

An Irish Nutrient Platform to Underpin Sustainable Development

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ENVIRONMENTAL PROTECTION AGENCY

The Environmental Protection Agency (EPA) is responsible for protecting and improving the environment as a valuable asset for the people of Ireland. We are committed to protecting people and the environment from the harmful effects of radiation and pollution.

The work of the EPA can be divided into three main areas:

Regulation: *We implement effective regulation and environmental compliance systems to deliver good environmental outcomes and target those who don't comply.*

Knowledge: *We provide high quality, targeted and timely environmental data, information and assessment to inform decision making at all levels.*

Advocacy: *We work with others to advocate for a clean, productive and well protected environment and for sustainable environmental behaviour.*

Our Responsibilities

Licensing

We regulate the following activities so that they do not endanger human health or harm the environment:

- waste facilities (*e.g. landfills, incinerators, waste transfer stations*);
- large scale industrial activities (*e.g. pharmaceutical, cement manufacturing, power plants*);
- intensive agriculture (*e.g. pigs, poultry*);
- the contained use and controlled release of Genetically Modified Organisms (*GMOs*);
- sources of ionising radiation (*e.g. x-ray and radiotherapy equipment, industrial sources*);
- large petrol storage facilities;
- waste water discharges;
- dumping at sea activities.

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- Conducting an annual programme of audits and inspections of EPA licensed facilities.
- Overseeing local authorities' environmental protection responsibilities.
- Supervising the supply of drinking water by public water suppliers.
- Working with local authorities and other agencies to tackle environmental crime by co-ordinating a national enforcement network, targeting offenders and overseeing remediation.
- Enforcing Regulations such as Waste Electrical and Electronic Equipment (WEEE), Restriction of Hazardous Substances (RoHS) and substances that deplete the ozone layer.
- Prosecuting those who flout environmental law and damage the environment.

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- Monitoring and reporting on the quality of rivers, lakes, transitional and coastal waters of Ireland and groundwaters; measuring water levels and river flows.
- National coordination and oversight of the Water Framework Directive.
- Monitoring and reporting on Bathing Water Quality.

Monitoring, Analysing and Reporting on the Environment

- Monitoring air quality and implementing the EU Clean Air for Europe (CAFÉ) Directive.
- Independent reporting to inform decision making by national and local government (*e.g. periodic reporting on the State of Ireland's Environment and Indicator Reports*).

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- Monitoring developments abroad relating to nuclear installations and radiological safety.
- Providing, or overseeing the provision of, specialist radiation protection services.

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- Developing a National Hazardous Waste Management Plan to prevent and manage hazardous waste.

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- Generating greater environmental awareness and influencing positive behavioural change by supporting businesses, communities and householders to become more resource efficient.
- Promoting radon testing in homes and workplaces and encouraging remediation where necessary.

Management and structure of the EPA

The EPA is managed by a full time Board, consisting of a Director General and five Directors. The work is carried out across five Offices:

- Office of Environmental Sustainability
- Office of Environmental Enforcement
- Office of Evidence and Assessment
- Office of Radiation Protection and Environmental Monitoring
- Office of Communications and Corporate Services

The EPA is assisted by an Advisory Committee of twelve members who meet regularly to discuss issues of concern and provide advice to the Board.

EPA RESEARCH PROGRAMME 2021–2030

**An Irish Nutrient Platform to
Underpin Sustainable Development**

(2017-RE-MS-10)

EPA Research Report

Prepared for the Environmental Protection Agency

by

The Irish Nutrient Sustainability Platform

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Figure 1 in Chapter 6 is adapted with permission from Macintosh, K.A., Mayer, B.K., McDowell, R.W., *et al.*, 2018. Managing diffuse phosphorus at the source versus at the sink. *Environmental Science and Technology* 52: 11995–12009. © American Chemical Society.

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This report is based on research carried out/data from 30 March 2018 to 30 June 2020. More recent data may have become available since the research was completed.

The EPA Research Programme addresses the need for research in Ireland to inform policymakers and other stakeholders on a range of questions in relation to environmental protection. These reports are intended as contributions to the necessary debate on the protection of the environment.

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Executive Summary

A central tenet of the United Nations (UN) Agenda for Sustainable Development is to achieve societal sustainability by promoting economic growth while protecting the environment and preserving all natural resources. At an all-island level, the agri-food sector is integral to Ireland's economy: intensification of this industry, in line with current national policies such as Food Harvest 2020 (Ireland) and Going for Growth (Northern Ireland), is essential for increased Irish economic prosperity. Yet a major challenge for this sector, both locally and globally, is to address the Sustainable Development Goal (SDG) targets while sustaining agricultural output to help feed a growing global population. A transition towards sustainable primary production and processing systems that can produce more food – and other bio-based products – while meeting those UN SDG targets that mandate fewer inputs, less environmental impact, waste recycling and reduced greenhouse gas emissions is thus an imperative. To this end the Environmental Protection Agency (EPA) of Ireland grant funded the establishment of a stakeholder-led “Irish Nutrient Sustainability Platform” (INSP) to promote sustainable nutrient management across the island of Ireland, under the auspices of the UN Agenda for Sustainable Development.

Key Outcomes

- Through a series of consultations, stakeholders ratified the need for a forum to:
 - promote UN SDGs and targets with respect to nutrient waste reduction, more efficient nutrient management, recycling, knowledge interchange and eco-technology development;
 - enable creation and development of new business opportunities, value chains and income streams in the context of waste valorisation and reuse of scarce natural resources alongside environmental protection;
 - provide a “safe space” for stakeholders to interact with regulators to discuss policy, challenges, solutions and technological innovations; and
 - facilitate access to an established network of national and international technology providers, cognate sustainability initiatives, governmental bodies, EU agencies, and universities and their cognate research centres of excellence.
- In collaboration with prospective members, a business and operational plan alongside documentation pertaining to membership agreements and platform structure have been developed. These have been further benchmarked against cognate sustainability initiatives in operation across the EU and globally, e.g. the European Sustainable Phosphorus Platform, the German Phosphorus Platform, the Dutch Nutrient Platform, the Italian Phosphorus Platform and the United States Sustainable Phosphorus Alliance.
- An all-island INSP has been established to engage the public and private sectors in the development and implementation of nutrient (and co-recoverable resource) management. Through memberships fees and additional grant-based income, the INSP will remain viable beyond the EPA funding period. There is the potential to seek funding from governmental departments, as seen in other EU countries, in Northern Ireland and Ireland, which is currently being investigated.
- The island of Ireland should consider developing a more integrated reporting tool to capture all work being undertaken across the island with respect to SDGs. Such a database would ensure better integration and promotion of SDG compliance. As an exemplar, a database relating to nutrient management projects funded across all funding bodies on the island has been created by the platform.
- The island of Ireland should consider mandating all companies that generate, use or recycle nutrients to be affiliated to the INSP. Consideration should also be given to providing a government subsidy to secure the platform's long-term operation: cognate platforms across the EU receive such central funding, e.g. the Italian Phosphorus Platform.
- The island of Ireland should consider setting a target (in terms of both percentage reduction and date) by which nutrient imports are to be reduced. Importation should be reduced through

the development and implementation of nutrient recycling technologies and new value chains across both the wastewater and agri-food industries.

- Further investment in both research on and application of biorefinery processes is required to deliver “value-added products” from waste, for example the removal and recovery of nitrogen and

phosphorus alongside the valorisation of biogas (carbon dioxide and methane), volatile fatty acids and bioplastics. This is particularly relevant in the context of circular- and bio-economy policy at both national and global levels, especially given the keystone role the SDGs will play in shaping national and international policy.

1 Introduction

1.1 Background and Context

The United Nations (UN) Agenda for Sustainable Development consists of 17 Sustainable Development Goals (SDGs), underpinned by 169 targets, which aim to “end poverty, protect the planet and ensure prosperity for all”. These SDGs are expected to frame national policy agendas over the next 15 years in the context of both domestic and international policy. The overarching themes of these SDGs are the desire to link environmental sustainability with sustainable economic development, and the recognition that the management and protection of the environment are vital to economic wellbeing and a healthy society.

At an all-island level, the agri-food sector is integral to Ireland’s economy: intensification of this industry, in line with current national policies such as Food Harvest 2020 (Ireland)¹ and Going for Growth (Northern Ireland),² is essential for increased Irish economic prosperity. Yet a major challenge for this sector, both locally and globally, is to address SDG targets while sustaining agricultural output to help feed a growing global population. The provision of a safe and secure food supply for all, against the backdrop of climate change, with its potential to affect primary production systems, such as agriculture, forestry and fisheries, is a critical global challenge that Ireland is well placed to help address. In the coming decades, the intensification of the Irish agri-food system will present the industry, and wider society, with the dual challenges of (1) elevated production, treatment and sustainable management of waste, and (2) increased competition for scarce natural nutrient resources.

To this end, a transition towards sustainable primary production and processing systems that can produce more food – and other bio-based products – while meeting those UN SDG targets that mandate fewer inputs, less environmental impact, waste recycling and reduced greenhouse gas emissions is an imperative. A comprehensive understanding of the

cycles of nutrients in nature is necessary to inform the development of a strategy for sustainability, and for the development of recycling processes that take account of both the source and fate of these valuable natural resources.

In 2014 an Environmental Protection Agency (EPA) sponsored project entitled “Phosphorus from Wastewater: Novel Technologies for Advanced Treatment and Re-use” (Macintosh *et al.*, 2019a) identified the need to establish an all-island Irish Nutrient Sustainability Platform (INSP) with a remit similar to cognate platforms in operation across the EU and globally, to engage the public and private sectors in the development and implementation of nutrient (and co-recoverable resource) management. Macintosh identified collaborative networks as one of five key transitional pathways to a transformed system in her transformational change model for phosphorous sustainability on the island of Ireland (Macintosh *et al.*, 2019b). In response to this, project 2017-RE-MS-10 (“An Irish Nutrient Platform to Underpin Sustainable Development”) was initiated. This sought to:

- establish an INSP, supported by stakeholders from across the agri-food, wastewater, government, regulator, academic and business communities and benchmarked against the current remit, operation and governance of cognate platforms functioning in Europe and beyond;
- promote SDG goals and targets with respect to nutrient waste reduction, more efficient nutrient use, recycling, knowledge interchange and eco-technology development to a wider public and private sector audience, thus promoting new business opportunities and economic growth while maintaining Ireland’s environment and resource security;
- develop innovative processes to generate, reflect and trial emerging sustainability initiatives and technologies.

1 <https://www.gov.ie/en/publication/5a0f2-food-harvest-2020/>

2 <https://www.daera-ni.gov.uk/articles/going-growth-strategic-action-plan>

2 Establishment of the Irish Nutrient Sustainability Platform

2.1 Stakeholder Consultation and Feedback

To determine the most appropriate model for developing an INSP on the island, a “Founders’ Day” meeting was held in Dublin (September, 2019). Nineteen stakeholder organisations from across the industrial, governmental and academic sectors were in attendance. Attendees were both canvassed with respect to their needs in relation to nutrient sustainability and presented with a series of documents outlining the platform’s vision, mission, operational structure, membership agreements, business plan and future activities. In preparation, platform governance documents were benchmarked against cognate international platforms, e.g. the European Sustainable Phosphorus Platform (ESPP; <https://www.phosphorusplatform.eu>), the German Phosphorus Platform (www.deutsche-phosphorplattform.de), the Dutch Nutrient Platform (<https://www.nutrientplatform.org/>), the Italian Phosphorus Platform (<https://www.piattaformaitalianafosforo.it/who-we-are.html>) and the United States Sustainable Phosphorus Alliance (<https://phosphorusalliance.org>). The Founders’ Day meeting concluded with a formal ratification of the INSP. Documentation relating to the platform’s objectives, vision, mission, operational structure and funding model – as agreed by the Founders’ Day attendees – is detailed below. Finalised platform membership agreements, governance documents and terms of reference are provided in Chapter 6.

2.1.1 Platform objectives

The INSP is a stakeholder-led initiative that seeks to bring together a wide range of stakeholder members spanning the nutrient value chain, including the agri-food industry; farmers; fertiliser, chemical and animal feed suppliers; waste and water treatment utilities; the food processing sector; bio-resources and bio-energy providers; regulators; technology providers; academia; education and training centres; research performing organisations (RPOs); food

safety and diet sector; consumer groups; and any other stakeholder organisation allied to the platform’s vision. The platform seeks to align itself with the delivery of national and regional policy through established links with governmental bodies, as well as collaborations relating to the *National Policy Statement on the Bioeconomy* (Government of Ireland, 2018) and the UN Agenda for Sustainable Development in relation to nutrients. The platform interacts with the wider international consortium of regional platforms operating in accordance with, and as members of, the ESPP – of which the INSP is a member.

The objectives of the INSP include:

- promote and support sustainable nutrient management across the island of Ireland;
- support the creation and development of new business opportunities, value chains and income streams;
- provide a “safe space” for stakeholders to interact with regulators to discuss policy, challenges, solutions and technological innovations;
- facilitate access to an established network of national and international technology providers, cognate sustainability initiatives, governmental bodies, EU agencies, RPOs and research centres;
- enable networking and knowledge exchange with diverse stakeholders from across the nutrient value chain both nationally and internationally;
- enhance corporate visibility as drivers of sustainability (through stakeholder organisation logo placement and promotion on the platform website – www.nutrientsustainability.ie – and at platform events);
- provide advocacy in the waste recycling and valorisation sectors;
- develop brand association with respect to national and regional policy, environmental stewardship and the UN SDGs on the island of Ireland;
- support access to grant funding opportunities, networks and infrastructure to build collaborative research programmes with academic and technical centres of excellence;

- coordinate grant and commercial funding partnerships and applications, and provide project management expertise and dissemination activities for relevant projects.

2.1.2 *Vision and mission statement*

The vision of the INSP is “To promote the United Nations Sustainable Development Goal Agenda – with respect to food, waste, climate, economic development and protection of the environment – across the island of Ireland through a stakeholder-led coalition. This envisions waste as a valuable nutrient resource and advocates for its sustainable reuse.”

The mission statement of the platform looks at the specific challenge that the platform will address and outlines how the platform’s work will contribute to the development of a more sustainable, and circular, society.

Our mission

The Irish Nutrient Sustainability Platform is founded on the principle that waste is a valuable resource of nutrients, energy and other high-value products. Its mission is to promote sustainable nutrient management on the island of Ireland in the context of the United Nations Sustainable Development Goals Agenda. The Platform seeks to enhance economic prosperity, whilst safeguarding the environment, by supporting the implementation of a nutrient circular and sustainable society through stakeholder co-operation, value chain development, corporate responsibility, education, technological innovation, knowledge exchange, dissemination and informing policy.

2.1.3 *Platform structure*

The platform is a not-for-profit organisation that will carry out or participate in commercial activities only in so far as these further the platform’s objectives. The platform may promote its stakeholder members’ commercial activities, services and products in so far as these are coherent with the platform’s objectives.

As the platform will become its own entity, it is imperative that structures and procedures are put in place to ensure governance of the platform. The governance structure will be overseen by a Platform Chairperson who will head the Platform Management Committee. The platform will consist of platform members, a Stakeholder Advisory Committee, a Scientific and Technical Advisory Committee, and the Platform Management Committee (Figure 2.1).

The Platform Management Committee (Figure 2.1) will inform the strategic direction of the platform in line with the Stakeholder and Scientific and Technical Advisory Committees and undertake the following main functions:

- oversee the development of the platform operational strategy;
- ratify key stakeholder-led nutrient priority areas and projects;
- monitor the outputs of the platform to ensure that these are aligned with business plan objectives, stakeholder targets and key performance indicators.

