Guidelines for Anaerobic Digestion in Ireland

cré
Composting & Anaerobic Digestion Association *of* Ireland

ACKNOWLEDGEMENTS

Authors

David McDonnell (Greengas AD Plant), Morgan Burke (Stream BioEnergy),
Jim Dowdall (Enviroguide Consulting), Percy Foster (Foster Environmental) & Karen Mahon.

Reviewer

Maurice Cremin

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PREFACE

Anaerobic digestion plants can play an important role in helping Ireland meet its waste and energy targets as set out in EU Directives and national legislation. Using industry experts knowledge and experience these guidelines are designed to give an overview of key regulations effecting the commissioning of an anaerobic digestion (AD) plant. They will help developers to avoid mistakes and expedite the process of developing AD plants across Ireland.

This guideline document is divided into four parts:

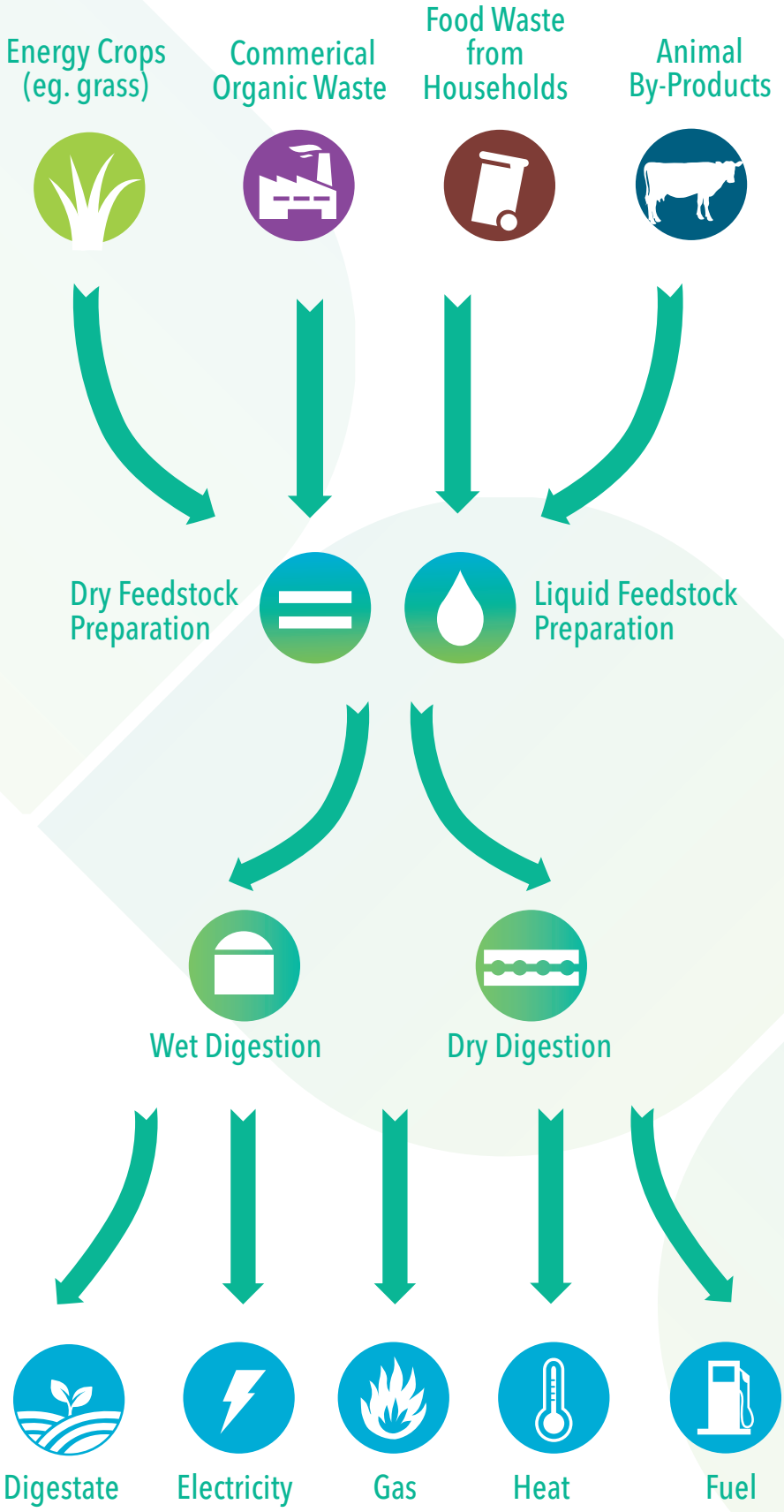
Part I: This section explains the anaerobic digestion process and its outputs. The various plant configurations and possible applications for anaerobic digestion are also discussed. EU and national Government policy influencing anaerobic digestion is described. The multiple cross-sectoral benefits of anaerobic digestion are investigated including energy, environmental, climate, waste and socio-economic benefits that may be delivered.

Part II: This section describes Health & Safety Legislation relating to AD plants. It also covers the identification of hazards and related mitigation measures from the construction phase through to the operation phase.

Part III: Compliance with Animal By-Product (ABP) Legislation is outlined in Part III. Topics covered include the background to ABP, a summary of existing national guidance documents and key recommendations for each step of the ABP validation process.

Part IV: An overview of waste permitting and licencing requirements in relation to anaerobic digestion is presented in this section, including the Environmental Protection Agency's requirements in relation to BAT and BREF, EIA, AA, Industrial Emissions Licences and the process for amending licences. A brief overview of financial provision (ELRA, CRAMP) is covered in this section.

Cré intends that these guidelines will provide a useful reference for planners, environmental officers, developers, farmers and consultants working in this field.


Energy Crops (eg. grass)
Commerical Organic Waste
Food Waste from Households
Animal By-Products
Dry Feedstock Preparation
Liquid Feedstock Preparation
Wet Digestion
Dry Digestion
Digestate
Electricity
Gas
Heat
Fuel

PART I
ANAEROBIC DIGESTION & GOVERNMENT POLICY

Anaerobic digestion (AD) is a sustainable form of renewable energy production through a naturally occurring biological process in which micro-organisms break down biodegradable material in the absence of oxygen in an enclosed system. The process produces a methane-rich biogas and a nutrient rich fertiliser known as 'digestate'. The biogas can be converted into renewable electricity for our homes and businesses or it can be upgraded to biomethane for use as a vehicle fuel or for injection directly into the gas network to provide a source of renewable heat.

Most organic material except wood can be used in the AD process. Feedstocks for biogas production include domestic and commercial municipal organic waste, industrial organics including waste from the food and beverage processing industry and sewage sludge from municipal wastewater treatment plants, energy crops (e.g. grass and maize silage), garden waste, organic residues and animal manures/slurries from the agricultural sector.

I. The Anaerobic Digestion Process & Plant Types

AD is a proven technology that extracts energy from organic materials in the form of biogas. It is the biological conversion of the organic fraction of waste to simple end-products. The process takes place in an airtight reactor vessel, with feedstock fed into the vessel and biogas and nutrient rich digestate taken out. Biogas is made up mostly of methane (about 60-65%), the main constituent of natural gas, and carbon dioxide (about 35-40%) with minor traces of other compounds such as hydrogen sulphide, hydrogen and ammonia.

A benefit of AD is that it allows both a mass and a volume reduction of the waste input as much of the organic matter in the process is converted to biogas, the rest is left as nutrient rich digestate with significantly reduced odour potential and increased nutrient availability.

AD encompasses a wide range of plant scales and applications for different types of feedstock and it is difficult to generalise about AD plants. The AD plant design, capital investment, operating costs and revenues as well as the level of regulation vary widely depending upon the location, scale and application of an AD plant.

Whilst it is not easy to categorise different types of AD plants, AD can be broadly separated into three main forms: on-farm AD, agri-food AD and industrial scale food waste AD.

