HelioPure

Beyond Water Recycling

Bio-solar purification :

A new process to treat domestic wastewater and to turn water and wastes in a safe reusable form

www.heliopure.com

FSM4

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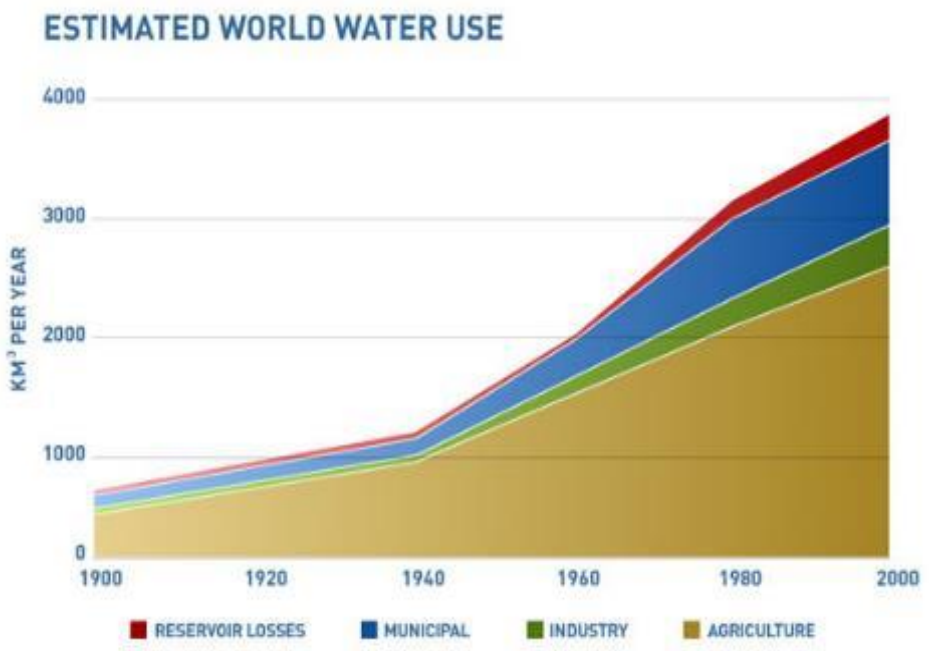
Water, unsuspected real needs

- 5,000 Liters per capita and per day average consumption:
  - **Drinking :** 2 L
  - **Domestic uses** (cleaning, watering, flushing) **:** 100 to 400 L
  - **Industrial products** (habitats, furniture, energy, cars, computers…):

800 to 1000 L

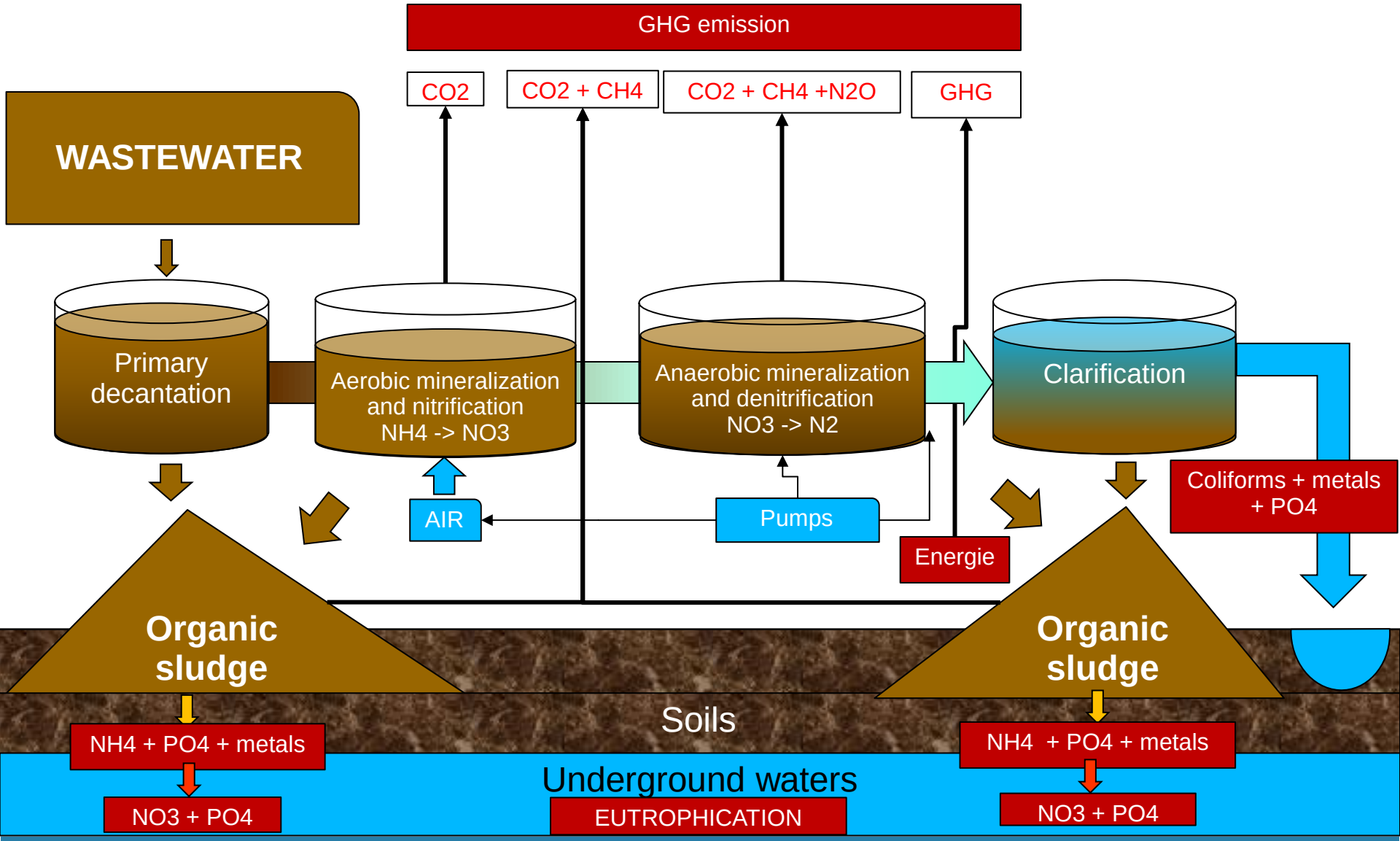
  - **Agriculture**: 4,000 L
    - 1 Kg beef = 15,500 L water
    - 1 Kg pork = 4,900 L water
    - 1 Kg chicken = 4,000 L water
    - 1 L milk = 1,000 L water
    - 1 Kg rice = 3,400 L water
    - 1 Kg soy = 2,750 L water
    - 1 Kg wheat = 1,300 L water



