BIOrural

Accelerating circular bio-based solutions integration in European rural areas

Microalgae as part of the circular economy

An introduction to the ALG-AD project

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Interreg North-West Europe ALG-AD

The ALG-AD project combines AD with microalgal cultivation to generate value

AIMS

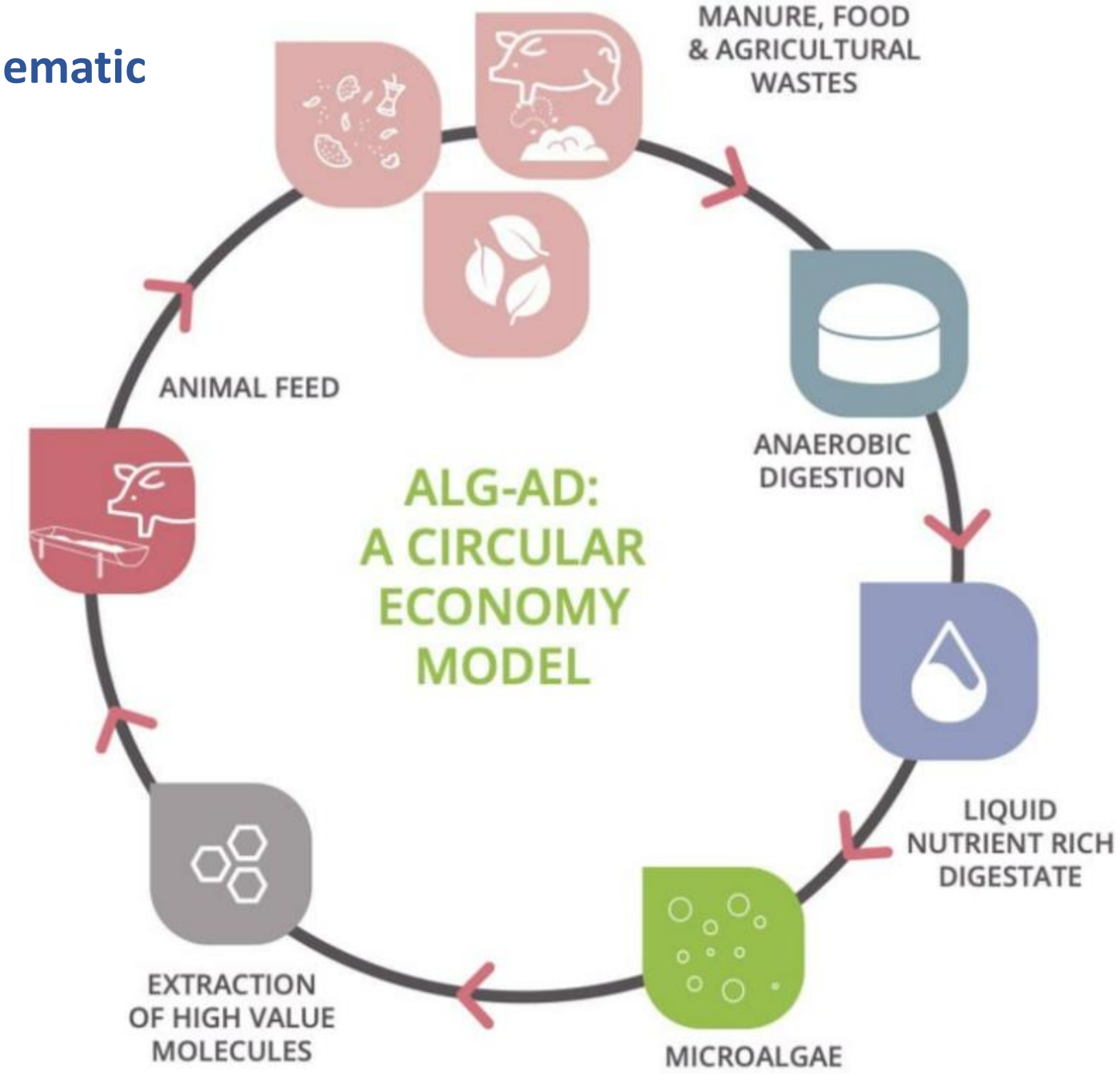
Develop new market opportunities for digestate without risk of eutrophication

Recycle liquid digestate into biomass

Produce sustainable animal feed

Provide an alternative to imported proteins for animal and fish feed

ALG-AD simplified schematic



ALG-AD work-packages

Work-package 2:

Charactering biomass

Developing algal biomass into commercial products

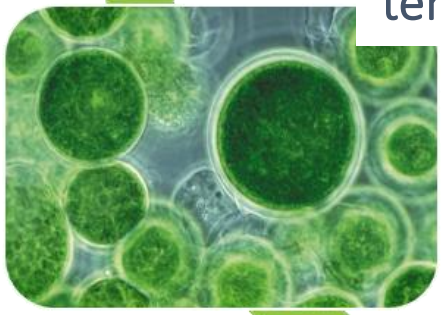
Piglet feed trials

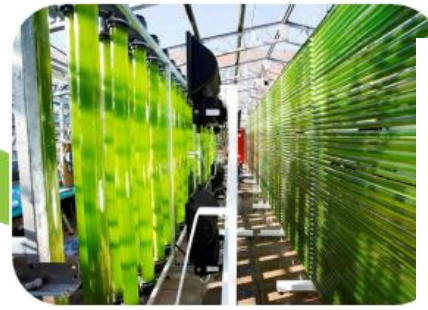
Capitalisation WP:

Fish feed trials

Work-package 3: Scenario & Decision Tools

Work-package 4: Long term roll out of technology





Work-package 1:

Three pilot facilities

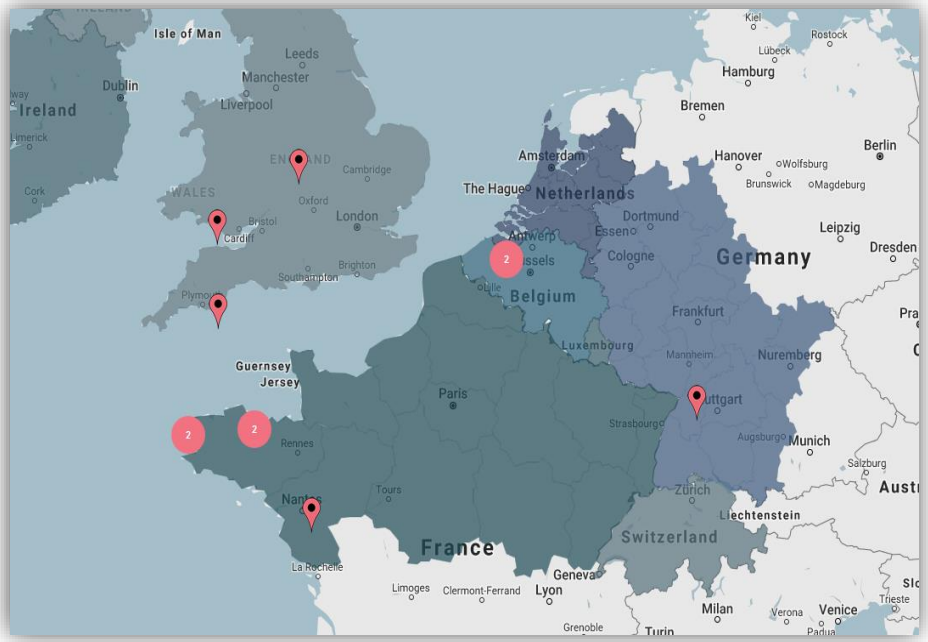
Operation of investments using waste nutrients from AD to produce algal biomass

Interreg North-West Europe ALG-AD

ALG-AD: Creating value from waste nutrients - Integrating Algal & AD technology

2017-2021: € 6.2 M

11 key partners
UK, France, Belgium, Germany



Swansea University
Prifysgol Abertawe

LANGAGE AD™
ANAEROBIC DIGESTION

BIRMINGHAM CITY University

cnrs

UBO
université de bretagne occidentale

Cooperl
Arc Atlantique

AGRICULTURES & TERRITOIRES
CHAMBRES D'AGRICULTURE
ARC ATLANTIQUE

anses
French agency for food, environmental and occupational health & safety
Investigate, evaluate, protect