On-farm systems are very common in Europe and typically process energy crops such as grass and maize silage as well as animal slurries. They normally range in scale from <100kWel to 500kWel systems and a standard on-farm AD plant includes feedstock reception facilities, digestion tanks, CHP unit, and end storage.

At the opposite end of the spectrum there are much larger industrial scale AD facilities designed to process primarily municipal, domestic and commercial organic waste. These are typically in the order of 3MWel to 6MWel or greater. Larger scale 'industrial' AD plants appear physically very different to smaller 'on-farm' systems. As well as having more and larger digestion tanks, these plants generally include a large processing building housing pre-treatment technologies to remove unwanted items from the feedstock and prepare it for digestion, pasteurisation modules, digestate dewatering and treatment, CHP and/or biogas upgrading plant, and odour control systems. All of these ancillary technologies and processes add significantly to the plant capital expenditure (capex) and operating expense (opex).

Photo 1 Industrial Scale Plant (Source Xergi)

Photo 2 On-Farm Scale Plant (Source T. Knitter)

Between these two categories there are the medium sized 'agri-food' type plants. These plants normally range from 1MWel to 2.5MWel and process a mixture of agricultural wastes and energy crops, as well as industrial sector organic wastes, typically from the food and beverage processing companies. Agri-food plants are physically very similar to large on-farm plants but with some degree of pre-treatment included.

Anaerobic Digestion Biochemistry

There are four key biological and chemical stages in AD: Hydrolysis, Acidogenesis, Acetogenesis and Methanogenesis (see Figure 1).

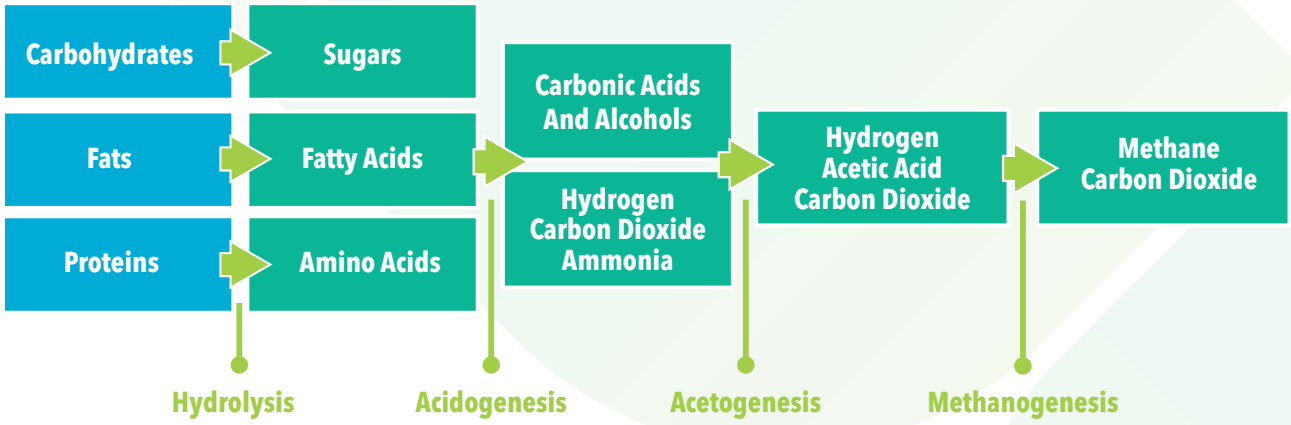


Figure 1: The 4 Stages of Anaerobic Digestion

In most cases, biomass is made up of large organic polymers. For the bacteria in anaerobic digesters to access the energy potential of the material, these chains must first be broken down into their smaller constituent parts. Through hydrolysis the complex organic molecules are broken down into simple sugars, amino acids, and fatty acids.

Acetate and hydrogen produced in the first stages can be used directly by methanogens. Other molecules such as volatile fatty acids (VFAs) with a chain length that is greater than acetate must first be catabolised into compounds that can be directly utilised by methanogens. The biological process of acidogenesis is where there is further breakdown of the remaining components by acidogenic (fermentative) bacteria.

The third stage of AD is acetogenesis. Here simple molecules created through the acidogenesis phase are further digested by acetogens to produce largely acetic acid as well as carbon dioxide and hydrogen.

The final stage of AD is the biological process of methanogenesis. Here methanogens utilise the intermediate products of the preceding stages and convert them into methane, carbon dioxide and water. It is these components that make up most of the biogas emitted from the system. The main parameters affecting the AD process include temperature, pH, dry matter, content organic loading rate and the retention time.

Anaerobic Digestion Process Configurations

There are several different process configurations around which AD systems may be designed. Factors to be considered when making design decisions include whether the process is 'batch' or 'continuous' feed, whether it is a 'dry' or 'wet' system, whether it is a 'single stage' or 'multi-stage' process and whether the anaerobic digester is operated at 'mesophilic' or 'thermophilic' temperatures. These considerations are described in more detail below.

A 'batch' flow system involves the single addition of feedstock to a digester at the start of the process. When the feedstock has been placed in the digester, the unit is sealed for the duration of the process with no more material added. In contrast, 'continuous' or 'plug-flow' systems have feedstock added constantly or in stages with products displaced as new material is added.

'Dry' AD systems treat feedstocks with high dry solid content in the range of 20-40%. In contrast, 'wet' systems are best suited to feedstocks with low solid content, in the range of 5-15% (see Figures 2 and 3 below).