Freshwater : a vital resource threatened

- Good quality freshwater resources are scarce
  - Increased demand due to development and urbanization
  - Permanent or seasonal water stress due to climate change
  - Dissolved compounds accumulation in aquatic ecosystems (nutrients, fertilizers, pesticides, drugs, metals)
- Wastewater reuse and recycling become unavoidable
- Today 4,500 billion m^3 of fresh water are withdrew annually by human activities
  - **Only 4%** of wastewater are treated before discharge
  - **Only 0.4%** are recycled in the world

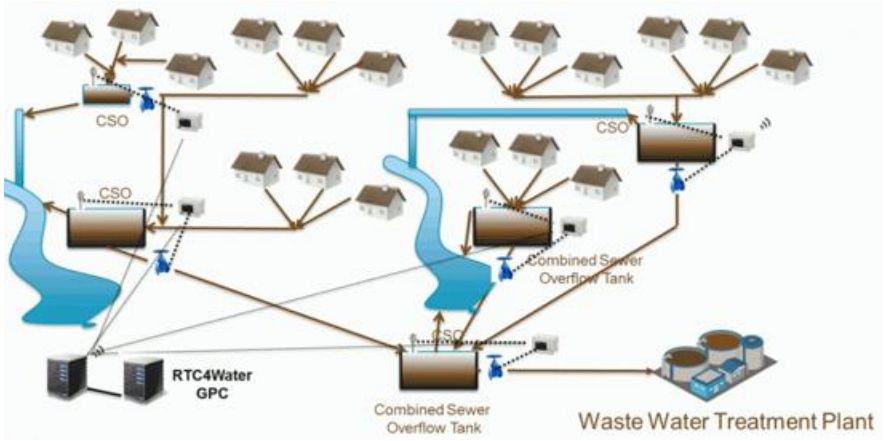
Conventional treatments based on mineralization and aeration are not adapted to water and nutrient recycling