UNIVERSITEIT GENT

Innolab

KIT
Karlsruher Institut für Technologie

The Bioeconomy Consultants
NNFCC

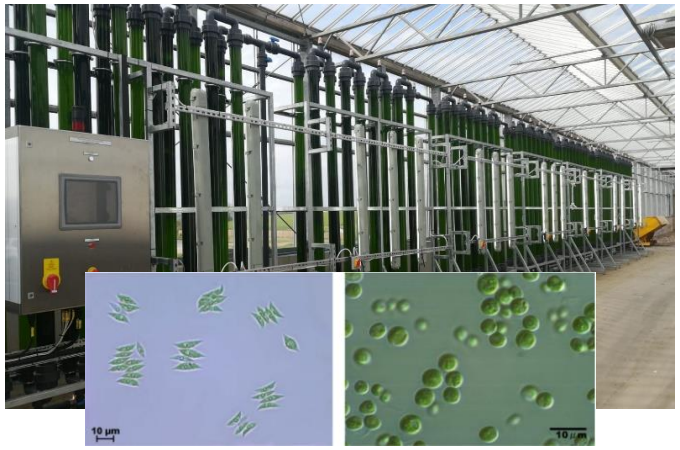
wrap

EABA
EUROPEAN ALGAE BIOMASS ASSOCIATION

BIOREFINE
CLUSTER EUROPE

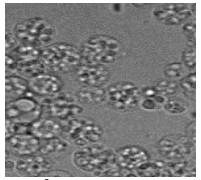
WP1: 3 pilot facilities testing different digestates & algae

Langage AD, Plymouth



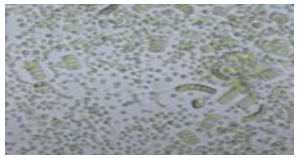
Chlorella and *Scenedesmus*
Autotrophic and mixotrophic

CooperI, Lamballe



Aurantiochytrium magrovei
Heterotrophic

Innolab, Ghent



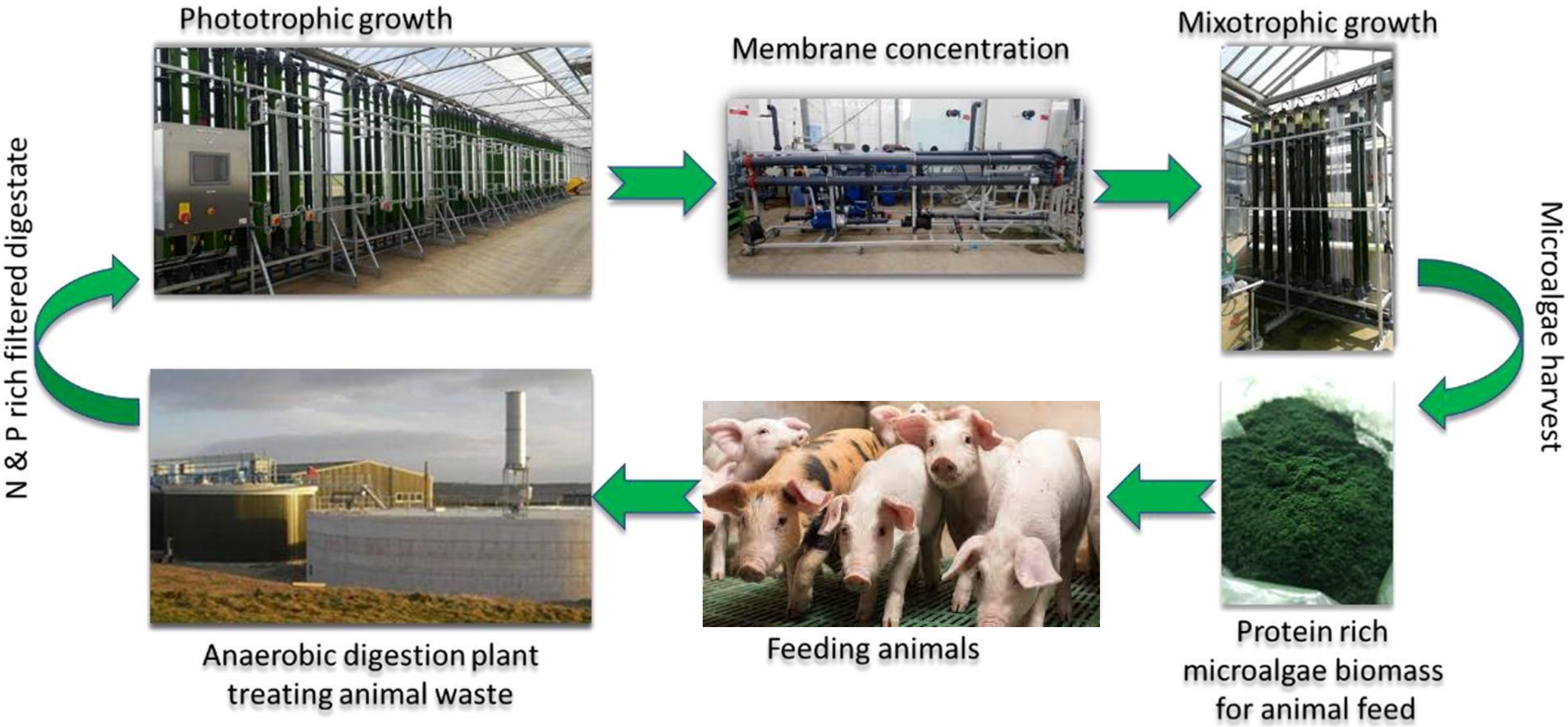
Mix *Chlorella* and *Desmodesmus*
Autotrophic

ALG-AD: Using waste nutrients from AD to cultivate algae to create animal and fish feed: 2017-2022

Integrating algal & AD technology

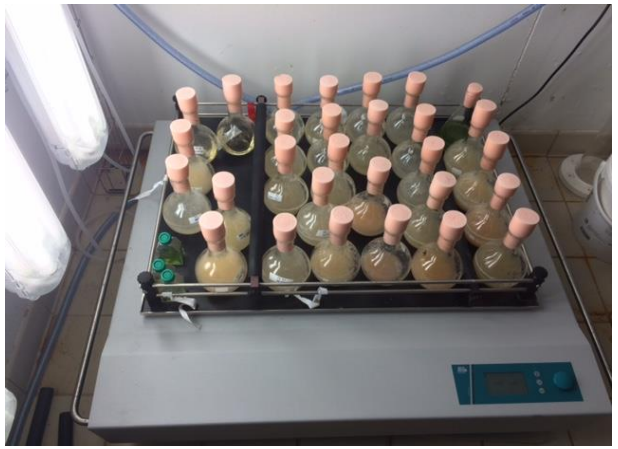
Interreg
North-West Europe
ALG-AD
European Regional Development Fund
EUROPEAN UNION

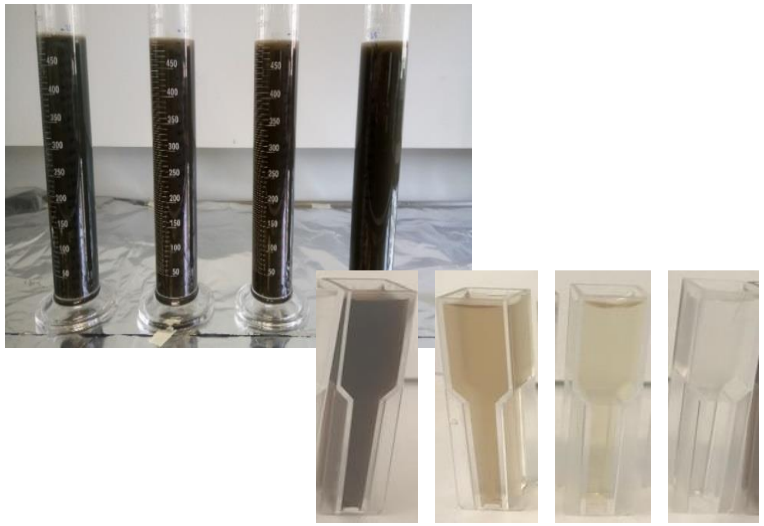
Overview of the UK process

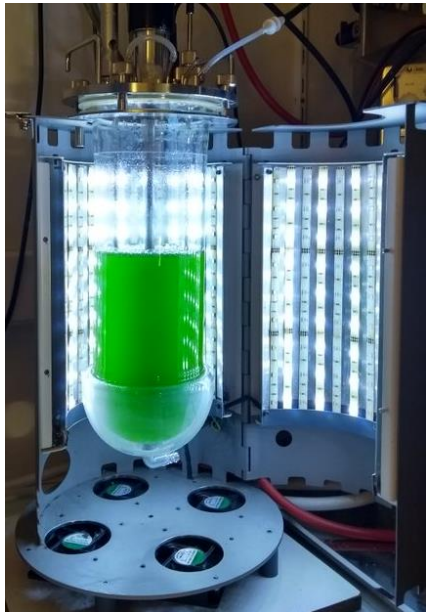


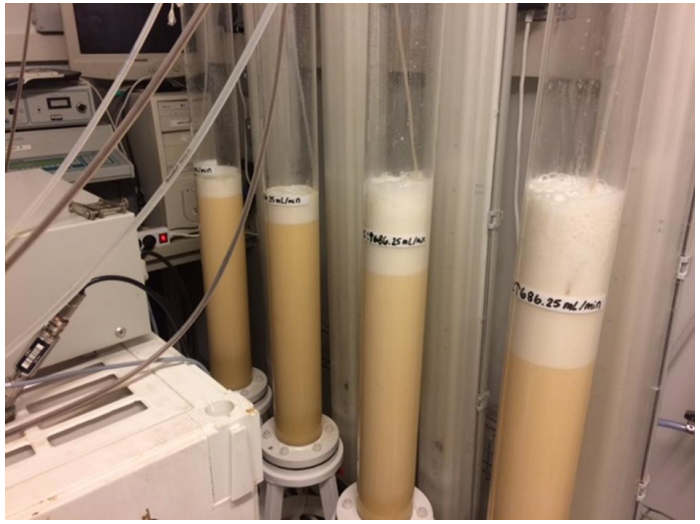
Combining a phototrophic-mixotrophic growth approach