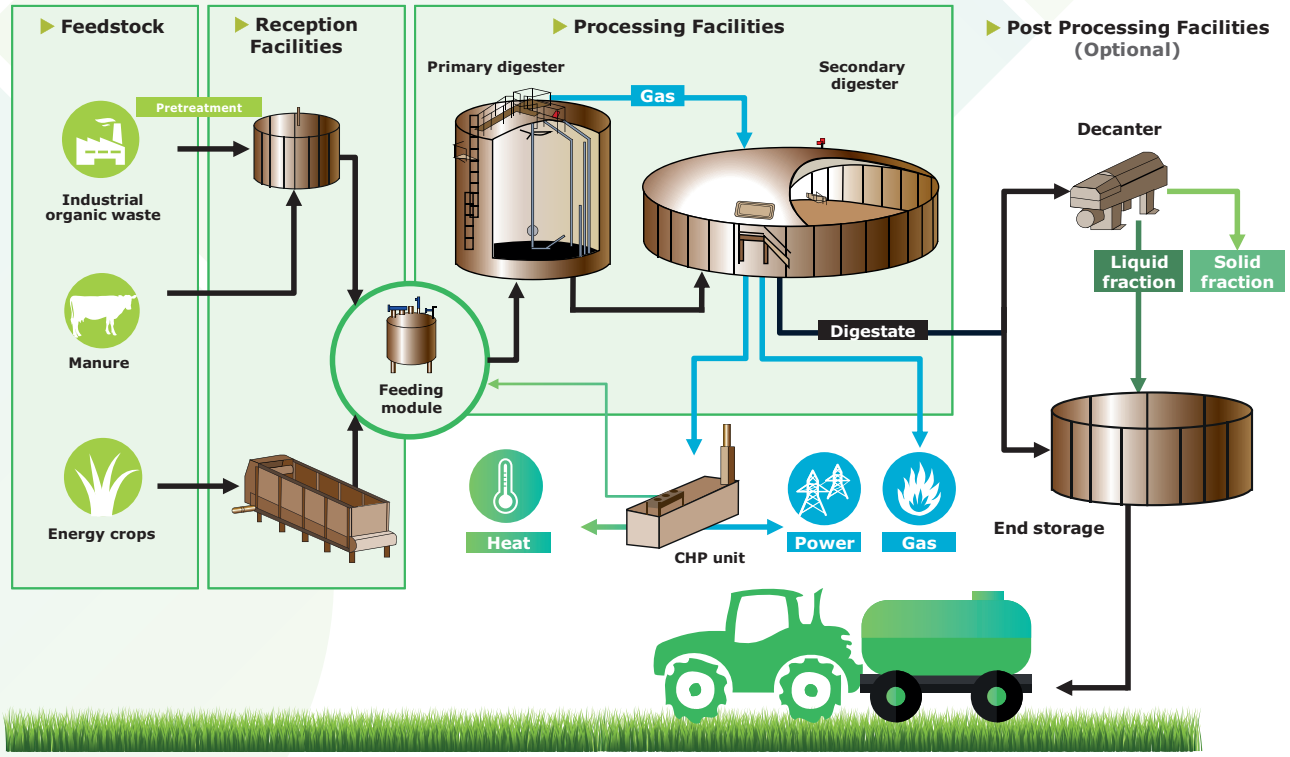


Figure 2: Typical Configuration of a 'Wet' AD System

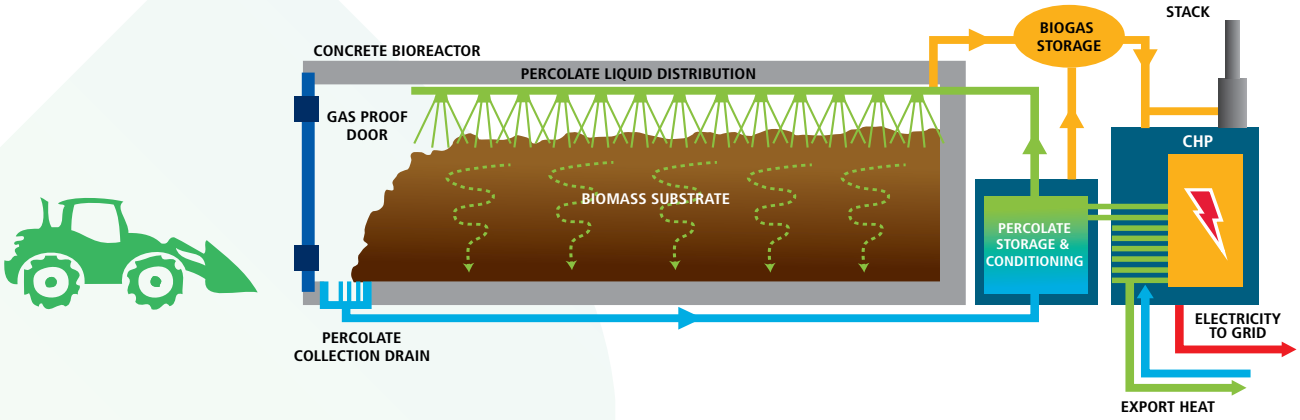


Figure 3: Typical Configuration of a 'Dry' Batch AD System

In terms of process complexity, 'single stage' digestion occurs in one tank, whereas a 'multi-stage' process separates different stages of the process and typically comprises primary and secondary digestion vessels. This enables individual control for increased biological stability, performance and biogas yield.

Temperature is an important parameter. 'Mesophilic' digestion occurs when the temperature range in the vessels varies between 30°C and 40°C. This is the most common temperature range of AD for the treatment of organic municipal waste. 'Thermophilic' digestion occurs at temperatures between 50°C and 60°C.

Mesophilic digestion systems are generally more stable than thermophilic systems because a wider diversity of bacteria grow at mesophilic temperatures and these bacteria are generally more robust and adaptable to changing environmental conditions.

Thermophilic digestion offers the advantages of faster reaction rates compared to mesophilic digestion, leading to shorter retention times. Thermophilic digestion also provides better pathogen kill due to the higher temperatures, although this is less important if the biomass is pasteurised as part of the treatment process. Thermophilic systems are usually more expensive to operate as they require additional energy to maintain the higher operating temperatures.

II. The Benefits of Anaerobic Digestion

AD is a proven and efficient technology that delivers multiple energy, climate, environmental, social and economic benefits. AD will assist Ireland in meeting many important energy and non-energy EU and national policy commitments and has wide ranging cross-sectoral benefits as summarised in Figure 4.

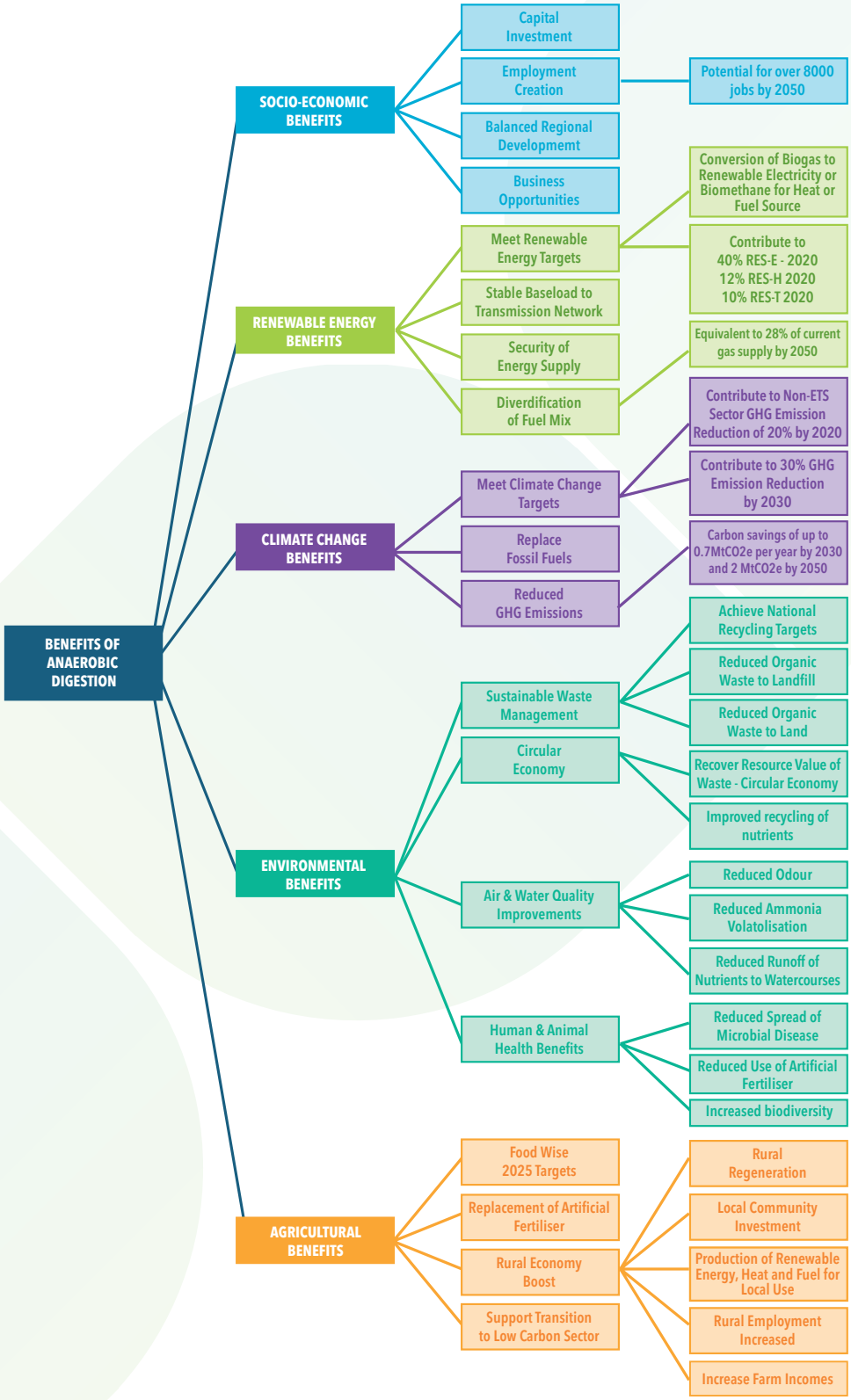


Figure 4: Benefits of Anaerobic Digestion

Socio-economic benefits

At the start of this decade, Bord Gais estimated a potential for almost 200 new AD plants in Ireland by 2020. The realisation of this number of plants could result in a capital investment of up to €1.4 billion to the economy (Bord Gais, 2010). More recently SEAI has suggested there is potential for 900 new AD plants in Ireland by 2050 (SEAI, 2017b). This could generate much needed employment by creating over 5,000 thousand jobs in engineering and construction, with a further 3,000 jobs required for operating these plants. There would also be new business opportunities for sectors providing services to the AD industry and the development of the AD sector would also promote more balanced regional economic development as revenue from the plants is likely to be spent locally.