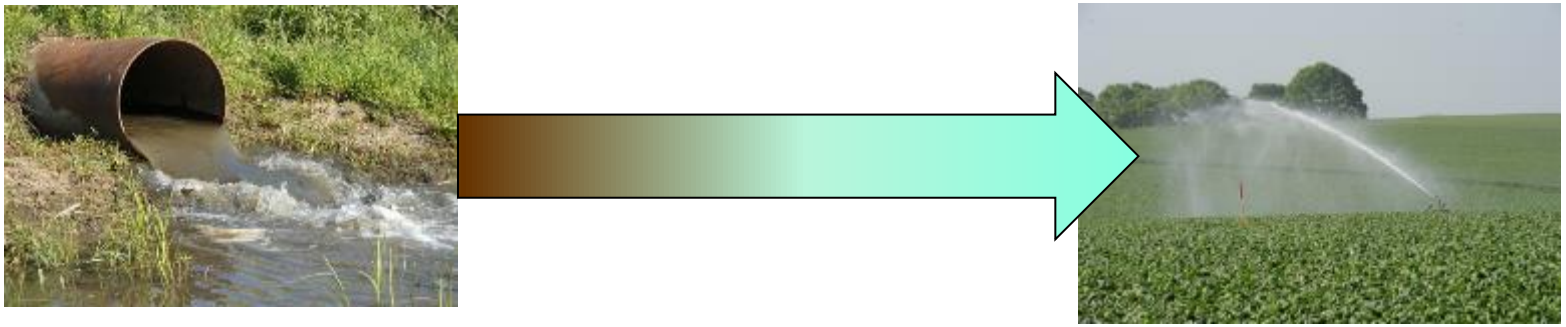
Conventional and centralized wastewater treatment plants

- Not suitable for water reuse and nutrient recycling
  - Coliforms are not treated enough
  - Various reuse needs are not the same
  - Nutrients (CO_2, NH_4, NO_3, PO_4) are turned in GHG or released in dissolved mineral form and accumulate in ground waters.

- Need collecting networks
  - To carry wastewater to the plant
  - To transport reusable water to consumers



HelioPure® : new solutions to treat urban wastewater and turn it into reusable safe water



- ☑ Hazardous substances and microbial contaminants removal
- ☑ CO_2 as **only** reagent
- ☑ **100% water recovery** i.e. no side sewage or evaporation losses
- ☑ **Low energy consumption** - 0.1 to 0.5 kWh per m^3
- ☑ **Organic waste recycling**
- ☑ **Decentralized and compact units** for small communities, hotels, camps

BSP a new approach of biological treatment using microbial photosynthesis

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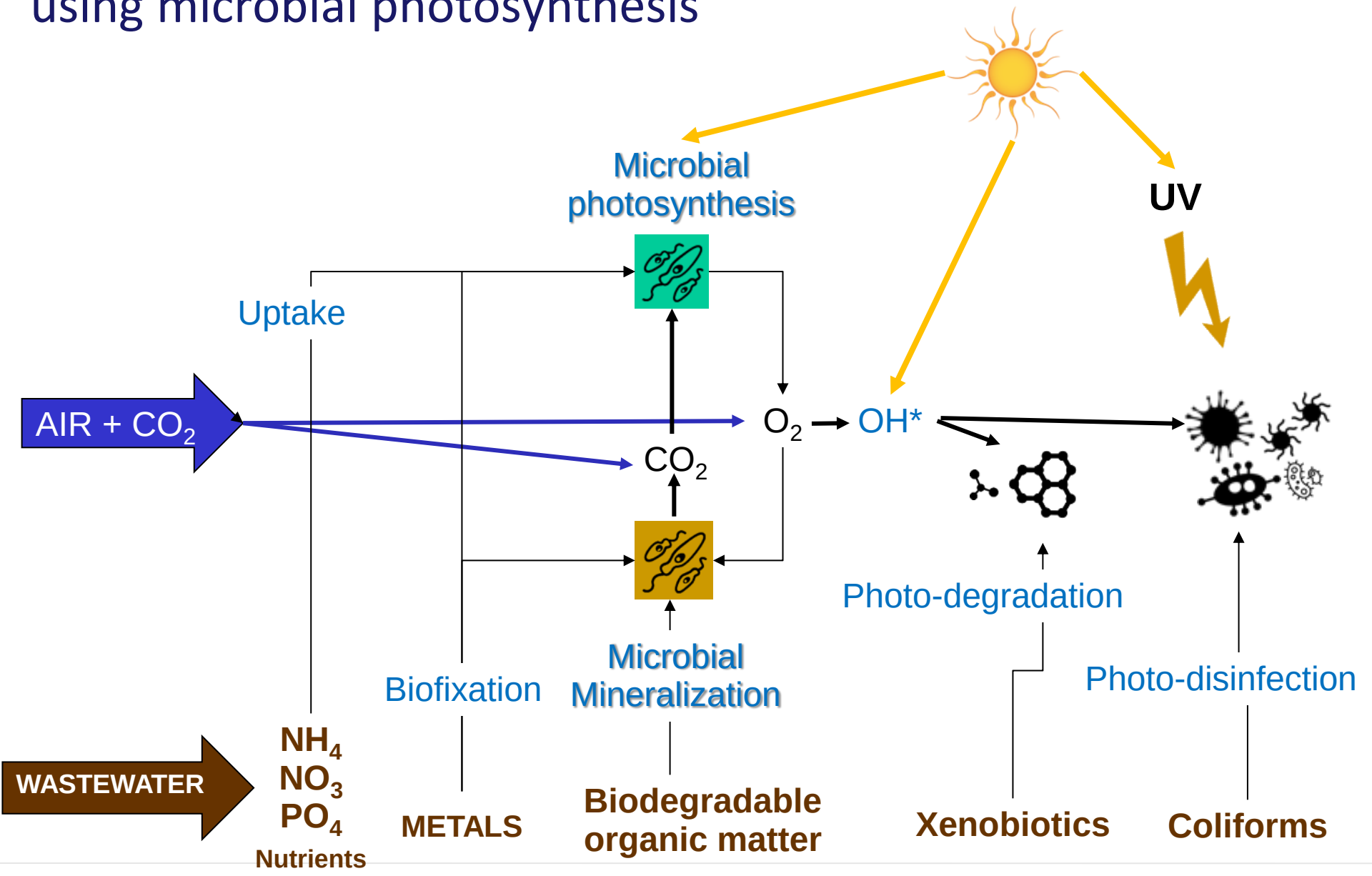

