

Interreg

EUROPEAN UNION

North-West Europe



ALG-AD

European Regional Development Fund



ALG-AD REPORT 2018 - 2019

INTRODUCTION

ALG-AD is an Interreg NWE funded project in which new technology is being developed to take excess waste from food and farm waste to cultivate algal biomass for animal feed and other products of value.

ALG-AD brings together a group of scientists and engineers from 11 different partners in four countries across North West Europe.

These academics and companies are working together to develop a circular economy solution to create value from waste.

This report provides information on our first year of operations and outlines activities for the coming twelve months.

If you would like further information on our project please contact Catharine Jones at c.r.jones@swansea.ac.uk

GLOSSARY

Microalgae - microscopic organisms found in freshwater and marine systems.

Anaerobic digestion - the process by which organic matter such as animal or food waste is broken down to produce biogas and biofertiliser

Digestate - material remaining after anaerobic digestion

Techno-Economic Assessment (TEA) - analysis of the technical and economic performance of a process, product or service

Life-cycle analysis (LCA)

- assessment of the environmental impact of a product

GIS - Geographic Information Systems enable the presentation of geographical data

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THE PROJECT

WHAT IS ALG-AD?

ALG-AD ADDRESSES REUSE OF FOOD AND FARMING WASTE USING MICROALGAE TO GENERATE PRODUCTS FOR A SUSTAINABLE ECONOMY, REDUCING POLLUTION RISK AND DEPENDENCE ON IMPORTED MATERIAL RESOURCES.

North West Europe is a densely populated area known for intensive agriculture. It contributes disproportionately to food and farm waste generated in the EU each year.

To reduce this waste, anaerobic digestion (AD) is used and there are currently around 2000 AD facilities in NWE. AD converts waste to biogas energy and a liquid nutrient rich digestate (NRD). Most of this is returned to the land as a biofertiliser.

However, strict limits have been imposed by the European Union on designated Nitrate Vulnerable Zones. These limits restrict the return of NRD to land in order to prevent pollution through over-enrichment with nutrients.

Much of NWE land falls within such zones. As such, solutions are needed and this is what ALG-AD is trying to provide.

ALG-AD's answer to the problem stems from combining algal and AD technology to reduce waste and harmful ammonia gases. It does this by using nutrients in the NRD to create algal biomass which

will in turn be used for sustainable animal feeds.

