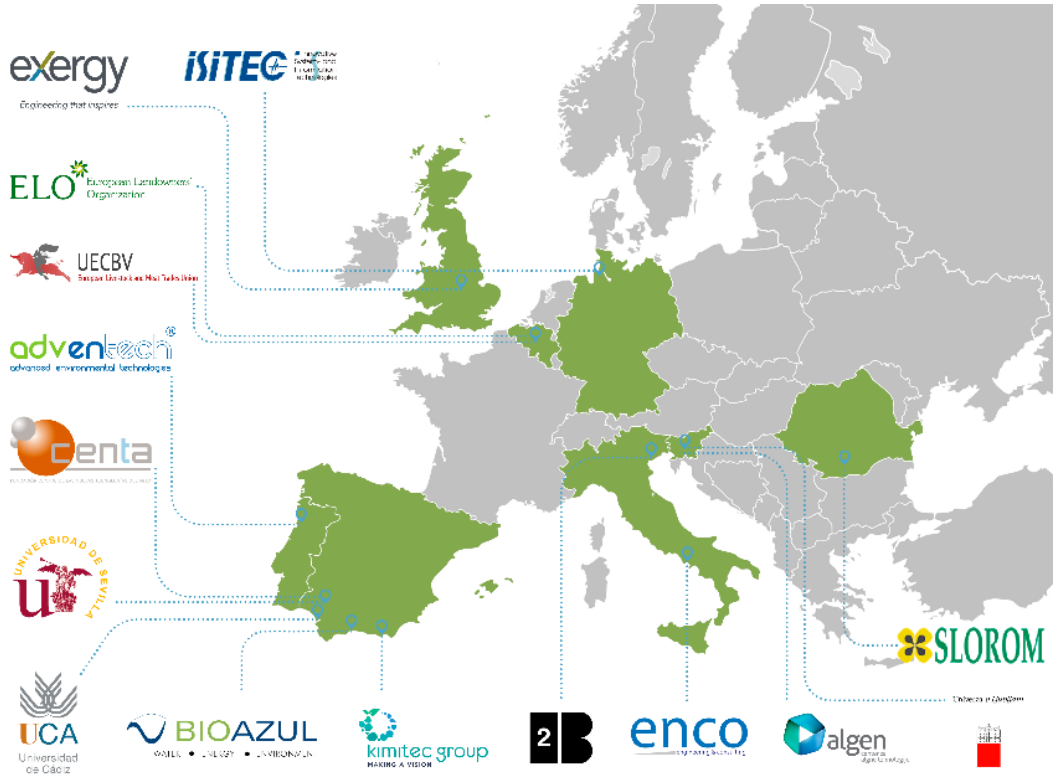
- **recover and recycle nutrients from slaughterhouse wastewater** in the framework of a **Circular Economy model;**
- recovered nutrients are turned into **value added products for the agro-chemical industry**, for the **agricultural sector;**
- solve slaughterhouse wastewater management problem and **reduced costs related to water consumption**



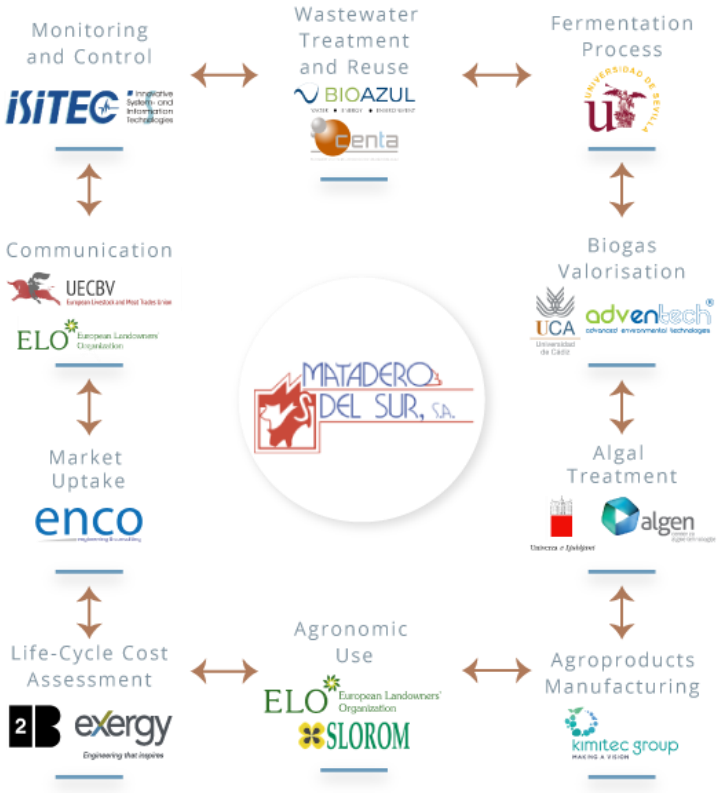
Products

- 3 different raw materials
  - nitrate and phosphate concentrate,
  - hydrolysed sludge
  - algal biomass
- 3 agronomic products:
  - organic fertiliser
  - Bacillus subtillis based biostimulant
  - Algal biomass based biostimulant

Consortium


exergy
Engineering that inspires
iSiTEC
ELO
European Landowners' Organization
UECBV
advenTech
advanced environmental technologies
centa
UNIVERSIDAD DE SEVILLA
UCA
Universidad de Cádiz
BIOAZUL
kimitec group
MAKING A VISION
2B
enco
algen
SLOROM

Consortium & Activities



Demo design and implementation

- slaughterhouse wastewater treatment and reuse
- fermentation process
- anaerobic digestion and biogas process
- algal treatment
- monitoring and control tool

