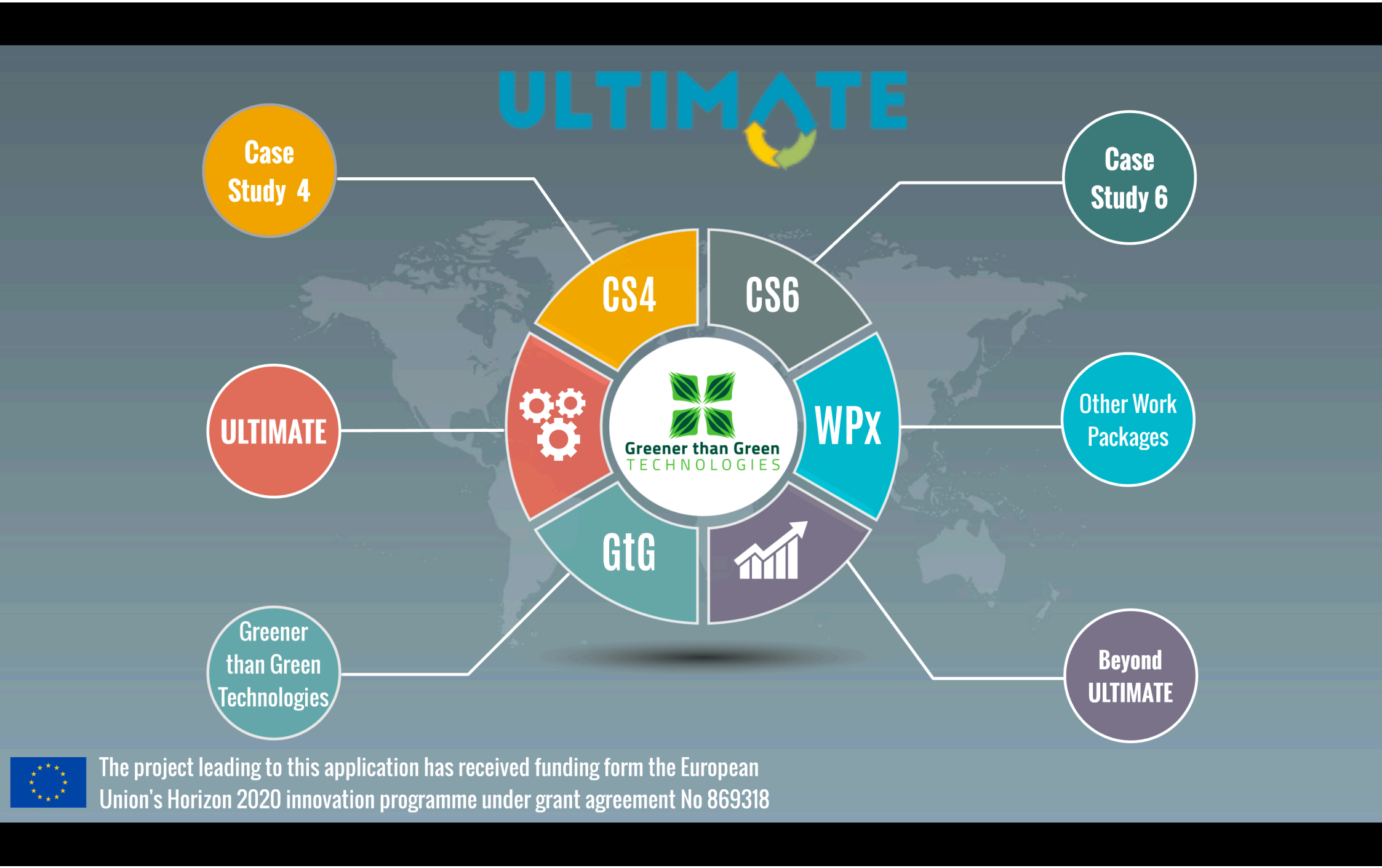

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Case Study 4

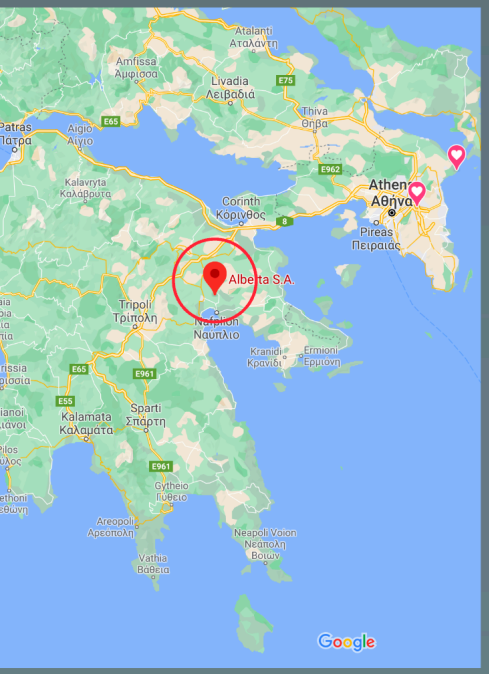
- Fruit processing industry

- Nafplio, Eastern Peloponese, Greece

- High water demand puts pressure in the aquifer

-Seasonality puts strain on the local biological treatment plant

- Under-performing biological treatment plant, leads to higher waste removal cost