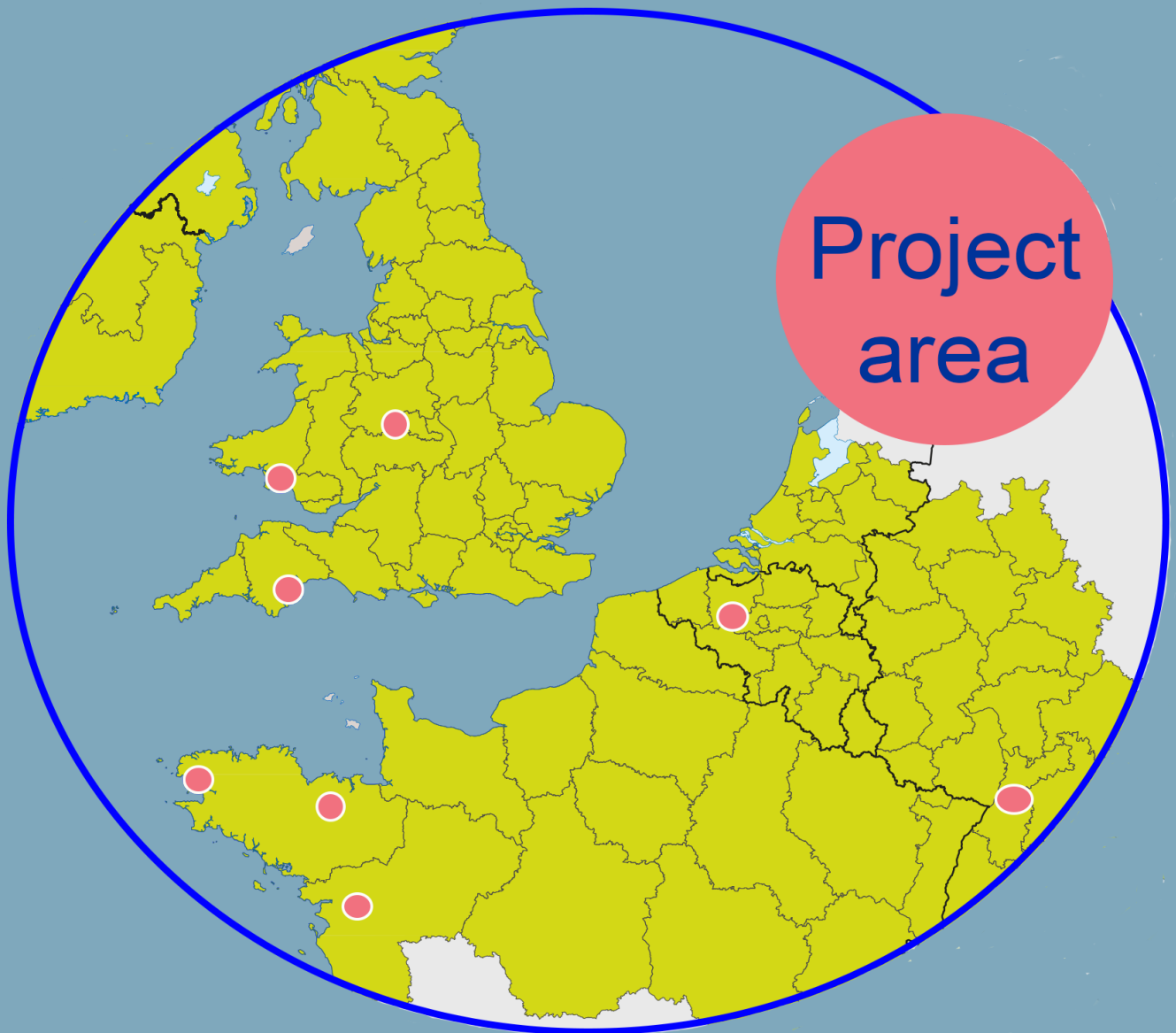
Technology is being collaboratively implemented and tested in 3 distinct 'real-life conditions' in Devon (UK), Brittany (FR) and Flanders (BE).

ALG-AD will demonstrate several Decision Support Tools to stakeholders which will allow the right information to be available to potential users to enable take-up of the technology. These tools will ensure businesses and investors have information freely available to them on the commercial and economic viability of ALG-AD technology.

The project is due to run until March 2021, when a long term plan will be put into play to ensure the technological innovation can be rolled out to AD sites across NWE and beyond, long after the end of the project.

In this way, the project aims to create a circular economy solution to the management of food and farm waste in North West Europe.

ALG-AD IS FUNDED BY THE EU VIA THE INTERREG NORTH WEST EUROPE FUNDING STREAM.



The key players.

The project partners are:

- Agence Nationale de Sécurité Sanitaire de l'Alimentation, de l'Environnement et du Travail
- Association des Chambres d'Agriculture de l'Arc Atlantique
- Birmingham City University
- Centre National de la Recherche Scientifique
- Cooperl Innovation
- Innolab
- Karlsruher Institut für Technologie
- Langage AD
- Swansea University
- Université de Bretagne Occidentale
- Universiteit Gent

THE PARTNERSHIP



**CROSS BORDER
COLLABORATION
SUCH AS ALG-AD
UNITES ACADEMICS,
INDUSTRY AND
POLICY MAKERS IN A
COMMON GOAL.**

A project such as ALG-AD needs a variety of expertise across the complementary sectors of AD, algal technology research, feed and food development industries as well as regulatory and policy organisations.

ALG-AD has been able to find enthusiastic partners from across North West Europe to collaborate and combine expertise to address the questions posed by ALG-AD, namely how to combine algal and AD technology to recover and reuse nutrients to prevent pollution while at the same time creating a useful and valuable product.

“I think it's quite good that there is a diverse range of partners and that the consortium is quite distributed in terms of feed safety, pre-treatment, industrial bio-gas sectors and some working on decision tools. For me collaboration is quite good, to take a product out of lab and into industrial scale. That really helps a lot. And when you have three knowledge centres, three universities involved I think it's a win, win situation.”

Jai Sankar Seelam, Ghent University

An eco-innovative solution

By integrating microalgal and anaerobic technologies, ALG-AD seeks to overcome a barrier which exists to the further development of AD practices. This involves reducing the amount of nutrient pollution from the industry and creating sustainable products instead by using microalgae.