Agronomic valorisation

- agronomic products manufacturing.
- agronomic products testing and use

Environmental, economic, social and risk assessment

Market update

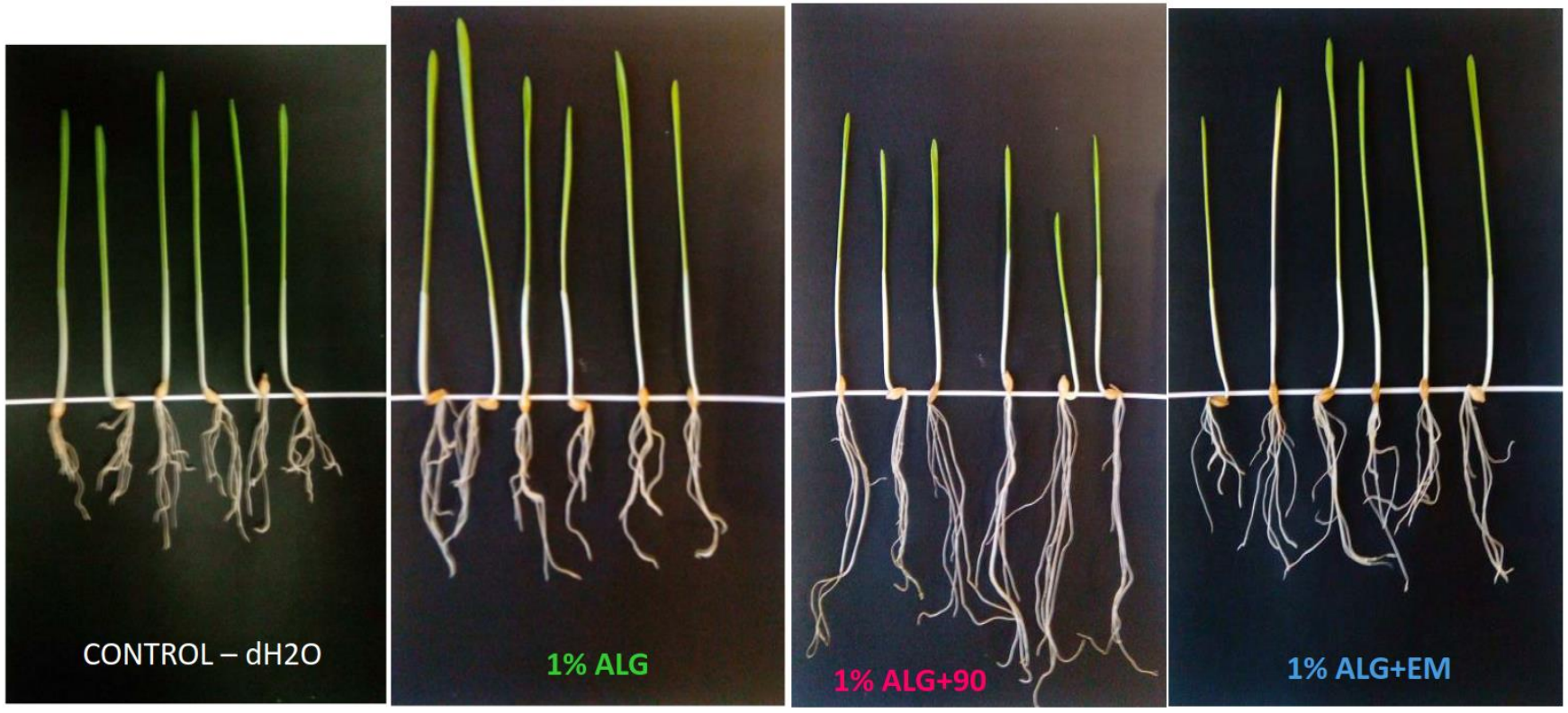
Capacity building and awareness raising

Small test installation Ljubljana

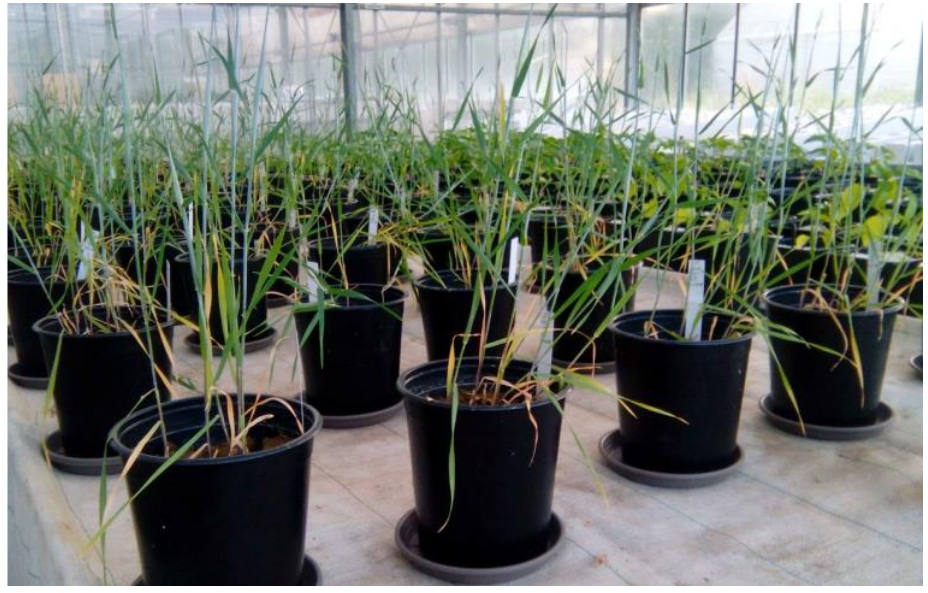




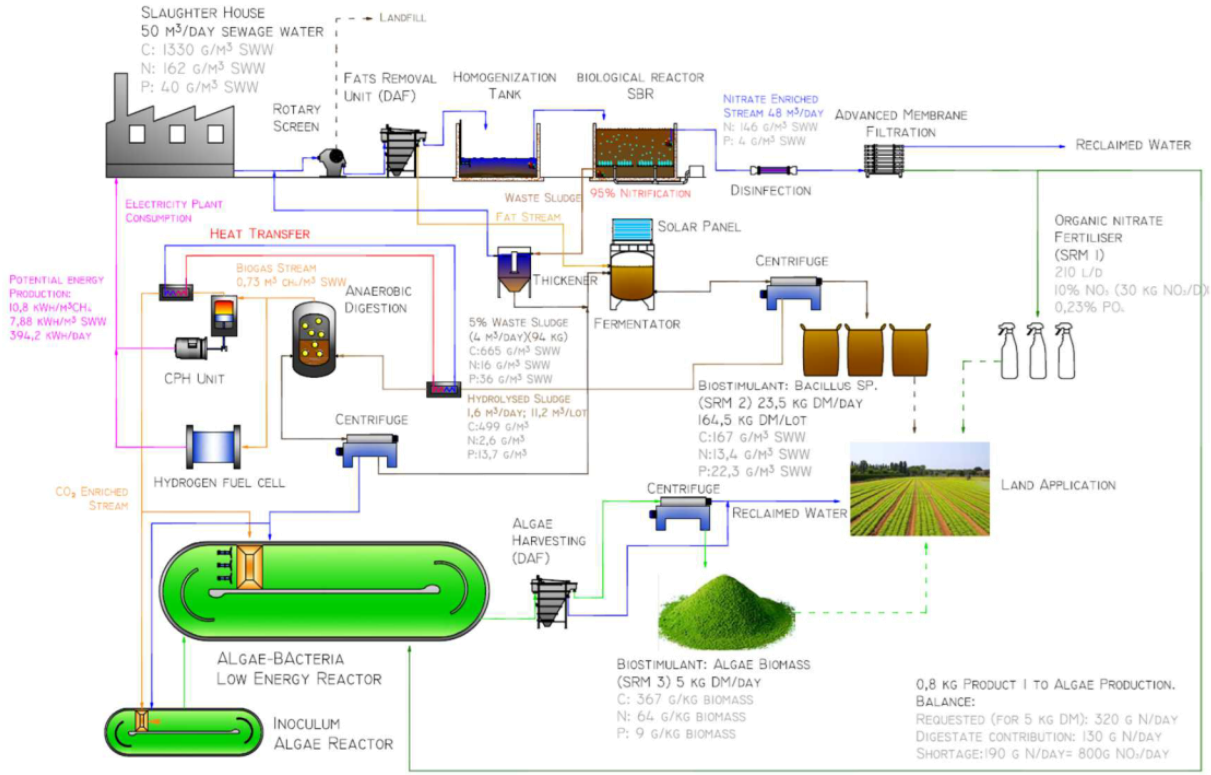

Preliminary Sprouting tests



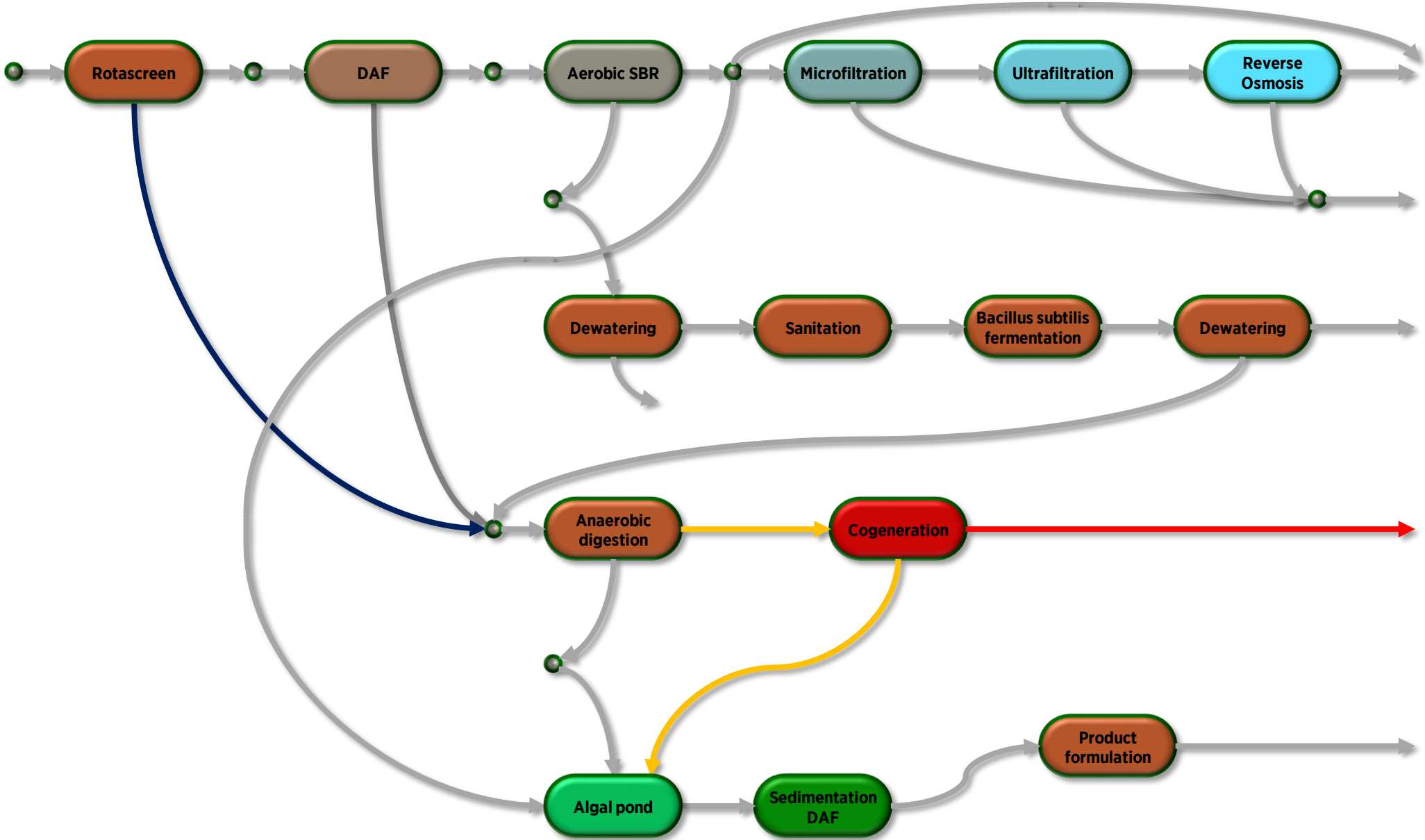
Pot tests



Process


SLAUGHTER HOUSE
50 M³/DAY SEWAGE WATER
C: 1330 G/M³ SWW
N: 162 G/M³ SWW
P: 40 G/M³ SWW
LANDFILL
ROTARY SCREEN
FATS REMOVAL UNIT (DAF)
HOMOGENIZATION TANK
BIOLOGICAL REACTOR SBR
NITRATE ENRICHED STREAM 48 M³/DAY
N: 146 G/M³ SWW
P: 4 G/M³ SWW
ADVANCED MEMBRANE FILTRATION
RECLAIMED WATER
DISINFECTION
95% NITRIFICATION
WASTE SLUDGE
FAT STREAM
ELECTRICITY PLANT CONSUMPTION
HEAT TRANSFER
SOLAR PANEL
CENTRIFUGE
THICKENER
FERMENTATOR
ORGANIC NITRATE FERTILISER (SRM 1)
210 L/D
10% NO₃ (30 KG NO₃/D)
0,23% PO₄
BIOGAS STREAM
0,73 M³ CH₄/M³ SWW
POTENTIAL ENERGY PRODUCTION:
10,8 KWH/M³CH₄
7,88 KWH/M³ SWW
394,2 KWH/DAY
ANAEROBIC DIGESTION
CPH UNIT
5% WASTE SLUDGE