Renewable Energy Benefits

Biogas is a valuable product of AD, which can play a key role in helping to achieve our EU Renewable Energy Targets for 2020 and beyond. It may be converted to renewable electricity via a Combined Heat & Power Plant (CHP) and this can be used to power homes and businesses. AD generates a constant supply of electricity thereby providing a stable base-load of renewable energy to the transmission grid.

Alternatively, biogas may be upgraded to biomethane for use as a natural gas substitute to help achieve our renewable heat target. Biomethane produced may also be used as a vehicle fuel, making a significant contribution to Ireland's renewable transport target. Austria, France, Germany, Italy, Luxembourg, Netherlands, Norway, Sweden, Switzerland and the UK all provide a legislative mechanism and economic support for the injection of biomethane into the gas network to maximise efficiency in distribution and usage.

Renewable energy generated from AD in Ireland would reduce reliance on fossil fuel based energy imports thus improving our security of energy supply and protecting against price volatility in international markets. According to (SEAI, 2017b) if the full potential of AD in Ireland is deployed, biomethane output in 2050 would be equivalent to 28% of current natural gas supply.

Climate Change Benefits

AD has a significant role to play in the fight against climate change. Landfilled organic waste and other human and animal waste streams including sewage sludge and slurry generate uncontrolled methane emissions to the atmosphere. Diversion of these wastes to AD prevents this as the process takes place in a totally enclosed system.

Replacing fossil fuels with renewable energy generated by AD also reduces Greenhouse Gas Emissions (GHG). SEAI recently predicted that AD in Ireland could realise carbon savings of up to 0.7 Mt CO_2 e per year by 2030 and 2 Mt CO_2 e per year by 2050 (SEAI, 2017b).

Environmental, health and waste management benefits

AD can make a significant contribution to the management of organic wastes in Ireland. Biodegradable municipal waste must be diverted from landfill to alternative more sustainable waste management methods, such as AD, to achieve national recycling targets. AD will also reduce reliance on landfill capacity which will become an increasingly scarce outlet in the coming years.

AD not only recovers energy from organic waste, but it also produces a nutrient rich digestate which is suitable for use as a biofertiliser. This reduces reliance on artificial fertilisers that are becoming increasingly expensive to manufacture. The nutrients in digestate, particularly nitrogen, are more freely available for plant uptake than in untreated organic waste sources leading to improved recycling of nutrients. Thus the use of digestate has water and air quality environmental benefits as it decreases organic pollution potential. It would also reduce the risk of spreading microbial contamination thus creating greater biodiversity in the countryside. AD can also reduce odours from slurry spreading as the concentration of odour in the air is significantly lower when digestate, instead of untreated slurry, is applied on the fields (SEAI, 2017b).

Benefits of Anaerobic Digestion for Agriculture

There is great potential for a new rural industry generating biogas from farm waste and agricultural organic residues in AD plants. This would support sustainable development in rural areas, provide better control of energy costs for farmers, as well as offering new income opportunities to supplement family farm incomes, which have dropped significantly in the past few years. It would generate jobs in the rural economy and attract young people back to farming.

The Government has set out its vision to increase food production levels from Irish agriculture, outlined in Food Wise 2025 (DAFM, 2015). This will increase the volume of agricultural manure and organic waste that will need to be managed in a sustainable way as we aim to address the challenge of converting to a low carbon farming sector going forward. AD can make a valuable contribution to achieving this objective by converting these wastes into energy and fertiliser thus achieving smart agriculture, which is a key component in the promotion of Ireland's food exports under the banner of the Bord Bia initiative, Origin Green.

The agriculture sector also faces a significant challenge to moderate its GHG emissions which account for 32% of Ireland's total (EPA, 2017a). Biomethane generated in on-farm AD plants could be used to fuel tractors, which would greatly assist with this challenge.

III. Government Policy and Drivers for Anaerobic Digestion

Drivers such as climate change, energy security, carbon foot-printing and waste recycling are to the forefront of the European Union's (EU) legislative agenda. The long-term goal for the EU is to become a zero waste society that seeks to use waste as a resource. The schematic presented in Figure 5 highlights the main legislative and policy drivers with regard to AD.

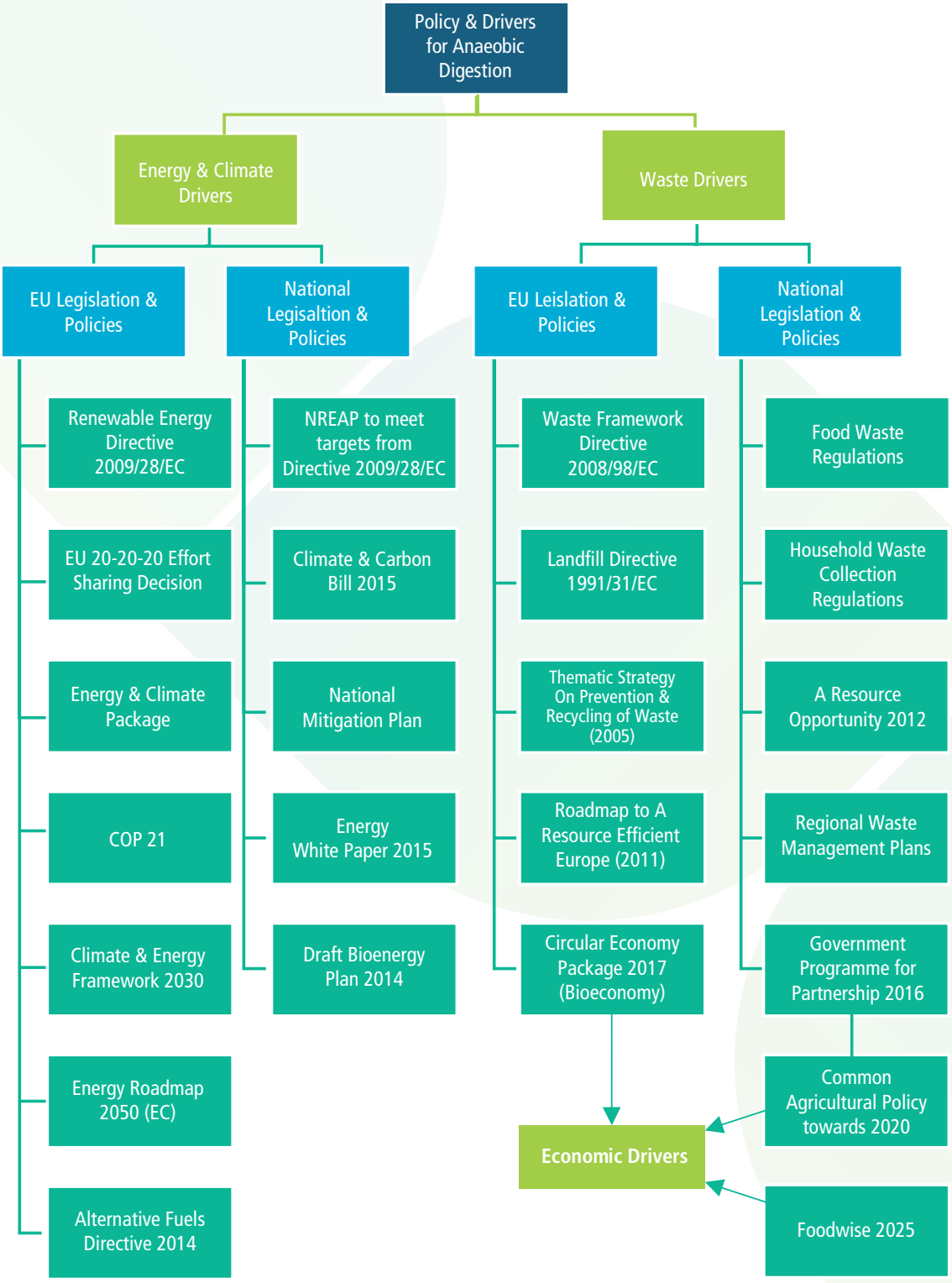


Figure 5: Drivers of Government Policy on Anaerobic Digestion

Waste Management Drivers – EU Directives and Guidance

The benefits of AD are recognised and promoted in EU and national waste management legislation and policy. EU Directives, which set the context for the management of waste in Ireland, encourage the use of AD to process organic material.