THE OUTPUTS

01

Demonstration of eco-innovative technology and decision support tools.

ALG-AD will develop, test and demonstrate the integration of microalgal technology with AD facilities at three sites across the North West Europe area territory.

During the course of the project demonstrations will be held for a wide range of stakeholders.

The aim of this engagement is to aid the long term roll out of the technology.

To aid this, the project will develop a set of decision support tools to enable potential users determine the best way forward.

02

Develop a process to reduce excess waste nutrients from waste nutrient rich digestate.

Excess nutrients which are produced during the anaerobic digestion process would normally be spread on the land as fertilizer, or where if that was not possible because of pollution concerns, they would simply be left to one side.

However, ALG-AD believes that by using the left over nutrient rich digestate, or NRD, to grow microalgae this waste produced can be put to good use.

The project will create a series of best practice documents which will allow exchange of knowledge on preparing and treating NRD and also on algae growth and nutrient recovery.

03

Develop a solution for the conversion of waste into sustainable products.

The biomass produced through the process can be converted into sustainable and valuable products.

The main focus for the ALG-AD project is to produce animal, fish and poultry feed.

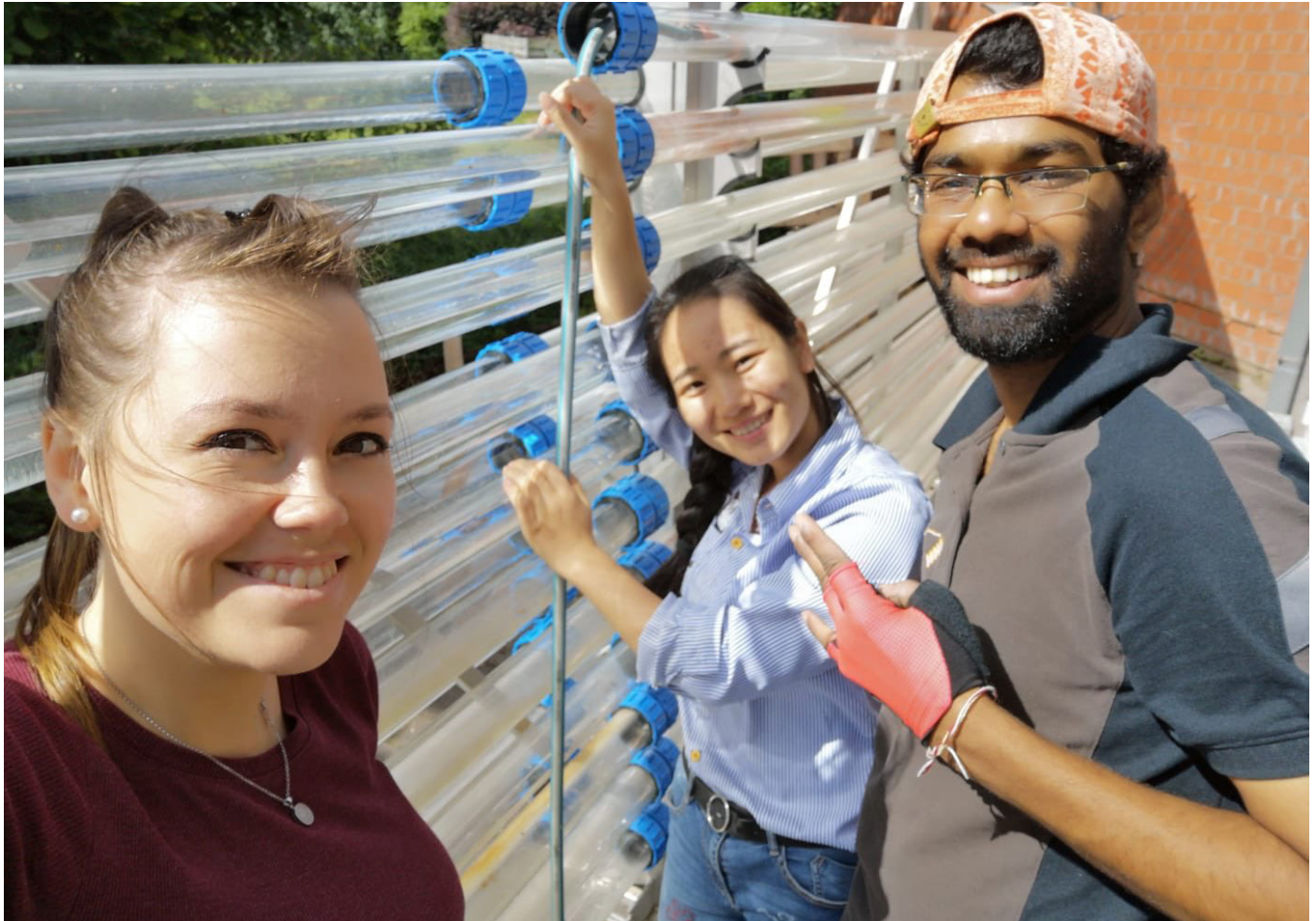
The biomass will be fractionated into useful components such as proteins, fats and peptides.