(4 M³/DAY)(94 KG)
C:665 G/M³ SWW
N:16 G/M³ SWW
P:36 G/M³ SWW
HYDROLYSED SLUDGE
1,6 M³/DAY; 11,2 M³/LOT
C:499 G/M³
N:2,6 G/M³
P:13,7 G/M³
CENTRIFUGE
BIOSTIMULANT: BACILLUS SP.
(SRM 2) 23,5 KG DM/DAY
164,5 KG DM/LOT
C:167 G/M³ SWW
N:13,4 G/M³ SWW
P:22,3 G/M³ SWW
HYDROGEN FUEL CELL
CO₂ ENRICHED STREAM
CENTRIFUGE
RECLAIMED WATER
LAND APPLICATION
ALGAE HARVESTING (DAF)
ALGAE-BACTERIA LOW ENERGY REACTOR
INOCULUM ALGAE REACTOR
BIOSTIMULANT: ALGAE BIOMASS
(SRM 3) 5 KG DM/DAY
C: 367 G/KG BIOMASS
N: 64 G/KG BIOMASS
P: 9 G/KG BIOMASS
0,8 KG PRODUCT I TO ALGAE PRODUCTION.
BALANCE:
REQUESTED (FOR 5 KG DM): 320 G N/DAY
DIGESTATE CONTRIBUTION: 130 G N/DAY
SHORTAGE:190 G N/DAY= 800G NO₃/DAY

Process


Rotascreen
DAF
Aerobic SBR
Microfiltration
Ultrafiltration
Reverse Osmosis
Dewatering
Sanitation
Bacillus subtilis fermentation
Dewatering
Anaerobic digestion
Cogeneration
Algal pond
Sedimentation DAF
Product formulation

Water2return

Present

- On-going agricultural field tests
- LCA & techno-economic analysis
- Workshops August 2021 – March 2022

- Nutrient density will limit the logistics
- Biostimulants seem to be successful