The **Waste Framework Directive (2008/98/EC)** enshrines a principle which aims to move waste away from landfill and towards treatment options, including AD, which are better for the environment than disposal. The separate collection of biowaste with a view to its biological treatment is also encouraged by this Directive. The objective of landfill diversion is also a requirement of the **Landfill Directive (1999/31/EC)**.

Other EU Strategies, Initiatives and Programmes have been published encouraging Europe towards a resource-efficient, low carbon economy to realise sustainable growth for the Region. These include the **'EU Thematic Strategy on the Prevention and Recycling of Waste (COM 2005 (666) Final)'**, the **'Roadmap to a Resource Efficient Europe (COM (2011) 571)'**, and **the '7th Environment Action Programme (EAP)'**. The 7th EAP builds on previous initiatives and further prioritises low carbon growth, resource efficiency and innovation and recognises the importance of treating waste as a resource.

'Towards a circular economy: a zero-waste programme for Europe' was proposed in 2014 by the European Commission to establish a common and coherent EU framework to promote the circular economy. In December 2017, a provisional agreement was reached with representatives of the European Parliament on all four legislative proposals of the Circular Economy package with new targets. These new targets which include separate collection of biowaste by 2023 will promote a more circular economy. The circular economy, and particularly the bioeconomy (the biological element of the circular economy), can provide opportunities for agricultural residues such as those from crops, animal and dairy by-products, to be used to produce fertiliser and heat and/or power through AD.

Waste Management Drivers – National Waste Policy and Guidance

A **'Resource Opportunity'** (2012) is the current waste management policy document in force in Ireland, supporting the development of biological treatment infrastructure and the roll-out of the brown bin, diverting organic waste from landfill towards more productive uses. Resource opportunity is also an underlying principle of the three regional **Waste Management Plans** that set out the regional vision, targets and strategic aims for waste management in Ireland. The **'Programme for Partnership Government' (2016)** recognises the contribution AD can make to national waste policy in terms of utilising waste as a resource.

Commercial and Household Food Waste Regulations now in force are designed to promote the segregation and recovery of food waste. These instruments impose obligations on waste collectors to provide separate food waste collection services and on householders and commercial premises to segregate food waste at source.

The **Waste Management (Food Waste) Regulations 2009 (SI 508 of 2009)** came into force on the 1st January 2010 and apply to commercial, industrial and institutional premises such as state buildings where food is prepared, restaurants and cafes, hot food outlets, canteens, hotels and larger guest houses, hospitals, universities, airports, supermarkets and other food retailers.

The segregation of household food is governed by the **European Union (Household Food Waste and Bio-waste) Regulations 2015 (SI 430 of 2015)**, while the **Household Waste Collection Regulations** passed in 2015 and 2016 (SI 197 of 2015 and SI 24 of 2016) have put greater obligations on both householders and waste collectors in relation to the roll out and use of brown bins.

The introduction of the Food Waste and Waste Collection Regulations along with the new incentivised charging schemes for kerbside household waste collections (announced by the government in June 2017), and economic instruments such as the landfill levy, will significantly increase the volume of source separated organic waste requiring treatment in a sustainable manner. Thus, there is an increasing demand for AD infrastructure to facilitate the successful implementation of the Food Waste Regulations and the required diversion of organic waste away from landfill.

In addition to European and national legislation and policy, the development of AD is also promoted and supported by relevant guidance documents including reports published by the Environmental Protection Agency. For instance, the **'Municipal Solid Waste – Pre-treatment & Residuals Management'** technical guidance document (EPA, 2009) establishes the minimum pre-treatment requirement for waste disposed to landfill or designated for incineration with the intention of preventing untreated organic waste reaching these forms of treatment. This could include the use of a brown bin in urban areas and the stabilisation of organic waste by biological treatment such as AD.

Energy and Climate Drivers – EU and National Policy and Guidance

Ireland's renewable energy and climate change strategy is set firmly in the global and European context. While progress has been made on lessening dependence on imported fossil fuels (from 98% in 1990), Ireland is still importing almost 70 per cent of its energy requirements at a cost of €3.4 billion in 2016 (SEAI, 2017a). This is one of the highest rates in Europe. The UK, by contrast, imports only around a third of the energy it uses.

Both Ireland's renewable energy and climate strategy are in accordance with the policy ambitions for renewable energy set by the EU. These are grounded in the economic, environmental and security of supply imperatives needed to decarbonise energy systems and diversify energy sources.

The **EU Renewable Energy Directive (2009/28/EC)** set a target to source 20% of the EUs energy needs from renewables by 2020. Ireland is required under this Directive to ensure that 16% of total final energy consumption comes from renewable sources by 2020 as set out in the **National Renewable Energy Action Plan**. This is to be achieved through a target of 40% electricity consumption from renewable sources by 2020, 12% renewable heat usage by 2020, and 10% renewable energy use in transport by 2020.

The latest published data (SEAI, 2017a) indicates that Ireland is still well short of its 2020 renewable energy targets with just 9.5% overall renewable energy contribution in 2016. In terms of the sectoral targets, Ireland had achieved 27.2% renewable electricity, 6.8% renewable heat and just 5.0% renewable transport by 2016 indicating a significant challenge to achieve the 2020 targets. The deployment of AD could greatly assist with this challenge.

Under the EUs **'Energy and Climate Package'** Ireland has a target to reduce non-Emissions Trading Sector (ETS) greenhouse gas (GHG) emissions from transport, agriculture, residential, waste and non-energy intensive industry by 20% relative to 2005 levels by 2020. Despite this, Ireland has one of the highest levels of GHG emissions per person in the EU and according to the EPA is off-track to meet its EU 2020 target. The latest data published (EPA, 2017a) shows that economy wide GHG emissions in Ireland in 2016 were over 61 million tonnes of carbon dioxide equivalent, which was 6.7% higher than they were in 1990 and 3.5% higher than 2015 levels.

The EPA has projected that Ireland's non-ETS sector emissions will increase between 2015 and 2020, and will only be 4-6% below 2005 levels by 2020, compared to the 20% target (EPA 2017b). The agriculture sector and burning of fossil fuels to generate electricity are two of the primary contributors of GHG emissions in Ireland and AD can play a key role in achieving emission reductions in these areas. Agriculture accounted for one third of Ireland's total emissions in 2016, with energy generation making up approximately a further 20% (Figure 6).