Analysis will focus on the quality of the algal biomass and how its composition varies according to NRD composition and to the seasonal condition.

The project will also investigate how to extract the most innovative and valuable components from the biomass.

“We hope that we will be able to roll out our system. It’s a challenging objective. First we have to get something that is working and then convince other plants to use it all over North West Europe. Its very challenging and ambitious but we are confident and optimistic that we will get there.”

Dr Philippe Soudant, head of research at CNRS.



THE WORK PACKAGES

AIMS & OBJECTIVES

The work which needs to be done in order to achieve the aims and objectives of ALG-AD has been broken down into a set of work packages. This is in order to make it easier to monitor progress on the project and share out the roles and responsibilities among the partnership.

There are three investment work packages focusing on the pilot facilities, three technical work packages looking at the biomass, a long term work package and one each for management and communication.

INVESTMENTS 1, 2, 3

STAFF AND ACTIVITIES

THE INVESTMENT WORK PACKAGES ARE LOCATED IN THREE SEPARATE COUNTRIES TO REFLECT THE DIVERSITY OF NORTH WEST EUROPE. EACH ARE HAS ITS OWN UNIQUE ISSUES THAT ALG-AD IS HOPING TO ADDRESS



Among the main outputs for the ALG-AD project is the creation of three individual pilots across three separate partner countries.

Each of these sites have certain commonalities. For example, Plymouth, Ghent and Lamballe are all low-lying fertile land with catchments that drain into waterbodies which are at risk from eutrophication.

More importantly, however, the three locations have their own unique features, and their greatest value to the project results from the heterogeneity of the three territories.

From 'predominantly rural remote' to 'predominantly urban' the sites offer

different types of biodegradable waste and different regulatory landscapes. This difference will ensure that ALG-AD explores a variety of scenarios in the cultivation of the algal biomass.

The design of the reactors will mean results can be compared and integrated across the different territories and best practice shared among project participants.

Each investment consists of three major equipment sections:

1. Upstream processing of NRD.
2. the algal reactor that will be modular in design.
3. Harvesting and further downstream processing (DSP).

INVESTMENT 1 - LANGAGE AD



Investment 1 - is situated in a greenhouse adjacent to the Langage AD plant, on the outskirts of Plymouth in Devon, UK. Langage-AD are an SME operating in a predominantly rural area that is at high risk from eutrophication pollution.

Swansea University and Langage AD are responsible for the day to day operation of this site. This investment will use the digestate produced at the plant.

INVESTMENT 2 - LAMBALLE



Investment 2 - is located on the Cooperl site at Lamballe in Brittany and is operated jointly by CNRS, UBO and Cooperl Innovation.

Brittany has the highest nutrient levels (nitrogen and phosphorus) levels in France and is one of the regions with the largest concentrations in the EU-28 due to its high livestock density.

INVESTMENT 3 - INNOLAB



Investment 3 - is located at Oostkamp outside Bruges and comes under the auspices of the University of Ghent and Innolab, a laboratory which specialises in eco-process analysis.

The Flanders region has the highest nutrient pressure in Europe and this investment will be positioned as an add-on technology to existing digestate treatment facilities with the added attraction of making optimal use of nutrients.