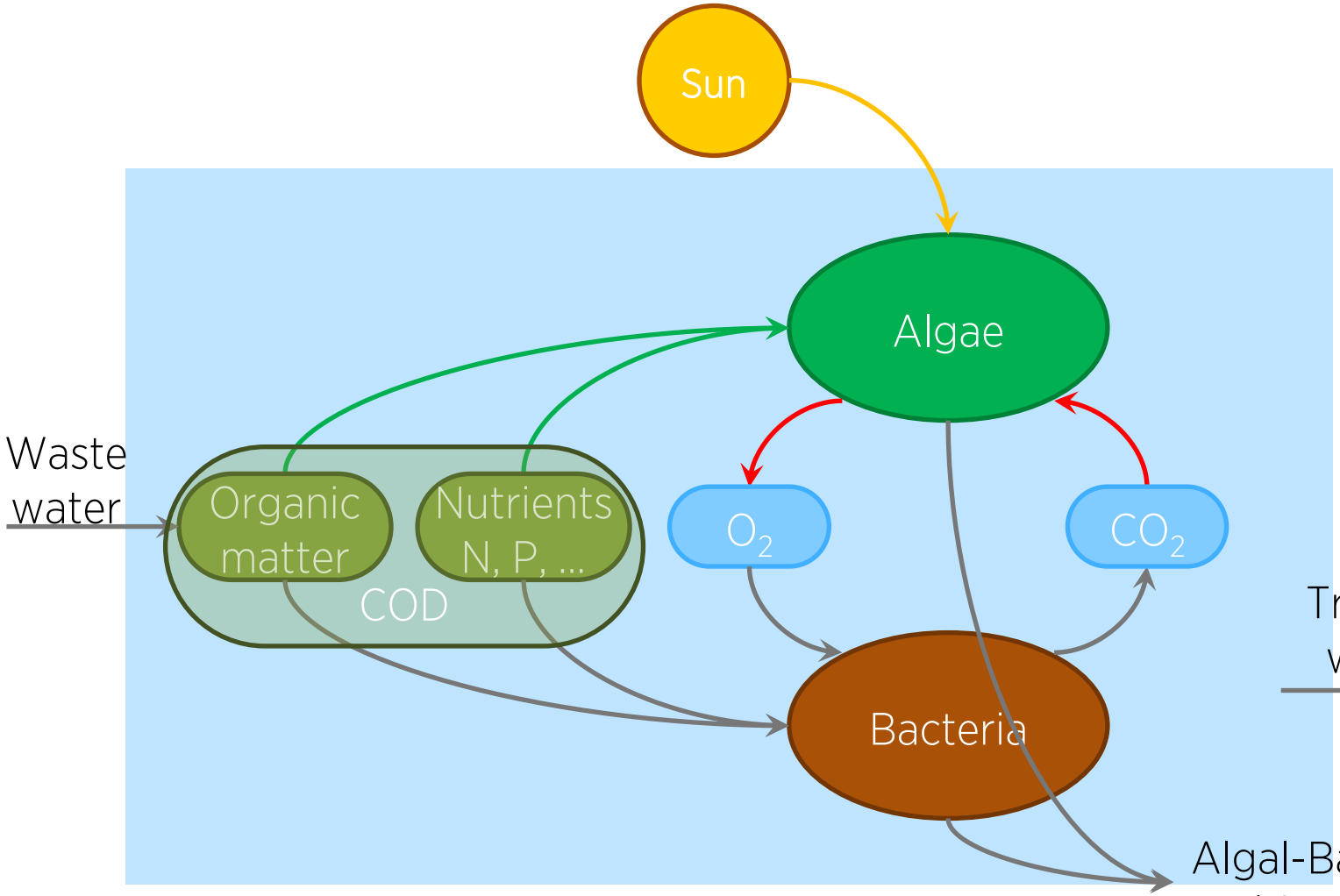
Thank you for attention

Questions

Where do algae fit?

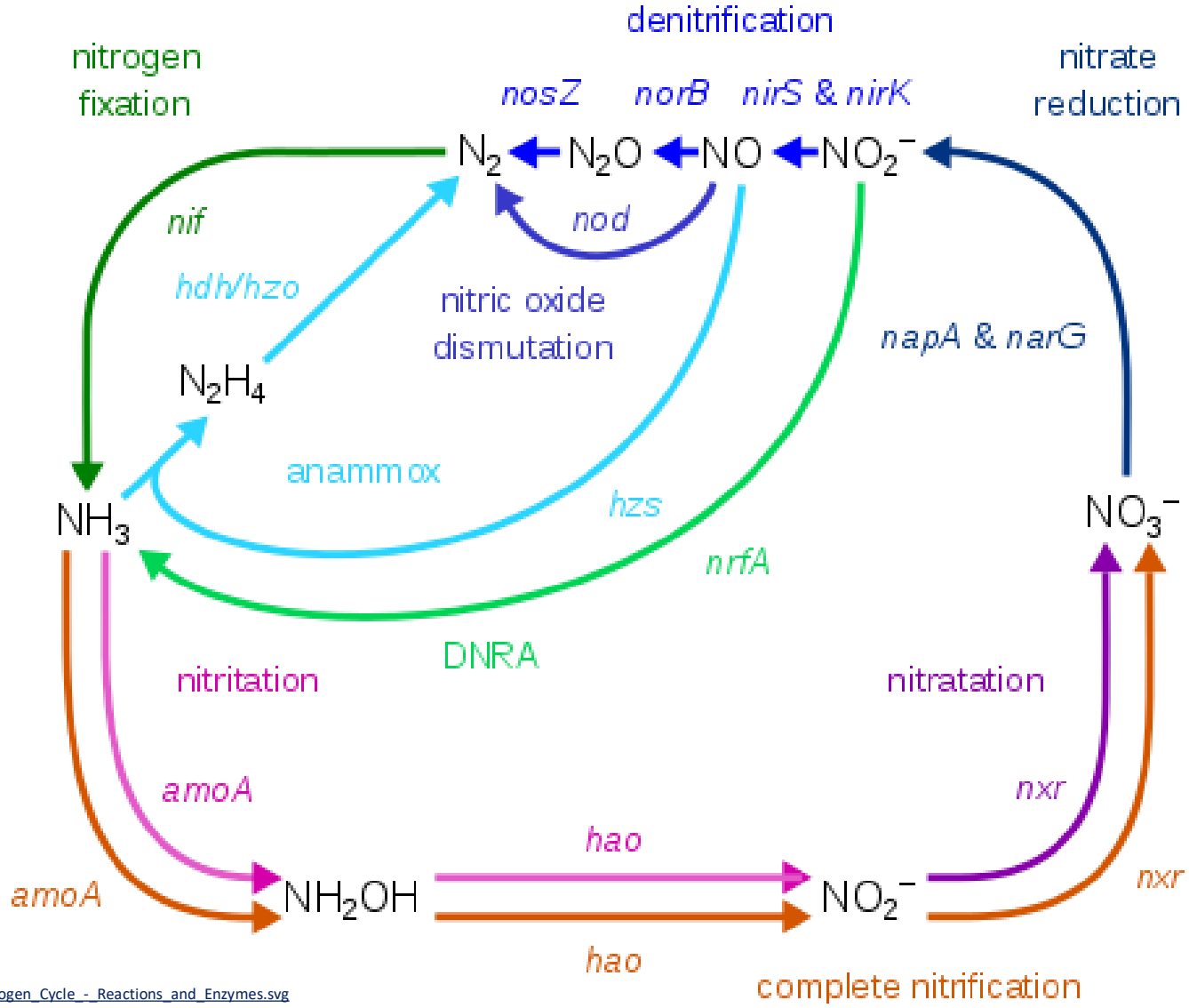
- More than one option
- Depends on
  - Wastewater
  - Area available
  - Use of algal biomass
  - Legislative requirements