The Management Committee will have a maximum of 15 members and will initially comprise the following:

- a chairperson;
- platform directors;
- platform manager;
- Chair of the Stakeholder Advisory Committee;
- Chair of the Scientific and Technical Advisory Committee;
- government department representatives (Ireland and Northern Ireland);
- farming representatives (Ireland and Northern Ireland);
- Queen’s University Belfast (QUB) representative;
- National University of Ireland Galway (NUIG) representative;
- additional co-opted members nominated by the Stakeholder and Scientific and Technical Advisory Committees.

The Platform Chairperson is to be a person independent of the platform membership and will be able to demonstrate their ability to act independently, as appointed by the Platform Management Committee. The Chairperson is to be appointed for a term of

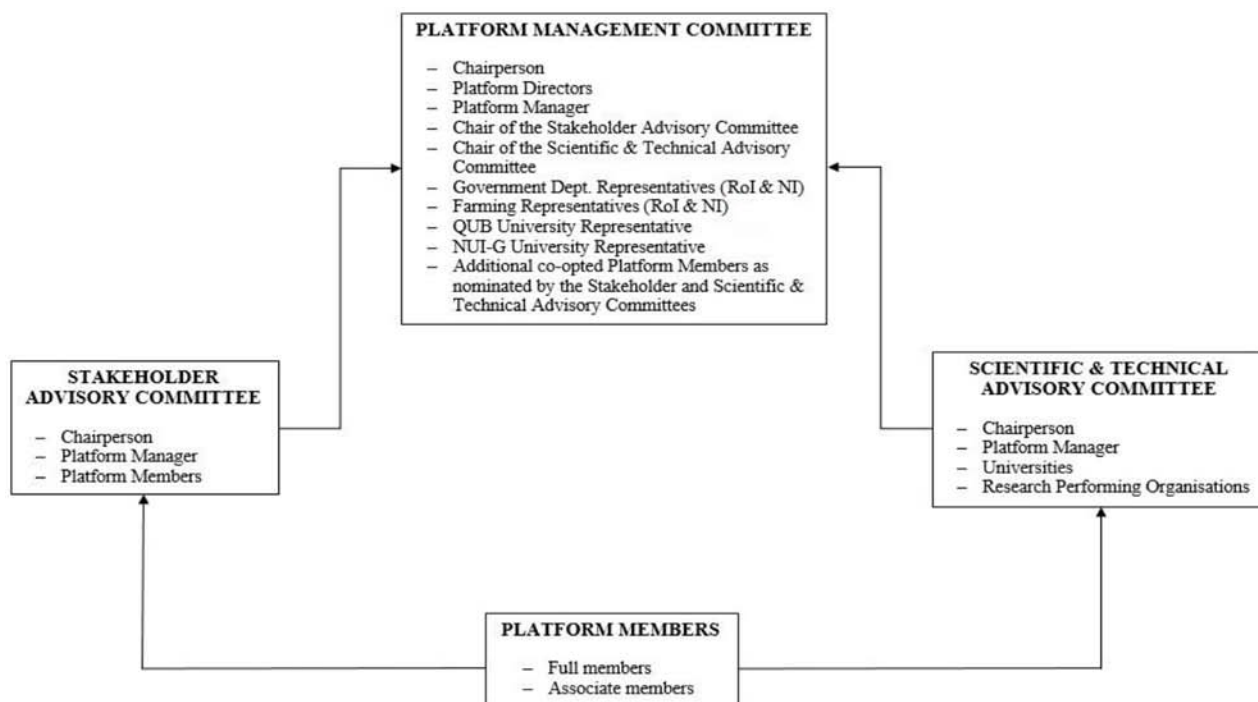


Figure 2.1. Governance structure of the Irish Nutrient Sustainability Platform. NI, Northern Ireland; NUIG, National University of Ireland Galway; QUB, Queen’s University Belfast; RoI, Republic of Ireland.

2 years initially, at the end of which term they may be re-appointed.

The platform will host an annual general meeting of its members to define the following year’s operational activities and key performance indicators, budget and membership fees, and to approve the legal accounts. The Platform Management Committee for the following year will also be reviewed and approved.

2.1.4 Platform funding model and business plan

A funding model for the INSP has been developed, based on those platforms currently operating across the EU. These cognate platforms are supported using a mixed model with support through governmental subsidies and membership fees and through the coordination of grant and commercial funding partnerships, providing project management expertise and dissemination activities for relevant projects. With respect to the INSP, the primary source of income will be membership fees. These will be set annually by the platform members and will be on a scale dependent on the size of the organisation as defined by the EU (turnover/full-time employees). The agreed membership fee will determine the minimum number

of members required to ensure that the platform is financially viable.

To diversify income streams, the platform will also seek to partner on research grant applications as a dissemination provider; the platform will also offer project management to relevant projects. The platform is well positioned to undertake the dissemination of new research, as knowledge exchange is one of the key objectives of the platform, and it has the capacity to disseminate the research widely through the platform network. There is also the opportunity for researchers to present their research and host workshops at platform events where appropriate.

A bottom-up approach was taken to budgeting for the platform. All platform activities for year 1 were costed, including platform management, and the budget required to ensure that the platform was financially viable was calculated. From this calculation it was possible to estimate the number of member companies required to fund the platform (Tables 2.1–2.3).

2.1.5 Branding

Proactive Design & Marketing was appointed to develop the branding for the platform and the website (<https://nutrientsustainability.ie>). The agency was

Table 2.1. Expenditure forecast for year 1 (revised in the light of the impact of the COVID-19 pandemic)

Activity	Total (€)
Platform manager salary (12 months @ 100% FTE)	52,259 (including NI and superannuation)
Platform manager travel expenses	0
Event costs	
Annual general meeting [September 2020 (online) or January 2021]:	2250
• venue @ €750 per event	
• catering @ €30 pp (50 attendees each)	
Two focused events (1 online, 1 physical; 3 keynote speakers each):	12,300
• venue @ €1500 per physical event	
• catering @ €60 pp (80 attendees each)	
• speaker costs and travel @ €1500 pp	
• delegate packs @ €500 per event	
• online event technology and support €1000	
One annual lecture (1 day; 1 keynote speaker):	4250
• venue @ €750 per event	
• catering @ €25 pp (100 attendees each)	
• speaker costs and travel @ €1000 pp	
Membership of ESPP	10,000
External consultancy	5000
Total forecast expenditure	86,059

FTE, full-time equivalent; NI, national insurance; pp, per person.

Table 2.2. Expenditure forecast for year 1 (prior to revision as a result of the COVID-19 pandemic)

Activity	Total (€)
Platform manager salary (12 months @ 100% FTE)	52,259 (including NI and superannuation)
Platform manager travel expenses	5000
Event costs	
Annual general meeting (January 2021):	4500
• venue @ €750 per event	
• catering @ €30 pp (50 attendees each)	
Two focused events (2 days; 3 keynote speakers each):	22,600
• venue @ €1500 per event	
• catering @ €60 pp (80 attendees each)	
• speaker costs and travel @ €1500 pp	
• delegate packs @ €500 per event	
One annual lecture (1 day; 1 keynote speaker):	4250
• venue @ €750 per event	
• catering @ €25 pp (100 attendees each)	
• speaker costs and travel @ €1000 pp	
Membership of ESPP	10,000
External consultancy	5000
Total forecast expenditure	103,609

FTE, full-time equivalent; NI, national insurance; pp, per person.

Table 2.3. Income forecast for year 1

Income stream	Fee	Total (€)
Membership		
Large stakeholder	5 @ €6000	30,000
Medium-sized stakeholder	7 @ €3000	21,000
Small stakeholder	10 @ €1500	15,000
Meeting registration fees	1 free registration to all platform events per paying member	
	1 focused event @ €100 pp	2200
	1 annual lecture @ €50 pp	1100
	(Each member sends one additional attendee to all physical events) ^a	
Sponsorship/"in-kind" contribution	€1000 per event	3000
Funded research projects	2.5% of the total grant value	5000
Projected external grant income	NUIG and QUB	30,000
Forecast income		107,300
Less host university overheads		14,250
Total forecast income		93,050

^aIncome in excess of operational costs will be used to fund research projects as directed by the Platform Management Committee.

pp, per person.

briefed to design a logo to represent the platform that would be recognisable and relate to the vision of the platform through the colour scheme and iconography. A number of options are presented in Figure 2.2.

The agency presented logo options, which were in turn presented to the steering committee for comment, and the decision was put to a vote. There were multiple versions of the logo, with varying designs and alternative names for the platform, including "network" and "partnership". It was concluded that it was important to highlight the all-island aspect of the platform by including the map of Ireland, but that this could be limiting and may need to be reviewed in the future if the remit of the platform extends outside Ireland.

Proactive Design & Marketing was briefed to design an intuitive and functional website that acts as a digital home for the platform. The website has a number of functions, including providing the public and prospective members with all the information they may require about the platform and its activities, giving members an area to connect with each other and access to the latest research and developments in the area of waste valorisation, and showcasing the work that the platform and its members are doing to build more sustainable nutrient management.

As part of the design brief, the agency also designed a leaflet for the platform as a take-away for events and meetings. The leaflet gives an overview of the platform and the key membership benefits for prospective members.



Figure 2.2. Examples of logo options presented by Proactive Design & Marketing.

2.1.6 Membership recruitment

As the platform is to be financially self-sufficient and predominantly funded by membership fees, the development of a pipeline of members is crucial to maintain and ensure the longevity of the platform. In the initial planning phase for the platform, stakeholders from a wide range of companies, government bodies and representative bodies were identified as key contributors.

These initial stakeholders were contacted with regard to the formation of the platform and invited to attend the Founders' Day meeting, as previously detailed. Following this meeting, attendees were asked to indicate if they were interested in becoming members of the platform.

A membership agreement was drafted by the legal team in QUB (Chapter 6) and is to be signed by the platform and the member company on confirmation of membership. The agreement covers the membership rights of the organisation, identifies the key contact in the member organisation and outlines the obligations of the member organisation and the platform. The agreement also covers the rights to any intellectual property and the publication of the results of any research undertaken by the platform, and it guarantees the non-disclosure of any third party or the member organisation's confidential information.

Recruitment of new members is an ongoing activity for the platform and is fundamental to the ongoing work and evolution of the platform.

3 Platform Communications

3.1 Platform Profile

A key element of the value proposition to member companies is their association with the platform and the wider work the platform is doing. Building the profile of the platform will therefore be central to the recruitment and retention of members and membership fees.

The platform communications strategy is a central component in building a public profile for the platform along with enabling the development of a members' network and dissemination of the latest research and innovations in nutrient sustainability. A number of tools are required to carry out the communications strategy, including a website, a newsletter and social media.

3.1.1 Website

The platform website will often be the first engagement prospective members have with the platform when considering membership, and thus it was important that the website contain all the relevant information, including the platform's vision and mission statement, membership details, case studies on current members, and any information on upcoming events and platform activities.

A password-protected members' area was added to the website and will host a current database of relevant research papers, a forum for members to raise questions and engage in discussions on relevant topics, board meeting minutes and presentations, and information on upcoming platform activities. The members' area is an important asset in building the network and creating a sense of community among the member organisations. At a later stage there will be the option to grow the members' area to include a swap shop-style platform to facilitate the supply and demand of recovered nutrients.

3.1.2 Newsletter

A quarterly newsletter will be disseminated to the platform mailing list, which will include platform members, prospective members, stakeholders and cognate platforms. The newsletter will be used to update members on platform activities, highlight case studies of the work the platform is doing with members, showcase members' work in the area of nutrient recovery, and profile new research and technology in the nutrient recovery sector.

The newsletter will be an important recruitment tool for the platform going forward, illustrating how membership of the platform can add value to members' businesses through highlighting developments or improvements in members' waste streams through the work of the platform.

3.1.3 Social media

The platform has a Twitter account, @Phosphorus_ie, that currently (July 2020) has over 1016 followers. The use of social media allows the platform to promote its work to a wider community, to engage in relevant discussions and to advocate on behalf of platform members.

3.1.4 Media

Where appropriate, the platform will engage with the media to raise the public profile of the platform. Highlighting how the platform is bringing industry, government and policymakers together to advance the sustainable agenda will be key messaging and will aid in building awareness and trust among stakeholders and interested parties.

4 Platform Launch

4.1 Public Launch Event

As part of the EPA work programme, a public launch for the platform was held on 3 September 2020 to formally welcome members to the platform and to commence the platform's activities. The event was originally due to take place in Dublin but, because of the COVID-19 pandemic restrictions on large gatherings, the decision was taken to move the event online.

As the launch event was moved online, numbers were no longer restricted and the launch was used as a way of engaging with and recruiting additional potential members. A database of stakeholders was collated targeting a broad range of organisations from the agri-food industry, RPOs, policymakers, regulators, government bodies, etc. Invitations were sent by email to 180 contacts with the event details and registration link. The information was shared further on social media and through the platform network. In total, there were 142 registrations for the event, and upwards of 90 attendees logged in on the day.

The move online also meant that the agenda had to be amended to be more concise and engaging. The launch went from a half-day event with speakers and workshops, to a 2-hour webinar where direct engagement was limited. The agenda was designed to demonstrate how nutrient platforms operate in other EU countries, and how Irish companies and organisations can benefit from actively participating in the platform (Figure 4.1).

Chris Thornton from the ESPP gave an insight into the work the ESPP does, and how a nutrient platform can provide a safe space for discussions to take place and bring about consensus, building a compelling case for the need for an Irish platform.

Ludwig Hermann from the ESPP followed with an overview of the new EU Fertilising Products Regulation [(EU) 2019/1009] and how other EU countries have transitioned to a recycled nutrient model.

Patrick Barrett (Department of Agriculture, Food and the Marine, DAFM) gave an overview of the circular bioeconomy and nutrients in Ireland, and European Green Deal funding opportunities. A panel discussion followed, chaired by Ian Marshall (QUB), in which the challenges and opportunities around nutrient sustainability on the island of Ireland and the European Green Deal were discussed.

A recording of the speakers and panel discussion can be found at the following link: <https://www.youtube.com/channel/UCJfyUBsJGGdabFgNLGWK0Yw/> featured

4.2 Annual General Meeting

Following the launch, the first annual general meeting was held, with all members in attendance, and the platform was officially ratified. The agenda covered the proposed work plan for year 1 and a discussion on topics of interest for future workshops. Ian Marshall (QUB) was elected as chair of the Management Board, and Philip Cosgrave (Yara) was elected as chair of the Stakeholder Advisory Committee.

Attendees: John McGrath (QUB), Vincent O'Flaherty (NUIG), Ian Marshall (QUB), Philip Cosgrave (Yara), Kevin Havekes (Kilwaughter Lime), Jonny Rice (Kilwaughter Lime), Julian Beatty (Nova Q Ltd), Flann O'Brien (CES Environmental Services Ltd), Thomas Gardiner (Northern Ireland Water), Etain Doherty (INSP).