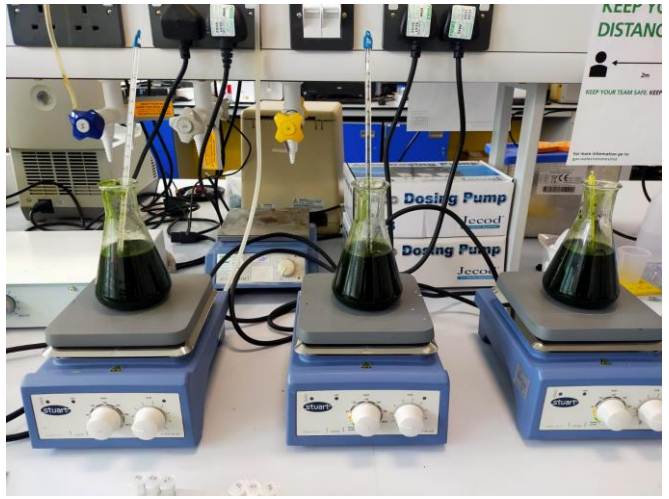
Pilot facilities backed up with extensive laboratory experiments optimising digestate and cultivation



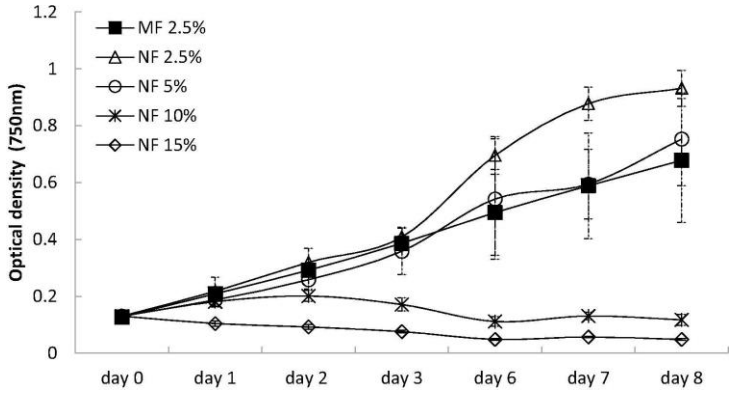




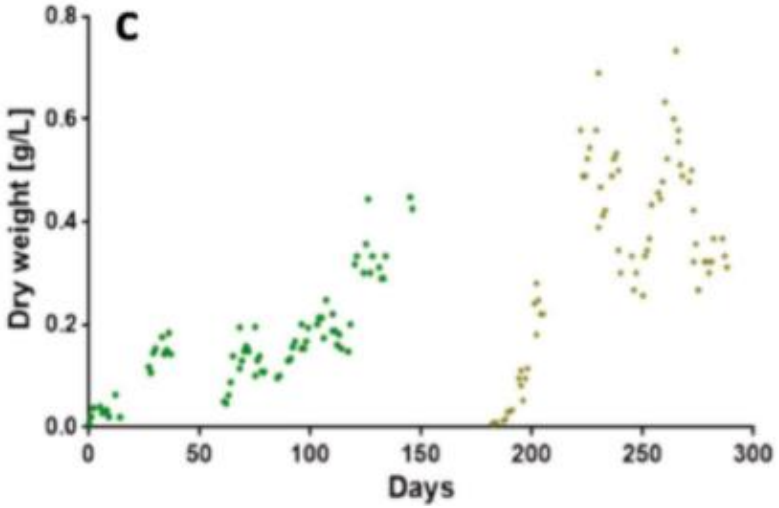




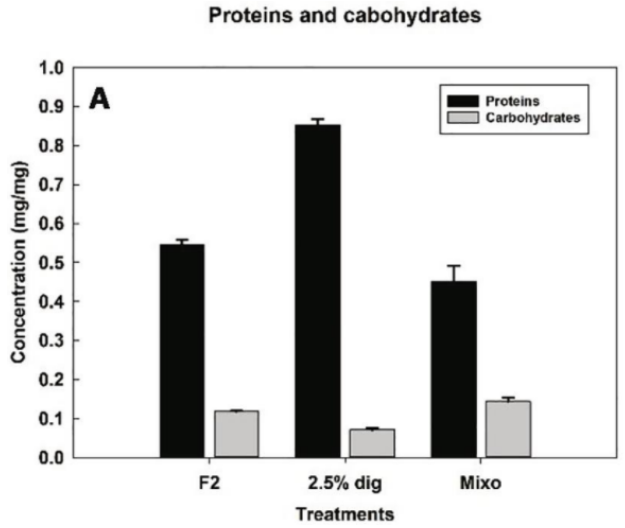
WP2: Characterising and processing



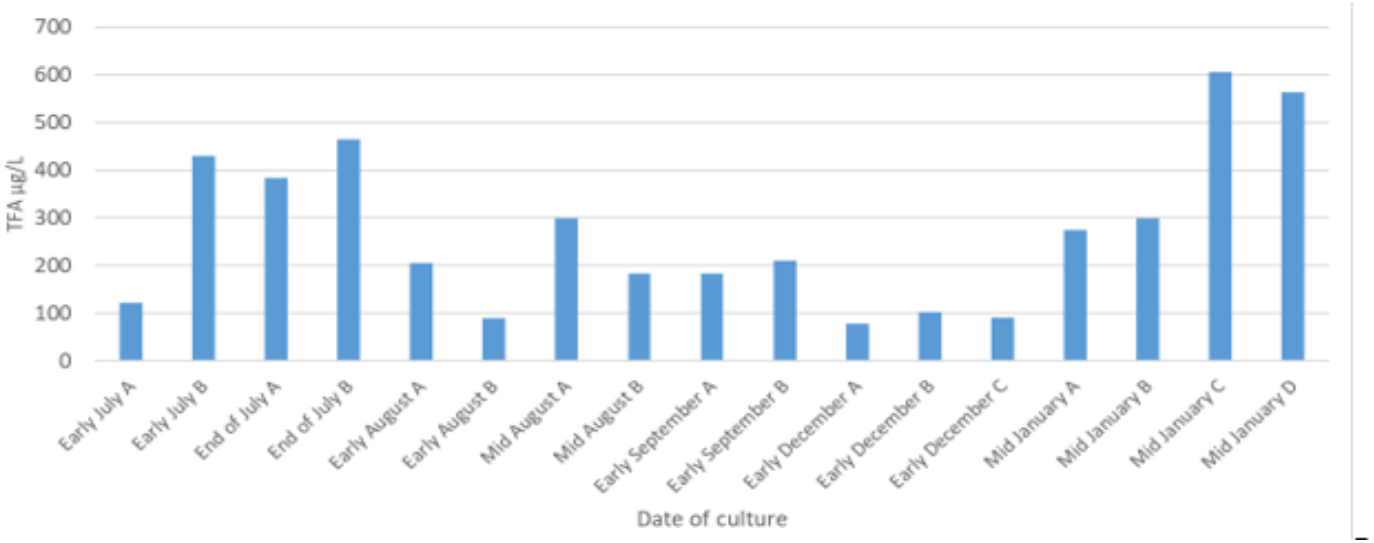
Digestate studies



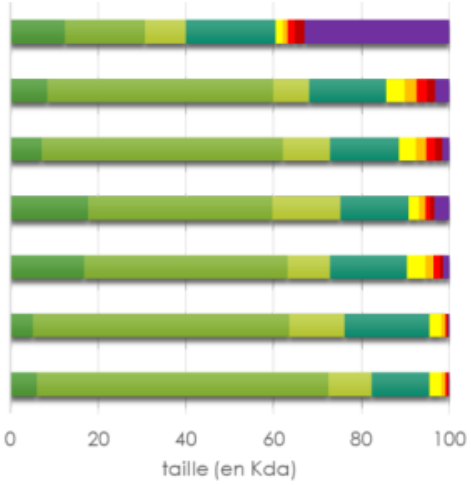
PBR long term studies



Characterisation studies



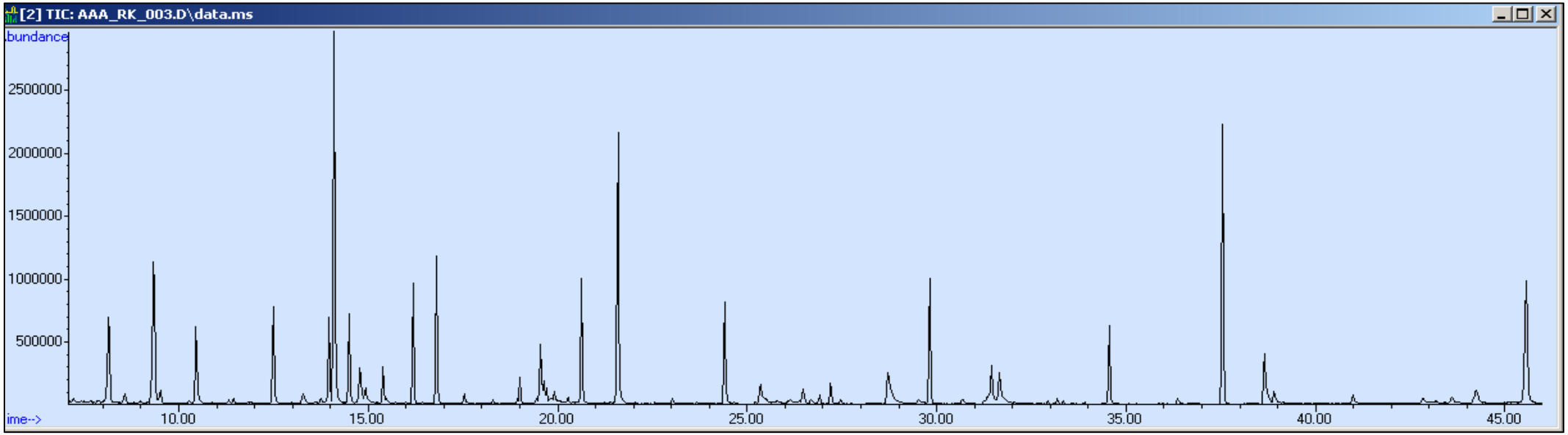
Seasonal studies