Basic concept



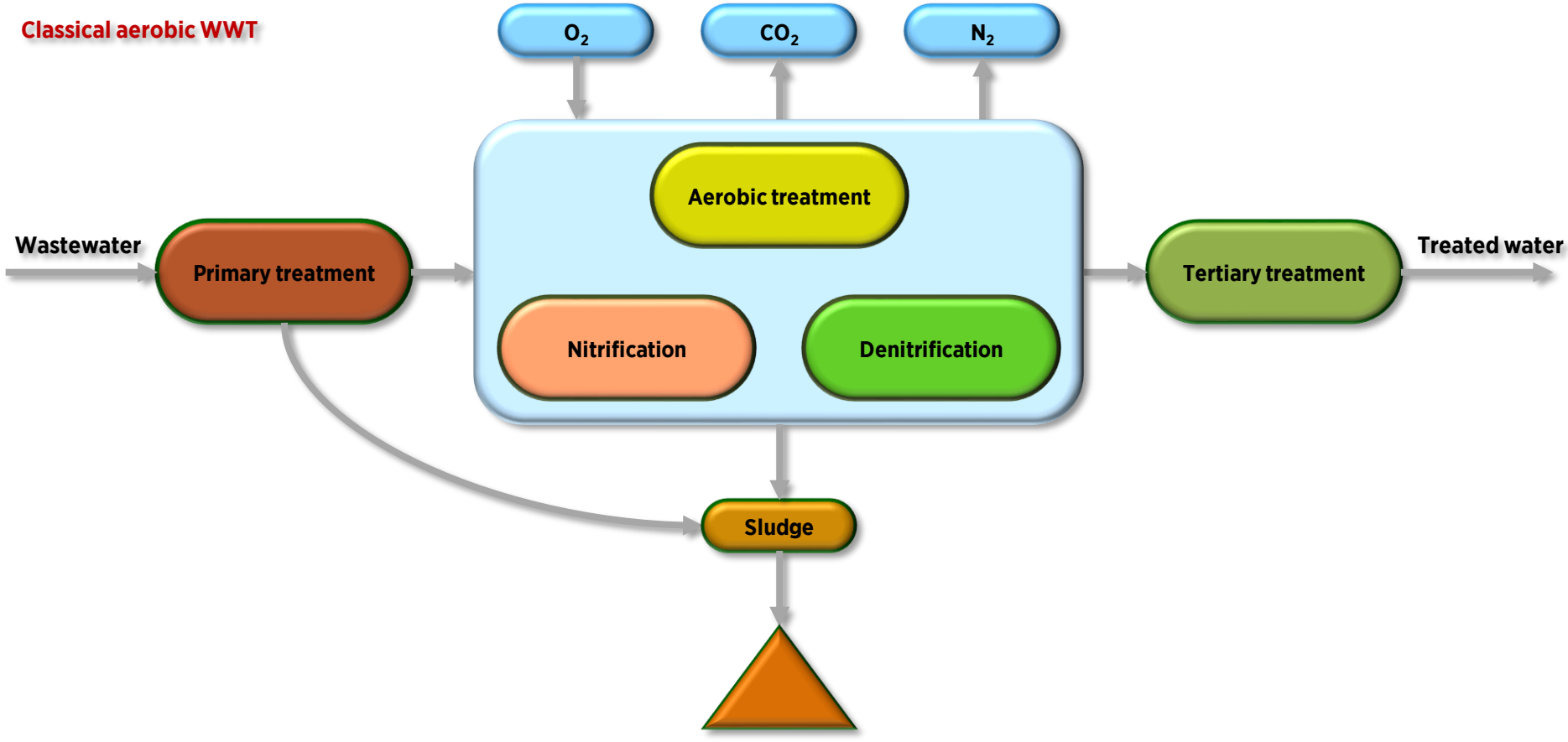
- Treatment by symbiotic algal bacterial community
- O2 provided in-situ (from sunlight)
- CO2 recycled in-situ
- Better matched community, more diverse community ↔ better nutrient and micropollutant removal
- More biomass ↔ more nutrients and energy recycled

Nitrogen

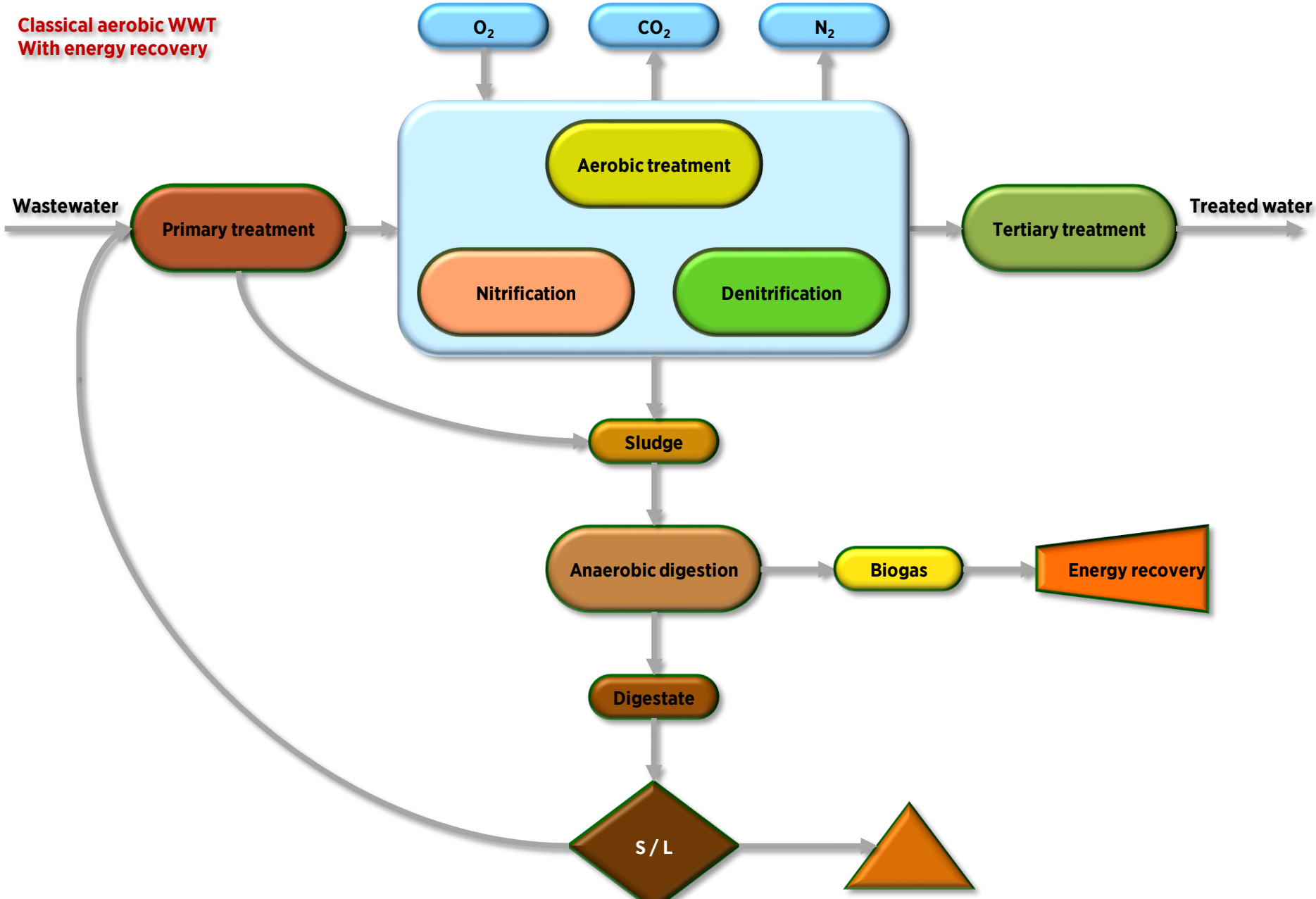


https://en.wikipedia.org/wiki/Nitrogen_cycle#/media/File:Nitrogen_Cycle_-_Reactions_and_Enzymes.svg