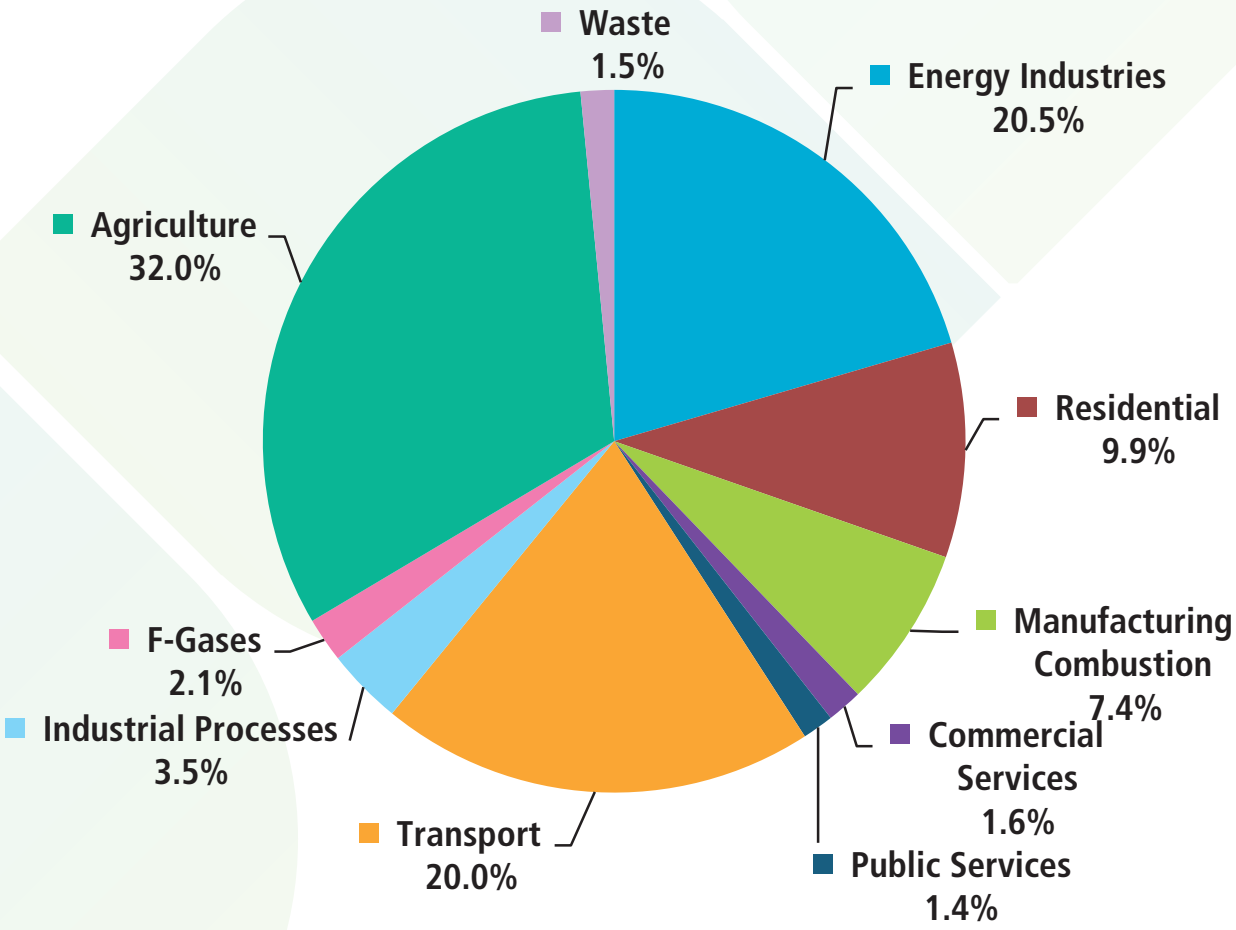


Figure 6: Ireland's GHG emissions by sector 2016
(source: EPA, 2017a, *Ireland's Provisional Greenhouse Gas Emissions 1990-2016*)

EU countries have agreed on a new **2030 Framework for Climate and Energy**, including EU-wide targets and policy objectives for the period between 2020 and 2030. These targets include a 40% cut in GHG emissions compared to 1990 levels and at least a 27% share of renewable energy consumption by 2030. The burden sharing of the non-ETS target between Member States has yet to be finalised but the target proposed for Ireland is a 30% GHG reduction from 2005 levels by 2030, which will be a considerable challenge. Looking further into the future the EU has set out ambitions to reduce GHG emissions by 80% to 95% by 2050, compared with 1990 levels.

The **Climate Action and Low Carbon Development Bill 2015** sets out Ireland's national climate policy position and the way the transition towards a low carbon economy will be achieved. Whilst the EU 2050 ambition is not a formal target, the Low Carbon Bill 2015 provides the legal framework for establishing sustainable environment policy focusing on lowered carbon emission levels on a national level in the period up to and including the year 2050. To achieve a low carbon economy and reductions of this scale by 2050 will be a massive challenge for Ireland and the use of fossil fuels will need to be substantially reduced if not eliminated.

A **National Mitigation Plan** published by the government in July 2017 sets out the various measures that can be pursued to achieve the transition objective across the Energy Generation, Built Environment, and Transport and Agriculture sectors. This Plan recognises the role AD can play in the future in reducing methane emissions from the agriculture sector. The preparation of the National Mitigation Plan was a requirement of the Low Carbon Bill 2015.

Ireland's Energy White Paper 2015 **'Ireland's Transition to a Low Carbon Energy Future 2015-2030'** presents an energy policy framework that sets out a clear and high level strategic direction for the country's energy future. This document presents an ambition to transition to a low carbon economy by 2050 and acknowledges AD as a possible technology to assist in the delivery of this objective.

A draft **Bioenergy Plan** was published by the Department of Communications, Energy and Natural Resources in October 2014. It sets out a vision of Ireland's bioenergy resources contributing to economic development and sustainable growth as well as generating employment.

Ireland is facing significant challenges in meeting its EU renewable energy and future emissions targets for greenhouse gases for 2020 and beyond. Effective action by all economic sectors is required for the transition to a low emissions economy and AD can play a crucial role to help achieve this ambition.

PART II
ANAEROBIC DIGESTION HEALTH & SAFETY LEGISLATION

I. Background and Legislation

The Health and Safety Authority was set up in 1989 under the Safety, Health and Welfare at Work Act, 1989 and reports to the Minister for Business, Enterprise and Innovation. The Authority is the national statutory body with responsibility for ensuring that approximately 1.8 million workers (employed and self-employed) and those affected by work activity are protected from work related injury and ill-health. The Authority enforces occupational health and safety law, promoting accident prevention, and providing information and advice across all sectors, including retail, healthcare, manufacturing, fishing, entertainment, mining, construction, agriculture and food services.

The primary legislation in Ireland is the Safety Health and Welfare at Work Act 2005. There are a number of amendments to the Act, as well as Regulations and Codes of Practice. Primary legislation can be referenced from the HSA website (http://www.hsa.ie/eng/Legislation) and the Act can be downloaded from the Irish Statue Book (http://www.irishstatutebook.ie).

Within the legislation responsibilities have been assigned to each party at the different stages of the development of a project. These apply to any construction project and are applicable to any AD project. Every AD plant will be developed by a person or an entity and this person or entity is considered the client under the 2005 Act. It is likely that most people developing an AD plant will be first time clients.

The HSA has published a best practice guide for clients; (http://www.hsa.ie/eng/Your_Industry/Construction/Construction_Duty_Holders/Client), which is helpful to let a developer know what their responsibilities are during the design and construction of an AD plant. Two important roles of the operator are to appoint a Project Supervisor for the Design Process (PSDP) and a Project Supervisor for the Construction Stage (PSCS). The Safety, Health and Welfare at Work (Construction) Regulations 2013 place these and other duties on clients. Each operator should familiarise themselves with these duties and ensure they are carried out.

Photo 3: **AD Plant under Construction** (Biocore Plant, Co. Roscommon)

Each project must have a PSDP. The PSDP is responsible for the compilation of the safety file for the client. The safety file must stay with each project from initial concept through to the demolition of the facility. The PSDP compiles the design risk assessment making sure that as many risks as possible are designed out and those that cannot be are communicated to the contractor and operator by way of a design risk register in the safety file.

What are the duties of the Project Supervisor for the Design Process (PSDP)?

The duty of the project supervisor for the design process is to ensure co-ordination of the work of designers throughout the project.