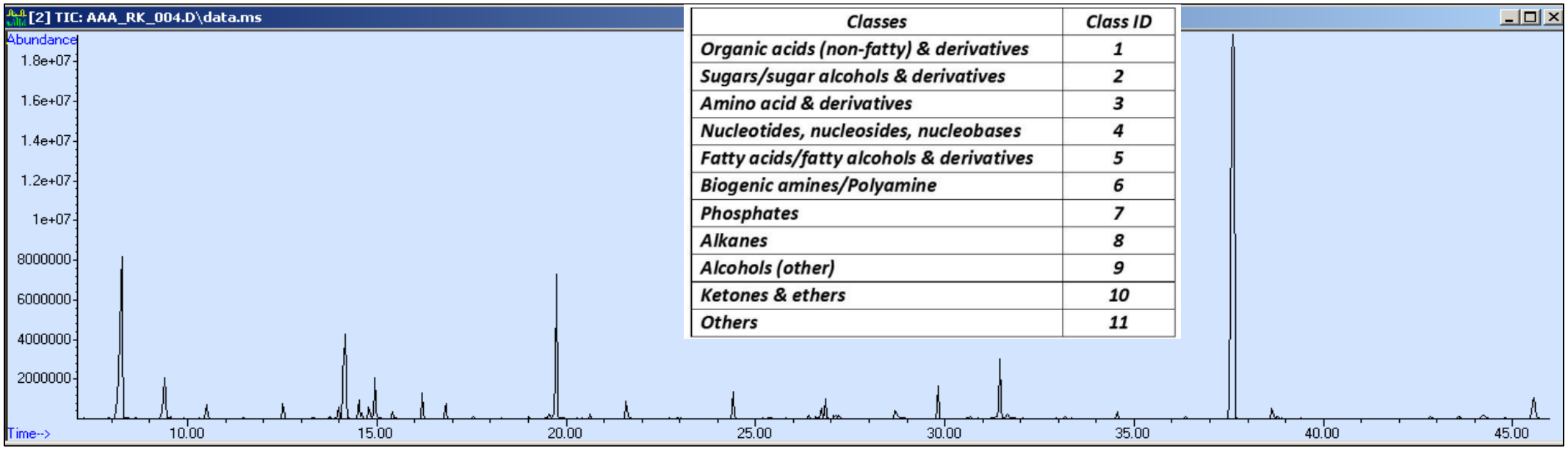
Algal Processing studies

WP2: Characteristion of the algae using GC-MS Metabolomics

2.5% Digestate Chlorella



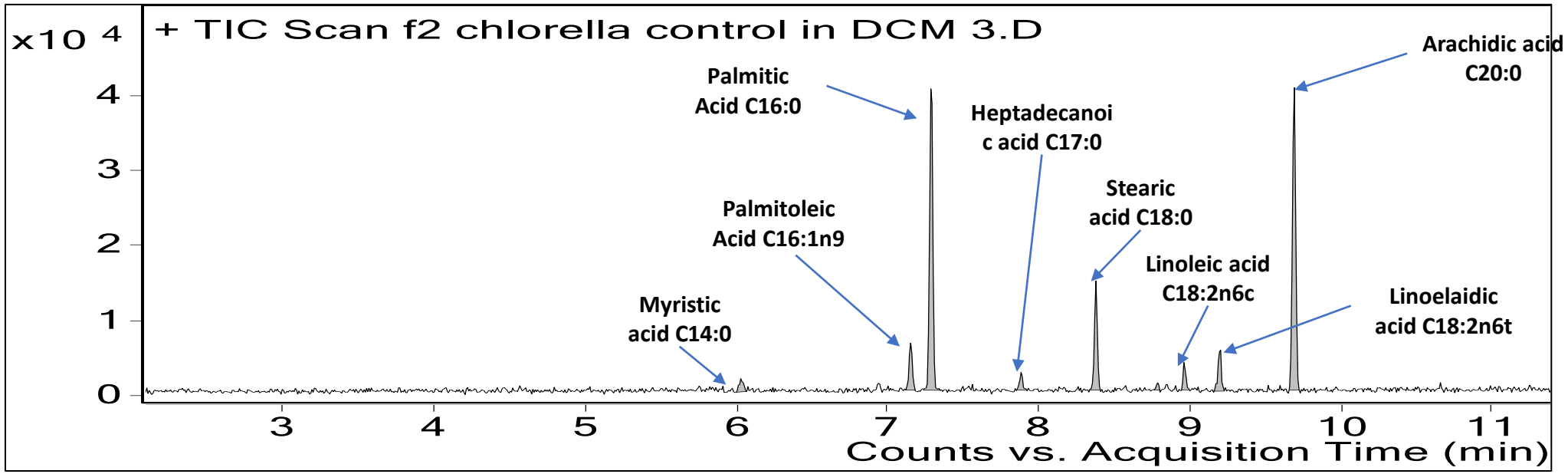
f/2 Chlorella (Control)



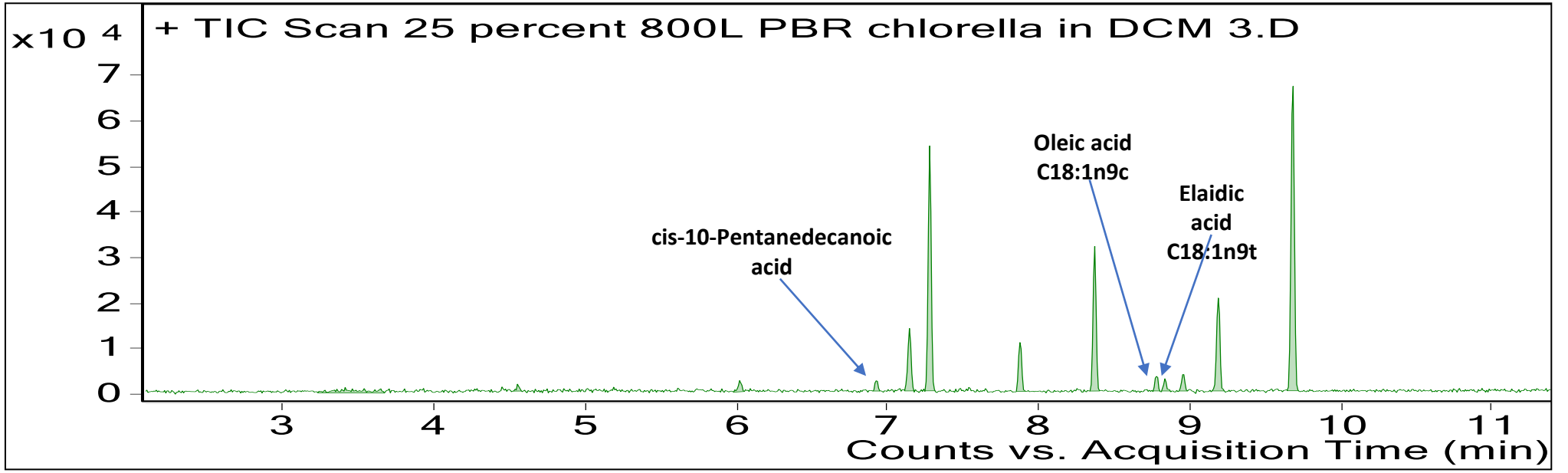
Classes	Class ID
Organic acids (non-fatty) & derivatives	1
Sugars/sugar alcohols & derivatives	2
Amino acid & derivatives	3
Nucleotides, nucleosides, nucleobases	4
Fatty acids/fatty alcohols & derivatives	5
Biogenic amines/Polyamine	6
Phosphates	7
Alkanes	8
Alcohols (other)	9
Ketones & ethers	10
Others	11