AGENDA

10:00	Welcome & Opening
10:10	What a Successful Nutrient Platform Looks Like Chris Thornton, European Sustainable Phosphorus Platform
10:30	Regulatory Framework for Nutrient Sustainability <i>An Overview of the New EU Fertiliser Regulations and how other EU Countries have transitioned to a recycled nutrient model</i> Ludwig Hermann, Proman Consulting
11:05	The Irish Bioeconomy and Funding Opportunities within the European Green Deal Patrick Barrett, DAFM
11:20	Panel Discussion <ul style="list-style-type: none">• The European Green Deal• Nutrient Sustainability Chairs: Ian Marshall, Etain Doherty Panellists: Chris Thornton, Ludwig Hermann, Patrick Barrett, Philip Cosgrave (YARA)
11:50	Close & Summary
Closed Session	
12:00	Annual General Meeting
13:00	ENDS

Figure 4.1. Agenda for the launch of the Irish Nutrient Sustainability Platform.

5 Future of the Platform

5.1 Platform Activities – Year 1

To date, the confirmed platform members include Yara, Kilwaughter Lime, Teagasc (ReNu2Farm project), University College Dublin (UCD) School of Biosystems & Food Engineering, Northern Ireland Water, CES Environmental Services Ltd, Natural World Products, Irish BioEnergy Association (IrBEA), QUB and NUIG. Discussions are ongoing with further companies and organisations to broaden the scope and interests of the membership base.

A 2-year plan for the platform has been developed to determine the outputs and key performance indicators for the platform over that timeframe. Indicators from year 3 onwards will be determined once the platform is deemed financially viable and productive.

Year 1 activities (Table 5.1) are focused on delivering three key actions: (1) establishing a financially viable platform, (2) creating the member network and

(3) delivering projects that demonstrate the value of a nutrient platform.

5.2 Platform Activities – Year 2

The work plan for year 2 (Table 5.2) is to build on the outputs of year 1 and broaden the platform network by bringing a broader range of stakeholders into the conversation. Increasing engagement with farmer organisations, industry representative bodies and consumer-facing organisations through requesting input into the platform’s workshops and research will broaden the scope of work undertaken by the platform and aims to take the discussion about nutrient sustainability from farm to fork.

Operationally, the platform will become much more member led through committees, in terms of selecting work priorities, lecture and workshop topics, and governance. The Stakeholder Advisory Committee

Table 5.1. Year 1 platform activities

Activity	Description	Date
Launch event	Online webinar to launch the platform	Complete
Stakeholder Advisory Committee	Plans for the first 6 months were proposed to members and approved: <ul style="list-style-type: none"> meet the stakeholder workshop programmes 	Complete
Meet the stakeholder	Each member was given 10 minutes to talk about their organisation and their work relevant to the platform, followed by 12-minute 1:1 meetings between members	Complete
Workshop programme	Workshop 1: Development, regulation and commercialisation of bio-based fertilisers on the island of Ireland	26 November 2020
	Workshop 2: Soil fertility	January 2021
	Workshop 3: TBC	April 2021
Demonstration projects	Work is currently under way on a funding application to enable the platform to fund 4–5 small-scale pilot projects, each bringing two member organisations together with an RPO. These projects will encourage member cooperation and, if successful, could potentially lead to larger scale projects	March 2021
Ongoing work	<ul style="list-style-type: none"> 1 × Annual general meeting 1 × Platform Management Committee meeting 2 × Stakeholder Advisory Committee meetings Maintain and update the research database Quarterly newsletter highlighting the work of the platform Active membership of the ESPP Membership recruitment Work related to any research funding secured 	

TBC, to be confirmed.

Table 5.2. Year 2 platform activities

Activity	Description	Date
Annual conference	Format dependent on COVID-19 pandemic restrictions Most likely to be a hybrid event, with the physical event supported by online access: <ul style="list-style-type: none"> • speaker presentations • platform case study • breakout session/workshop 	September 2021
Workshop programme	Three workshops, topics TBC depending on the outcomes of year 1 and the scope of member organisations	October 2020 to January 2021
Research programme	Pilot projects: <ul style="list-style-type: none"> • 3–4 small-scale pilot projects, each bringing two member organisations together with an RPO. These projects will encourage member cooperation and, if successful, could potentially lead to larger scale projects Scaling of year 1 projects: <ul style="list-style-type: none"> • scaling and further research into one viable project from year 1; subject to funding 	March 2021
Projects	Nutrient inventory: <ul style="list-style-type: none"> • Development of a database of nutrient waste streams produced or required by member organisations to facilitate the circular cycle of nutrients on the island of Ireland Nutrient mass balance study: <ul style="list-style-type: none"> • Subject to sufficient funding, the platform will manage a nutrient mass balance study Three-year strategy: <ul style="list-style-type: none"> • Once the platform has been deemed viable, a 3-year plan will be developed to review the outputs of previous years and determine the direction the platform should take 	
Ongoing work	1 × Annual general meeting 1 × Platform Management Committee meeting 2 × Stakeholder Advisory Committee meetings Maintain and update the research database Quarterly newsletter highlighting the work of the platform Active membership of the ESPP Membership recruitment Work related to any research funding secured	

TBC, to be confirmed.

will be reviewed to represent the interests of member organisations and will make recommendations on the activities of the platform. The Scientific and Technical Advisory Committee will be elected to provide scientific advice and feedback on proposed and ongoing research priority areas, projects and operations of the platform.

5.3 Platform Funding

A sustainable funding model is critical to the success of the platform. The original proposal suggested that the platform should be funded predominantly by membership fees, but after the initial member recruitment phase it was felt that the level of membership fees was a barrier to companies participating in the platform. The uncertainty around the future impacts of the COVID-19 pandemic on budgets also had an impact, because some

companies issued policies halting spending and reducing costs.

The current income from membership is £23,000, with discussions ongoing with potential members that would increase membership income to £35,000. Although membership fees will remain a key source of income for the platform, it is continually looking for mechanisms to reduce fees by subsidising costs through government and research funding. The platform is aiming for a 50/50 approach, in which 50% of the costs are covered by membership fees and 50% are funded through research funding. To date, the platform has been, and is, involved in a number of research funding applications in which the platform takes on the role of facilitating dissemination and demonstration of research outcomes. The increased emphasis on research funding gives the platform more stability and long-term viability, as projects can run for a number of years. It also provides member organisations with a more tangible return on investment for their membership fees and allows them to be involved in ongoing research.

The all-island nature of the platform and the association with NUIG and QUB is an advantage, as the platform is eligible to apply for research funding through EU, UK, Irish and cross-border funding schemes. As a result of the UK's departing the EU, uncertainty remains around how regulations will differ in both jurisdictions going forward. Although this poses a potential threat to the viability of the platform, there are collaboration agreements in place between QUB and NUIG outlining how the universities will work together moving forward from Brexit, and there are also organisations such as InterTradeIreland whose remit is to encourage collaboration north and south of the border.

5.4 Platform Network

One of the challenges originally identified in the rationale for the formation of the INSP was the current fragmentation of sustainability initiatives on the island of Ireland, and the need for these initiatives to cooperate and communicate with each other, as opposed to working in silos. The INSP has the opportunity to bridge this gap to create a network of networks by engaging with different sectors, representative bodies, government agencies, etc., and finding where they have common ground.

The network created by the platform is a key component of the value proposition for members, and the development and expansion of the network will be a continued priority for the platform. There are three main interactions the platform will use to develop a dialogue and communications between entities that may not normally come into contact with each other.

1. Member to member

The platform members represent a diverse group of companies operating at different points along the nutrient value chain. By bringing these organisations together, new opportunities for collaboration can be identified to:

- develop pilot projects between members to trial and demonstrate new concepts/products/solutions, etc.;
- identify complementary supply and demand issues among members;
- facilitate peer-to-peer learning;
- speak directly with policymakers in a safe space without fear of repercussions.

2. Platform to platform

Membership of the ESPP gives the INSP access to other nutrient platforms throughout Europe and is instrumental in providing the European view on nutrient sustainability to members. Participation at EU level gives the platform the opportunity to:

- collaborate on research projects with other EU organisations;
- broaden dissemination of platform research;
- develop plans and programmes through shared experiences and objectives;
- attend and represent Irish interests at international events and conferences.

3. Network to network

As previously identified, the large number of sustainability initiatives on the island of Ireland that are working in isolation from each other is a barrier to progress and can be inefficient. The platform engages with other networks working towards a more sustainable society, such as the Irish Bioeconomy Foundation, CIRCULÉIRE and RPOs. The platform's engagement and participation in other networks can help in joining the dots and linking members to other projects and initiatives that are ongoing.

6 Platform Governance Documents

6.1 Business Plan

IRISH NUTRIENT SUSTAINABILITY PLATFORM

BUSINESS PLAN

YEAR 1

(1st September 2020 – 31st August 2021)

DATED: 1st October 2019

BACKGROUND

The Environmental Protection Agency (EPA) of Ireland grant funded research to establish a stakeholder-led “**IRISH NUTRIENT SUSTAINABILITY PLATFORM**” (herein referred to as the “**PLATFORM**”) to promote sustainable nutrient management in the context of the United Nations (UN) Sustainable Development Goals (SDGs) on the island of Ireland. This cross-border initiative is facilitated and hosted by The National University of Ireland, Galway (NUIG: Prof. Vincent O’Flaherty) and Queen’s University Belfast (QUB: Prof. John W. McGrath and Etain Doherty).

- (1) **THE NATIONAL UNIVERSITY OF IRELAND, GALWAY** WHOSE ADDRESS FOR THESE PURPOSES IS UNIVERSITY ROAD, GALWAY, DUBLIN 4 (“**NUIG**”); AND
- (2) **THE QUEEN’S UNIVERSITY OF BELFAST** WHOSE ADDRESS FOR THESE PURPOSES IS AT UNIVERSITY ROAD, BELFAST BT7 1NN (“**QUEEN’S**” OR “**QUB**”).

Finance for the PLATFORM is secured until the 29th February 2020 via the EPA Research Call (2017): UN SDGs (Grant No: 2017-RE-MS-10). Beyond the duration of the EPA grant funding period the PLATFORM will operate as a legally established not-for-profit organisation.

PLATFORM operation and governance is detailed in the TERMS OF REFERENCE.

ACTIVITIES – To commence under EPA grant funding and continue thereafter subject to PLATFORM finances

Activity	Objective	Target Date
Contacting potential stakeholder members	Establish membership	On-going
Database of interested stakeholders	Establish contacts database	Immediate (with continual update)
Twitter account	Promote Platform	Immediate (with continual update)
Platform branding	Name and logo	Completed
Stakeholder information flyer	Branded and designed	Completed
Pop-up Banners	Promote Platform	Completed
Website	Promote Platform and membership; online information	Completed
Platform e-Newsletter	Promote Platform activities and membership	First edition by end of Quarter 1 in 2020
Act as an information/knowledge exchange and innovation hub	Go to point of contact on the island of Ireland in relation to nutrient sustainability	Immediate (case by case)
Platform Manager will participate in relevant international conference and meetings	Promote the Platform and its activities	Immediate and on-going dependent on budget
Official Public Platform launch	Promote Platform establishment and its activities Engage with existing and new members	January 2020
Hold sector wide events	To identify specific pressures and priority areas in relation to nutrient sustainability across the agri-food sector, and the wider bioeconomy in the context of UN SDGs	See Operational Plan (Year 1 + 2)
Stakeholder – Stakeholder engagement facilitated by Platform Directors and Platform Manager	On request	Immediate, but level of interactions dependent upon Stakeholder commitment to the Platform via the Membership Agreement
Co-ordinate stakeholder-led projects and case studies	Develop research arm of the Platform	On-going and NDA's signed
Apply for external research funding	To financially support the Platform and promote the Platform as a dissemination and knowledge exchange tool	On-going

Commercial activities	Develop commercial arm of the Platform <ul style="list-style-type: none"> • Nutrient Management Plans • Methane Testing • Technology development 	On-going	
Liaise with ESPP and cognate platforms	Knowledge share	Immediate (with continual update)	
Annual General Meeting	Members agreement on Platform operational plan and budget	See Operational Plan (Year 1 + 2)	
Meetings of the Platform Management Committee	Operation and governance of the Platform Activities of the Platform Manager	See Operational Plan (Year 1 + 2)	
Meetings of the Stakeholder Advisory Committee	Recommendations on proposed and on-going research, policy, and operational activities	See Operational Plan (Year 1 + 2)	
Meetings of the Scientific and Technical Advisory Committee	Scientific advice and feedback on proposed and on-going research, policy, and operations	See Operational Plan (Year 1 + 2)	

BUDGET – expenditure forecast for Year 1

Expenditure forecast for Year 1 (revised due to impact of Covid-19)

Activity	Total €
Platform Manager salary (12 months @ 100% FTE)	52,259 (NI & Superannuation)
Platform Manager travel expenses	0
Event costs	
- Annual General Meeting (Sep 2020 (online); Jan 2021)	2,250
- Venue @ €750 per event	
- Catering @ €30 pp (50 attendees each)	
- 2 Focused Events (1 online, 1 physical; 3 keynote speakers each)	12,300
- Venue @ €1,500 per physical event	
- Catering @ €60 pp (80 attendees each)	
- Speaker costs and travel @ €1,500 pp	
- Delegate packs @ €500 per event	
- Online event technology & support €1,000	
- 1 Annual Lecture (1 day; 1 keynote speaker each)	4,250
- Venue @ 750 per event	
- Catering @ 25 pp (100 attendees each)	
- Speaker costs and travel @ €1,000 pp	
Membership of ESPP	10,000
External consultancy	5,000
Total forecasted expenditure	86,059

BUDGET – expenditure forecast for Year 1 (prior to Covid-19 revision)

Activity	Total €
Platform Manager salary (12 months @ 100% FTE)	52,259 (NI & Superannuation)
Platform Manager travel expenses	5,000
Event costs	
- Annual General Meeting (Jan 2020; Dec 2020)	4,500
- Venue @ €750 per event	
- Catering @ €30 pp (50 attendees each)	
- 2 Focused Events (2 days; 3 keynote speakers each)	22,600
- Venue @ €1,500 per event	
- Catering @ €60 pp (80 attendees each)	
- Speaker costs and travel @ €1,500 pp	
- Delegate packs @ €500 per event	
- 1 Annual Lecture (1 day; 1 keynote speaker each)	4,250
- Venue @ 750 per event	
- Catering @ 25 pp (100 attendees each)	
- Speaker costs and travel @ €1,000 pp	
Membership of ESPP	10,000
External consultancy	5,000
Total forecasted expenditure	103,609

BUDGET – income forecast for Year 1

Membership	Fee	Total €
Large stakeholder	5 @ €6,000	30,000
Medium-sized stakeholder	7 @ €3,000	21,000
Small stakeholder	10 @ €1,500	15,000
Meeting registration fees	1 free registration to all Platform events per paying Member	
	1 Focused event @ €100 pp	2,200
	1 Annual lecture @ €50 pp	1,100
	(*Each Member sends 1 additional attendee to all physical events)	
Sponsorship/"in-kind" contribution	€1,000 per event	3,000
Funded research projects	2.5% of the total grant value	5000
Projected external grant income	NUIG and QUB	30,000
	Forecasted income	107,300
	Less Host University Overheads	14,250
	Total forecasted income	93,050

*Income in excess of operational costs will be used to funded research projects as directed by the Platform Management Committee

6.2 Membership Agreement

MEMBERSHIP AGREEMENT

IRISH NUTRIENT SUSTAINABILITY PLATFORM

(1) THE NATIONAL UNIVERSITY OF IRELAND, GALWAY (“NUIG”)

(2) THE QUEEN’S UNIVERSITY OF BELFAST (“QUB”)

(3) PLATFORM MEMBER ORGANISATION

THIS AGREEMENT dated [Date] is made **BETWEEN**:

(1) **IRISH NUTRIENT SUSTAINABILITY PLATFORM** whose address jointly resides between the following host UNIVERSITY institutions:

- National University of Ireland Galway, University Road, Galway, Dublin 4
- The Queen’s University of Belfast, University Road, Belfast BT7 1NN

(2) **PLATFORM MEMBER ORGANISATION** [address] (the “Organisation”).