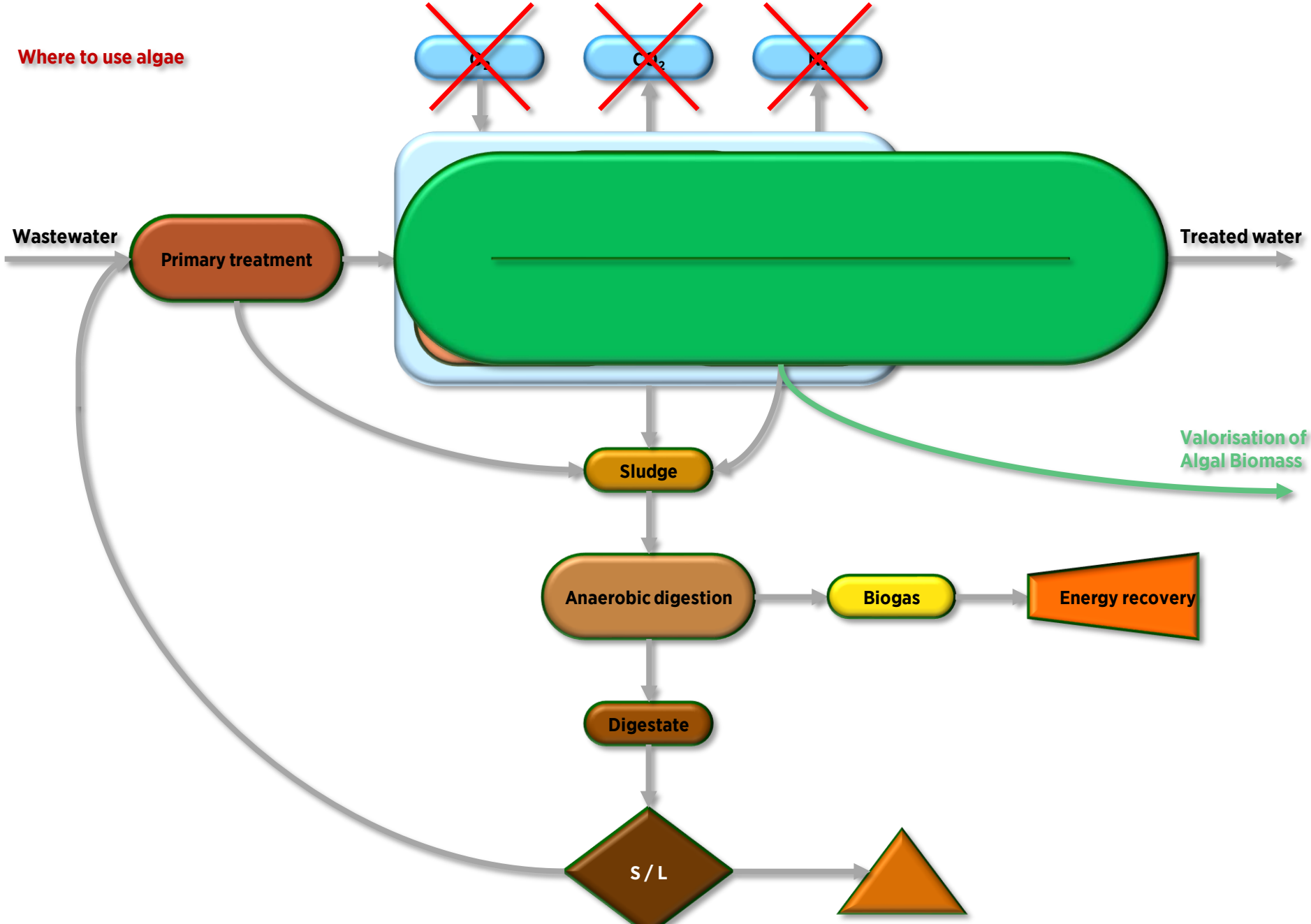
Classical aerobic WWT



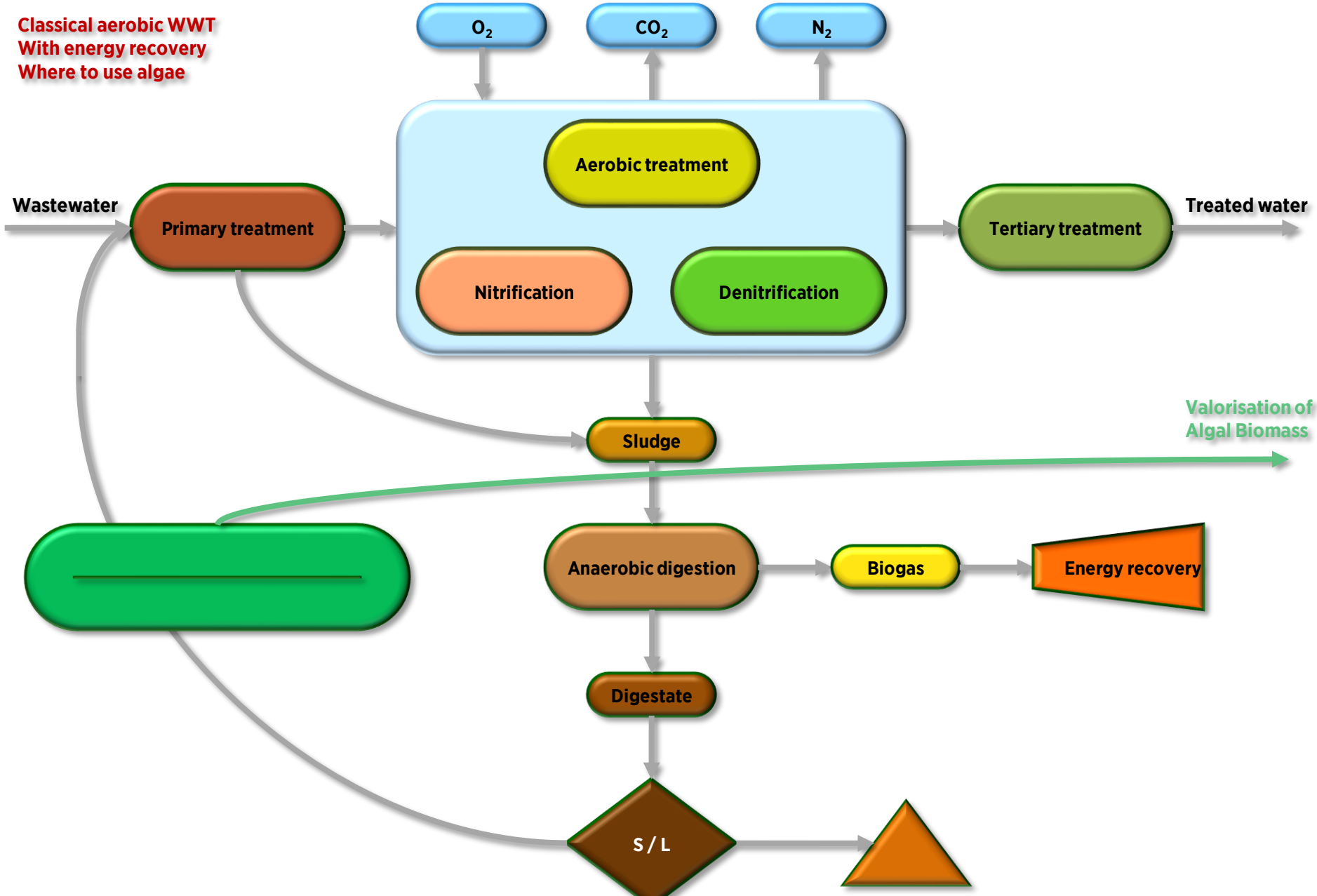
Classical aerobic WWT
With energy recovery