WP2: Fatty acid characteristion of the algae using GC-MS Metabolomics

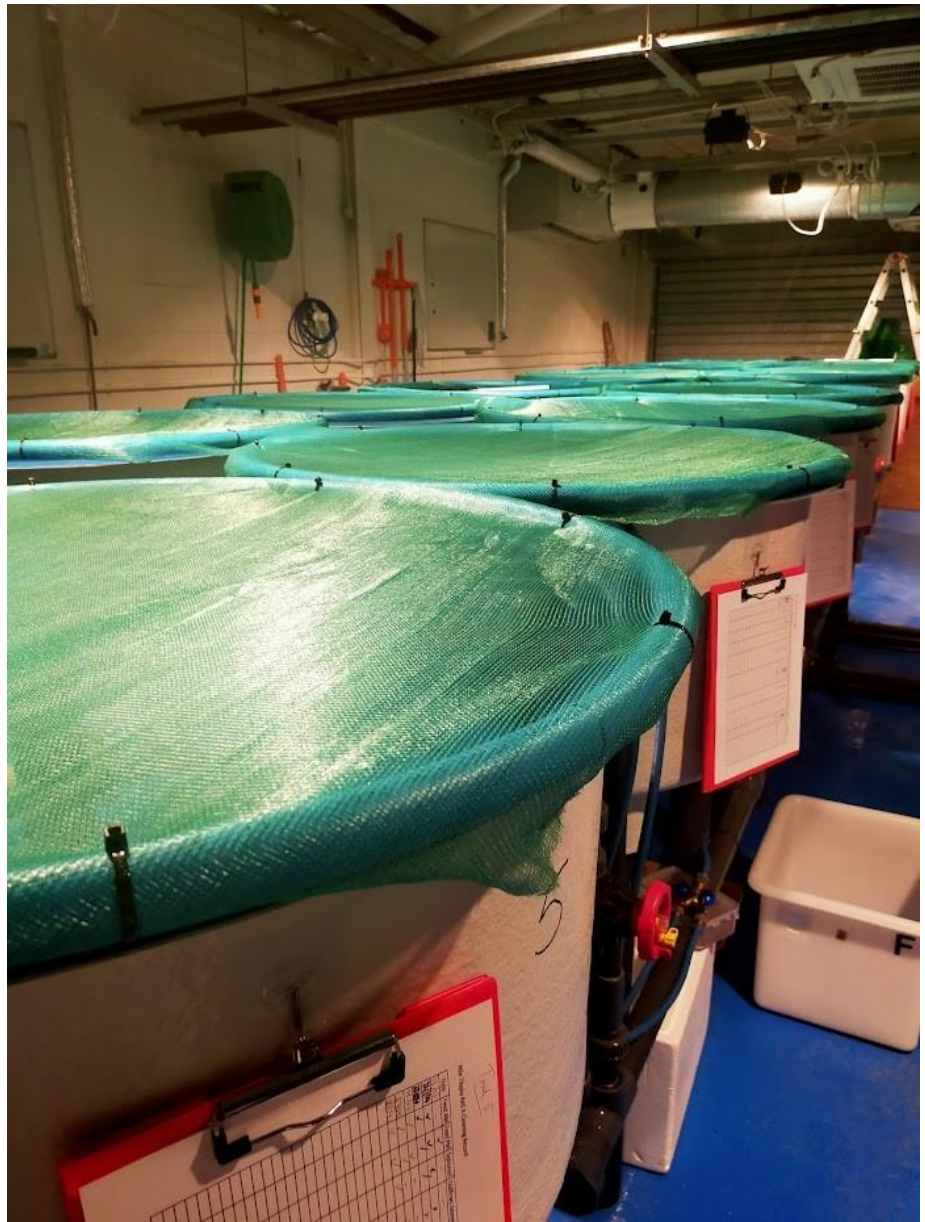
f/2 Chlorella (Control)