Each a “Party” and together the “Parties”.

BACKGROUND

The National University of Ireland, Galway and The Queen’s University of Belfast are the joint hosts of the IRISH NUTRIENT SUSTAINABILITY PLATFORM. The ORGANISATION now wishes to become a member of the IRISH NUTRIENT SUSTAINABILITY PLATFORM, and the Parties have agreed to enter into this Agreement to define certain rights and obligations in regard to IRISH NUTRIENT SUSTAINABILITY PLATFORM membership.

1 DEFINITIONS AND INTERPRETATION

1.1 In this Agreement the following expressions have the meaning set opposite:

Agreement:	this document;
Business Day:	Monday to Friday (inclusive) except bank or public holidays in Ireland or Northern Ireland;
PLATFORM:	IRISH NUTRIENT SUSTAINABILITY PLATFORM; a stakeholder-led collaborative initiative on the island of Ireland;
PLATFORM Member:	Fee paying organisational member of the PLATFORM;
Membership Fees:	the financial contribution paid by the ORGANISATION towards the operation of the PLATFORM as outlined in the PLATFORM Terms of Reference;
Management Committee:	PLATFORM Management Committee comprising of PLATFORM directors, PLATFORM manager; Chair of the Stakeholder Advisory Committee; Chair of the Scientific and Technical Advisory Committee; additional co-opted members as deemed necessary by the PLATFORM Management Committee representatives and a Chairperson;
Stakeholder Advisory Committee:	PLATFORM Stakeholder Advisory Committee comprising Chair of the Committee; a representative from each organisational PLATFORM MEMBER and the PLATFORM manager;
Scientific and Technical Advisory Committee:	PLATFORM Scientific and Technical Advisory Committee comprising Chair of the Committee; a representative from each University or

	Research Performing Organisation PLATFORM MEMBER and the PLATFORM manager;
PLATFORM Manager:	Etain Doherty of the Queen's University of Belfast, or her successor as appointed by the PLATFORM Management Committee and ratified at the PLATFORM Annual General Meeting;
The Effective Date:	[date];
Confidential Information:	each Party's confidential information is: any information disclosed by that Party or the other Party and identified as confidential before or at the time of disclosure;
Intellectual Property or IP:	patents, trademarks, service marks, registered designs, copyrights, database rights, design rights, know-how, confidential information, applications for any of the above, and any similar right recognised from time to time in any jurisdiction, whether registered or unregistered, together with all rights of action in relation to the infringement of any of the above;
PLATFORM IP:	All IP arising from activities of the PLATFORM are owned and managed in accordance with the intellectual property framework for NUIG and QUB;
Internal Use:	means use to inform internal activities but excludes incorporation into products or services for commercial exploitation;
Key Contact:	a staff member of the Organisation nominated by the Company to receive communication from the PLATFORM Manager.

2 MEMBERSHIP RIGHTS

2.1 For the duration of this Agreement, the ORGANISATION shall be a member of the IRISH NUTRIENT SUSTAINABILITY PLATFORM, and will be listed on official registers of members. Organisation membership will be actively promoted via the PLATFORM website, promotional material and at PLATFORM events. Membership shall confer on the ORGANISATION the following rights:

2.1.1 The ORGANISATION is entitled to nominate a representative of the Organisation to sit on either the Stakeholder Advisory Committee or the Scientific and Technical Advisory Committee dependent upon organisational background. These Committees make recommendations on (a) the activities and projects to be carried out by the PLATFORM and (b) the apportionment of resources to these activities and projects.

2.1.2 The ORGANISATION will be invited by the PLATFORM Manager, on behalf of the Stakeholder Advisory Committee, to identify priority areas and provide input to the annual review and revision of the PLATFORM operational plan and activities.

3 ORGANISATION CONTACT

3.1 The ORGANISATION shall nominate a Key Contact, who will receive all communication from the PLATFORM Manager on behalf of the ORGANISATION.

3.2 The Key Contact for the receipt of all communication, until changed by notice given in accordance with clause 7, shall be [INSERT NAME AND ADDRESS].

4 ORGANISATION OBLIGATIONS

- 4.1 The ORGANISATION agrees to pay the Membership Fee or Participatory Fees as set out in the PLATFORM TERMS OF REFERENCE to either NUIG or QUB (depending on jurisdiction) for the duration of this Agreement.
- 4.2 The term of this Agreement is 1st September to 31st August. Payment of fees shall be made to either The National University of Ireland, Galway or The Queen's University of Belfast as a lump sum effective from the 1st September 2020; or in four quarterly instalments on 1st September, 1st December, 1st March and 1st June.
- 4.3 Because work of the type to be carried out by the PLATFORM takes time and research results may not be obvious immediately, Organisations should join the PLATFORM with the intention of remaining a fee paying member for a minimum of at least two years. However, the ORGANISATION may terminate this Agreement by giving the PLATFORM 90 days' written notice prior to the termination date.
- 4.4 Should the member of staff nominated by the ORGANISATION under Clause 2.1.1 be elected to the PLATFORM Management Committee, the Organisation shall procure that said staff member adheres to the Management Committee as per the PLATFORM TERMS OF REFERENCE.

5 INTELLECTUAL PROPERTY

- 5.1 MEMBER Universities and Research Performing Organisations reserve the right to publish in scientific peer reviewed journals the results of any research performed through membership of the PLATFORM. MEMBERS, however, shall have the opportunity to review any paper or presentation containing results of the research program of the PLATFORM prior to publication or dissemination. If a MEMBER determines that the proposed publication contains patentable subject matter and the MEMBER desires to have such subject matter protected by a patent application, the PLATFORM agrees, at its choosing, to either delay publication or disclosure for up to ninety (90) days until a patent application has been filed or to remove the description of patentable subject matter. The PLATFORM in line with the host UNIVERSITIES shall have the final authority to determine the scope and content of any publications, provided that such authority shall be exercised with reasonable regard not to publish confidential or proprietary information except as allowed by this Agreement.
- 5.2 It is understood that in the course of carrying out this Agreement, the MEMBER and the PLATFORM (and host Universities) may wish to share proprietary information. If so, the exchange of Proprietary Information will be handled via a Non-Disclosure Agreement (see Appendix 1).
- 5.3 Full MEMBERS of the PLATFORM are entitled to a nonexclusive royalty-free license to PLATFORM-funded host University inventions for a period of up to X years. MEMBERS will have the right to sublicense to its subsidiaries and affiliates. Full Members that wish to exercise rights to a royalty-free license agree to pay for the costs of patent application.
- 5.4 Copyright registration may be obtained for software developed by the PLATFORM. Full MEMBERS shall be entitled to a nonexclusive, royalty-free license to all software developed by the PLATFORM, exercisable within six (6) months from disclosure of any software. MEMBERS will have the right to enhance and to re-market enhanced or unenhanced software with royalties due to the PLATFORM to be negotiated, based on the worth of the software.

6 CONFIDENTIALITY

- 6.1 Parties will not, either during the term of this Agreement or for five (5) years after the end of the term of this Agreement, disclose to any third party the other Party's Confidential Information.
- 6.2 Neither of the Parties will be in breach of any obligation to keep any Confidential Information or other information confidential or not to disclose it to any other party to the extent that it:
 - 6.2.1 is known to the Party making the disclosure before its receipt from the other Party, and not already subject to any obligation of confidentiality to the other Party;

- 6.2.2 is at the time of its disclosure by the Party who has received it from the other Party publicly known without any breach of this Agreement or any other undertaking to keep it confidential;
 - 6.2.3 has been obtained by the Party making the disclosure from a third party in circumstances where the Party making the disclosure has no reason to believe that there has been a breach of an obligation of confidentiality;
 - 6.2.4 has been independently developed by the Party making the disclosure;
 - 6.2.5 is disclosed pursuant to the requirement of any law or regulation (provided, in the case of a disclosure under the Freedom of Information Act 2000, none of the exceptions to that Act applies to the information disclosed) or the order of any Court of competent jurisdiction, and the Party required to make that disclosure has informed the Party whose information it is, within a reasonable time after being required to make the disclosure, of the requirement to make the disclosure and the information required to be disclosed; or
 - 6.2.6 is approved for release in writing by an authorised representative of the Party whose information it is. If any Party that is subject to the Freedom of Information Act 2000 receives a request under that Act to disclose any information that, under this Agreement, is owned by the other Party, it will notify the other Party and will consult with it promptly and before making any disclosure under that Act. The other Party will respond to the Party that received the request within five (5) Business Days after receiving the notice, providing information to assist the Party that received the request to determine whether or not an exemption to the Freedom of Information Act applies to the information requested under that Act.
- 6.4 Neither of the Parties will use the other Party's name or logo, in any publication or press release or product advertising, or for any other promotional purpose, without first obtaining that other Party's written consent; except that the PLATFORM may identify the sums received from the ORGANISATION in its annual report and similar publications.

7 TERMINATION AND WITHDRAWAL

- 7.1 The ORGANISATION may withdraw from the PLATFORM at any time by giving written (on paper) or electronic (by email) notice to the PLATFORM Manager to that effect, and this Agreement shall then terminate after 90 days' written notice prior to the termination date. Membership fees remain due for the financial year in progress.
- 7.2 The PLATFORM may treat the ORGANISATION as having withdrawn from the PLATFORM with immediate effect by giving written notice to the Organisation if:
 - 7.2.1 it is in breach of any provision of this Agreement (including an obligation to make payment) and (if it is capable of remedy) the breach has not been remedied within 90 days after receipt of written notice specifying the breach and requiring its remedy; or
 - 7.2.2 it becomes insolvent, or if an order is made or a resolution is passed for its winding up (except voluntarily for the purpose of solvent amalgamation or reconstruction), or if an administrator, administrative receiver or receiver is appointed over the whole or any part of its assets, or if it makes any arrangement with its creditors or it suspends or ceases to carry on the whole or a substantial part of its business or that part of its business engaged in the participation of the PLATFORM;
 - 7.2.3 and in either case the ORGANISATION will be deemed to have withdrawn from the PLATFORM and this Agreement shall terminate.
- 7.3 If the ORGANISATION withdraws or is treated as having withdrawn from the PLATFORM in accordance with clauses 7.1 or 7.2, it may not recover from either NUIG or QUB any of the Membership Fees paid in advance of the withdrawal.
- 7.4 Upon withdrawal, all rights granted under this Agreement to the Organisation will cease immediately.

7.5 Clause 6 will survive the termination or expiry of this Agreement, or the withdrawal of any ORGANISATION for any reason and will continue in force in accordance with clause 6.1.

8 GENERAL

8.1 Notices: Any notice to be given under this Agreement must be in writing, addressed to the Parties as per the addresses in the Parties section of this Agreement, may be delivered to the other Party by any of the methods set out in the left hand column below and will be deemed to be received on the corresponding day set out in the right hand column.

8.2 Any royalties and fees received by the PLATFORM under this Agreement will be handled in accordance with relevant host UNIVERSITY policies and regulations.

8.3 The PLATFORM shall not assume any liability for the actions or omissions of MEMBERS. MEMBERS shall indemnify and hold the PLATFORM harmless against all claims, liability, injury, damage or cost based upon injury or death to person, or loss of, damage to, or loss of use of property, which arises out of the performance of this agreement to the extent that such claims, liability, damage, cost or expense results from the negligence of a party's agents or employees.

8.4 It is understood that this Agreement may be modified only under terms mutually agreed upon in a duly executed amendment to this Agreement.

Method of service	Deemed day of receipt
By hand or courier	the day of delivery
By pre-paid first class post	the second Business Day after posting
By recorded delivery post	the next Business Day after posting
By fax (provided the sender's fax machine confirms complete and error-free transmission of that notice to the correct fax number)	the next Business Day after sending or, if sent before 16.00 (sender's local time) on the Business Day it was sent

The Parties' respective representatives for the receipt of notices are, until changed by notice given in accordance with this clause, as follows:

For: The PLATFORM:	For: The ORGANISATIONAL Member
Name:	Name:
Contact number:	Contact number:

8.5 Amendments: No variation or amendment of this Agreement will be effective unless it is made in writing and signed by each Party's representative.

8.6 Third Parties: No one except a Party to this Agreement has any right to prevent the amendment of this Agreement or its termination, and no one except a Party to this Agreement may enforce any benefit conferred by this Agreement.

8.7 Governing law: This Agreement is governed by, and is to be construed in accordance with, Republic of Ireland and Northern Irish law. The Courts, in either of the respective jurisdictions, will have exclusive jurisdiction to deal with any dispute which has arisen or may arise out of or in connection with this Agreement, except that any Party may bring proceedings for an injunction in any jurisdiction.

SIGNED for and on behalf of NUIG or QUB:

Name:

Position:

Signature:

SIGNED for and on behalf of _____:

Name:

Position:

Signature:

6.3 Operational Plan Year 1 and Year 2

IRISH NUTRIENT SUSTAINABILITY PLATFORM OPERATIONAL PLAN YEAR 1 & 2

DATED: 1st October 2019

YEAR 1 – ACTIVITIES AND KEY PERFORMATIVE INDICATORS

- Hold official public launch event in September 2020
- Develop the network between PLATFORM MEMBERS
- Integrate the PLATFORM with research performing organisations and funded research projects as a vehicle for project output dissemination
- Hold bi-annual meetings of the STAKEHOLDER ADVISORY COMMITTEE
 - Nominate chairperson
 - Identify and agree key nutrient related themes for action
- Hold annual meeting of the SCIENTIFIC AND TECHNICAL ADVISORY COMMITTEE
 - Nominate chairperson
 - Agree on key nutrient related research projects for action
- Hold annual meeting of the PLATFORM MANGEMENT COMMITTEE
 - Secure chairperson
- Circulate quarterly issues of the PLATFORM e-newsletter to MEMBERS
- Seek to attract a cohort of MEMBERS from across the nutrient value chain
- Hold annual lecture on topic agreed by PLATFORM MEMBERS
- Hold 2 focused events in Year 1
 - Workshop 1 on new EU Fertiliser Regulations
 - Workshop 2 on End-of-Waste
 - Engage with Ulster Farmers Union and Irish Farming Association to plan a farmer-led workshop in Year 2
- Develop and secure funding/resources for a project with respect to 'Nutrient Mass Balance on the Island of Ireland'
- Develop the MEMBERS ONLY area of the PLATFORM website to include:
 - A resources repository
 - An inventory of nutrient waste streams produced and/or used by MEMBERS
- Hold first ANNUAL GENERAL MEETING in early December 2021
- Continue to update the PLATFORM website and Twitter feed

YEAR 2 – ACTIVITIES AND KEY PERFORMATIVE INDICATORS

- Continue to attract a cohort of new MEMBERS from across the nutrient value chain
- Hold bi-annual meetings of the STAKEHOLDER ADVISORY COMMITTEE
 - Identify and agree on key nutrient related themes for action
- Hold annual meeting of the SCIENTIFIC AND TECHNICAL ADVISORY COMMITTEE
 - Agree on key nutrient related research projects for action
- Hold annual meeting of the PLATFORM MANGEMENT COMMITTEE
- Circulate quarterly issues of the PLATFORM e-newsletter to Members
- Hold annual lecture on topic agreed by PLATFORM MEMBER
- Hold 2 focused events in Year 2
 - Workshop 1 on Nutrient Trading Schemes and Carbon Tax/Offset
 - Workshop 2 – farmer-led – topic TBC
- Project underway with respect to 'Nutrient Mass Balance on the Island of Ireland'
- Continue to develop the MEMBERS ONLY area of the PLATFORM website to include:
 - A resources repository
 - Update inventory of nutrient waste streams produced and/or used by MEMBERS
- Hold ANNUAL GENERAL MEETING in early December 2022
- Continue to update the PLATFORM website and Twitter feed

6.4 Research Project Associate Membership

IRISH NUTRIENT SUSTAINABILITY PLATFORM RESEARCH PROJECT ASSOCIATE MEMBERSHIP AGREEMENT

RESEARCH PROJECT DETAILS

Project Title:

Contact Name(s):

Research Lead Contact Address:

Contact Telephone Number:

Contact Email Address:

Project Abstract: (250 words max)

Project website/Twitter/Facebook details

Funder Details: (duration of project)

Logo: (insert for inclusion on Platform website)

THIS AGREEMENT dated [Date] is made **BETWEEN**:

- (1) **IRISH NUTRIENT SUSTAINABILITY PLATFORM** whose address jointly resides between the following host UNIVERSITY institutions:
 - National University of Ireland Galway, University Road, Galway, Dublin 4
 - The Queen's University of Belfast, University Road, Belfast BT7 1NN
- (2) **RESEARCH PROJECT** [address] (the lead "Organisation"). Associate membership for the purposes of project output dissemination and promotion through IRISH NUTRIENT SUSTAINABILITY PLATFORM events and online activities. Logo placement on the IRISH NUTRIENT SUSTAINABILITY PLATFORM website and access to the members only area.