WP 11 leader
Dr Darren Oatley-Radcliffe, SU



WP 11 technician
Vanessa Ndovela, SU



WP 11 technician
Jose Ignacio, SU

Investment 1: Langage AD

The reactor at Langage AD was designed by Dr Darren Oatley-Radcliffe from Swansea University's engineering department. The day to day management will be taken care of by a team from Swansea, including Vanessa Ndovela, Jose Ignacio and Dr Claudio Fuentes Grünewald.



WP 12 leader
Dr Denis de la Broise, UBO



WP 12 technician
Luc Chauchat, CNRS



WP 12 technician
Barbara Clement LaRosiere, Cooperl

Investment 2: Cooperl

Denis de la Broise leads on the Investment 2 work package. The reactor was built by Luc Chauchat at Université de Bretagne Occidentale and has now moved to its permanent location at Cooperl in Lamballe, where it will be under the careful watch of Barbara Clement La Rosiere.



WP 13 leader
Dr Marcella
Fernandes de
Souza
Ghent



WP 13
technician
Jai Seelam
Sankar
Ghent



WP 13 analyst
Nidal
Aouamri,
Innolab



WP 13 analyst
Bernard
Willems,
Innolab



WP 13 support
Erik Meers,
Ghent

Investment 3: Innolab

Our Ghent colleagues will have a reactor similar to the one constructed at Langage. Once completed it will be situated at Oostkamp and looked after by Dr Marcella Fernandes de Souza and Jai Sankar Seelam from Ghent University and Nidal Aouamri from Innolab.

**“THE POSSIBILITIES
OFFERED BY THIS
TECHNOLOGY COULD
SOLVE A LOT OF
PROBLEMS AROUND
POLLUTION FACED BY
NORTH WEST EUROPE.”**

Dr Carole Llewellyn is the scientist in overall charge of ALG-AD.

She passionately believes that algae has the potential to solve a range of issues, from excess ammonia production from dairy farming, to sustainable feed for both humans and animals.

LONG TERM WORK PACKAGE

STAFF AND ACTIVITIES

ALG-AD PLANS TO HAVE A LEGACY BEYOND THE LIFESPAN OF THE PROJECT, AND A LONG TERM FOCUS HAS BEEN BUILT IN TO A WORK PACKAGE THAT AIMS TO ENCOURAGE UP-TAKE OF THE TECHNOLOGY.

Long term work package: The aim of this work stream is to put into place enablers for the roll out of the successfully demonstrated technology produced by ALG-AD.

It also aims to ensure the project's environmental and economic effects on the NWE territory extend beyond the end of the project in March 2021.

The aim, therefore, is to install the technology in more than 100 AD facilities across NWE within five years of the end of the project. This figure will increase to more than 2000 AD plants within ten years.

To achieve this, there will be a need to clearly demonstrate to the potential end user the benefits of installing such a system.

During the lifespan of the project, therefore, there will be demonstration events, engagement activities with key stakeholders and efforts to influence and inform regulators and policy makers. These will start in earnest during the course of 2019.

This work package will also work closely with WPT 3 in demonstrating the Decision Support Tools.



Long term work package leader
Pascal Dagon, AC3A



Long term team member
Nina Bailet, AC3A

Long term

Pascal Dagon has a wide range of contacts in the farming industry in France. As the director of the Association des Chambres d'Agriculture de L'Arc Atlantique he will use his networks to increase knowledge of the ALG-AD technology. Nina Bailet is a recent addition to his team and helps with planning and communication.

TECHNICAL 1, 2, 3

THE TECHNICAL WORK PACKAGES FOCUS ON THE BIOMASS, NUTRIENT REMOVAL AND POTENTIAL PRODUCTS AS WELL AS THE CREATION OF A SET OF TOOLS TO AID UPTAKE OF THE TECHNOLOGY

Technical 1:

Focus is on preparing the waste nutrients in the nutrient rich digestate to feed into the algal bioreactor.

Once fed into the reactor, the algal cultivation will be optimised to recover the nutrients. Among the methods being trialled for this will be membrane technology.

Different algal species will be grown and tested in each location in relation to the take up of nutrients and algal biomass production. Knowledge and best practice on algal strains and consortia will then be shared.

The work stream will also look to optimise nutrient uptake and maximise the production of algal biomass.

Technical 2:

The biomass generated in Technical 1 will be harvested, stored, processed and analysed in this work stream.

The work stream will assess the biomass for marketable products and map this with commercial opportunities focussed on the feed sector.