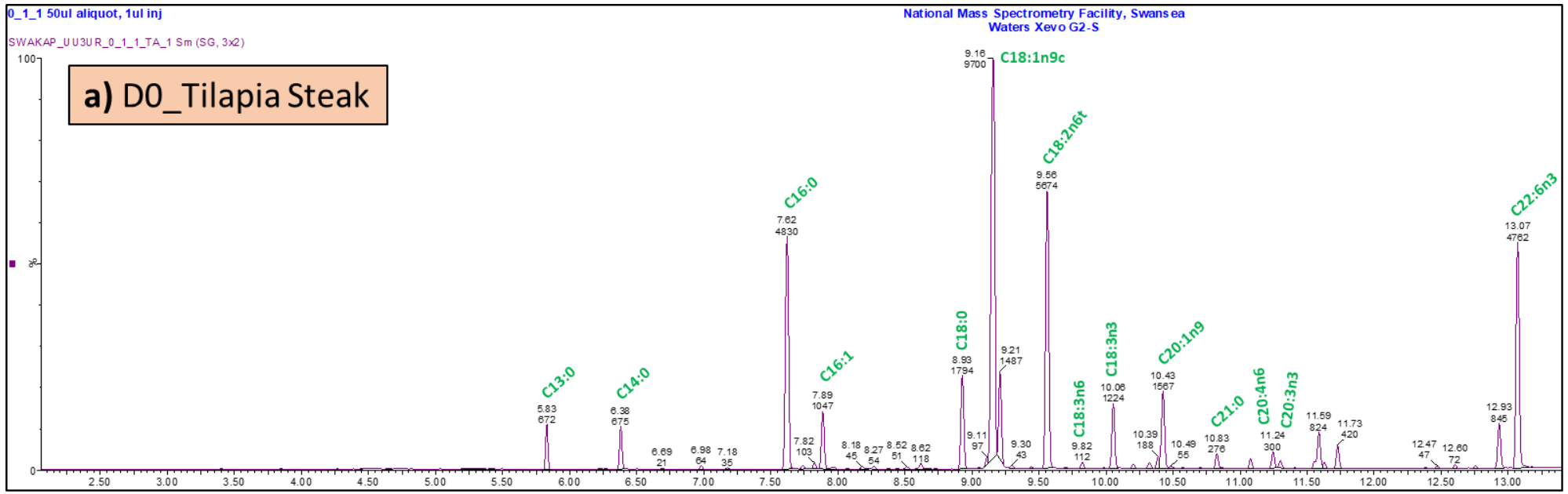
2.5% Digestate Chlorella

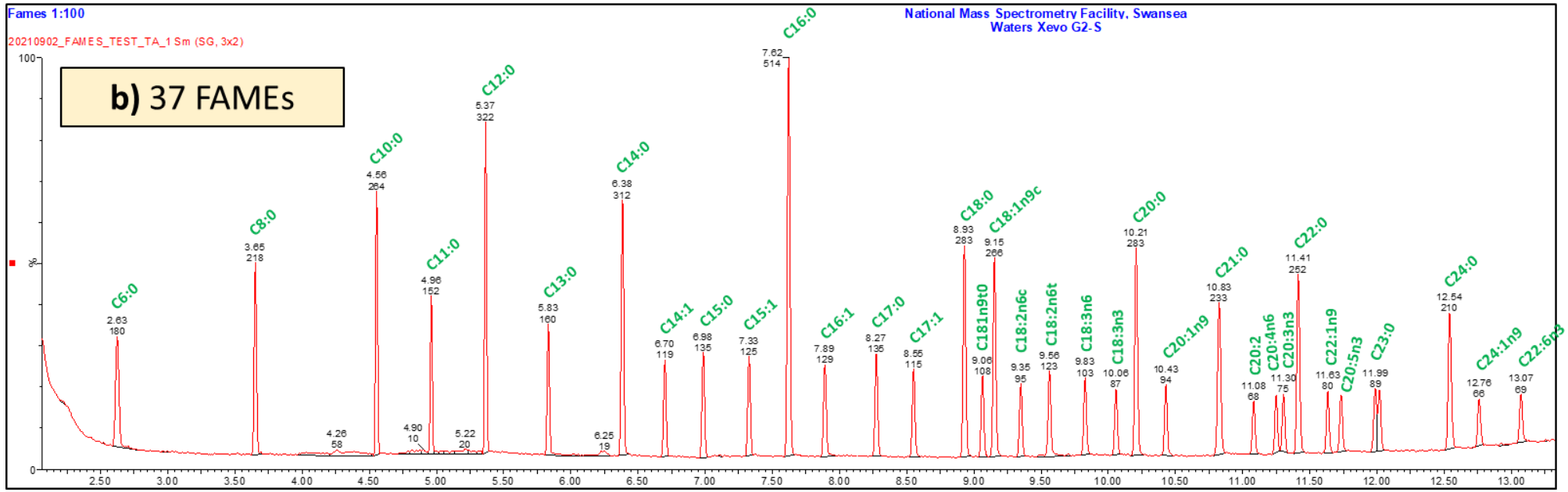


WP-Cap: Fish trials using algae cultivated on digestate

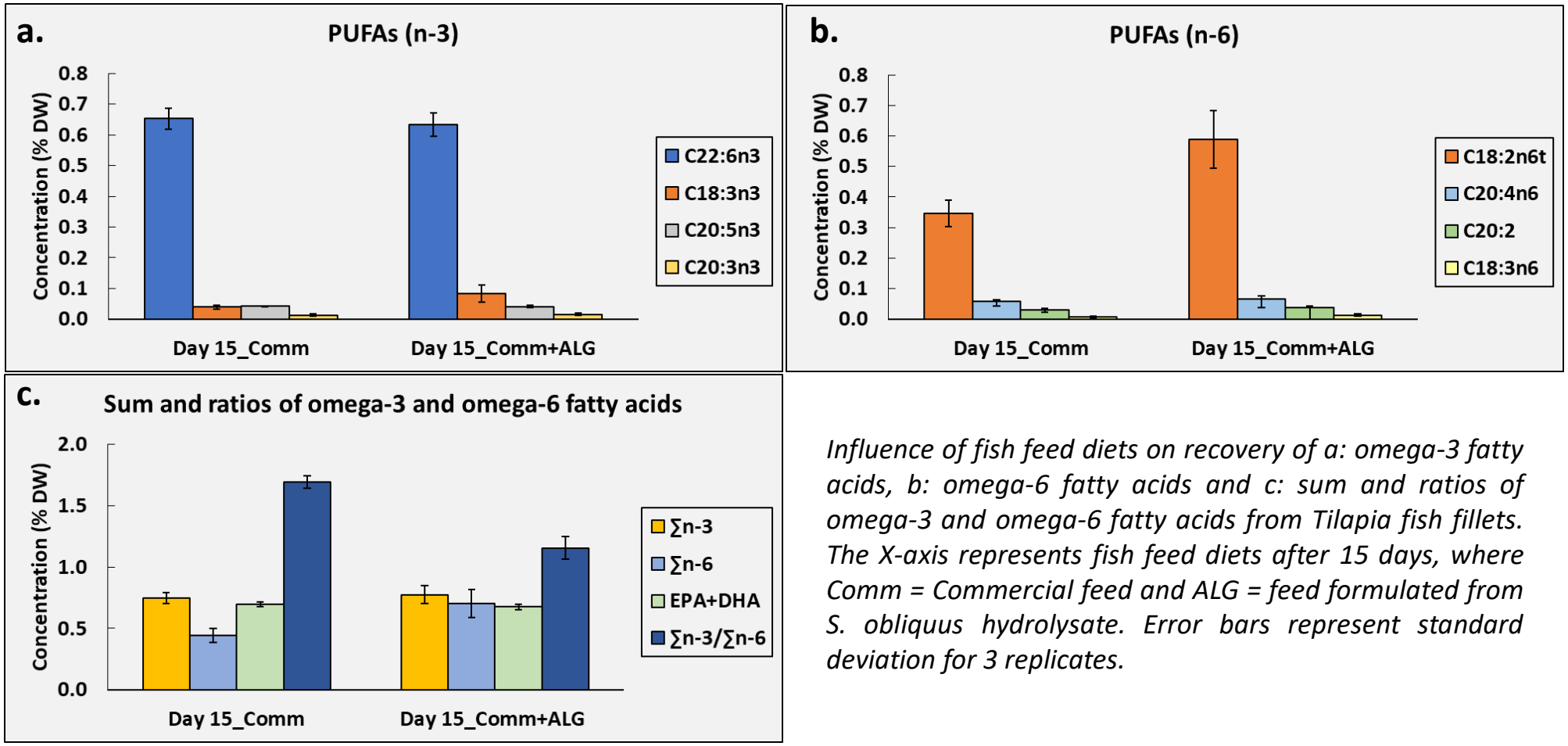


WP-Cap: Fatty acid analysis of fish flesh – GC-MS





WP-Cap: Fatty acid analysis of fish fed on algae



Influence of fish feed diets on recovery of a: omega-3 fatty acids, b: omega-6 fatty acids and c: sum and ratios of omega-3 and omega-6 fatty acids from Tilapia fish fillets. The X-axis represents fish feed diets after 15 days, where Comm = Commercial feed and ALG = feed formulated from S. obliquus hydrolysate. Error bars represent standard deviation for 3 replicates.

Advantage of including microalgal ingredients grown on digestate in the diet of Nile Tilapia, with **added value to the aquaculture sector**.

WP3: Scenario Planning/ Decision Support

The ALG-AD Decision Support Tools

The ALG-AD Decision Support Tools can help you to understand and explore how algal cultivation technologies might work for you.

Search AD Plants

The ALG-AD Project is focused on the use of digestate from AD for algae cultivation. This tool provides a GIS map of existing AD plants in North West Europe.

Document and Resources

DST enables you to search for relevant information on algae and AD technologies, policy, research etc.

Search Stakeholders

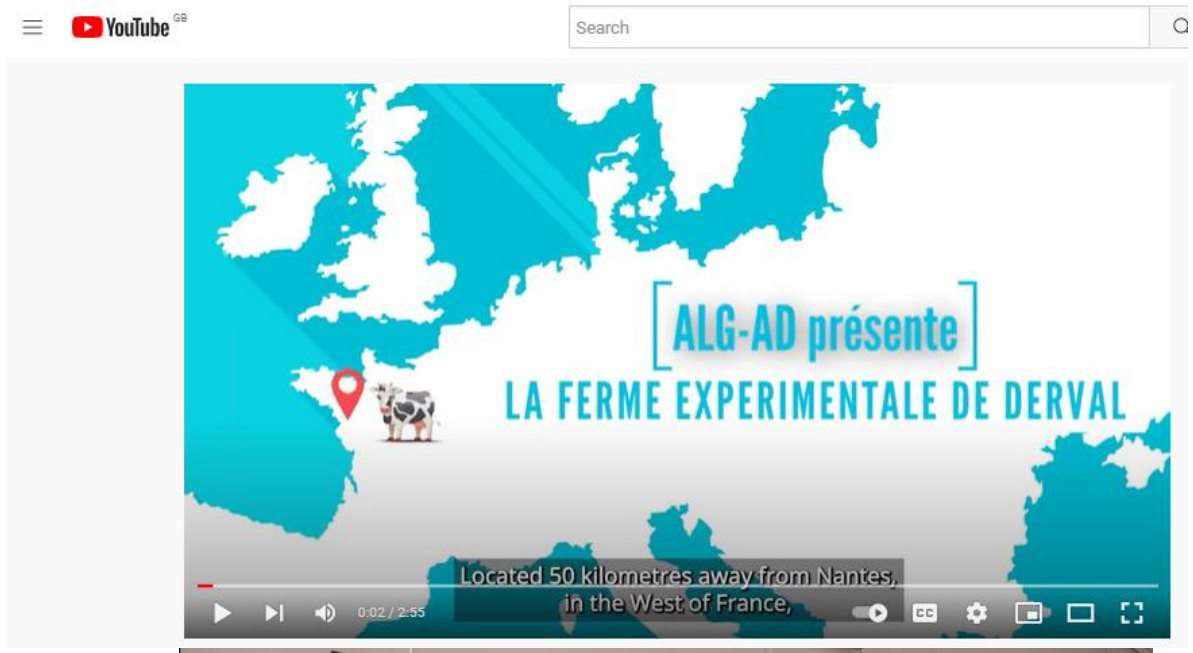
DST provides a stakeholders search tool that helps you identify and connect with partners across North West Europe.