BACKGROUND

The National University of Ireland, Galway and The Queen's University of Belfast are the joint hosts of the IRISH NUTRIENT SUSTAINABILITY PLATFORM. The RESEARCH PROJECT now wishes to become an associate member of the IRISH NUTRIENT SUSTAINABILITY PLATFORM, and have agreed to enter into this Agreement to define certain rights and obligations in regard to IRISH NUTRIENT SUSTAINABILITY PLATFORM associate membership.

1 DEFINITIONS AND INTERPRETATION

1.1 In this Agreement the following expressions have the meaning set opposite:

Agreement:	this document;
Business Day:	Monday to Friday (inclusive) except bank or public holidays in Ireland or Northern Ireland;
PLATFORM:	IRISH NUTRIENT SUSTAINABILITY PLATFORM; a stakeholder-led collaborative initiative on the island of Ireland;
PLATFORM Member:	Paying organisational member of the PLATFORM;
Associate Membership Fee:	The financial contribution (2.5% of total grant) paid by the RESEARCH PROJECT towards the operation of the PLATFORM as outlined in the PLATFORM Terms of Reference;
Management Committee:	PLATFORM Management Committee comprising of PLATFORM directors, PLATFORM manager; Chair of the Stakeholder Advisory Committee; Chair of the Scientific and Technical Advisory Committee; additional co-opted members as deemed necessary by the PLATFORM Management Committee representatives and a Chairperson;
Stakeholder Advisory Committee:	PLATFORM Stakeholder Advisory Committee comprising Chair of the Committee; a representative from each organisational PLATFORM MEMBER and the PLATFORM manager;
Scientific and Technical Advisory Committee:	PLATFORM Scientific and Technical Advisory Committee comprising Chair of the Committee; a representative from each University or Research Performing Organisation PLATFORM MEMBER and the PLATFORM manager;
PLATFORM Manager:	Etain Doherty of the Queen's University of Belfast, or her successor as appointed by the PLATFORM Management Committee and ratified at the PLATFORM Annual General Meeting;
The Effective Date:	[date];
The End Date:	[date];

Confidential Information:	each Party's confidential information is: any information disclosed by that Party or the other Party and identified as confidential before or at the time of disclosure;
Intellectual Property or IP:	patents, trademarks, service marks, registered designs, copyrights, database rights, design rights, know-how, confidential information, applications for any of the above, and any similar right recognised from time to time in any jurisdiction, whether registered or unregistered, together with all rights of action in relation to the infringement of any of the above;
PLATFORM IP:	All IP arising from activities of the PLATFORM are owned and managed in accordance with the intellectual property framework for NUIG and QUB;
Internal Use:	means use to inform internal activities but excludes incorporation into products or services for commercial exploitation;
Key Contact:	a staff member of the RESEARCH PROJECT nominated to receive communication from the PLATFORM Manager.

2 MEMBERSHIP RIGHTS

- 2.1 For the duration of this Agreement, the RESEARCH PROJECT shall be an associate member of the IRISH NUTRIENT SUSTAINABILITY PLATFORM. Membership and project outputs will be actively promoted via the PLATFORM website, promotional material and at PLATFORM events.

3 RESEARCH PROJECT CONTACT

- 3.1 The RESEARCH PROJECT shall nominate a Key Contact, who will receive all communication from the PLATFORM Manager on behalf of the RESEARCH PROJECT.
- 3.2 The Key Contact for the receipt of all communication, until changed by notice given in accordance with clause 7, shall be [INSERT NAME AND ADDRESS].

4 RESEARCH PROJECT OBLIGATIONS

- 4.1 The RESEARCH PROJECT agrees to pay the associate membership fee as set out in the PLATFORM TERMS OF REFERENCE to either NUIG or QUB (depending on jurisdiction).
- 4.2 Payment of fees shall be made to either The National University of Ireland, Galway or The Queen's University of Belfast as a lump sum or in instalments over the duration of the research project.

5 CONFIDENTIALITY

- 5.1 Parties will not, either during the term of this Agreement or for five (5) years after the end of the term of this Agreement, disclose to any third party the other Party's Confidential Information.
- 5.2 Neither of the Parties will be in breach of any obligation to keep any Confidential Information or other information confidential or not to disclose it to any other party to the extent that it:
- 5.2.1 is known to the Party making the disclosure before its receipt from the other Party, and not already subject to any obligation of confidentiality to the other Party;
 - 5.2.2 is at the time of its disclosure by the Party who has received it from the other Party publicly known without any breach of this Agreement or any other undertaking to keep it confidential;

- 5.2.3 has been obtained by the Party making the disclosure from a third party in circumstances where the Party making the disclosure has no reason to believe that there has been a breach of an obligation of confidentiality;
 - 5.2.4 has been independently developed by the Party making the disclosure;
 - 5.2.5 is disclosed pursuant to the requirement of any law or regulation (provided, in the case of a disclosure under the Freedom of Information Act 2000, none of the exceptions to that Act applies to the information disclosed) or the order of any Court of competent jurisdiction, and the Party required to make that disclosure has informed the Party whose information it is, within a reasonable time after being required to make the disclosure, of the requirement to make the disclosure and the information required to be disclosed; or
 - 5.2.6 is approved for release in writing by an authorised representative of the Party whose information it is. If any Party that is subject to the Freedom of Information Act 2000 receives a request under that Act to disclose any information that, under this Agreement, is owned by the other Party, it will notify the other Party and will consult with it promptly and before making any disclosure under that Act. The other Party will respond to the Party that received the request within five (5) Business Days after receiving the notice, providing information to assist the Party that received the request to determine whether or not an exemption to the Freedom of Information Act applies to the information requested under that Act.
- 5.4 Neither of the Parties will use the other Party's name or logo, in any publication or press release or product advertising, or for any other promotional purpose, without first obtaining that other Party's written consent; except that the PLATFORM may identify the sums received from the RESEARCH PROJECT in its annual report and similar publications.

6 TERMINATION AND WITHDRAWAL

- 6.1 The RESEARCH PROJECT may withdraw from the PLATFORM at any time by giving written (on paper) or electronic (by email) notice to the PLATFORM Manager to that effect, and this Agreement shall then terminate after 90 days' written notice prior to the termination date. Associate membership fees remain due for the financial year in progress.
- 6.2 The PLATFORM may treat the RESEARCH PROJECT as having withdrawn from the PLATFORM with immediate effect by giving written notice to the RESEARCH PROJECT if:
- 6.2.1 it is in breach of any provision of this Agreement (including an obligation to make payment) and (if it is capable of remedy) the breach has not been remedied within 90 days after receipt of written notice specifying the breach and requiring its remedy; or
 - 6.2.2 it becomes insolvent, or if an order is made or a resolution is passed for its winding up (except voluntarily for the purpose of solvent amalgamation or reconstruction), or if an administrator, administrative receiver or receiver is appointed over the whole or any part of its assets, or if it makes any arrangement with its creditors or it suspends or ceases to carry on the whole or a substantial part of its business or that part of its business engaged in the participation of the PLATFORM;
 - 6.2.3 and in either case the RESEARCH PROJECT will be deemed to have withdrawn from the PLATFORM and this Agreement shall terminate.
- 6.3 If the RESEARCH PROJECT withdraws or is treated as having withdrawn from the PLATFORM, it may not recover from either NUIG or QUB any of the associate membership fee paid in advance of the withdrawal.
- 6.4 Upon withdrawal, all rights granted under this Agreement to the RESEARCH PROJECT will cease immediately.
- 6.5 Clause 5 will survive the termination or expiry of this Agreement, or the withdrawal of any RESEARCH PROJECT for any reason and will continue in force in accordance with clause 5.1.

7 GENERAL

- 7.1 Notices: Any notice to be given under this Agreement must be in writing, addressed to the Parties as per the addresses in the Parties section of this Agreement, may be delivered to the other Party by any of the methods set out in the left hand column below and will be deemed to be received on the corresponding day set out in the right hand column.
- 7.2 Any royalties and fees received by the PLATFORM under this Agreement will be handled in accordance with relevant host UNIVERSITY policies and regulations.
- 7.3 The PLATFORM shall not assume any liability for the actions or omissions of ASSOCIATE MEMBERS. MEMBERS shall indemnify and hold the PLATFORM harmless against all claims, liability, injury, damage or cost based upon injury or death to person, or loss of, damage to, or loss of use of property, which arises out of the performance of this agreement to the extent that such claims, liability, damage, cost or expense results from the negligence of a party's agents or employees.
- 7.4 It is understood that this Agreement may be modified only under terms mutually agreed upon in a duly executed amendment to this Agreement.

Method of service	Deemed day of receipt
By hand or courier	the day of delivery
By pre-paid first class post	the second Business Day after posting
By recorded delivery post	the next Business Day after posting
By fax (provided the sender's fax machine confirms complete and error-free transmission of that notice to the correct fax number)	the next Business Day after sending or, if sent before 16.00 (sender's local time) on the Business Day it was sent

The Parties' respective representatives for the receipt of notices are, until changed by notice given in accordance with this clause, as follows:

For: The PLATFORM:	For: The RESEARCH PROJECT Member
Name:	Name:
Contact number:	Contact number:

- 7.5 Amendments: No variation or amendment of this Agreement will be effective unless it is made in writing and signed by each Party's representative.
- 7.6 Third Parties: No one except a Party to this Agreement has any right to prevent the amendment of this Agreement or its termination, and no one except a Party to this Agreement may enforce any benefit conferred by this Agreement.
- 7.7 Governing law: This Agreement is governed by, and is to be construed in accordance with, Republic of Ireland and Northern Irish law. The Courts, in either of the respective jurisdictions, will have exclusive jurisdiction to deal with any dispute which has arisen or may arise out of or in connection with this Agreement, except that any Party may bring proceedings for an injunction in any jurisdiction.

SIGNED for and on behalf of NUIG or QUB:

Name:

Position:

Signature:

SIGNED for and on behalf of _____:

Name:

Position:

Signature:

6.5 Terms of Reference

IRISH NUTRIENT SUSTAINABILITY PLATFORM TERMS OF REFERENCE

DATED: 1st October 2019

BACKGROUND

The Environmental Protection Agency (EPA) of Ireland grant funded research to establish a stakeholder-led “**IRISH NUTRIENT SUSTAINABILITY PLATFORM**” (herein referred to as the “**PLATFORM**”) to promote sustainable nutrient management in the context of the United Nations (UN) Sustainable Development Goals (SDGs) on the island of Ireland (www.nutrientsustainability.ie). This cross-border initiative is facilitated and hosted by The National University of Ireland, Galway (NUIG: Prof. Vincent O’Flaherty) and Queen’s University Belfast (QUB: Prof. John W. McGrath and Etain Doherty).

- (1) **THE NATIONAL UNIVERSITY OF IRELAND, GALWAY** WHOSE ADDRESS FOR THESE PURPOSES IS UNIVERSITY ROAD, GALWAY (“**NUIG**”); AND
- (2) **THE QUEEN’S UNIVERSITY OF BELFAST** WHOSE ADDRESS FOR THESE PURPOSES IS AT UNIVERSITY ROAD, BELFAST BT7 1NN (“**QUEEN’S**” OR “**QUB**”).

Finance for the PLATFORM is secured until the 29th February 2020 via the EPA Research Call (2017): UN SDGs (Grant No: 2017-RE-MS-10). Beyond the duration of the EPA grant funding period the PLATFORM will operate as a legally established not-for-profit organisation.

ESTABLISHMENT AND OPERATION OF THE PLATFORM

Establishment

On the 30th March 2018, NUIG and QUB undertook to develop the PLATFORM in accordance with the terms of the EPA research grant (Grant No: 2017-RE-MS-10).

Operation

The PLATFORM is founded on the principle that waste is a valuable resource of nutrients, energy and other high-value products. The mission of the PLATFORM is to promote sustainable nutrient management on the island of Ireland in the context of the UN SDGs. The PLATFORM seeks to enhance economic prosperity, whilst safeguarding the environment, by supporting the implementation of a nutrient circular and sustainable society (Fig. 1), through stakeholder co-operation, value chain development, corporate responsibility, education, technological innovation, knowledge exchange, dissemination and informing policy.

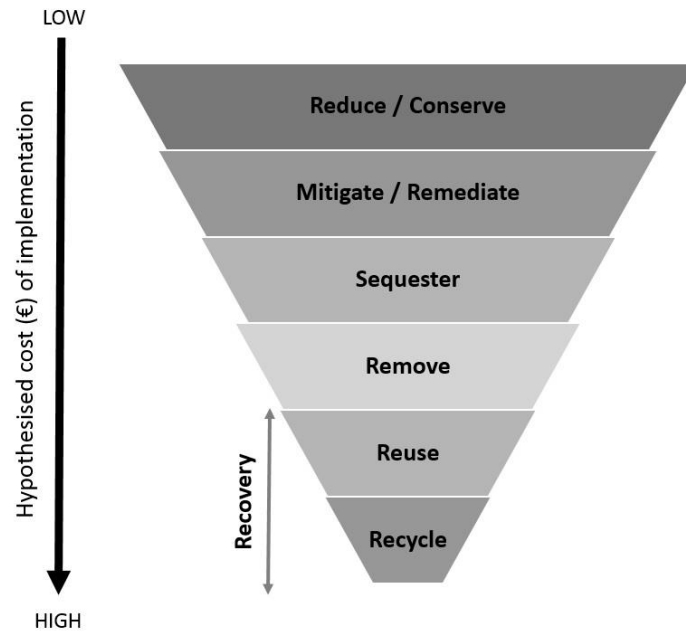


Figure 1. Tiered system for sustainable nutrient management (edited from Macintosh, K. A., Mayer, B. K., McDowell, R. W., Powers, S. M., Baker, L. A., Boyer, T. H. & Rittmann, B. E. 2018. Managing diffuse phosphorus at the source versus at the sink. *Environmental Science and Technology* 52 (21): 11995–12009).