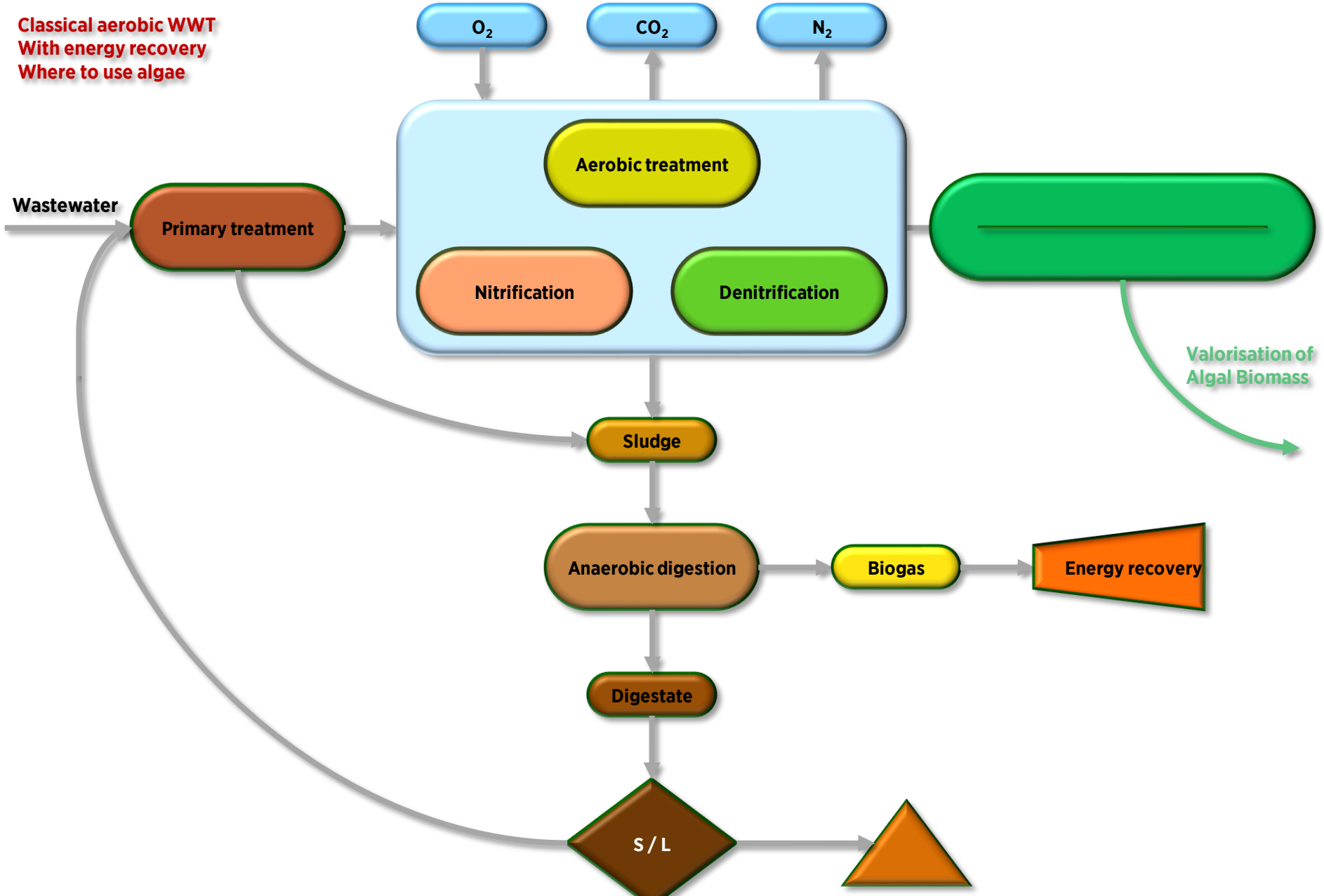
Where to use algae



Classical aerobic WWT
With energy recovery
Where to use algae

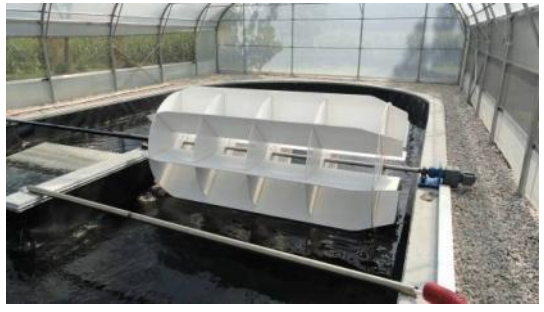


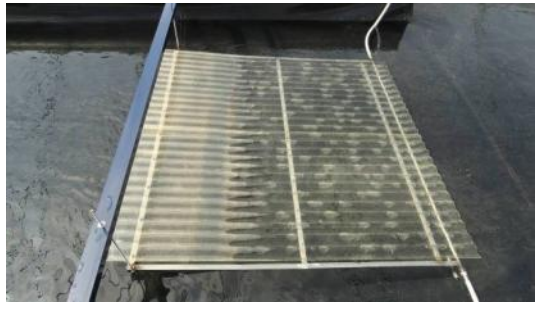
Classical aerobic WWT
With energy recovery
Where to use algae