Bio-Solar Purification (BSP): a new wastewater treatment technology using sunlight and CO2

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Vacuum pump

AIR + O2

Wastewater : Organic matter, xenobiotics, metals, nutrients, coliforms

AIR + CO2

PHOTOSYNTHESIS

BIOFIXATION

PHOTO-OXIDATIVE DEGRADATION

MINERALIZATION

PHOTO-OXIDATIVE DISINFECTION

Purified water + Biomass

Reusable water

BIOMASS

BIOMASS RECOVERY

BSP can be integrated with various existing pretreatments

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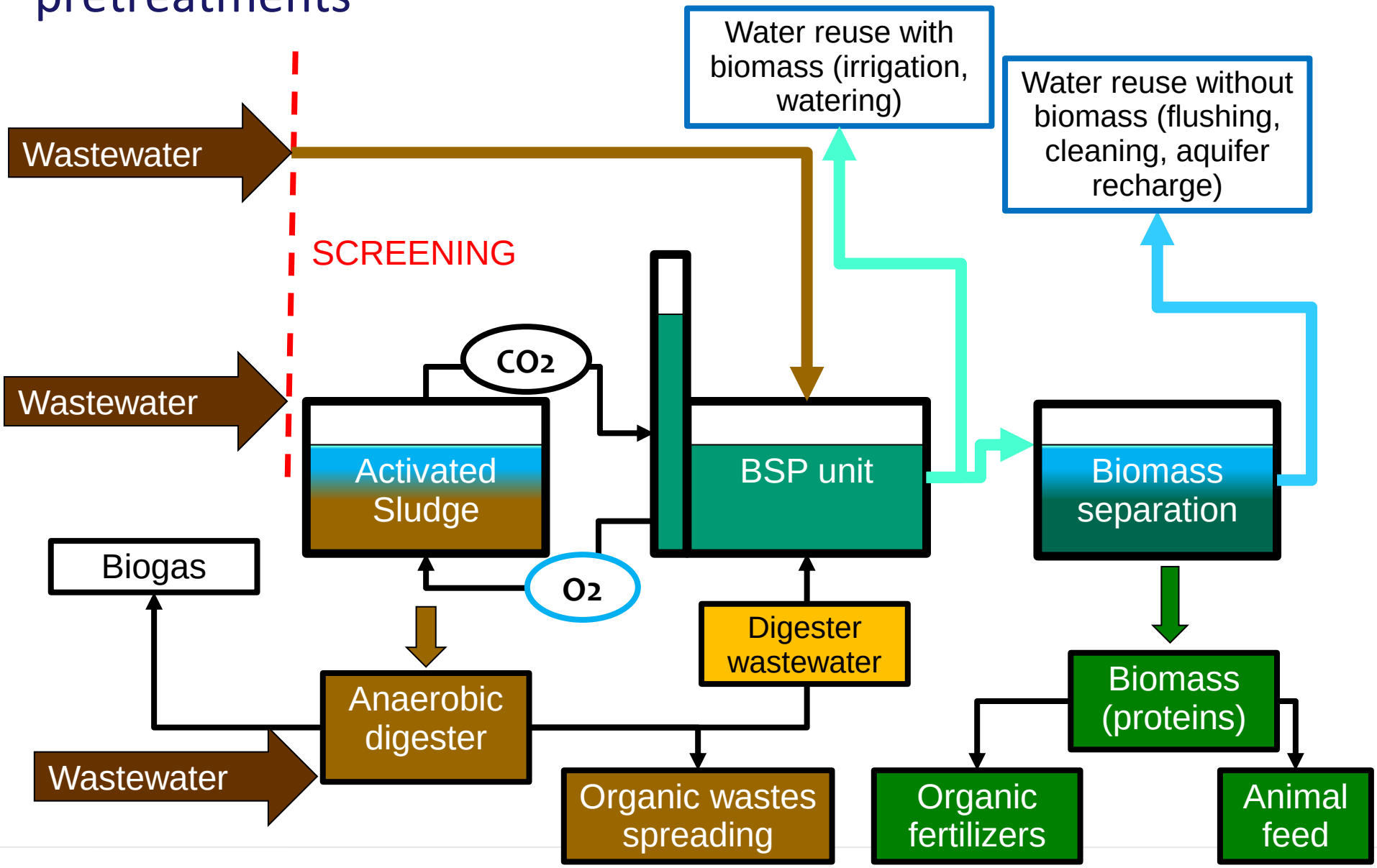