The PSDP must:

- Identify hazards arising from the design or from the technical, organisational, planning or time related aspects of the project;
- Where possible, eliminate the hazards or reduce the risks;
- Communicate necessary control measure, design assumptions or remaining risks to the PSCS so they can be dealt with in the safety and health plan;
- Ensure that the work of designers is coordinated to ensure safety;
- Organise co-operation between designers;
- Prepare a written safety and health plan for any project where construction will take more than 500 person days or 30 working days or there is a particular risk and deliver it to the client prior to tender;
- Prepare a safety file for the completed structure and give it to the client;
- Notify the Authority and the client of non-compliance with any written directions issued.

The PSDP may issue directions to designers or contractors or others. (http://www.hsa.ie/eng/Your_Industry/Construction/Construction/Dutyholders/ProjectSupervisor_Design_Process)

The role of the project supervisor construction stage is to manage and co-ordinate health and safety matters during the construction stage. The project supervisor construction stage is appointed before the construction work begins and remains in that position until all construction work on the project is completed. (http://www.hsa.ie/eng/Publications_and_Forms/Publications/Construction/Guidelines_on_the_Procurement_Design_and_Management_Requirements_of_the_Safety_health_and Welfare_at_Work_Construction_Regulations_2013_Updated_.html)

II. Risks and Mitigation

Building and operating an anaerobic digestion (AD) plant presents health and safety risks both during construction and operation. The previous section outlined the legislation governing health and safety in Ireland. Central to the carrying out of these roles and complying with legislation is the identification of hazards and quantifying the risks they pose. Such hazards can then be designed out during the planning phases or if that is not possible mitigation can be put in place to minimise the risk.

It is important to understand firstly what hazards are present due to anaerobic digestion and the production of biogas. Once the main hazards are identified, it is then important to quantify the risks posed by such hazards and how risks can be eliminated or reduced. AD plants require complex engineering in order to produce biogas from feedstock and may contain a range of different hazards. While each plant design will pose different specific hazards, there are a number of hazards that are generally common to all AD plants, namely:

- Environmental hazards
- Health hazards
- Hazardous substances
- Biological agents
- Hazards from electrical equipment
- Mechanical hazards
- Gas hazards
- Explosion and fire hazards
- Sources of danger from the surrounding environment
- Hazards arising from inappropriate behaviour

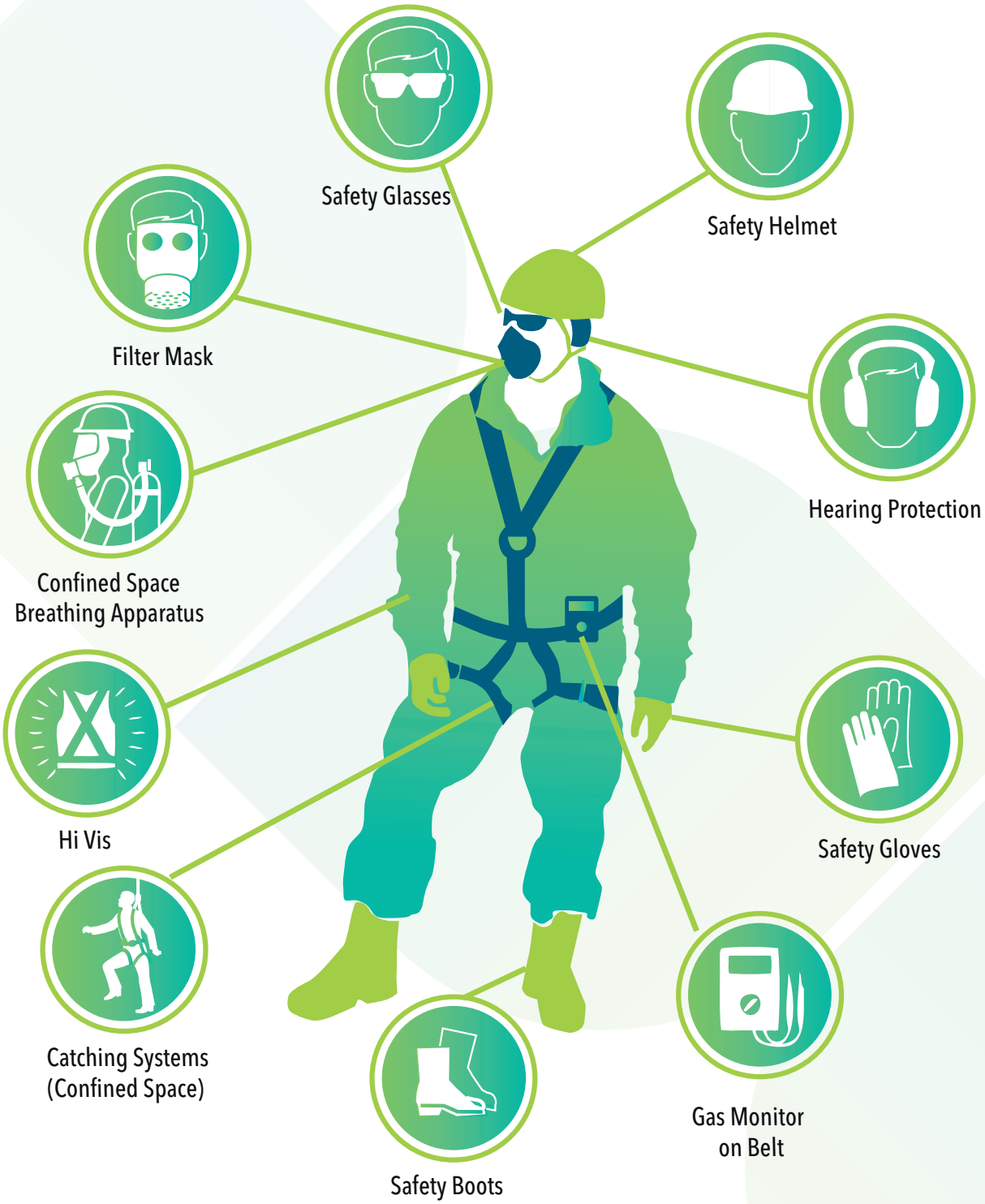


Figure 7: Protective Work Gear

Environmental hazards

The main hazards to the environment from an AD plant are emissions of biogas, and working materials escaping from production facilities. Such emissions will be from structural faults or from process failures. The biogas produced in an AD plant contains a large proportion of methane, a potent greenhouse gas. This gas is also highly explosive so any unwanted emissions of biogas could cause an environmental hazard through the release of a large amount of methane and other gases.

Some of the main areas within an AD plant where biogas may escape include the digestate storage tank, the plant pipework and the Combined Heat and Power unit. There are some specific actions that can be taken to minimise the risks associated with the hazard of biogas escaping. These include:

- Make all civil and process works as gas tight as possible
- Install an automatic flare system. The CHP unit is typically shut down for 5% to 10% of the time for essential maintenance and repair, and during this time biogas is continually produced, but must not be allowed to escape from the plant unburned.
- The flare system should kick in before the overpressure relief device does. The overpressure relief device should only activate if there is an issue with the flare.
- All digestate storage tanks should be gas tight, including the cover.
- Methane emissions should be checked using appropriate measuring devices, such as a gas camera or foam forming agent.
- The CHP unit should be optimised for the combustion of biogas. Methane emissions from CHP units can range from 1% to more than 2% of methane produced.

Nitrous oxides, sulphur dioxide, carbon monoxide, particulates and other combustion products need to be regulated to avoid excess emissions to the local environment. Proper maintenance of the CHP unit will greatly reduce any hazards occurring from these sources.

The other main output from an AD plant is the digestate that is left after the process. This digestate needs appropriate handling within the plant to ensure that it does not contaminate soil or ground water. Digestate is usually land spread, as it is a good source of nutrients. This land spreading must be conducted in line with the Nitrates Directive to ensure there is no pollution of water courses.