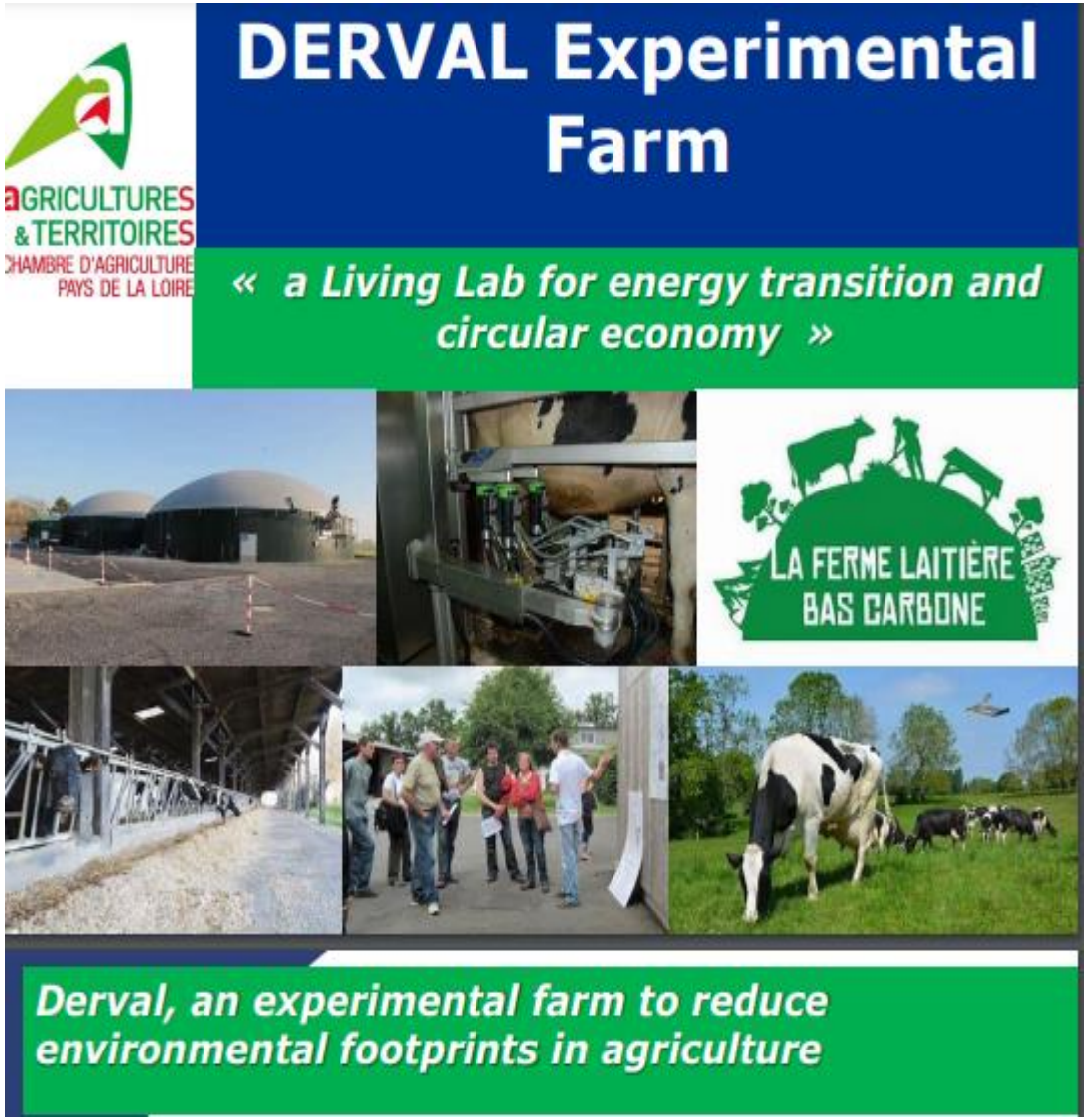
Process Pathway Tool

This tool helps you better understand algal cultivation and PBR implementation, based on your AD process conditions and future requirements.

https://www.alg-ad-dst.com/

Derval experimental farm





https://www.youtube.com/watch?v=ZHlnWN6Q54E

Published ALG-AD research

Contents lists available at ScienceDirect

Waste Management

journal homepage: www.elsevier.com/locate/wasman

Valorising nutrient-rich digestate: Dilution, settlement and membrane filtration processing for optimisation as a waste-based media for microalgal cultivation

Fleuriane Fernandes [a,*], Alla Silkina [a], Claudio Fuentes-Grünewald [a], Eleanor E. Wood [a], Vanessa L.S. Ndovela [a], Darren L. Oatley-Radcliffe [b], Robert W. Lovitt [b], Carole A. Llewellyn [a]

Bioresource Technology 320 (2021) 124349

Contents lists available at ScienceDirect

Bioresource Technology

journal homepage: www.elsevier.com/locate/biortech

Towards a circular economy: A novel microalgal two-step growth approach to treat excess nutrients from digestate and to produce biomass for animal feed

Claudio Fuentes-Grünewald [*], José Ignacio Gayo-Peláez, Vanessa Ndovela, Eleanor Wood [1], Rahul Vijay Kapoore, Carole Anne Llewellyn

applied sciences

MDPI

Article

Microalgae cultivation on nutrient rich digestate: the importance of strain and digestate tailoring under pH control

Fleuriane Fernandes[1,*], Alla Silkina[1], José Ignacio Gayo-Peláez [1], Rahul Vijay Kapoore[1], Denis de la Broise[2], Carole A. Llewellyn[1]

sustainability

MDPI

Article

Evaluation of *Aurantiochytrium mangrovei* Biomass Grown on Digestate as a Sustainable Feed Ingredient of Sea Bass, *Dicentrarchus labrax*, Juveniles and Larvae

Philippe Soudant [1,*], Mariana Ventura [1], Luc Chauchat [1], Maurean Guerreiro [1], Margaux Mathieu-Resuge [1], Fabienne Le Grand [1], Victor Simon [1], Sophie Collet [1], José-Luis Zambonino-Infante [1], Nelly Le Goïc [1], Christophe Lambert [1], Fleuriane Fernandes [2], Alla Silkina [2], Marcella Fernandes de Souza [3] and Denis de la Broise [1]

BioEnergy Research
https://doi.org/10.1007/s12155-022-10397-2

Animal Feed from Microalgae Grown on Biogas Digestate as Sustainable Alternative to Imported Soybean Meal

Mohamed Elshamy[1,2] · Christine Rösch[1]

Received: 2 November 2021 / Accepted: 18 January 2022

Biotechnology Advances 49 (2021) 1077

Contents lists available at ScienceDirect

Biotechnology Advances

journal homepage: www.elsevier.com/locate/biotechadv

Research review paper

Algae biostimulants: A critical look at microalgal biostimulants for sustainable agricultural practices

Rahul Vijay Kapoore [*,1], Eleanor E. Wood [1,2], Carole A. Llewellyn

Chemosphere
Volume 290, March 2022, 133180

Maximizing nutrient recycling from digestate for production of protein-rich microalgae for animal feed application

Jai Sankar Seelam [a], Marcella Fernandes de Souza [a], Peter Chaerle [b], Bernard Willems [c], Evi Michels [a], Wim Vyverman [b], Erik Meers [a]

marine drugs

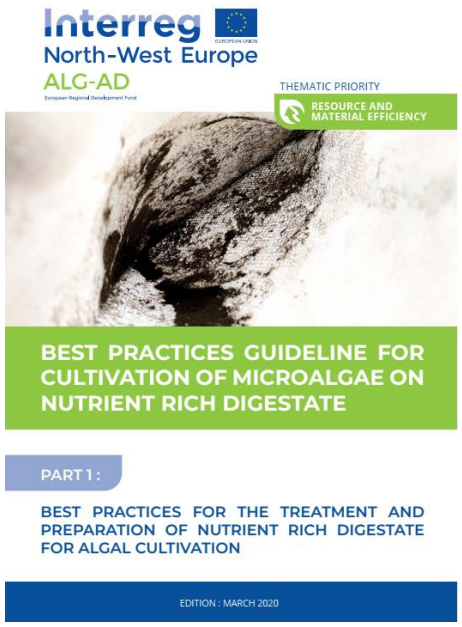
MDPI

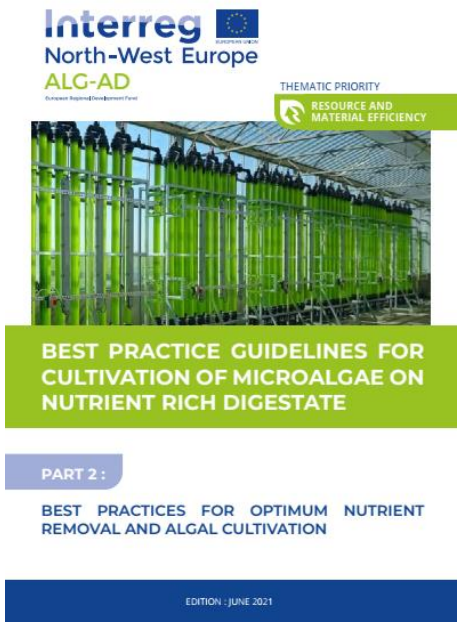
Article

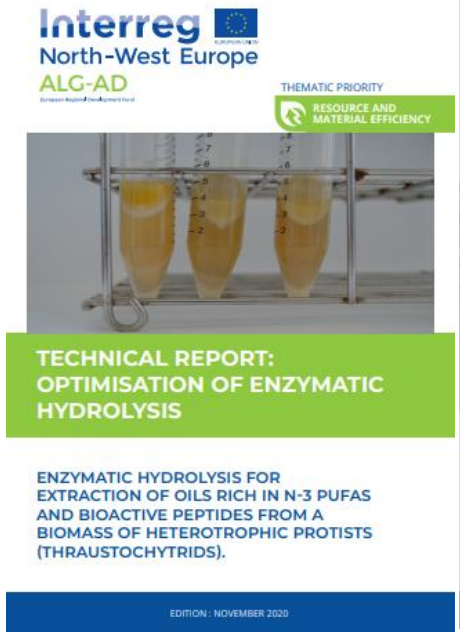
Scale-Up to Pilot of a Non-Axenic Culture of Thraustochytrids Using Digestate from Methanization as Nitrogen Source