Goals

The Unit

Value-added compound extraction

AOP

SBP

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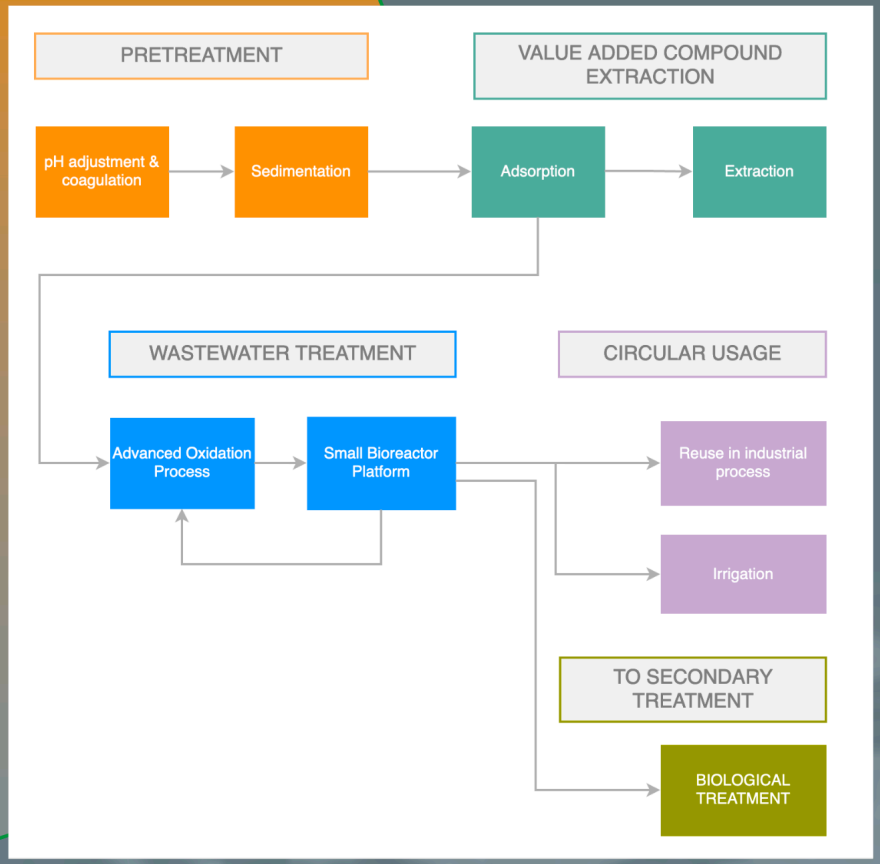
Unit Design

Cross-section

P&ID



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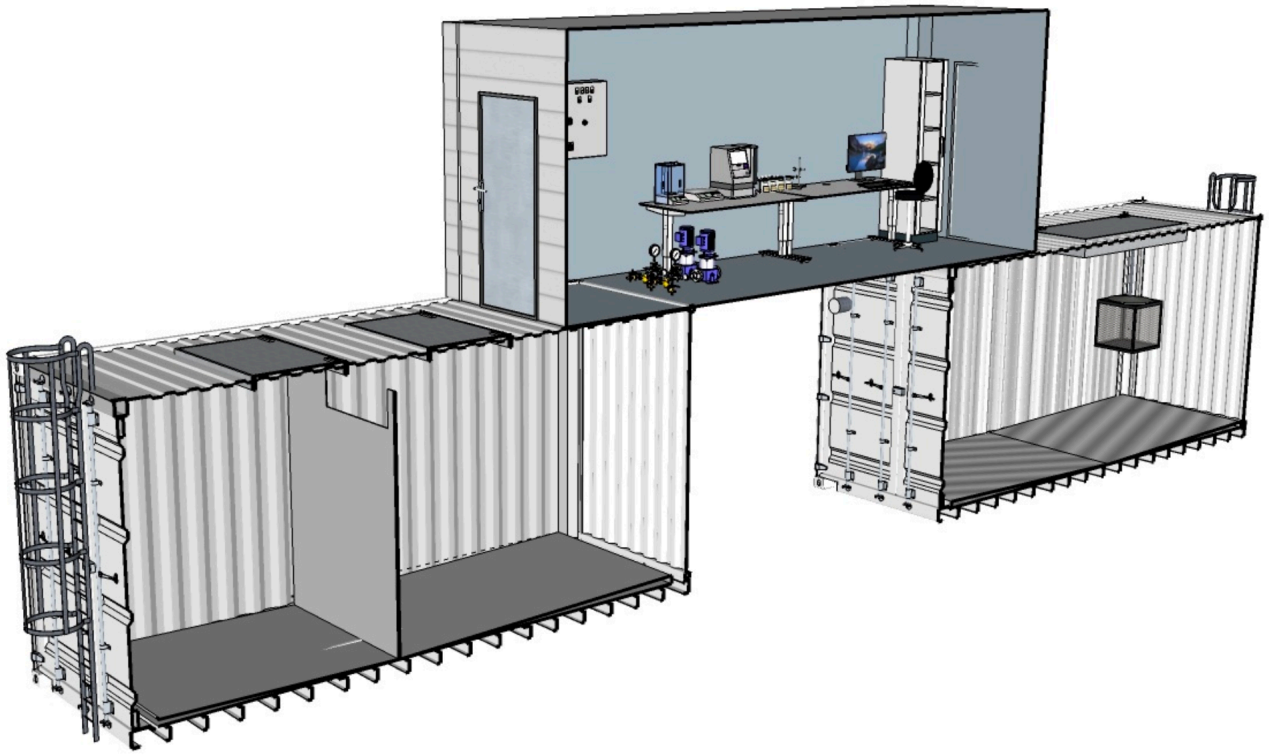
Unit Cross-section