The PLATFORM is stakeholder-led and driven. It will bring together a wide range of stakeholder members spanning the nutrient value chain including, but not restricted to:

- Agri-food industry;
- Farmers;
- Fertiliser and animal feed;
- Chemicals and minerals;
- Waste and water treatment;
- Food processing;
- Bio-resources and bio-energies;
- Regulators;
- Technology providers;
- Academia;
- Education and training centres;
- Research performing organisations;
- Food safety and diet;
- Consumer groups;
- Any stakeholder organisation allied to the PLATFORM vision.

The PLATFORM seeks to align with delivery of national and regional policy through established links with governmental bodies, as well as collaborations relating to the National Policy Statement on the Bioeconomy in relation to nutrients.

The PLATFORM interacts with the wider international consortium of regional platforms operating in accordance with, and as a member of the EUROPEAN SUSTAINABLE PHOSPHORUS PLATFORM (<https://phosphorusplatform.eu/>). The PLATFORM works collaboratively with the United States SUSTAINABLE PHOSPHORUS ALLIANCE (<https://phosphorusalliance.org/>).

Objectives of the PLATFORM include but are not limited to:

- Promote and support sustainable nutrient management across the island of Ireland;
- Support for the creation and development of new business opportunities, value chains and income streams;
- A 'safe-space' for stakeholders to interact with regulators to discuss policy, challenges, solutions and technological innovations;
- Access to an established network of national and international technology providers, cognate sustainability initiatives, governmental bodies, and EU agencies;
- Networking and knowledge exchange with diverse stakeholders from across the nutrient value chain both nationally and internationally;
- Corporate visibility and advocacy in the waste recycling and valorisation sectors;
- Recognition as a leader in sustainability through stakeholder organisation logo placement and promotion on the PLATFORM website (www.nutrientsustainability.ie) and at PLATFORM events;
- Brand association with respect to national and regional policy, environmental stewardship and the UN SDGs on the island of Ireland;
- Access to grant funding opportunities, networks and infrastructure to build collaborative research programmes with academic and technical centres of excellence.

The PLATFORM is a not-for-profit organisation and will carry out or participate in commercial activities only in so far as these further the PLATFORM's objectives. Furthermore, the PLATFORM may promote its stakeholder MEMBERS's commercial activities, services and products in so far as these are coherent with the PLATFORM's objectives.

In pursuing the activities of the PLATFORM, the stakeholder MEMBERS do not seek to directly obtain financial or research advantage for themselves, nor shall it be the objective of the PLATFORM to directly procure financial advantage for the MEMBERS.

NUTRIENTS AS A SDG CHALLENGE

Valorisation of nutrient-rich waste streams, in tandem with maintaining ecosystem service delivery, is embedded across a number of the SDGs and their cognate targets. The PLATFORM specifically aligns to the delivery of the following SDGs with regard to nutrient management:

- Goal 2, **Zero Hunger** – by 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, and help maintain ecosystems;
- Goal 6, **Clean Water and Sanitation** – by 2030, improve water quality by reducing pollution, protect and restore water-related ecosystems, and support and strengthen local communities in improving water quality;

- Goal 8, **Economic Growth** – improve progressively, through 2030, global resource efficiency in consumption and production and endeavour to decouple economic growth from environmental degradation;
- Goal 9, **Industry, Innovation and Infrastructure** – by 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes;
- Goal 12, **Responsible Consumption and Production** – by 2030 ensure sustainable consumption and production patterns, achieve the sustainable management and efficient use of natural resources, achieve environmentally sound management of all wastes throughout their life cycle, substantially reduce waste generation through prevention, reduction, recycling and reuse, and encourage companies to adopt sustainable practices; and
- Goal 15, **Life on Land** – by 2030, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services.

PLATFORM DURATION

The PLATFORM has been created for a duration of two (2) years initially, subject to the annual BUSINESS PLAN, which will be reviewed at the ANNUAL GENERAL MEETING.

PLATFORM MEMBERSHIP AND PARTICIPATION

The PLATFORM is open to all stakeholder organisations that support the PLATFORM vision through membership fee or other participatory payments.

Information will be disseminated to STAKEHOLDER MEMBERS by email, e-newsletter and via the members only page on the PLATFORM website www.nutrientsustainability.ie

Participation in the PLATFORM shall take effect upon signing the MEMBERSHIP AGREEMENT or RESEARCH PROJECT ASSOCIATE MEMBERSHIP AGREEMENT and shall continue for the duration of their membership fee or the project funding period.

GOVERNANCE

The PLATFORM will consist of:

- PLATFORM MEMBERS;
- STAKEHOLDER ADVISORY COMMITTEE;
- SCIENTIFIC AND TECHNICAL ADVISORY COMMITTEE; and
- PLATFORM MANAGEMENT COMMITTEE as depicted in Fig. 2.

PLATFORM MANAGEMENT COMMITTEE

The MANAGEMENT COMMITTEE will have a maximum of 15 members and shall initially comprise the following:

- a) A Chairperson;
- b) Platform Directors;
- c) Platform Manager;
- d) Chair of the Stakeholder Advisory Committee;

- e) Chair of the Scientific and Technical Advisory Committee;
- f) Government Department Representatives (Republic of Ireland and Northern Ireland);
- g) Farming Representatives (Republic of Ireland and Northern Ireland);
- h) QUB University Representative;
- i) NUIG University Representative;
- j) Additional co-opted Members as nominated by the Stakeholder and Scientific and Technical Advisory Committees.

PLATFORM CHAIRPERSON

The Chairperson shall be a person independent of the PLATFORM membership and will be able to demonstrate their ability to act independently, as appointed by the PLATFORM MANAGEMENT COMMITTEE.

If the Chairperson or any person connected with the Chairperson becomes associated with any PLATFORM MEMBER, the Chairperson shall within five (5) Business Days of becoming aware of such association notify the MANAGEMENT COMMITTEE in writing and the MANAGEMENT COMMITTEE shall consider whether such association of the Chairperson is sufficiently serious to require the Chairperson to resign. If the MANAGEMENT COMMITTEE pass a resolution, by a simple majority, to the effect that (i) it considers that the Chairperson has ceased to be independent of the membership (whether by virtue of any association notified to the MANAGEMENT COMMITTEE under the foregoing provisions of this paragraph or otherwise) and (ii) that the Chairperson should immediately resign from their position as Chairperson. The Chairperson may not vote on any such resolution.

The Chairperson shall be appointed for a term of two (2) years initially, at the end of which term they may be re-appointed.

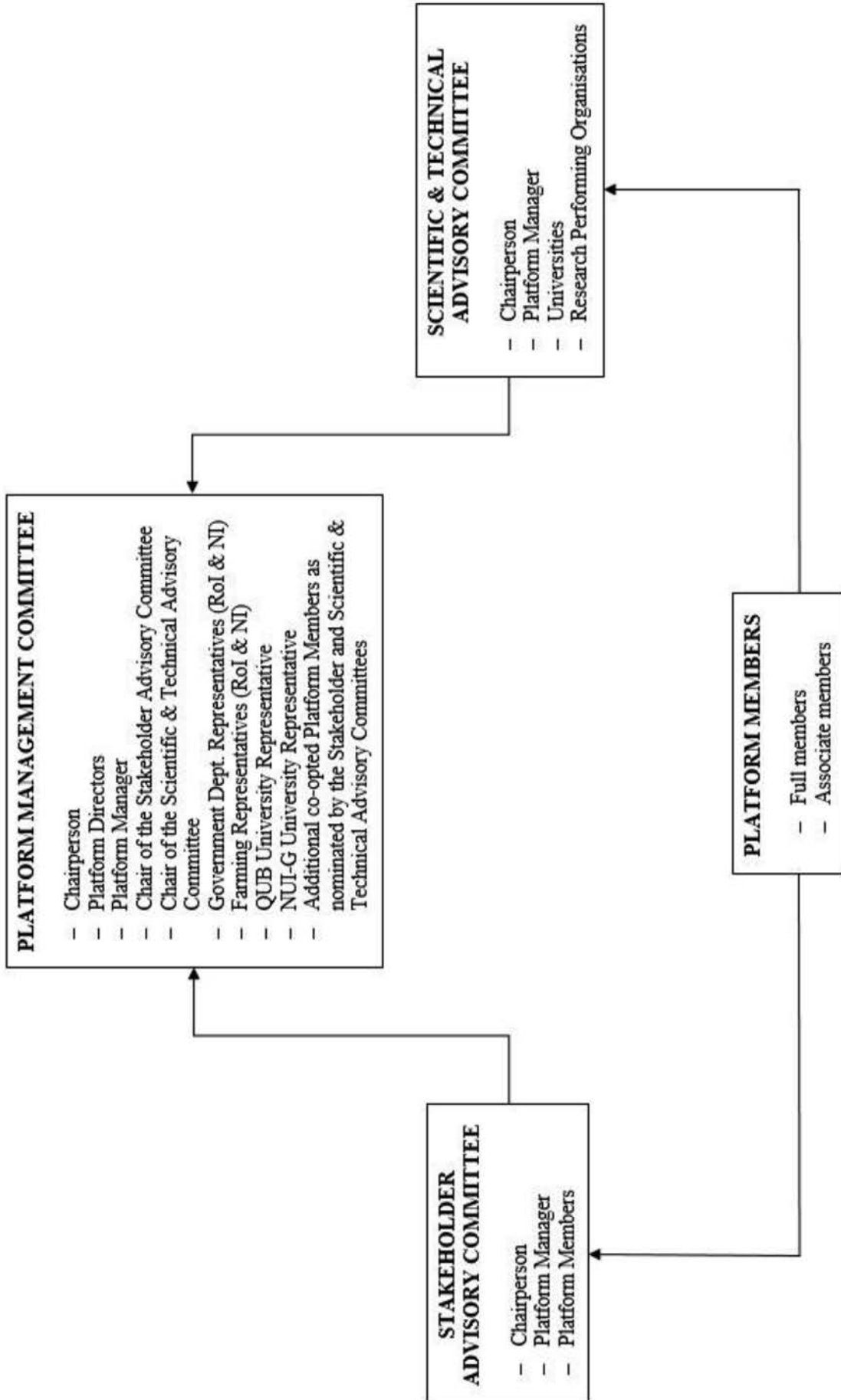


Figure 2. Organisational structure of the IRISH NUTRIENT SUSTAINABILITY PLATFORM

Activities of the PLATFORM MANAGEMENT COMMITTEE

The MANAGEMENT COMMITTEE will inform the strategic direction of the PLATFORM in line with the STAKEHOLDER and SCIENTIFIC AND TECHNICAL ADVISORY COMMITTEES and undertake the following main functions:

- a) Oversee the development of the PLATFORM operational strategy;
- b) Ratify key stakeholder-led nutrient priority areas and projects; and
- c) Monitor the outputs of the PLATFORM to ensure that these align with business plan objectives, stakeholder targets and key performance indicators.

Specifically, the MANAGEMENT COMMITTEE will:

- a) Implement the outcomes of the ANNUAL GENERAL MEETING;
- b) Ratify priority areas, review and report to MEMBERS at the PLATFORM ANNUAL GENERAL MEETING;
- c) Approve and monitor the BUSINESS PLAN and Budget;
- d) Monitor progress against annual key performance indicators;
- e) Oversee the role of the PLATFORM MANAGER;
- f) Provide relevant advice and guidance to the PLATFORM MANAGER;
- g) Liaise with the STAKEHOLDER and SCIENTIFIC AND TECHNICAL ADVISORY COMMITTEES
- h) Approve annual reports;
- i) Use influence and authority to assist the PLATFORM in achieving its outcomes;
- j) Champion the PLATFORM public image and brand;
- k) Identify potential conflicts of interest (particularly in relation to IP);
- l) In respect of jointly owned PLATFORM IP, finally determine all matters of ownership and management;
- m) Review post-project evaluations; and
- n) Appoint a Chairperson.

Meetings of the PLATFORM MANAGEMENT COMMITTEE

Any representative of the PLATFORM who is a member of the MANAGEMENT COMMITTEE or the Chairperson may call a meeting of the MANAGEMENT COMMITTEE. A minimum of fourteen (14) working days' notice of a meeting shall be given to all Management Committee Members. Members of the MANAGEMENT COMMITTEE may send proxies to attend MANAGEMENT COMMITTEE meetings when they are unable to attend themselves. Proxies are entitled to participate in discussion and to vote.

Meetings of the MANAGEMENT COMMITTEE will be held annually, and unless otherwise informed, meetings will take place at either NUIG or QUB or any place that the MANAGEMENT COMMITTEE chooses on the island of Ireland. The MANAGEMENT COMMITTEE are called by the Chairperson, electronically, with the agenda, at least one (1) full week in advance of the date of the meeting. The MANAGEMENT COMMITTEE Meeting may take place either as a physical meeting or electronically (via telephone meeting, video conference...).

The quorum for meetings of the MANAGEMENT COMMITTEE will be seven (7) to include a majority of MEMBERS. The Chairperson, or if absent another member chosen by the MANAGEMENT COMMITTEE, shall chair the meeting.

The MANAGEMENT COMMITTEE will endeavour to make decisions by consensus. In the event that a vote is required each MANAGEMENT COMMITTEE member will be entitled to cast one vote and decisions will be made by a majority vote. Such vote can take place electronically. In the event of a tied vote the Chairperson may exercise a casting vote except in matters relating to disputes of jointly owned PLATFORM IP. When voting, any member of the MANAGEMENT COMMITTEE must declare any interest.

Meetings of the STAKEHOLDER ADVISORY COMMITTEE

A representative from each full PLATFORM MEMBER will sit on the STAKEHOLDER ADVISORY COMMITTEE and represent the interests of their organisation within the PLATFORM. The STAKEHOLDER ADVISORY COMMITTEE will meet at least twice a year and make recommendations on proposed and on-going nutrient priority areas, projects, policy, and operational activities of the PLATFORM.

The PLATFORM MANAGER will sit on the STAKEHOLDER ADVISORY COMMITTEE.

A CHAIR of the STAKEHOLDER ADVISORY COMMITTEE will be elected by the STAKEHOLDER ADVISORY COMMITTEE to run the meetings and represent STAKEHOLDER ADVISORY COMMITTEE interests at meetings of the PLATFORM MANAGEMENT COMMITTEE. The CHAIR of the STAKEHOLDER ADVISORY COMMITTEE will be reviewed every two (2) years.

The STAKEHOLDER ADVISORY COMMITTEE will endeavour to make decisions by consensus. In the event that a vote is required each STAKEHOLDER ADVISORY COMMITTEE representative will be entitled to cast one vote per organisation and decisions will be made by a majority vote. Such vote can take place electronically. In the event of a tied vote the CHAIR of the STAKEHOLDER ADVISORY COMMITTEE may exercise a casting vote except in matters relating to disputes of jointly owned PLATFORM IP. When voting, any representative of the STAKEHOLDER ADVISORY COMMITTEE must declare any interest. Representatives of the STAKEHOLDER ADVISORY COMMITTEE may send proxies to attend STAKEHOLDER ADVISORY COMMITTEE meetings when they are unable to attend themselves. Proxies are entitled to participate in discussion and to vote.

Meetings of the SCIENTIFIC AND TECHNICAL ADVISORY COMMITTEE

A representative from each university or research performing organisation who is a full PLATFORM MEMBER will sit on the SCIENTIFIC AND TECHNICAL ADVISORY COMMITTEE. The SCIENTIFIC AND TECHNICAL ADVISORY COMMITTEE will meet at least once a year and provide scientific advice and feedback on proposed and on-going research priority areas, projects and operations of the PLATFORM.