Algaebiogas






Algal treatment of biogas digestate and feedstock production

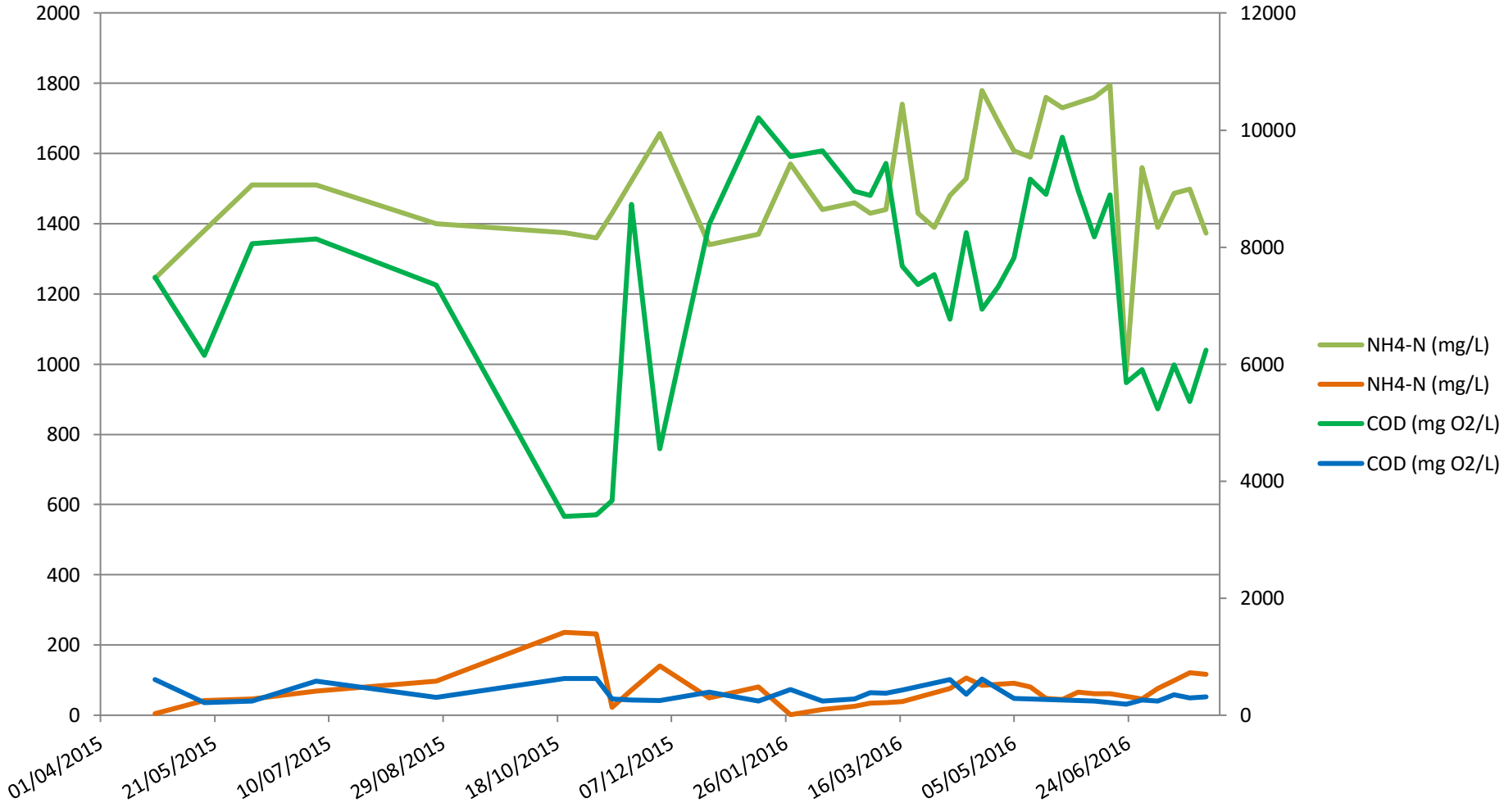
- Eco-Innovation project (CIP-EIP-Eco-Innovation-2012)
- 2013 – 2016 in Ljubljana, Slovenia
- Pilot and market replication project
- Demo centre has been in operation for 5 years
- Legislation analysis, LCA, business plan
- Complementary technology trials

Algaebiogas

S/L Separation
Anaerobic filter

Digestate color!

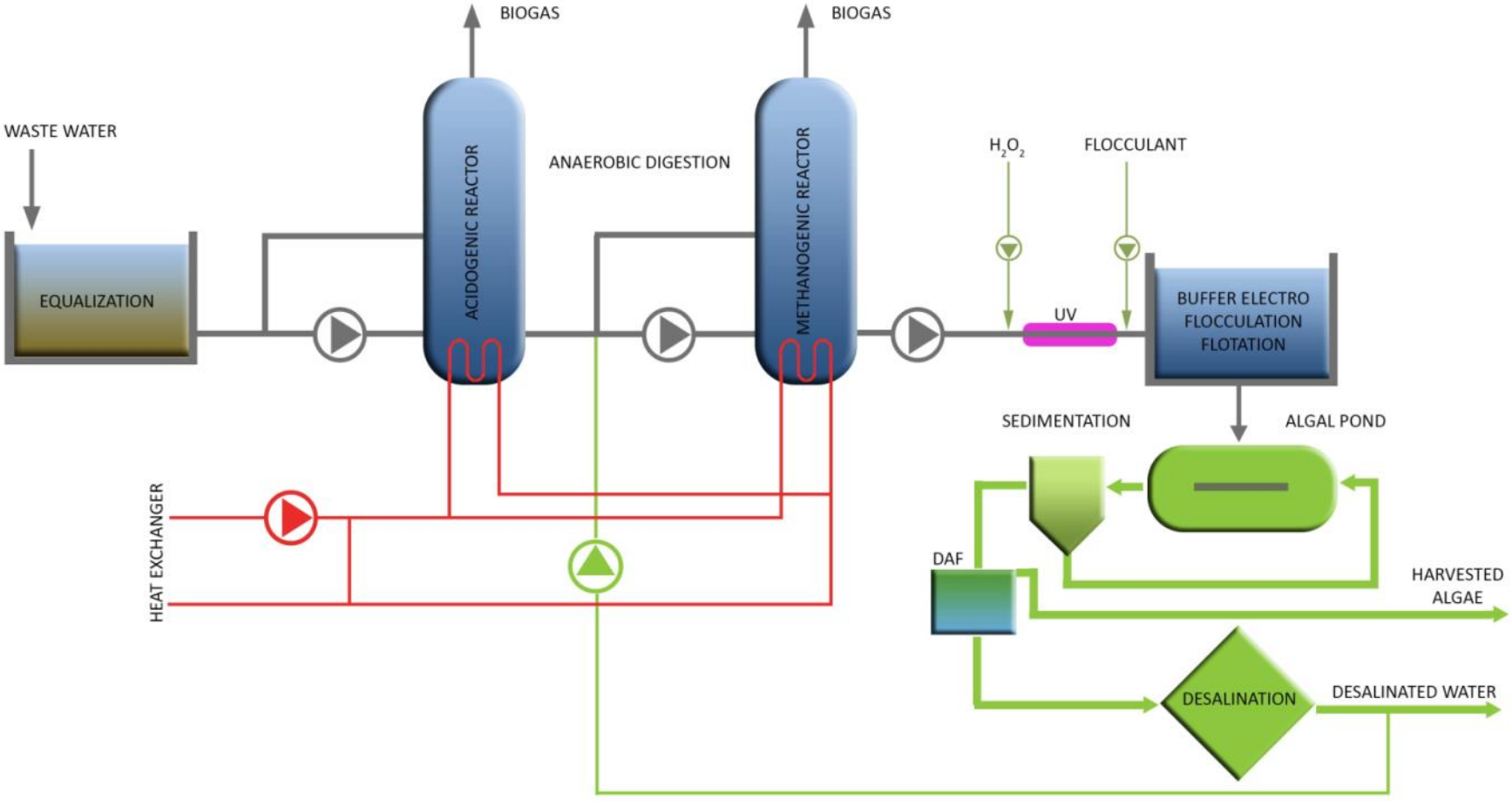
Algaebiogas



Saltgae

- Demonstration project exploring techno-economic options for use of algae to treat saline wastewater from food & beverage industry
- Innovative Action Horizon 2020
- June 2016 – September 2019
- Three demo locations
  - Camporosso, Italy (dairy cleaning water)
  - Ljubljana, Slovenia (animal hide warehouse WW KOTO)
  - Arava, Israel (fishery)

Saltgae

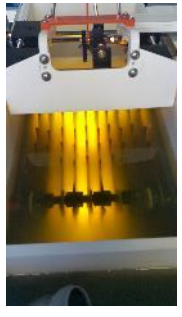

BIOGAS
BIOGAS
WASTE WATER
EQUALIZATION
ACIDOGENIC REACTOR
ANAEROBIC DIGESTION
METHANOGENIC REACTOR
H_2O_2
FLOCCULANT
UV
BUFFER ELECTRO FLOCCULATION FLOTATION
SEDIMENTATION
ALGAL POND
HEAT EXCHANGER
DAF
HARVESTED ALGAE
DESALINATION
DESALINATED WATER

Saltgae – demo Ljubljana









Saltgae – demo Camporosso, Arava, applications