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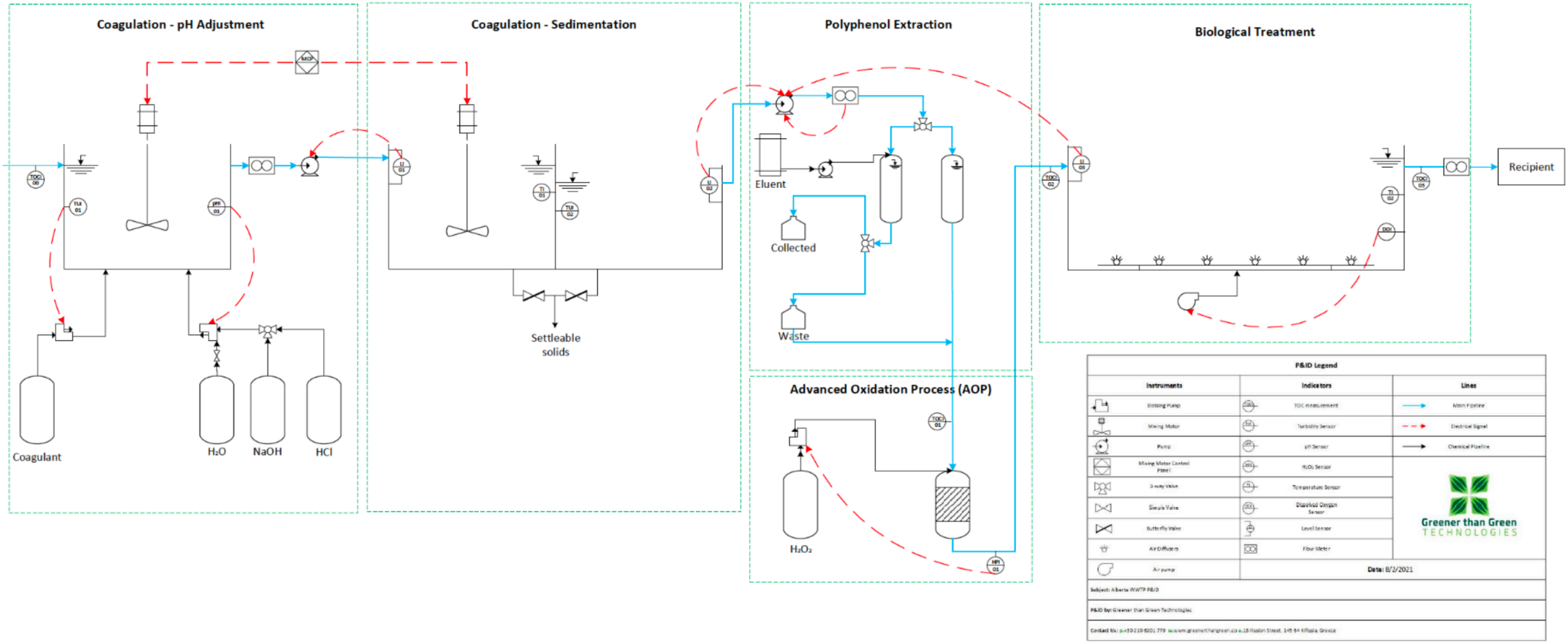
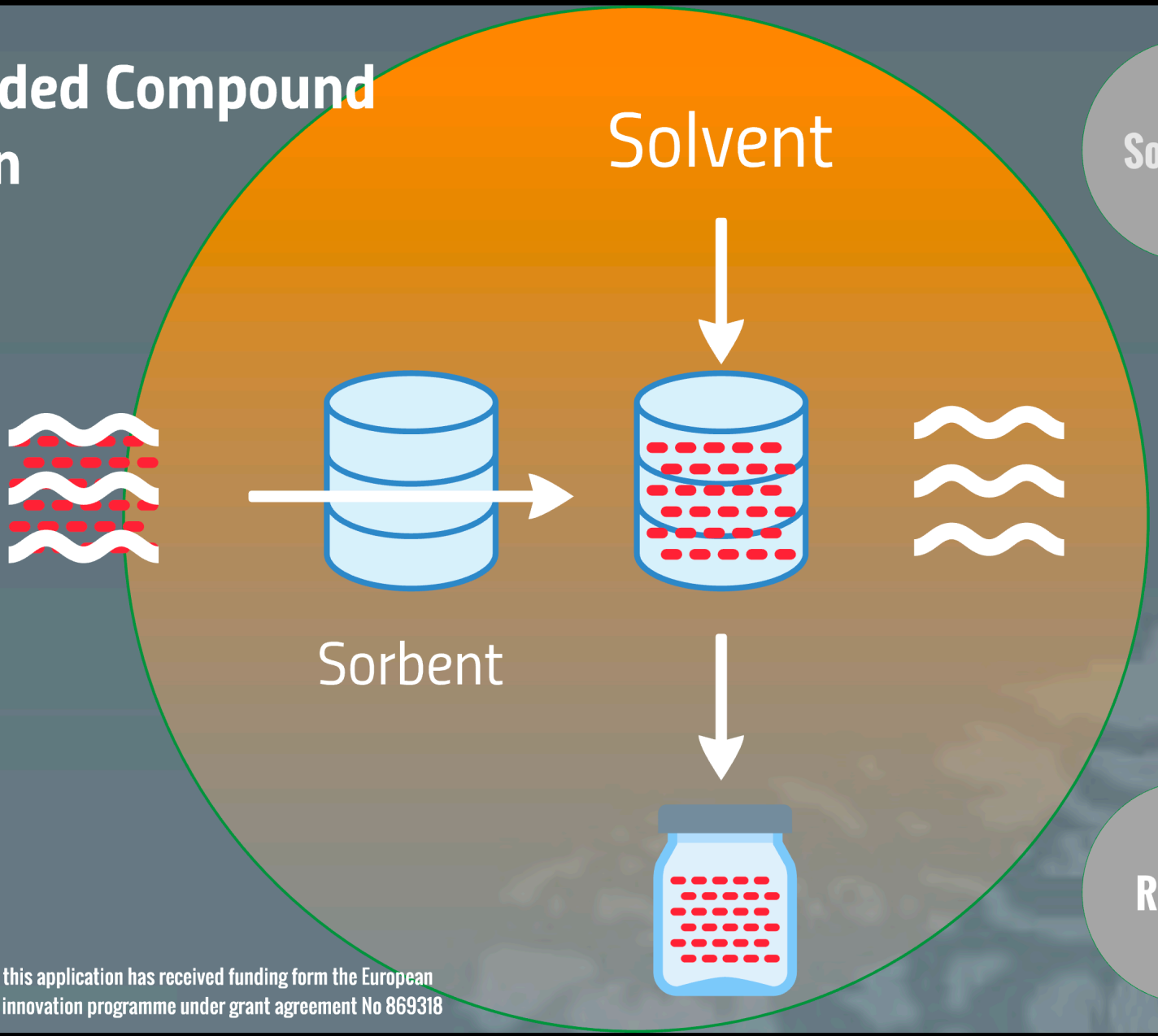
Unit P&ID


Coagulation - pH Adjustment
Coagulation - Sedimentation
Polyphenol Extraction
Biological Treatment
Coagulant
H₂O
NaOH
HCl
Settleable solids
Eluent
Collected
Waste
Advanced Oxidation Process (AOP)
H₂O₂
Recipient
P&ID Legend
Instruments
Indicators
Lines
Dosing Pump
Mixing Motor
Pump
Mixing Motor Control Panel
3-way Valve
Simple Valve
Butterfly Valve
Air Diffusers
Air pump
TOC measurement
Turbidity Sensor
pH Sensor
H2O2 Sensor
Temperature Sensor
Dissolved Oxygen Sensor
Level Sensor
Flow Meter
Main Pipeline
Electrical Signal
Chemical Pipeline
Greener than Green
TECHNOLOGIES
Date: 8/2/2021
Subject: Alberta WWTP P&ID
P&ID by: Greener than Green Technologies