Key considerations for this undertaking include the quality of the algal biomass and how it varies according to NRD composition and to the seasonal conditions (i.e. seasonal variation), how best to concentrate the biomass, how best to store it, how to fractionate according to product requirements and how to get the most value out of the biomass.

Technical 3:

Data outputs and mapping of commercial opportunities will feed into the Techno-Economic Assessment, Life Cycle Analysis and process pathways support tools.

Algal products will be developed within current and developing regulatory frameworks and knowledge will be used to inform and influence regulation for this emerging industry.



WP T1 leader
Dr Claudio
Fuentes
Grünewald,
SU



WP T1
technician
Fleuriane
Fernandes,
SU



WP T1
technician,
Alla Silkina,
SU



WP T1
technician
Ellie Wood,
SU

Technical 1: Biomass optimisation

This work package focuses on the operation of the investments and recovery of waste nutrients to produce algal biomass. Dr Claudio Fuentes Grünewald, leads on this work package.



WP T2 Leader
Dr Philippe Soudant, CNRS



WP T2 officer
Dr Rahul V Kapoore, SU



WP T2 advisor
Alassane Keita, ANSES

Technical 2: Value products

Dr Phillippe Soudant from CNRS leads on looking at the value products which can be produced by ALG-AD, in particular animal feed. He is closely supported by Dr Rahul Kapoore from Swansea University. Alassane Keita from Anses is focusing on the safety of the products.



WP T3 leader
Dr Lynsey
Melville,
BCU



WP T3
Khondokar
Rahman,
BCU



WP T3 LCA
Analysis
Roshni Paul,
BCU



WP T3 DST
Guolong
Zhong,
BCU



WP T3 DST
Venkatesh
Vijay,
BCU



WP T3 LCA
Analysis
Ombeni
Ranzmeyer,
KIT

Technical 3: Decision Support Tools

Dr Lynsey Melville from Birmingham City University leads on developing the decision support tools which will be created for the potential end users of the ALG-AD technology. She is aided by Ombeni Ranzmeyer in KIT in Germany and Roshni Paul in Birmingham who are looking at life cycle analysis.

PROJECT MANAGEMENT AND COMMUNICATION

ROBUST MANAGEMENT AND CLEAR COMMUNICATION IS ESSENTIAL FOR ANY PROJECT. A SWANSEA-BASED TEAM TAKES CARE OF THIS.

Project management:

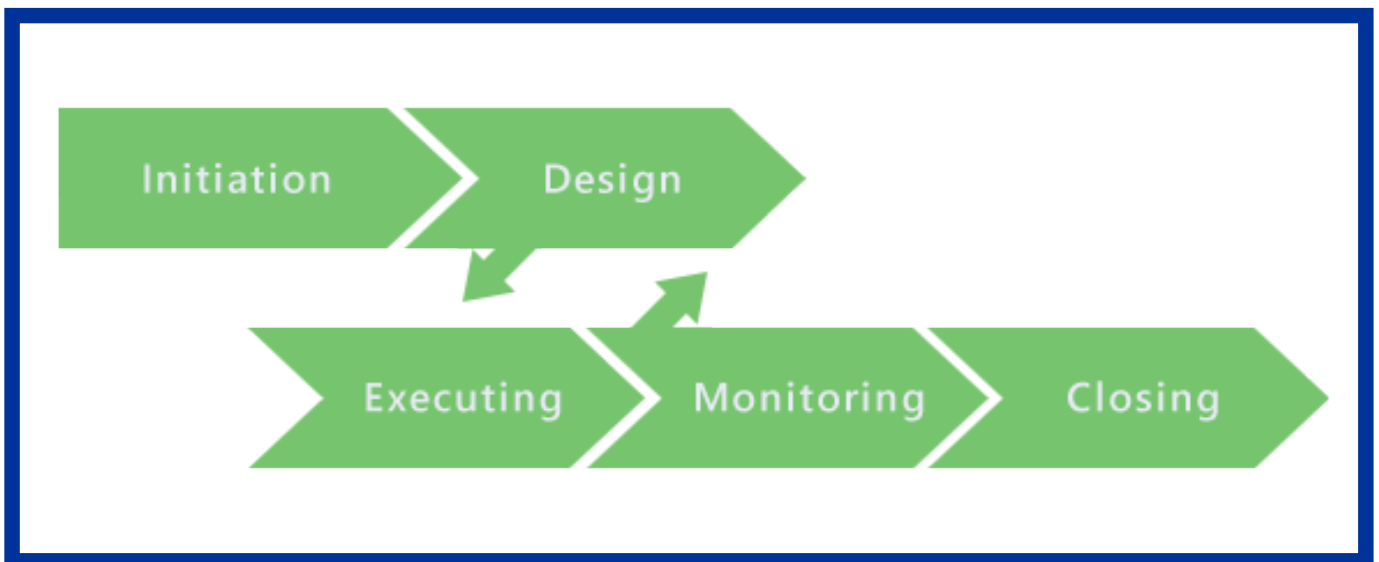
This entails putting in place the structures, responsibilities, day to day management and coordination for running the project.