Domestic water reuse management

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Biomass separation

Toilets

Kitchens

Bathrooms

Black waters: organic matter

Grey waters: detergents

HelioPure BSP integrated unit

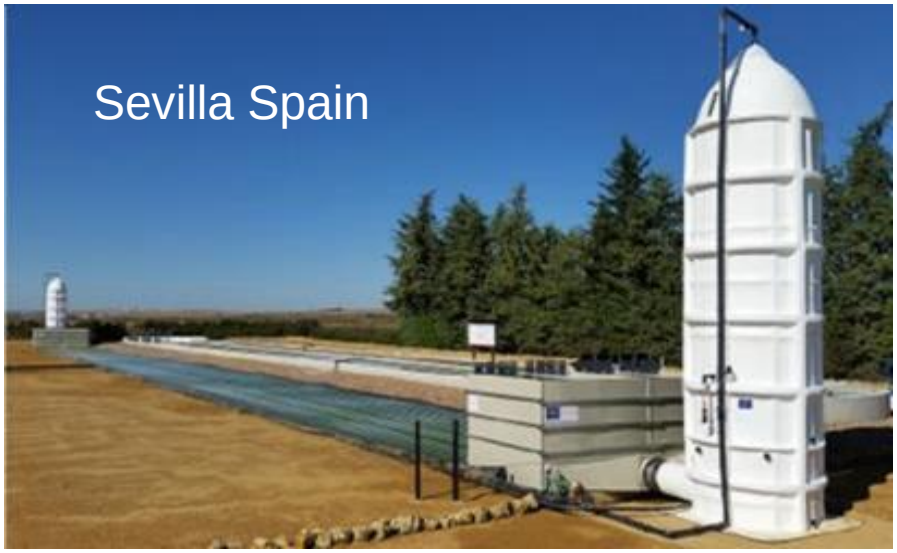
Irrigation, Watering, Aquifer recharge

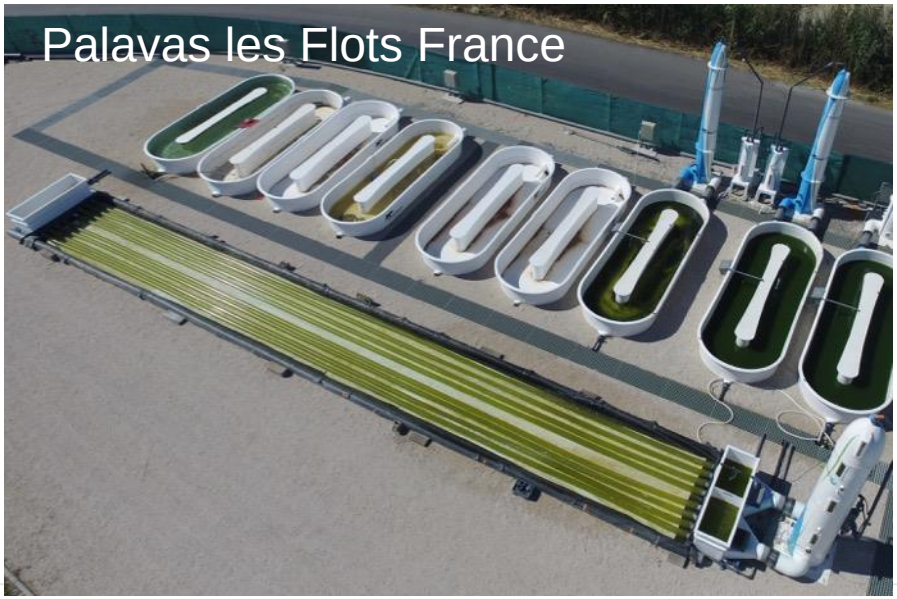
Soils

Underground waters

Wells

BSP tubular and pond units adapted to Europe





Treatment performances are consistent with safe water reuse

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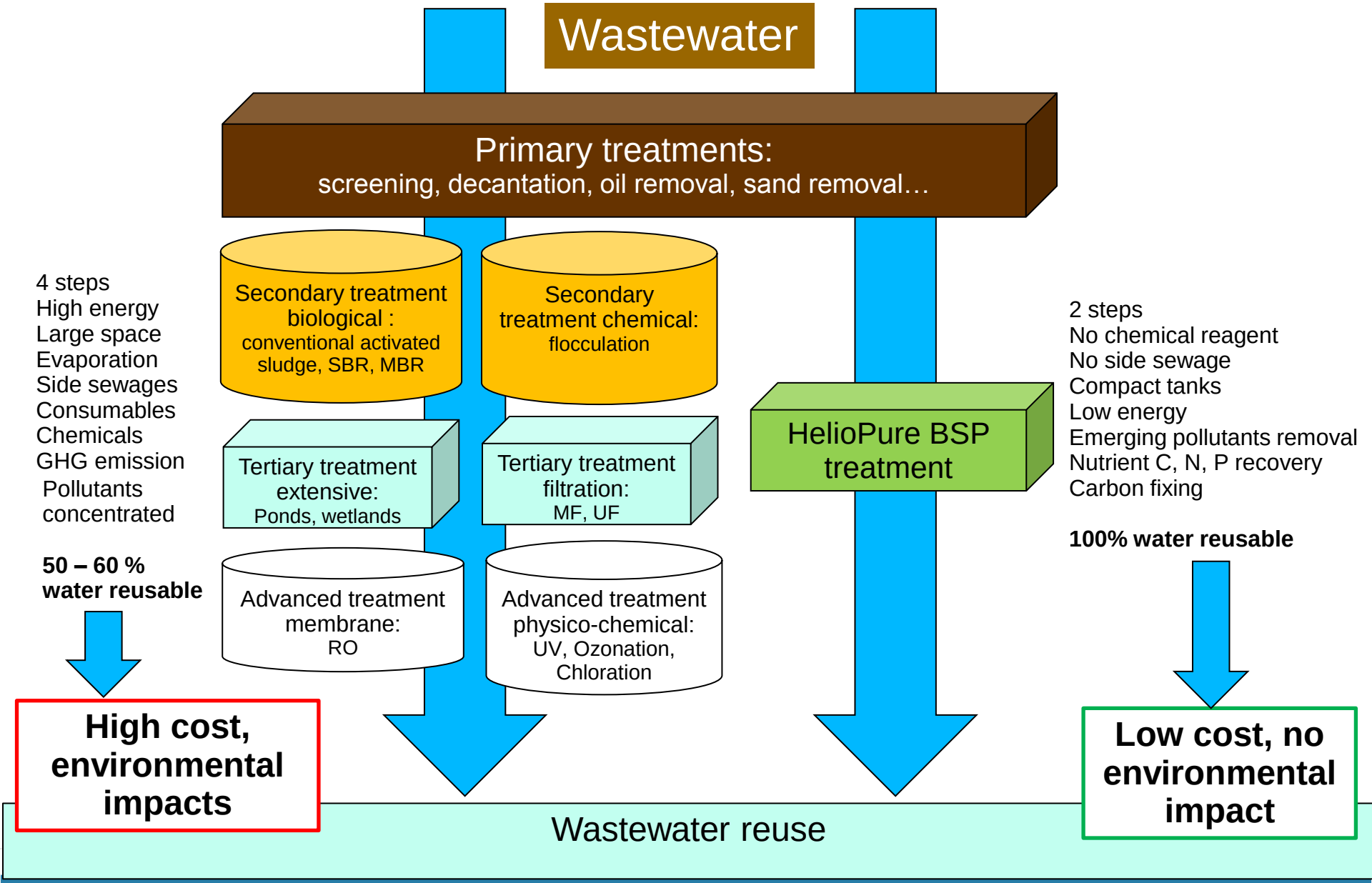
Type of pollutants	Substances or indicators	Type of treatment	Treatment performance	Comments
Nutrients	CO2, NO3, NH4, PO4	Uptake	80 - 100%	Pilot results
Organic wastes	BOD5, COD	Mineralization	90 – 100%	Pilot results
Toxic metals	As, Cr, Cd, Cu, Mn, Ni, Hg, Pb, U	Biofixation	60 - 90%	Lab results and papers
Pharmaceuticals	Diclofenac Sulfamethoxyazole	Photooxidative degradation	100% 60 - 100%	Lab results and papers
Pesticides	Thiamethoxam	Photooxidative degradation	100%	Lab results and papers
Organic micropollutants	Bisphenol A	Photooxidative degradation	65%	Lab results and papers
Other organic pollutants	Phenols Adsorbable Organic Halogens (AOX)	Photooxidative degradation + mineralization	100% 80 – 100%	Lab results and papers
Fecal contamination	E. Coli in 100 mL Fecal Enterococci in 100 mL	Photooxidative disinfection	<60 5 to 6 log removal <60 4 to 5 log removal	Pilot results