Value-Added Compound Extraction



Sorbents

Extraction Solvents

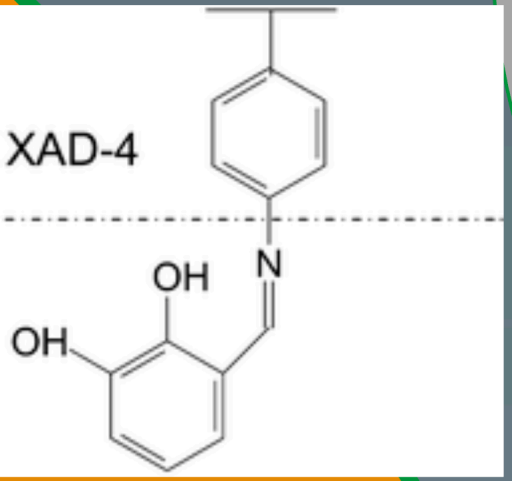
Value-Added Compounds

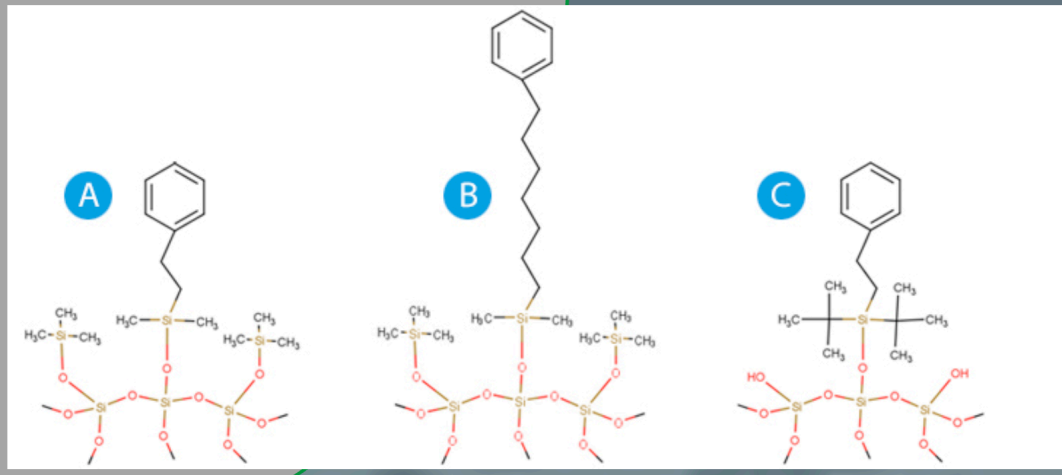
Results

The project leading to this application has received funding form the European Union's Horizon 2020 innovation programme under grant agreement No 869318

Sorbents

Adsorbent	Material	Structure	Particle size (µm)	Surface Area (m^2/g)	Pore Size (Å)
AmberLite™ FPX66	Resin	Aromatic	700	800	150
AmberLite™ XAD-4	Resin	Aromatic	640	750	100
Phenyl-Hexyl	Silica	Aromatic	15	400	100

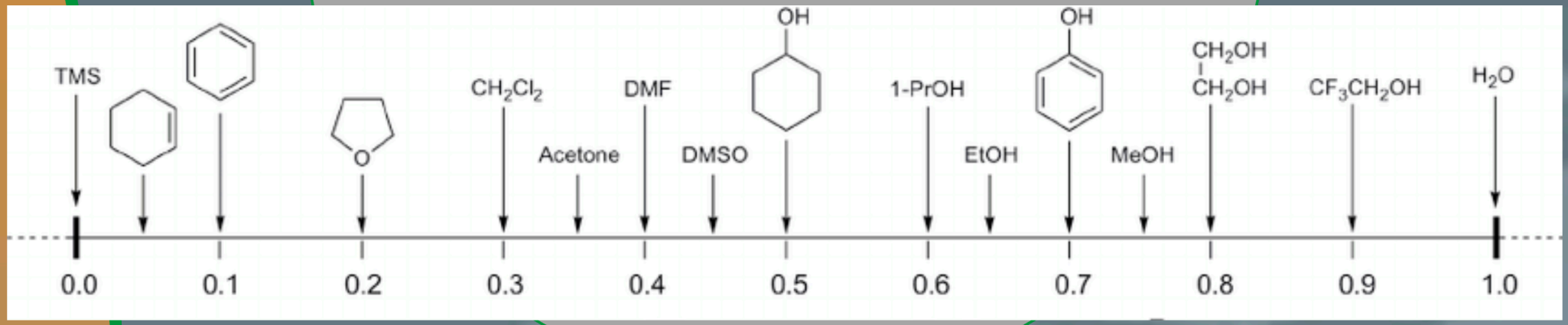




Extraction Solvents

Water - cheap, inefficient, non-toxic
Methanol - high cost, increased toxicity
Ethanol - high cost, lower toxicity

Subcritical Water Extraction



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Value-Added Compounds

Fruit	Compound	Class	Properties & Uses	Price/g*
Orange	Hesperetin	Flavonone	Lowers cholesterols, Anticancer, Favourably favours lipids	€13
	Naringenin	Flavonone	Antioxidant	€1
	Kaempferol	Lignan	Reducing the risk of chronic diseases, especially cancer.	€5.900
Redcurrant	Cyanidin 3-O-glucoside	Anthocyanin	Food colourant	€29
Beetroot	Luteolin	Flavone	Potentials for cancer prevention and therapy	€18.100
			Used in green tea extracts	€22.499
Blsck Chokeberries	Cyanidin 3-O-arabinoside	Anthocyanin	Used as natural colorant	€84.000
Pomegranate	(+)-Catechin	Flavonol	Used in green tea extracts	€22.499
	(+)-Gallocatechin	Flavonol	Antibacterial, Antifungal, Antimalarial, Diuretic, Antiulcer, Xanthine oxidase inhibitor, Antiplasmodic…	€150.000
Carot	3,4-Dicaffeoylquinic acid	Phenolic acid	Antioxidative, DNA protective, Neuroprotective, Hepatoprotective, Anti-influenza viral activity	€374.000