A CHAIR of the SCIENTIFIC AND TECHNICAL ADVISORY COMMITTEE will be elected by the SCIENTIFIC AND TECHNICAL ADVISORY COMMITTEE to run the meetings and represent SCIENTIFIC AND TECHNICAL ADVISORY COMMITTEE interests at meetings of the PLATFORM MANAGEMENT COMMITTEE. The CHAIR of the SCIENTIFIC AND TECHNICAL ADVISORY COMMITTEE will be reviewed every two (2) years.

University or research performing organisation PLATFORM MEMBERS will commit to the inclusion of the IRISH NUTRIENT SUSTAINABILITY PLATFORM in all grant funding applications as a dissemination tool for research outputs and will budget where appropriate a % as permitted under the relevant funding terms and conditions of the grant made payable to the PLATFORM for dissemination. The PLATFORM MANAGER will assist in development of any dissemination strategy and budget for inclusion in grant funding applications. All project dissemination plans which involve the PLATFORM must be discussed with the PLATFORM MANAGER before submission of any project grant.

University or research performing organisation full MEMBERS will also commit to recruiting additional MEMBERS to the PLATFORM.

An annual membership fee of €6,000 will be applied to university or research performing organisation full PLATFORM MEMBERS who do not secure project dissemination monies for the PLATFORM via grant funding nor recruit any additional fee paying MEMBERS to the PLATFORM.

Already funded RESEARCH PROJECTS can participate in the PLATFORM as an associate member by paying 2.5% of the total grant value to the PLATFORM for participation and output dissemination and signing the RESEARCH PROJECT ASSOCIATE MEMBERSHIP AGREEMENT.

The PLATFORM MANAGER

The PLATFORM MANAGER will be hosted at either NUIG or QUB and will work in close collaboration with the PLATFORM MEMBERS. The PLATFORM MANAGEMENT COMMITTEE delegates the day-to-day management of the PLATFORM to the PLATFORM DIRECTORS and PLATFORM MANAGER.

The role of the PLATFORM MANAGER is to manage and supervise the PLATFORM on a daily basis, prepare information for consideration at the MANAGEMENT COMMITTEE, and a range of other duties as outlined below:

Management and Operations

- a) Manage and supervise the activities of PLATFORM on a daily basis, and be the first point of contact for MEMBERS in the PLATFORM;
- b) Produce on an annual basis, and submit to the MANAGEMENT COMMITTEE for approval, operational activities and key performance indicators;
- c) Review and monitor delivery of the operational activities and key performance indicators, and provide six monthly reports on performance to the PLATFORM MANAGEMENT COMMITTEE;

- d) Coordinate and prioritise the resources of the PLATFORM to meet the joint needs of the MEMBERS;
- e) Manage interaction with MEMBERS and to attract new Members.
- f) Promote the PLATFORM public image and brand;
- g) Attend relevant meetings both national and internationally as approved and/or required by the PLATFORM MANAGEMENT COMMITTEE;
- h) Respond to matters raised by the MANAGEMENT COMMITTEE on an ad hoc basis;
- i) Attend meetings of the PLATFORM MANAGEMENT COMMITTEE and the STAKEHOLDER and SCIENTIFIC AND TECHNICAL ADVISORY COMMITTEES, being a non-voting member in each case;
- j) Organise the PLATFORM ANNUAL GENERAL MEETING.

Finance

- a) To ensure that the financial elements of the operational activities and key performance indicators are robust and adequately monitored throughout the life of PLATFORM;
- b) To verify the Business Plan targets;
- c) To seek opportunities to secure the sustainability of the PLATFORM;
- d) To ensure that the PLATFORM is appropriately resourced throughout its lifetime, including access to additional leveraged funding from national and EU competitive funding programmes.

Research

- a) Oversee the delivery of annually agreed research projects (as approved at the PLATFORM ANNUAL GENERAL MEETING);
- b) Monitor and review project deliveries and should a MEMBER withdraw from any activity, seek a replacement or prepare alternative recommendations for consideration by the PLATFORM MANAGEMENT COMMITTEE;
- c) Seek both national and international partners for the PLATFORM and opportunities to create global collaborations.

ANNUAL GENERAL MEETING of the PLATFORM

The PLATFORM will organise an annual meeting of MEMBERS to define the following year's operational activities and key performance indicators, budget and membership fees, and approve the legal accounts. The PLATFORM MANAGEMENT COMMITTEE for the following year will also be reviewed and approved.

The chair of the STAKEHOLDER and SCIENTIFIC AND TECHNICAL ADVISORY COMMITTEES will report on activities at the ANNUAL GENERAL MEETING.

All MEMBERS can only validly be represented by one individual, which can be appointed for each meeting of the ANNUAL GENERAL MEETING, by the MEMBER, but must be a legal representative or hold an appropriate mandate.

Each stakeholder MEMBER shall bear its own personnel, travel and other costs related to its attendance at the ANNUAL GENERAL MEETING.

The ANNUAL GENERAL MEETING is chaired by the PLATFORM MANAGEMENT COMMITTEE CHAIRPERSON. It can be held in any place selected, for the next time, by the ANNUAL GENERAL MEETING or by the MANAGEMENT COMMITTEE.

The ANNUAL GENERAL MEETING is empowered to:

- a) Change the objective(s) or decide to dissolve the PLATFORM;
- b) Elect and revoke some or all of the PLATFORM MEMBERS of the MANAGEMENT COMMITTEE;
- c) Approve annually the budget and accounts proposed by the MANAGEMENT COMMITTEE;
- d) Approve annual operational activities and key performance indicators proposed by the MANAGEMENT COMMITTEE;
- e) Set the annual membership fee and its terms of payment;
- f) Appoint auditor(s).

MEMBERS are called to the ANNUAL GENERAL MEETING by the chair of the PLATFORM MANAGEMENT COMMITTEE. The call will contain the agenda and is addressed to all stakeholder MEMBERS electronically at least four (4) weeks in advance of the date of the meeting. The ANNUAL GENERAL MEETING may take place either as a physical meeting or electronically (via telephone meeting, video conference...).

The decision of the ANNUAL GENERAL MEETING are recorded by the PLATFORM MANAGER in the form of minutes of the meetings. These are distributed to all PLATFORM MEMBERS and the MANAGEMENT COMMITTEE for approval, then jointly signed by the PLATFORM DIRECTORS. The minutes will be kept by the PLATFORM MANAGER. All PLATFORM MEMBERS may on request receive a copy of the minutes.

PLATFORM Membership will be reviewed annually at the PLATFORM ANNUAL GENERAL MEETING.

The first ANNUAL GENERAL MEETING of the PLATFORM will be held in early December 2020 and annually thereafter.

BUDGETS AND PLANS

The future requirements of the MEMBERS will be a key driver in determining the activities of the PLATFORM (as decided at the PLATFORM ANNUAL GENERAL MEETING).

On an annual basis the PLATFORM MANAGER shall update the ACTION PLAN which shall include planned activities and budgets, and submit it to the PLATFORM MANAGEMENT COMMITTEE for approval and recommendation, and ratification at the ANNUAL GENERAL MEETING.

FINANCIAL ADMINISTRATION

Resources and Assets

The resources of the PLATFORM forming its assets for non-profit-making purposes are composed of:

- a) Annual membership fees and/or associate membership fees paid by MEMBERS;

- b) Fees for services provided by the PLATFORM;
- c) Incomes from sales/licence of products or contributions for project development by the PLATFORM for its MEMBERS and/or any third party;
- d) Grant, donations, external funding or "in-kind" contributions to the PLATFORM from any third party;
- e) Any other source of income authorised by law.

Application for Membership and Fees Structure

Any eligible stakeholder organisation wishing to become a MEMBER of the PLATFORM must address the PLATFORM by email requesting to become a MEMBER.

Members will be required to sign a MEMBERSHIP AGREEMENT (Appendix 1). Associate Members will be required to sign a RESEARCH PROJECT ASSOCIATE MEMBERSHIP AGREEMENT (Appendix 2).

Full MEMBERS of the PLATFORM will participate in decision making (voting rights at the ANNUAL GENERAL MEETING and via the STAKEHOLDER and SCIENTIFIC AND TECHNICAL ADVISORY COMMITTEES) and pay the annual membership fee. In certain circumstances MEMBERS can, with agreement of the MANAGEMENT COMMITTEE, make an equivalent or "in kind" payment to the PLATFORM in lieu of fees, such arrangements will be reviewed on an annual basis.

NUIG and QUB shall be responsible for co-ordinating annual membership fees in accordance with the following pricing structure:

€6,000* – Large stakeholder organisations (greater than 250 employees and either a turnover of over €50 million or a balance sheet total of over €43 million);

€3,000* – Medium-sized stakeholder organisations (fewer than 250 employees and either a turnover of up to €50 million or a balance sheet total of up to €43 million);

€1,500* – Small stakeholder organisations (fewer than 50 employees and either a turnover of up to €10 million or a balance sheet total of up to €10 million).

Funded research projects can participate in the PLATFORM as an ASSOCIATE MEMBER (no voting rights) by paying 2.5% of the total grant value to the PLATFORM for participation and dissemination.

[*Membership fees paid in £STG will be calculated based on the exchange rate as of 1st January each year using www.oanda.com.]

Fees will only be collected when there is sufficient critical mass of committed fee paying MEMBERS to ensure financial sustainability of the PLATFORM each year. Fees will be collected on the 1st September 2020.

Thereafter new membership fees will be collected on an annual basis from the date of signing the MEMBERSHIP AGREEMENT. Financial sustainability of the PLATFORM will be reviewed annually at the ANNUAL GENERAL MEETING. Fees are in no case reimbursable, neither totally nor partly.

Residence of Membership Fees

All fee payment from MEMBERS will be made to QUB.

Joint consent of NUIG and QUB is required to transact any funds or assets pertaining to the PLATFORM in line with MANAGEMENT COMMITTEE approved action plan for the period in question.

Fees and other sources of revenue will be used to pay the salary of the PLATFORM MANAGER, to execute platform activities and events, associated travel and fund research projects, as per the PLATFORM business and action plan.

Termination of Membership

MEMBERS may leave the PLATFORM at any time by informing the PLATFORM MANAGER in writing, on paper or by email. Resignation shall be effective by giving the PLATFORM MANAGER 90 days' written notice prior to the termination date. However, membership fees remain due for the financial year in progress.

DURATION AND TERMINATION OF THE PLATFORM

The TERMS OF REFERENCE shall commence on the Effective Date (1st September 2020) and shall continue in force until terminated.

If in the opinion of the MANAGEMENT COMMITTEE the PLATFORM is no longer operationally viable in accordance with the Business Plan, the MANAGEMENT COMMITTEE will endeavour to give as much notice as possible and in any event at least one (1) year's notice of its intention to cease operating the PLATFORM. The Terms of Reference and Membership Agreement shall terminate on the end date set out in the notice. For the avoidance of doubt, no decision on cessation of PLATFORM shall be considered during the first year of its operation.

7 Bioactive Anaerobic Digestion Filter Process for Phosphorus Recovery: Case Studies for Industrial and Municipal Wastewaters

7.1 Background and Context

Wastewaters, such as sewage and effluents produced by the dairy processing industry are amenable to high-rate anaerobic digestion (AD) wastewater treatment. AD provides efficient and cost-effective removal of pollutants, combined with the recovery of a usable fuel in the form of biogas (methane). Despite widespread full-scale applications, AD wastewater treatment is not an effective method to remove or recover inorganic nutrients, in particular phosphate (P). This means that aerobic biological or chemical post-treatment of AD effluents is required to meet discharge standards (McGrath and Quinn, 2003; Caravelli *et al.*, 2012; Hauduc *et al.*, 2015). A second drawback is that AD wastewater treatment systems must generally be heated to ensure optimal activity, which is a barrier to the treatment of dilute wastewaters where the volumetric biogas yield is low (Smith *et al.*, 2012). The recent development of low-temperature AD has overcome this latter barrier and allows for the economically efficient application of AD to low-strength wastewaters in temperate regions (Keating *et al.*, 2016, 2018).

The potential for efficient removal and recovery of P during AD of dilute wastewaters was significantly advanced by Hughes *et al.* (2011) using a novel hybrid bioreactor system incorporating a fixed-film section based on a pumice stone matrix. The biological nature of P removal during such AD wastewater treatment, through the formation of polyphosphate (polyP), was reported by the project team and collaborators in a groundbreaking paper (Keating *et al.*, 2016).

The aim of this technology case study was to demonstrate this approach to potential end-user stakeholders, and to show that high levels of biologically mediated P removal during AD would be achievable during low-temperature, high-rate, treatment of dairy processing wastewater and sewage at low-ambient temperatures, (1) at loading rates of 1–5 kg total chemical oxygen demand (COD) m⁻³ day⁻¹

and (2) while producing an effluent quality of <125 mg total COD l⁻¹.

The research methodology was based on:

- laboratory- and pilot-scale trials of effluents from various product streams;
- detailed process optimisation research;
- detailed biological analysis to assess long-term stability and robustness.

During the project, over 250 days of continuous bioreactor process data were generated.

7.2 Process Performance during Treatment of Dairy Processing Wastewater

7.2.1 Laboratory-scale treatment of dairy processing wastewater

The technical aim of the laboratory-scale trials was to establish operating parameters for the pilot-scale treatment trials based on real industry effluents, in a controlled and replicated manner. P removal from the wastewater, well in excess of microbial growth requirements (1.5–2% of biomass dry weight), was observed (Table 7.1). The efficiency of P removal on start-up (by day 44) was approximately 40%, but it increased significantly during phase I, with values of >60% being consistently achieved, and removal >70% being achieved during phase V, when the highest loading rates were applied (Table 7.1).

In addition to significant P removal, the bioreactors demonstrated efficient and stable process performance throughout continuous operation at 15°C, with soluble COD (COD_{Sol}) removal efficiency generally above 80% (Table 7.1). COD_{Sol} removal efficiency was stable and efficient throughout all phases of the trial. Total COD (COD_{Tot}) and COD_{Sol} removal efficiency values exceeded those reported in other low-temperature AD trials and were comparable to

Table 7.1. Reactor operation phases, associated operational conditions and mean performance for treatment of dairy processing wastewater

Operational conditions	Phase (days)					
	Start up (1–44)	I (45–57)	II (58–79)	III (80–111)	IV (112–132)	V (133–185)
Hydraulic retention time (h)	36	36	24	18	12	8
Temperature (°C)	18	18	18	18	18	18
Up-flow velocity (m h ⁻¹)	2.5	2.5	2.5	2.5	2.5	2.5
COD _{Tot} removal efficiency (%)	60	56	68	60	57	59
COD _{Sol} removal efficiency (%)	78	85	86	90	90	85
P removal efficiency (%)	41	66	69	68	65	73

results observed in an anaerobic membrane bioreactor treating domestic wastewater (Smith *et al.*, 2012).

7.2.2 Pilot-scale treatment of dairy processing wastewater

Pilot-scale trials were then undertaken to showcase the scalability of the novel P removal process, under real-world conditions. A 1.3 m³ NUIG AD pilot plant was installed at an industry wastewater treatment plant site where it treated a combined wastewater stream, with a line sourced from a large balancing tank.