HelioPure® BSP pilot unit in France: Results of trials campaign Sept. 2015

Parameters	Input BSP unit	Output BSP unit	Removal performance
Escherichia Coli (Coliforms)	2,8E + 07	< 60	5,7 log (99,997%)
Faecal Enterococci	3,5E + 06	< 60	4,7 log
TOC (mg/L)	210	7,8	96%
BOD 5 days (mg/L)	500	3	99%
COD (mg/L)	1050	32	97%
Suspended Materials (mg/L)	450	17	96%
Total Phosphorus (mg P/L)	10,65	1,75	80%
TKN (mg N/L)	73,44	23,35	68%
N-NH4 (mg N/L)	42,9	0,5	98%

- Analysis performed on wastewater after screening and primary decantation.
- Treated water quality is compatible with water reuse in irrigation for food crops, fruits, vegetables **without sanitary risk for consumers**

HelioPure compared to other existing solutions



HelioPure® : Sustainable Solutions

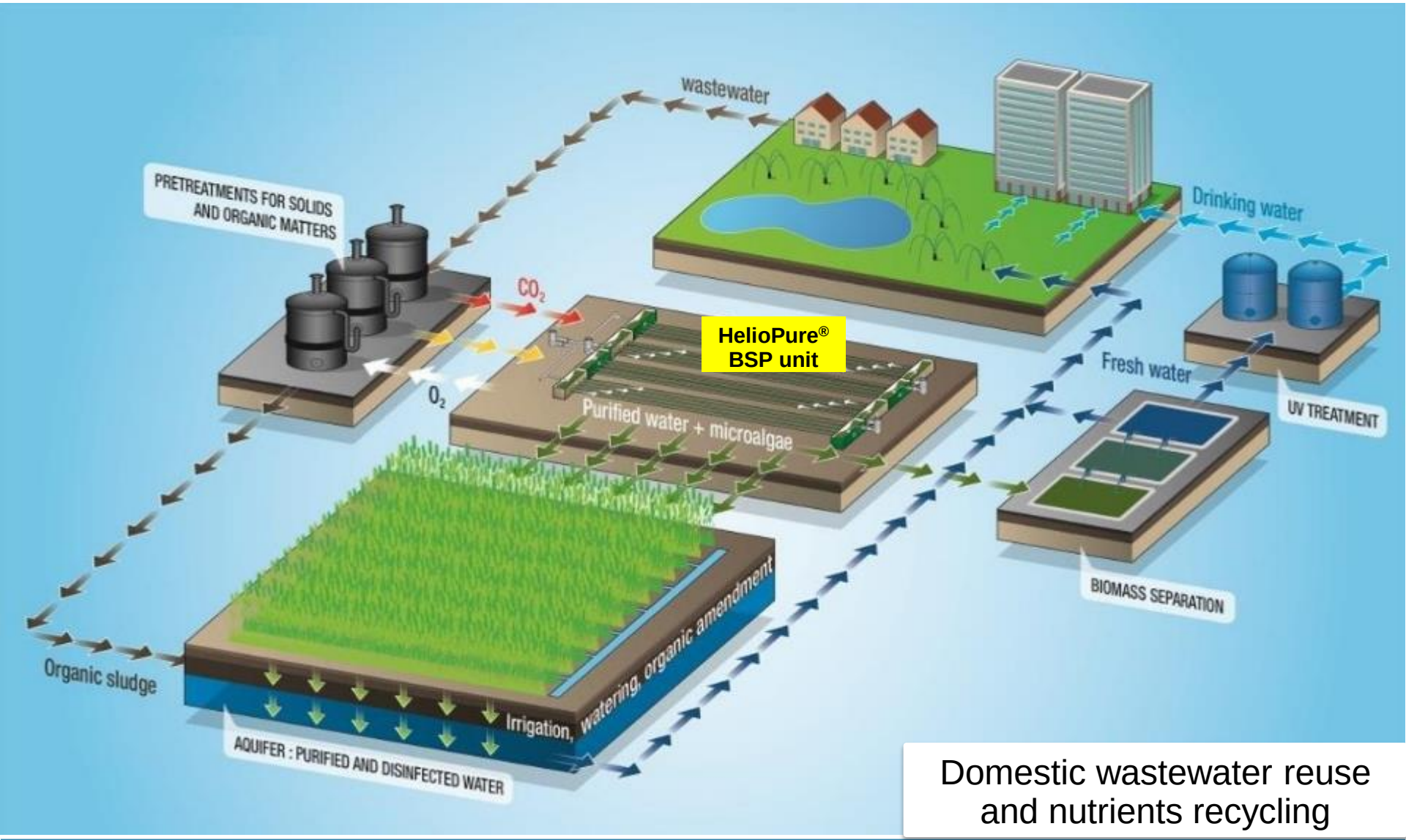
- Water savings and water resources preservation :
  - **No side sewage** => no hazardous compounds accumulation
  - **No hazardous microorganism released**
  - **Water and nutrient recycling** => no eutrophication of aquatic ecosystems