*Price of analytics standards normalised to 1g

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Small Bioreactor Platform

BioCastle
Nature open-code inspired

SBP is a product of BioCastel, Israel

US Patent No. US 8,673,606
Europe Patent No. EP 2421544 (Germany, France, U.K, Nederland, Ireland and Switzerland)
Australia Patent No. 2010240486
Israel Patent No. 213072

Patented Technology by BioCastel, Israel

SBPs encapsulate bacteria within a porus membrane
Cellulose acetate
0.2 µm pore

The membrane:

- **keeps bacteria safe from predators and other microorganisms**
- **prevents biomass from escaping to the environment**

Problems addressed:
Controlling the type of bacteria needed
Defining the space they grow
Controlling the amount of biomass

How does it work

Benefits

Applications

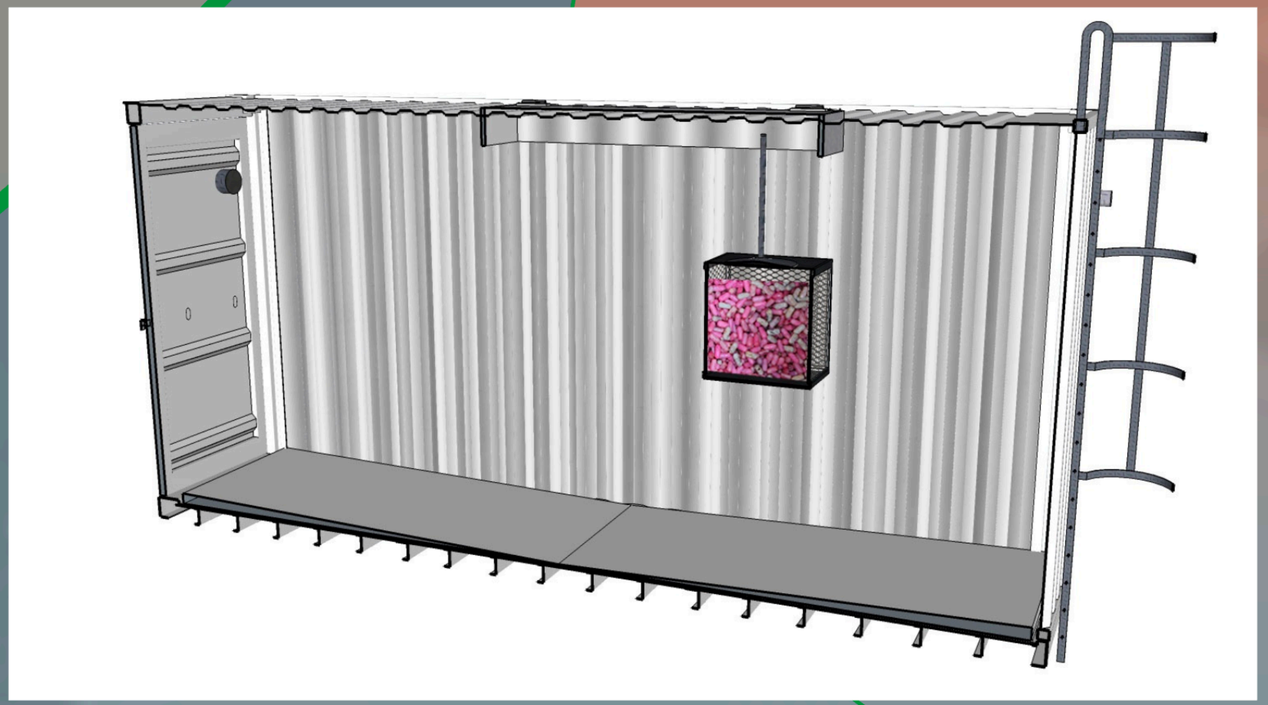
ULTIMATE

The project leading to this application has received funding form the European Union's Horizon 2020 innovation programme under grant agreement No 869318

SBPs application in ULTIMATE

Investigate the synegistic effect of AOP-SBP

Goal: To create a universal treatment methodology for the food processing sector



Treat wastewater rich in compounds with antibacterial properties, e.g. polyphenols

Wastewater from:

- **Olive oli mill**
- **Fruit & vegetable processing and juice production**

Future: Phrmaceutical wastewater treatment

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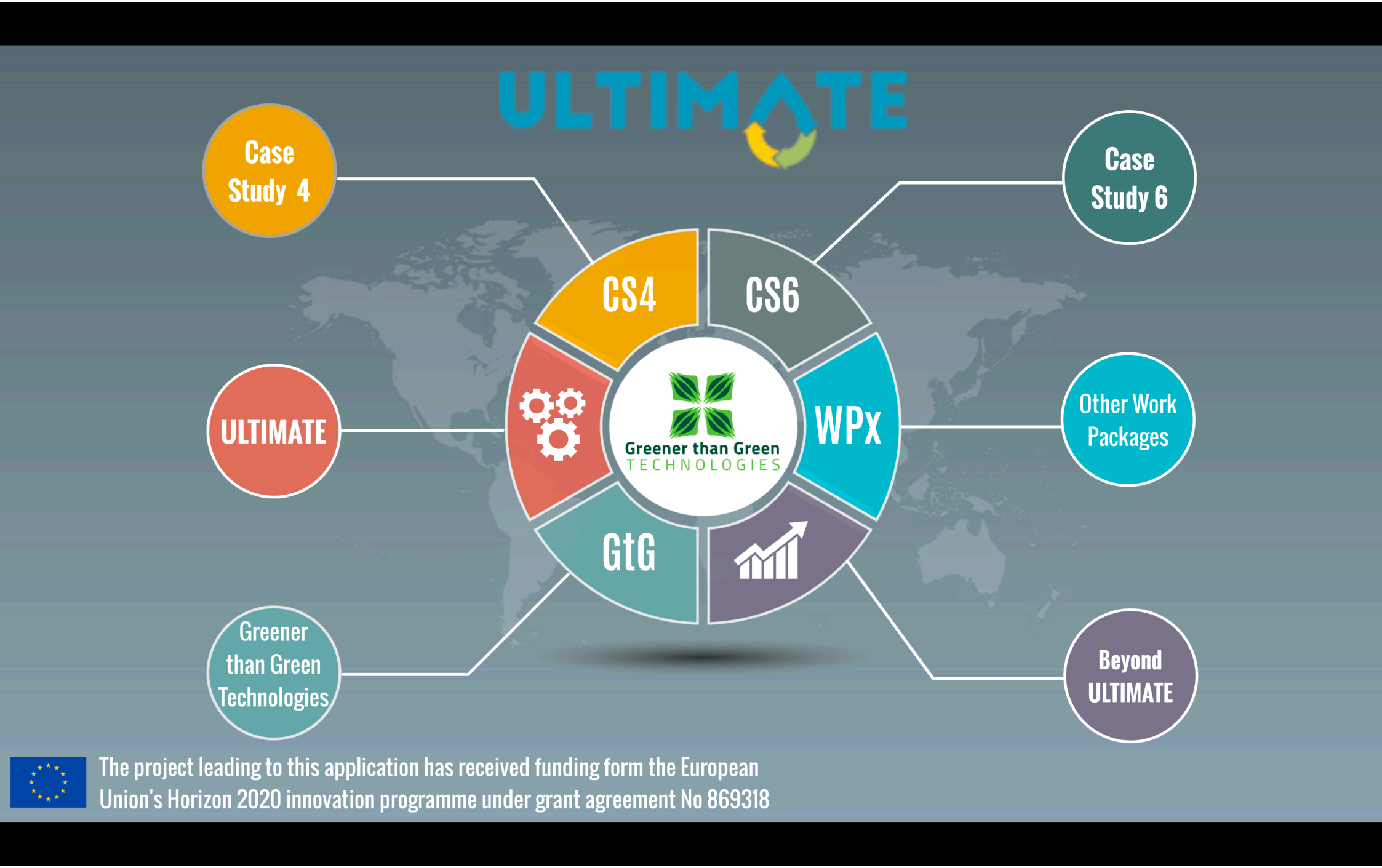