Each partner has defined tasks within each work package with clear contributions that they have to make to the main outputs.

Each WP has a WP leader responsible for the WP including overseeing the activity leaders and delivery of day to day outputs.

There is also an overarching Project Management Board (PMB) comprising the PMT and one representative from each partner which ensures all partners gain from the project and contribute to decision making.

The team also arranges bi-annual partner meetings which are organised on rotation among the pilot partners to facilitate knowledge exchange and provide dissemination opportunities.



Communication:

A communications strategy and plan has been developed to inform and direct activities undertaken by all partners.

It aims to increase awareness and broaden the impact of the project's activities and results to the widest audience possible

across North West Europe.

Essential to this strategy is identifying and incorporating stakeholder feedback. This will be achieved through feedback from demonstration events and the emphasis throughout will be on demonstrating innovation and making results visible to stakeholders.

Project Management



Principle Investigator
Dr Carole Llewellyn, SU



Project manager
Louise Hall, SU



Finance manager
Jennifer Evans, SU

ALG-AD's principle investigator, and the person with overall responsibility for the project, is Dr Carole Llewellyn who proposed the original idea to merge algal and anaerobic digestion technologies. She is aided by the project manager Louise Hall and project financial administrator Jennifer Evans.

Communication



Communication manager
Catharine Jones, SU



Communication Team
Margherita Genua, Ghent

Communication both internally and externally is extremely important for any project.

Catharine Jones leads on this element from Swansea University, and is supported with help from Angela Sainz Arnau from Biorefine Cluster Europe and Margherita Genua from Ghent University.

EVENTS AND MEDIA



Conferences

Colleagues from across the partnership have been attending conferences to introduce the wider academic community to the aims and purpose of ALG-AD. To date we have given presentations at:

- Renewable Resources & Biorefineries Conference, Ghent, June 2018
- Algae Tech Conference, Munich, September 2018
- European Sustainable Nutrient Initiative, Ghent, Jan 2019
- 2nd Nordic Algae Symposium, Oslo, Feb 2019

Public outreach

Engaging with a wide range of people is important if we are to increase awareness of ALG-AD among as broad an audience as possible.

To that end, colleagues have engaged with the following:

- Foods Standards Agency visit to Swansea University, September 2018
- Super Science Sunday event Swansea, March 2019
- Swansea City Centre Conference, April 2019

Demonstration

As the investments are operational there will be opportunities to share the work being undertaken with interested parties.

These events include:

- Site visit to investment at Cooperl's site in Lamballe, Brittany
- Policy event to discuss barriers to uptake of the technology
- Demonstration of DST to interested stakeholders.

Super Science Sunday

Takara Webber, aged 11, and her father Don pay a visit to the Algae World stand and talk with ALG-AD research assistant Ellie Wood at Super Science Sunday.



ESNI

Dr Marcella Fernandes de Souza gives a presentation at the European Sustainable Nutrient Initiative in Ghent.

2nd Nordic Algae Symposium

Dr Carole Llewellyn represented ALG-AD at this conference in Oslo, displaying a poster outlining the aims and objectives of the project.



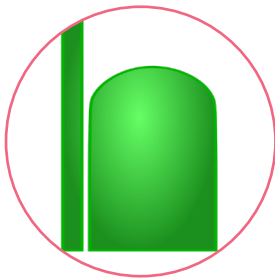
Food Standards Agency

Dr Rahul Kapoore talks with members of the FSA on their visit to Swansea University.