- Carbon footprint : For 1 m^3 treated water :
  - CO_2 consumed: 500 to 1,000 g
  - CO_2 emission: 200 to 400 g

C balance : up to 250 g C captured

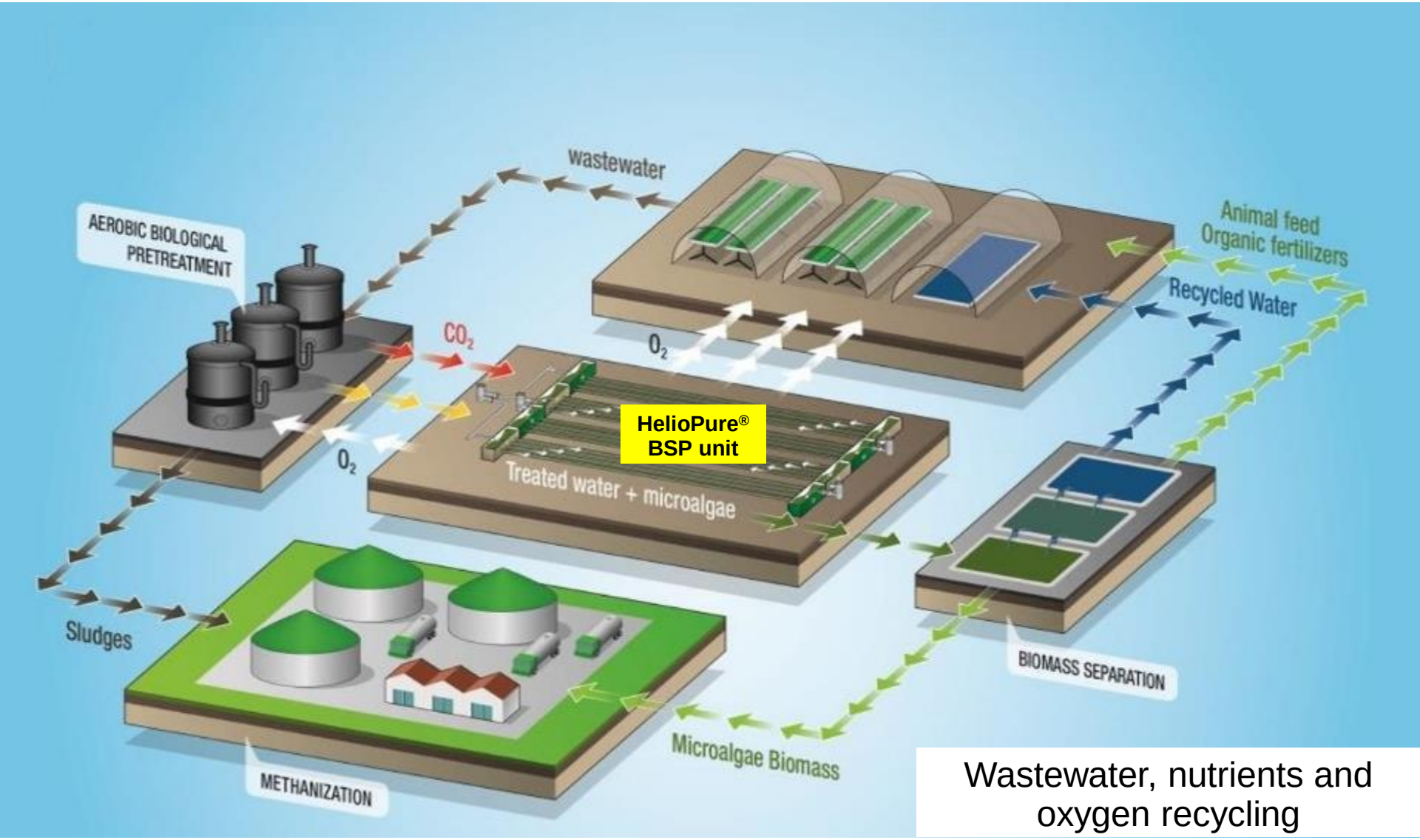
- Land footprint:
  - From 100 to 300L water treated per m^2 and per day in tubular reactor.
  - From 1 to 2 m^3 water treated per m^2 and per day in compact tank reactor

Our domestic wastewater reuse solutions



Domestic wastewater reuse and nutrients recycling

Our soilless agriculture, livestock and fish farming water recycling solutions



Wastewater, nutrients and oxygen recycling

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Beyond Water Recycling

Thank you for your attention!

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