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Case Study 6

Karmiel, Israel

Oliveoil mill wastewater treatment

Partners: The Galilee Society, MEKOROT, GtG

Oliveoil mill wastewater is reach in **polyphenols** which are toxic to bacterial and inhibit aerobic or anaerobic digestion in biological wastewater treatment plants

Goal

Polyphenol Extraction

Design

Lab-scale

The project leading to this application has received funding form the European Union's Horizon 2020 innovation programme under grant agreement No 869318

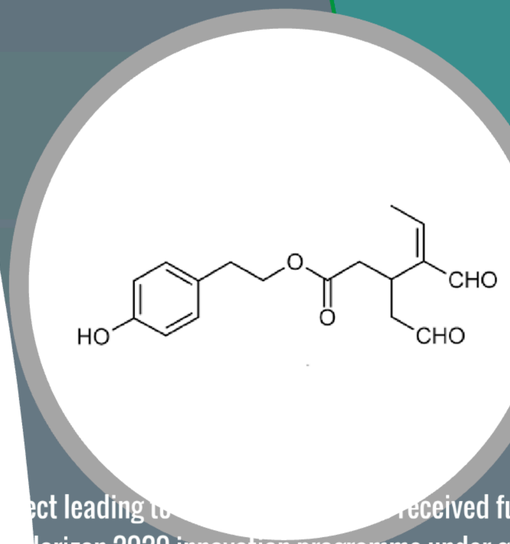
Polyphenol Extraction

Sorbents

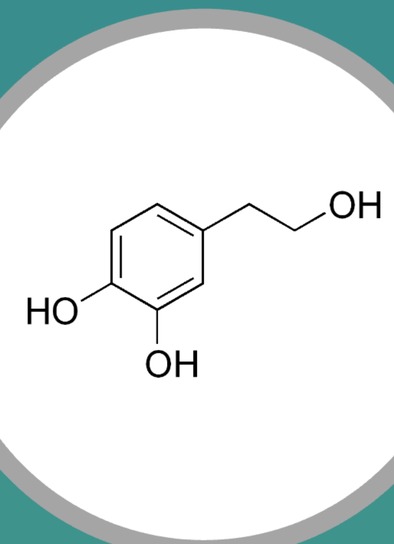
Compound	Properties	Price/g*
Oleocanthal	Antioxidant, Anti-inflammatory, Anti-cancer, Reduce risk of AD, Reduce risk of heart disease	€5.780
3-Hydroxytyrosol	Antioxidant, Anti-inflammatory, Anti-cancer, Protects skin & eyes, Protection from pathogens	€1.620
Oleuropein	Antioxidant, Anti-inflammatory, Anti-cancer, Antinociceptive, Antimicrobial, Gastrorotective, Neuroprotective	€7.240