THE NEXT 12 MONTHS

PLANNED ACTIVITIES

THE COMING YEAR WILL BE AN EXCITING ONE FOR THE PROJECT. EACH OF THE INVESTMENTS WILL BE UP AND RUNNING AND PRODUCING BIOMASS, ALLOWING SCIENTISTS TO CAPTURE, ANALYSE AND SHARE THE DATA. DEMONSTRATION AND DISSEMINATION WILL BE AT THE TOP OF THE AGENDA TOO, AS WE INTRODUCE THE DECISION SUPPORT TOOLS TO POTENTIAL END-USERS.



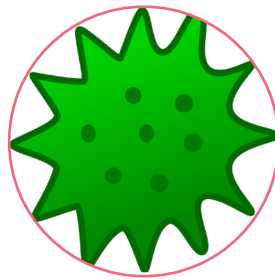
INVESTMENTS

In the UK, the Langage AD investment came online in March 2019.

The French investment at Lamballe in Brittany was not far behind, with commissioning of the reactor also taking place in March.

Partners in Ghent are currently constructing their reactor and the expectation is that this will be operational by the summer.

Once all three are generating biomass, there will be regular exchange of best practice and learning to inform further research and publications.



BIOMASS

As the biomass is produced at each investment site, work will be undertaken on analysing the physical content of the material.

Lipids, proteins and fatty acids will all be analysed and tested. This process is important in developing an understanding of what is possible when creating the high value products.

Partners will work together from across the partnership to test and analyse the biomass.

The results will then inform how future growth experiments progress and whether operational parameters need to be changed.



DISSEMINATION

As scientific results are generated, there will be a greater emphasis on communicating them to a wider audience.

As part of the goals of the ALG-AD project, we have identified specific target groups which we need to engage with. These include public authorities at local, national and international level, sectoral agencies, enterprise and small businesses and the general public.

Dissemination opportunities will be geared to each individual audience where possible in the coming year.



DST

The Decision Support Tool will be one of the main focuses for dissemination activities in the coming year.

Colleagues from BCU are currently finalising the look and feel of the tools and ensuring their functionality meet what is needed.

The next step will be to take these tools out to potential end users in order to make sure that they are fit for purpose, and make any adjustments which are necessary.

Stakeholder feedback events will be a regular occurrence for the remaining lifespan of the project.



LONG TERM

The long term work package will begin to pick up momentum throughout the year, as colleagues widen their engagement activities to include not only potential technology end-users but also policy and regulatory bodies.

A round-table event is planned by French project partners in June 2019 which will investigate the current state of regulation at both a European and National level. Expected speakers at this event will include representatives from the European Commission and other regulation experts and policy advisors.



EVENTS

As our science progresses and data is generated, our colleagues will be keen to share this information with as wide an audience as possible.

To that end, we anticipate attending several key conferences during 2019, such as the AlgaEurope event in Paris in December.

There will also be engagement with members of the general public at outreach science events, including the Science Festival in the UK in the autumn.

USING ALGAE TO PROMOTE AGRICULTURAL SUSTAINABILITY AND THE CIRCULAR ECONOMY



Swansea University
Prifysgol Abertawe

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



Karlsruher Institut für Technologie



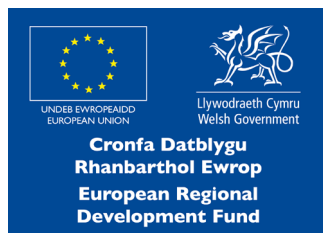
**AGRICULTURES
& TERRITOIRES**
CHAMBRES D'AGRICULTURE
ARC ATLANTIQUE



Université de Bretagne Occidentale



BIRMINGHAM CITY
University





The Bioeconomy Consultants



ALG-AD IS SUPPORTED BY ASSOCIATE PARTNERS WITH IMPORTANT LINKS

Associate partners are not directly involved in the day to day management of the project, but their expertise and knowledge can be a useful source of information and guidance as the project progresses.

Not only that, but they can call upon their network of contacts to help the project, particularly in the spheres of politics and regulatory environments.

ALG-AD is grateful to be able to call on the support of a range of associate partners.

These include:

- Renewable Energy Associate
- European Biomass Industry Association
- Waste and Resources Action Programme
- The National Non-Food Crops Centre
- Biogas-E
- Feed Design Lab