The mean wastewater characteristics were 3250 mg l⁻¹ COD_{Tot}; 1633 mg l⁻¹ COD_{Sol}; pH 6.5; 8–18°C; P 47 mg l⁻¹. During the pilot trial, the hydraulic retention time (HRT) applied to the reactor was reduced from 24 h to the operational target of 6 h (4 × reactor volumes fed per day).

The overall performance of the trial is summarised in Table 7.2. COD_{Sol} removal of >60% and P removal of 40–50% was achieved during phases III–V at operationally relevant HRTs and organic loading rates. Analysis of the biomass sampled from the bioreactor

confirmed that the basis for P removal was identical to that in the laboratory-scale bioreactors – i.e. biological polyP accumulation.

The data obtained from the pilot-scale site trials demonstrated that COD_{Sol} removal rates of 69–79% and P removal rates of 40–55% were achievable and that this level of performance could be sustained despite fluctuating ambient temperatures, loading rates and occasional spikes in organic loading.

7.2.3 Pilot-scale treatment of municipal wastewater

To showcase the potential for the technology to be applied to the treatment of municipal wastewaters, the NUIG AD pilot plant was employed to carry out a trial on wastewater, sourced from the Mutton Island treatment plant in Galway city, for 135 days. The outcome of this trial is summarised in Table 7.3. In general, a degree of P removal could be achieved under real-world conditions from more dilute wastewaters similar to that recorded with more concentrated industrial effluents.

Table 7.2. Pilot reactor operation phases, associated operational conditions and mean performance for dairy processing wastewater treatment

Operational conditions	Phase (days)				
	I (1–13)	II (14–41)	III (42–55)	IV (56–70)	V (71–93)
HRT (h)	24	24	12	8	6
COD _{Tot} removal efficiency (%)	53	56	55	57	50
COD _{Sol} removal efficiency (%)	78	79	74	70	69
Influent total P (mg l ⁻¹)	53	46	57	53	45
Effluent total P (mg l ⁻¹)	24	21	27	30	26
Total P removal efficiency (%)	55	54	52	43	40

Table 7.3. Operational conditions and performance characteristics of pilot-scale AD-P removal from municipal wastewater

Operational conditions	Phase (days)				
	I (1–25)	II (26–41)	III (42–57)	IV (58–71)	V (72–135)
HRT (h)	18	16	12	8	6
Influent COD _{Tot} (mg l ⁻¹)	483±102	482±74	462±111	468±82	377±103
Effluent COD _{Tot} (mg l ⁻¹)	246±53	282±69	249±85	222±57	239±68
Total suspended solids (mg l ⁻¹)	83±54	90±42	75±51	98±47	101±66
Influent total P (mg l ⁻¹)	20±4	16±2	18±3	13±4	15±4
Effluent total P (mg l ⁻¹)	11±4	9±3	9±2	5±2	6±3
Total P removal efficiency (%)	45	44	50	61	60

7.3 Technical Outcomes and Next Steps

A potentially important new method for the sequestration of phosphorus using luxury polyP uptake under anaerobic conditions was demonstrated at technology readiness level (TRL) 6. We have shown that the process is scalable and that it can be deployed at pilot scale in real-world industrial and wastewater plant settings to treat both concentrated and more dilute streams.

There are three targets that require optimisation before technology transfer, or application of the novel process at full scale, can be considered.

There is a need to improve the extent of P removal during long-term wastewater treatment to levels mirroring our results using the bioactive filter at laboratory scale (70–80% recovery efficiency).

The applicable loading rates and HRTs where high levels of P removal were recorded at pilot scale in this study may still be too low to enable economically

attractive scale-up (required HRT < 12 h; organic loading rates > 6 kg COD m⁻³ day⁻¹).

The integration of a polishing technology to ensure that the P levels are reduced to discharge standards (<0.5 mg P l⁻¹, and ideally <0.2 mg l⁻¹, to provide a competitive advantage with respect to performance, as well as cost and recoverability, with other P-removal technologies) and to de-risk the system against any biological perturbations, should be demonstrated at pilot scale. Research efforts designed to optimise the bioreactor configuration – with and without the addition of polisher technology – and to increase the applicable loading rates will bring the technology from TRL 6 to TRL 8 and further towards implementation as a full-scale technological solution. In addition, although recovery of P from enhanced biological phosphorus removal (EBPR) sludges is a well-established method, the ease of recovery of P from biofilms within the bioactive filter should also be demonstrated.

This is work that it is hoped the INSP will now progress in collaboration with relevant member stakeholders, who have expressed strong interest based on this research case study.

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Abbreviations

AD	Anaerobic digestion
COD	Chemical oxygen demand
COD_{Sol}	Soluble chemical oxygen demand
COD_{Tot}	Total chemical oxygen demand
DAFM	Department of Agriculture, Food and the Marine
ESPP	European Sustainable Phosphorus Platform
HRT	Hydraulic retention time
INSP	Irish Nutrient Sustainability Platform
NUIG	National University of Ireland Galway
QUB	Queen's University Belfast
RPO	Research performing organisation
SDG	Sustainable Development Goal
TRL	Technology readiness level
UN	United Nations

AN GHNÍOMHAIREACTH UM CHAOMHNÚ COMHSHAOIL

Tá an Gníomhaireacht um Chaomhnú Comhshaoil (GCC) freagrach as an gcomhshaoil a chaomhnú agus a fheabhsú mar shócmhainn luachmhar do mhuintir na hÉireann. Táimid tiomanta do dhaoine agus don chomhshaoil a chosaint ó éifeachtaí díobhálacha na radaíochta agus an truaillithe.

Is féidir obair na Gníomhaireachta a roinnt ina trí phríomhréimse:

Rialú: Déanaimid córais éifeachtacha rialaithe agus comhlionta comhshaoil a chur i bhfeidhm chun torthaí maithe comhshaoil a sholáthar agus chun díriú orthu siúd nach gcloíonn leis na córais sin.

Eolas: Soláthraimid sonraí, faisnéis agus measúnú comhshaoil atá ar ardchaighdeán, spriocdhírthe agus tráthúil chun bonn eolais a chur faoin gcinnteoireacht ar gach leibhéal.

Tacaíocht: Bimid ag saothrú i gcomhar le grúpaí eile chun tacú le comhshaoil atá glan, táirgiúil agus cosanta go maith, agus le hiompar a chuirfidh le comhshaoil inbhuanaithe.

Ár bhFreagrachtaí

Ceadúnú

Déanaimid na gníomhaíochtaí seo a leanas a rialú ionas nach ndéanann siad dochar do shláinte an phobail ná don chomhshaoil:

- saoráidí dramhaíola (*m.sh. láithreáin líonta talún, loisceoirí, stáisiúin aistriúcháin dramhaíola*);
- gníomhaíochtaí tionsclaíocha ar scála mór (*m.sh. déantúsaíocht cógaisíochta, déantúsaíocht stroighne, stáisiúin chumhachta*);
- an diantalmhaíocht (*m.sh. muca, éanlaith*);
- úsáid shrianta agus scaoileadh rialaithe Orgánach Géinmhodhnaithe (*OGM*);
- foinsí radaíochta ianúcháin (*m.sh. trealamh x-gha agus radaiteiripe, foinsí tionsclaíocha*);
- áiseanna móra stórála peitрил;
- scardadh dramhuisece;
- gníomhaíochtaí dumpála ar farraige.

Forfheidhmiú Náisiúnta i leith Cúrsaí Comhshaoil

- Clár náisiúnta iniúchtaí agus cigireachtaí a dhéanamh gach bliain ar shaoráidí a bhfuil ceadúnas ón nGníomhaireacht acu.
- Maoirseacht a dhéanamh ar fhreagrachtaí cosanta comhshaoil na n-údarás áitiúil.
- Caighdeán an uisce óil, arna sholáthar ag soláthraithe uisce phoiblí, a mhaoirsiú.
- Obair le húdarás áitiúla agus le gníomhaireachtaí eile chun dul i ngleic le coireanna comhshaoil trí chomhordú a dhéanamh ar líonra forfheidhmiúcháin náisiúnta, trí dhírú ar chiontóirí, agus trí mhaoirsiú a dhéanamh ar leasúchán.
- Cur i bhfeidhm rialachán ar nós na Rialachán um Dhramhthrealamh Leictreach agus Leictreonach (DTLL), um Shrian ar Shubstaintí Guaiseacha agus na Rialachán um rialú ar shubstaintí a ídionn an ciseal ózóin.
- An dlí a chur orthu siúd a bhriseann dlí an chomhshaoil agus a dhéanann dochar don chomhshaoil.

Bainistíocht Uisce

- Monatóireacht agus tuairisciú a dhéanamh ar cháilíocht aibhneacha, lochanna, uisce idirchriosacha agus cósta na hÉireann, agus screamhuisecí; leibhéal uisce agus sruthanna aibhneacha a thomhas.
- Comhordú náisiúnta agus maoirsiú a dhéanamh ar an gCreat-Treoir Uisce.
- Monatóireacht agus tuairisciú a dhéanamh ar Cháilíocht an Uisce Snámha.

Monatóireacht, Anailís agus Tuairisciú ar an gComhshaoil

- Monatóireacht a dhéanamh ar cháilíocht an aeir agus Treoir an AE maidir le hAer Glan don Eoraip (CAFÉ) a chur chun feidhme.
- Tuairisciú neamhspleách le cabhrú le cinnteoireacht an rialtais náisiúnta agus na n-údarás áitiúil (*m.sh. tuairisciú tréimhsiúil ar staid Chomhshaoil na hÉireann agus Tuarascálacha ar Tháscairí*).

Rialú Astaíochtaí na nGás Ceaptha Teasa in Éirinn

- Fardail agus réamh-mheastacháin na hÉireann maidir le gáis ceaptha teasa a ullmhú.
- An Treoir maidir le Trádáil Astaíochtaí a chur chun feidhme i gcomhar breis agus 100 de na táirgeoirí dé-ocsaíde carbóin is mó in Éirinn.

Taighde agus Forbairt Comhshaoil

- Taighde comhshaoil a chistiú chun brúnna a shainiú, bonn eolais a chur faoi bheartais, agus réitigh a sholáthar i réimsí na haeráide, an uisce agus na hinbhuanaitheachta.

Measúnacht Straitéiseach Timpeallachta

- Measúnacht a dhéanamh ar thionchar pleananna agus clár beartaithe ar an gcomhshaoil in Éirinn (*m.sh. mórfheananna forbartha*).

Cosaint Raideolaíoch

- Monatóireacht a dhéanamh ar leibhéal radaíochta, measúnacht a dhéanamh ar nochtadh mhuintir na hÉireann don radaíocht ianúcháin.
- Cabhrú le pleananna náisiúnta a fhorbairt le haghaidh éigeandálaí ag eascairt as tairmí núicléacha.
- Monatóireacht a dhéanamh ar fhorbairtí thar lear a bhaineann le saoráidí núicléacha agus leis an tsábháilteacht raideolaíochta.
- Sainseirbhísí cosanta ar an radaíocht a sholáthar, nó maoirsiú a dhéanamh ar sholáthar na seirbhísí sin.

Treoir, Faisnéis Inrochtana agus Oideachas

- Comhairle agus treoir a chur ar fáil d'earnáil na tionsclaíochta agus don phobal maidir le hábhair a bhaineann le caomhnú an chomhshaoil agus leis an gcosaint raideolaíoch.
- Faisnéis thráthúil ar an gcomhshaoil ar a bhfuil fáil éasca a chur ar fáil chun rannpháirtíocht an phobail a spreagadh sa chinnteoireacht i ndáil leis an gcomhshaoil (*m.sh. Timpeall an Tí, léarscáileanna radóin*).
- Comhairle a chur ar fáil don Rialtas maidir le hábhair a bhaineann leis an tsábháilteacht raideolaíoch agus le cúrsaí práinnfhreagartha.
- Plean Náisiúnta Bainistíochta Dramhaíola Guaisí a fhorbairt chun dramhaíl ghuaiseach a chosaint agus a bhainistiú.

Múscaill Feasachta agus Athrú Iompraíochta

- Feasacht chomhshaoil níos fearr a ghiniúint agus dul i bhfeidhm ar athrú iompraíochta dearfach trí thacú le gnóthais, le pobail agus le teaghlaigh a bheith níos éifeachtúla ar acmhainní.
- Tástáil le haghaidh radóin a chur chun cinn i dtithe agus in ionaid oibre, agus gníomhartha leasúcháin a spreagadh nuair is gá.

Bainistíocht agus struchtúr na Gníomhaireachta um Chaomhnú Comhshaoil

Tá an ghníomhaíocht á bainistiú ag Bord Iáinimseartha, ar a bhfuil Ard-Stiúrthóir agus cúigear Stiúrthóirí. Déantar an obair ar fud cúig cinn d'Oifigí:

- An Oifig um Inmharthanacht Comhshaoil
- An Oifig Forfheidhmithe i leith cúrsaí Comhshaoil
- An Oifig um Fianaise is Measúnú
- Oifig um Chosaint Radaíochta agus Monatóireachta Comhshaoil
- An Oifig Cumarsáide agus Seirbhísí Corparáideacha

Tá Coiste Comhairleach ag an nGníomhaireacht le cabhrú léi. Tá dáréag comhaltáí air agus tagann siad le chéile go rialta le plé a dhéanamh ar ábhair inní agus le comhairle a chur ar an mBord.

An Irish Nutrient Platform to Underpin Sustainable Development



Authors: Vincent O’Flaherty, John McGrath, Dermot Hughes, Juan Castilla Archilla, Jose Antonio Pícon, Andrew Bartle, Therese Mahony, Katrina Macintosh and Etain Doherty

The UN Agenda for Sustainable Development consists of 17 Sustainable Development Goals (SDGs), underpinned by 169 targets, which aim to “end poverty, protect the planet and ensure prosperity for all”. These SDGs are expected to frame national policy agendas over the next 15 years in the context of both domestic and international policy, with an overarching desire to link environmental sustainability to sustainable economic development and the recognition that the management and protection of the environment are vital to economic wellbeing and a healthy society.

Identifying Pressures

At an all-island level, the agri-food sector is integral to Ireland’s economy: intensification of this industry, in line with current national policies such as Food Harvest 2020 (Ireland) and Going for Growth (Northern Ireland), is essential to increase Irish economic prosperity. Yet a major challenge for this sector, both locally and globally, is to address the SDG targets while sustaining agricultural output to help feed a growing global population.

In the coming decades, the intensification of the Irish agri-food system will present the industry, and wider society, with the dual challenges of (1) elevated production, treatment and sustainable management of waste, and (2) increased competition for scarce natural nutrient resources. To this end, a transition towards sustainable primary production and processing systems that can produce more food – and other bio-based products – while meeting those UN SDG targets that mandate fewer inputs, less environmental impact, waste recycling and reduced greenhouse gas emissions is an imperative.

Informing Policy

The Irish Nutrient Sustainability Platform is a stakeholder-led initiative, which seeks to bring together a wide range of stakeholder members spanning the nutrient value chain. The platform seeks to align with the delivery of national and regional policy through established links with governmental bodies, as well as collaborations relating to the National Policy Statement on the Bioeconomy/Sustainable Development Goals Agenda in relation to nutrients.

Developing Solutions

The Irish Nutrient Sustainability Platform seeks to provide a “safe space” for stakeholders and regulators to interact and discuss policy, challenges, solutions and technological innovations openly with a view to gaining consensus on how the challenges of nutrient sustainability can be addressed. The platform encourages cooperation at all levels of the nutrient value chain through networking and knowledge exchange opportunities such as workshops, panel discussions, and webinars featuring international speakers and contributors.