*Price of analytics standards normalised to 1g

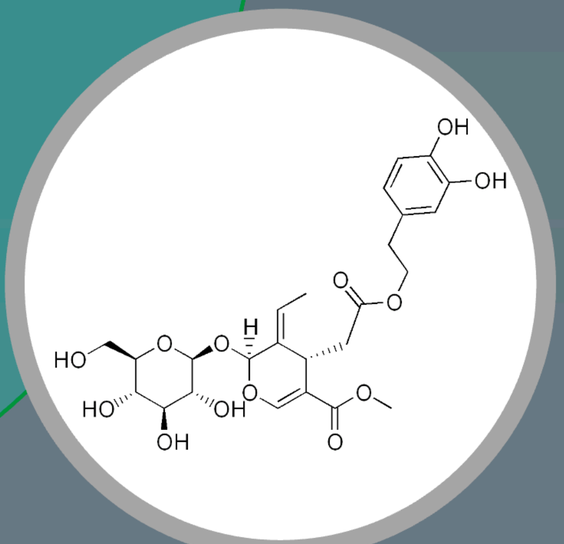
Oleocanthal



3-Hydroxy tyrosol



Oleuropein



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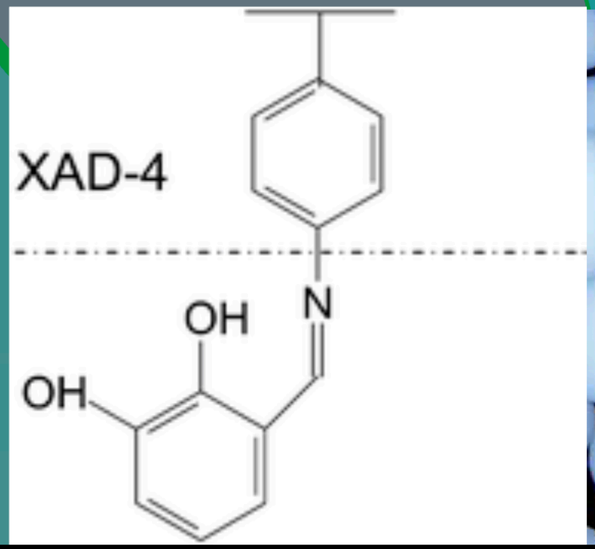
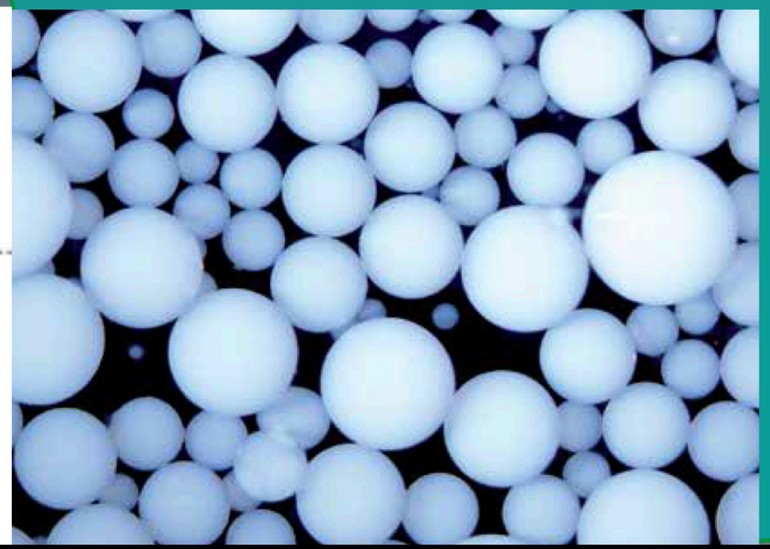
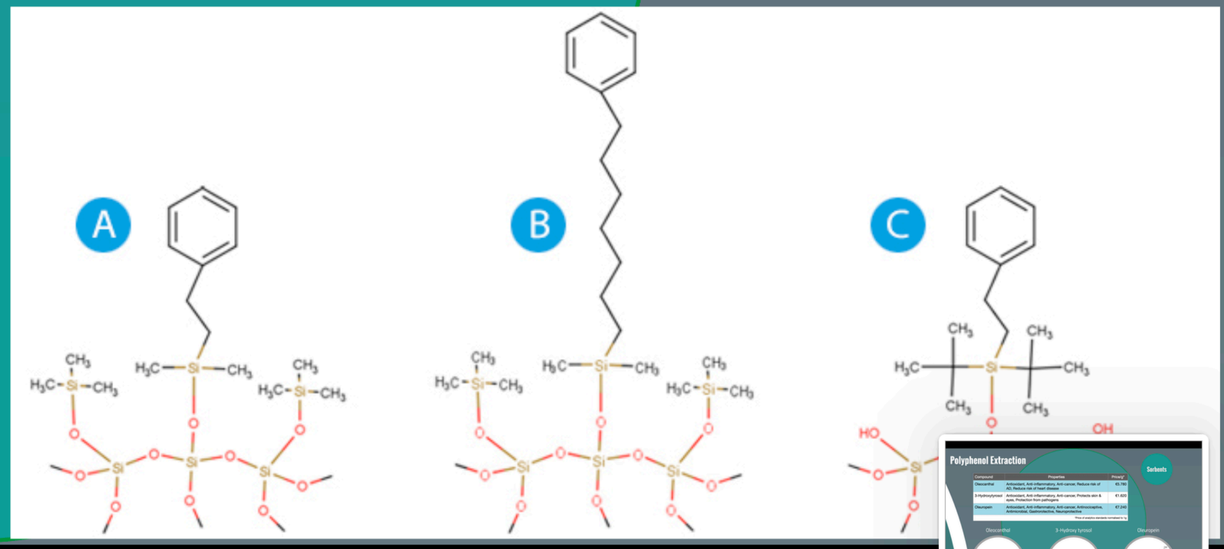
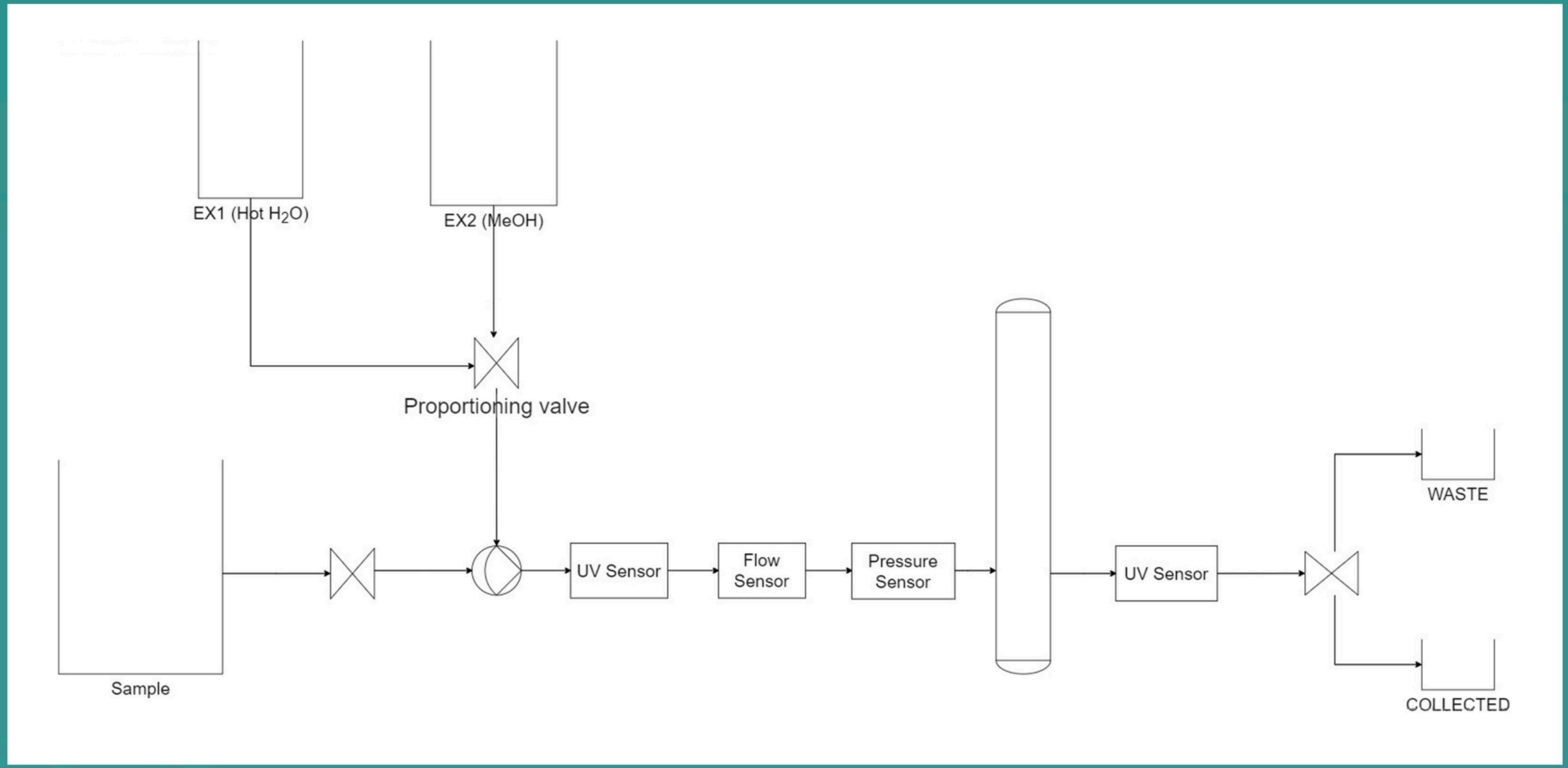