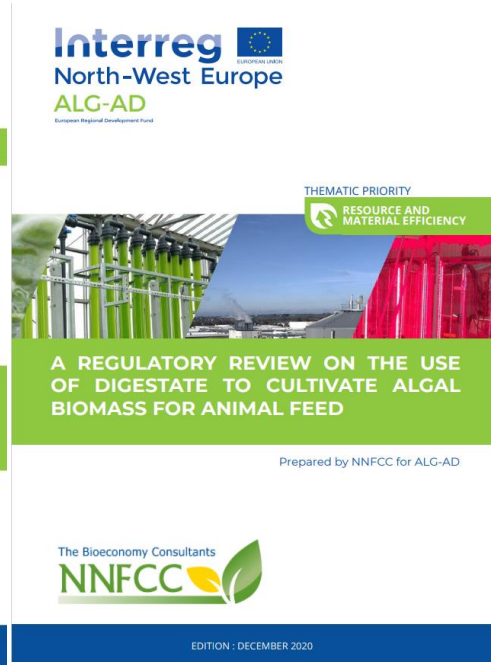
Denis de la Broise [1,*], Mariana Ventura [1], Luc Chauchat [1], Maurean Guerreiro [1], Teo Michez [1], Thibaud Vinet [2], Nicolas Gautron [1], Fabienne Le Grand [1], Antoine Bideau [1], Nelly Le Goïc [1], Adeline Bidault [1], Christophe Lambert [1] and Philippe Soudant [1,*]

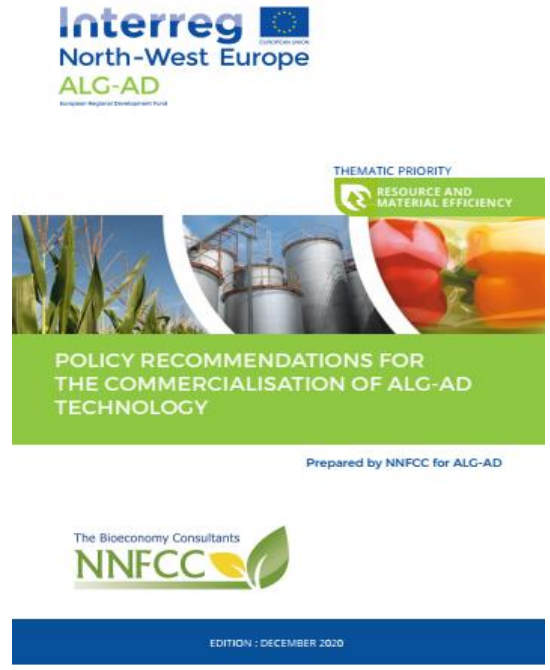
Selected output documents

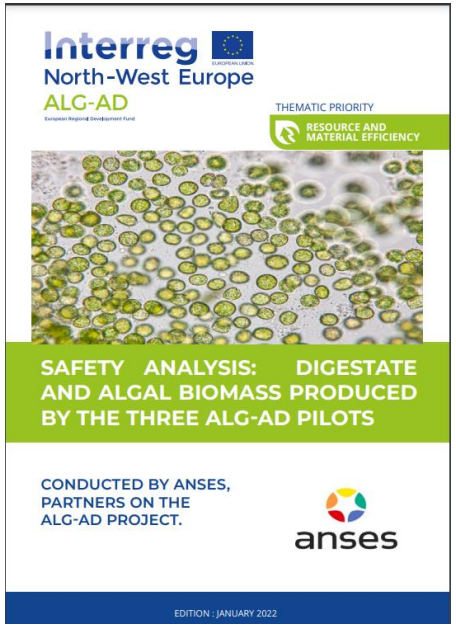


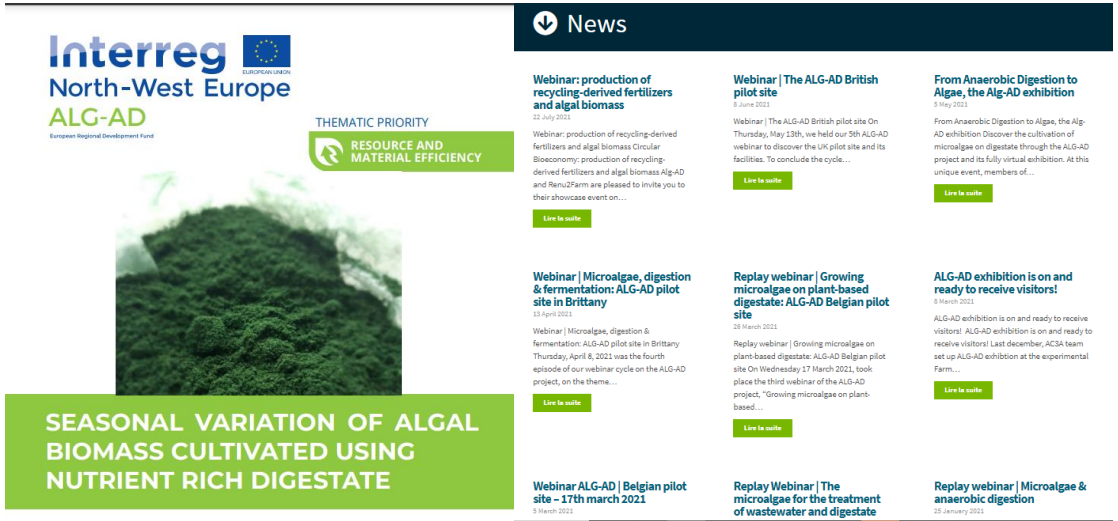


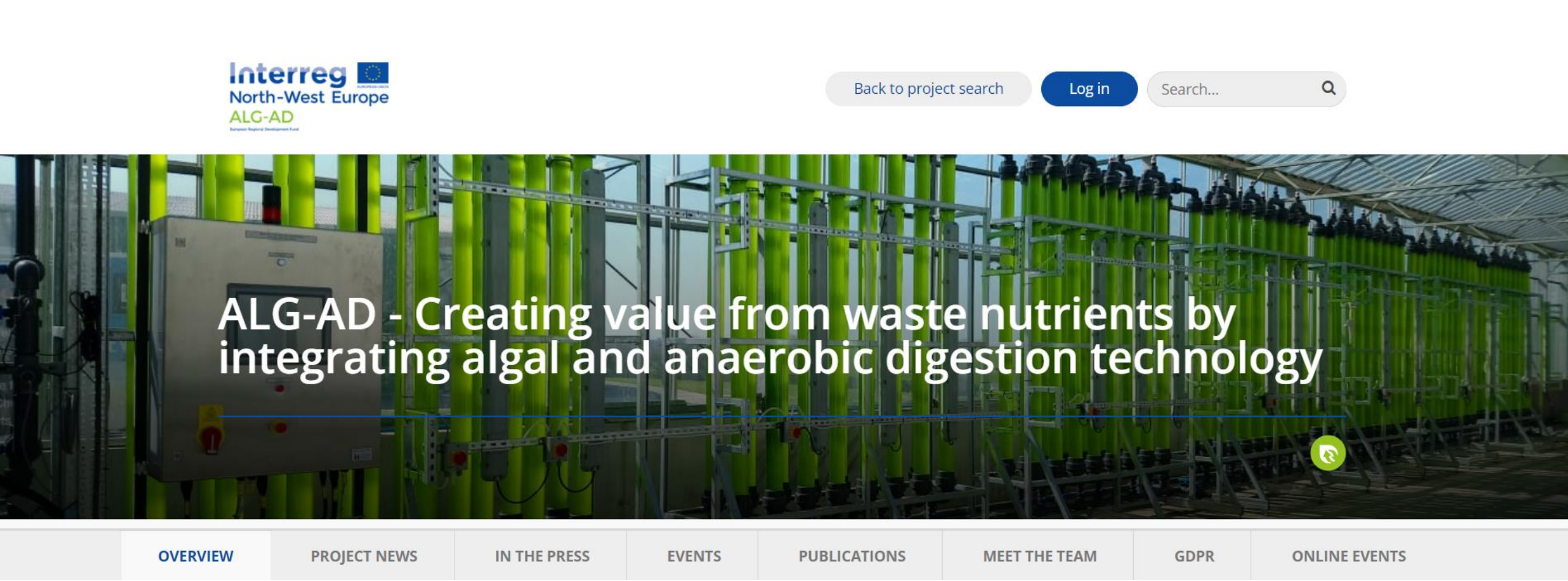












- https://vb.nweurope.eu/projects/project-search/alg-ad-creating-value-from-waste-nutrients-by-integrating-algal-and-anaerobic-digestion-technology/
- https://www.alg-ad-dst.com