Design



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Lab-scale

Results

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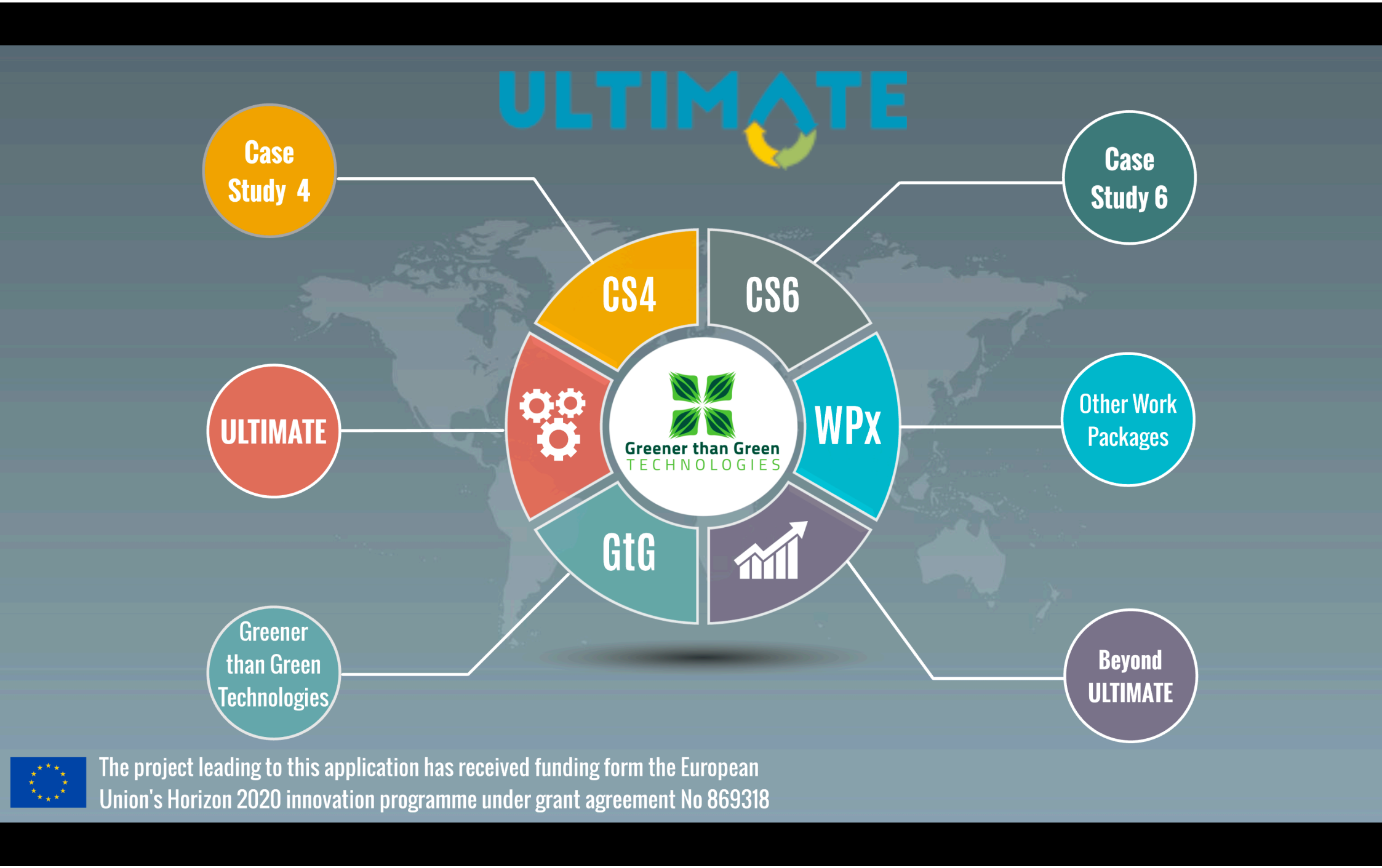

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The team

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MEng MSc

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Chemist, BSc MSc PhD

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Greener than Green
TECHNOLOGIES

Greener than Green Technologies SA (GtG)

is active in R&D and marketing of disruptive water and **wastewater remediation** technologies and methodologies for the circular usage of water providing valuable tools for the transition of industries and communities towards a **circular economy** model, taking a step closer to a circular economy. In cases where high interest and **value added** compounds are present in the waste, these can be **reclaimed**, purified and reused, minimising production cost, or can be commercially exploited, thus, turning **waste into a resource**.

Established in 2014, we are start-up company that sprung out of pioneering university research. Our research efforts are funded by private capital as well as EU grants and we continuously seeking synergies in both the industrial and research partners. Since 2019 we are marketing and promoting in Greece and the wider southeastern European area novel and innovative environmental technologies.

The team

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