Health hazards

Due to the nature of the AD process, there are potential health hazards. These hazards could include exposure to hazardous substances, electrical hazards, mechanical hazards and explosion and fire hazards. The main hazards however are prolonged low level exposure to gases and faulty equipment, such as electrical or mechanical equipment. A proper safety management system and regular repair and maintenance on the plant as well as suitable plant design will greatly reduce the risks from these hazards.

Generally incidents and accidents occur during the operation of the plant and are either caused by equipment failure, improper equipment utilization, or plain human errors. Death causing accidents are generally related to gas poisoning (Hydrogen Sulphide and Ammonia) in open and confined spaces. Proper confined space training and portable gas detection should be mandatory for all biogas plant operators.

Equipment lockout procedures should be strictly enforced to avoid unnecessary accidents. Proper training on processes and equipment should be mandatory for all biogas plant operators. Health and safety equipment, both systemic gas detection and personal, should be routinely checked for precision and calibration.

Proper hygienic procedures (showers, hands cleaning, etc.) must be enforced to avoid pathogen linked disease contamination and spread. Finally, the staff of a biogas plant should be trained in basic firefighting skills and CPR.

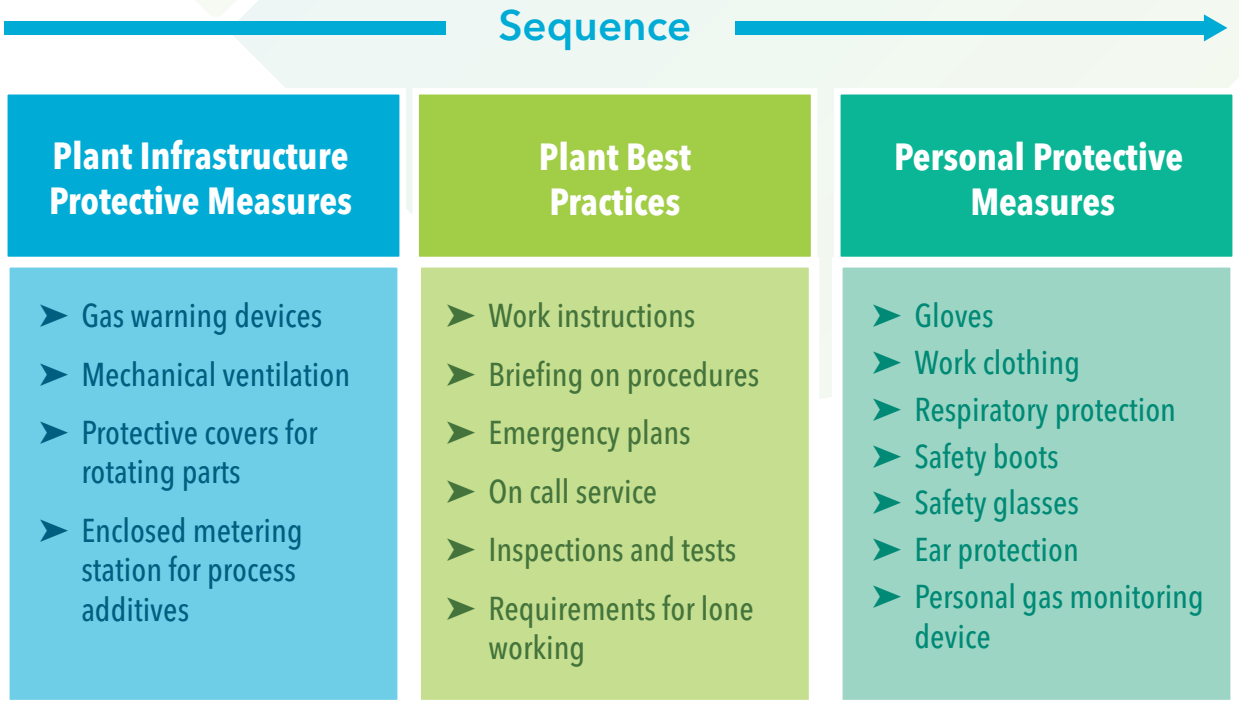


Figure 8: Health Hazards Mitigation Measures

Hazardous substances

Hazardous substances are substances that could be harmful to health, toxic, corrosive, sensitising, or carcinogenic, etc. Such substances can be in the form of solids, liquids and gases. It is important to be aware of what substances are present on an AD plant and what their properties are. Examples of likely hazardous substances are processing aids, oils, effluent, wastes, etc. Gases from the process may also be harmful within certain areas of the plant. The hazards that could occur include:

- Risk of asphyxiation and/or poisoning from fermentation gases and/or biogas in the feedstock receiving areas.
- Release of highly toxic gases such as hydrogen sulphide into the receiving area especially during mixing.
- The use of additives and auxiliary materials with hazardous properties (e.g. carcinogenic properties)

Material Safety Data Sheet

	Page : 1
	Revised edition no : 5
	Date : 6 / 3 / 2012
	Supersedes : 5 / 3 / 2012
BIOGAS (Methane)	BIOGAS

F+ : Extremely flammable

SECTION 1. Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier
Trade name : BIOGAS (Methane)
SDS Nr : BIOGAS

1.2. Relevant identified uses of the substance or mixture and uses advised against
Relevant identified uses: Vehicle fuel and flammable gas for heating

1.3. Details of the supplier of the safety data sheet
Company identification: xyz Company
Dublin, Ireland
Tel: 12345678
E-post: info@xyzcompany.ie

1.4. Emergency telephone number
Emergency telephone number : +353 12345678

SECTION 2. Hazards identification

2.1. Classification of the substance or mixture
Classification EC 67/548 or EC 1999/45
: F+; R12

2.2. Label elements
Labelling EC 67/548 or EC 1999/45
• **Symbol(s):** F+: Extremely flammable

• **R Phrase(s):** R12: Extremely flammable.
• **S Phrase(s):** S9: Keep container in a well-ventilated place.
S16: Keep away from sources of ignition - No smoking.
S33: Take precautionary measures against static discharges.

2.3. Other hazard: None.

Figure 9: Sample Material Safety Data Sheet (MSDS) for Biomethane

European occupational safety and health directives transposed into the national legislation of the Member States set minimum standards of protection for workers. **The OSH Framework Directive (89/391/EEC)** lays down the obligation of the employers to evaluate the risks to the safety and health of workers, among others those arising from the chemical substances or preparations used. It contains the general principles of prevention, the elimination of risks and accident factors, the informing, consultation and balanced participation and training of workers and their representatives. The permit-to-work system is an essential element of a safe system of work with hazardous substances. A permit-to-work system is a formal recorded process used to control work which is identified as potentially hazardous. Permits to work should be used for high-risk tasks. The permit to work is a documented procedure that authorises certain workers to carry out specific work within a specified time frame. It is a way to control hazardous activities. It describes what work will be done and how, setting out the precautions required to complete the work safely, based on a risk assessment.

Biological agents

An AD plant uses biological material to make methane, using a biological process, therefore there are a lot of potential for biological agents to be present and to present hazards. A biological agent is any micro-organism, cell culture or human endoparasite which may cause an infection, allergy, toxicity or otherwise create a hazard to human health. These biological agents may be present in the feedstock, digestates and biogas condensates on an AD plant. Biological agents usually enter a human through the respiratory tract, hand-to-mouth contact, skin/mucous membrane contact, cuts, jabs, stab injuries etc. Examples of such hazards include:

- The inhalation of ducts or aerosols containing mould, bacteria or endotoxins which may be present in silage or dry poultry manure which has become damp.
- The inhalation of mycotoxins and other microbiological metabolic products from visibly mouldy wastes which may cause acute toxic effects.
- Biological hazards from rodent birds and other animals and their excrement. Weil's disease being a notable example.

As mentioned previously rigorous cleaning and controls at each step in the biogas supply chain will avoid careless contamination and disease spread at all stages – feedstock, digestate and biogas production areas. Procedures and protocols must be put in place as well as ongoing training onsite for suppliers, employees and visitors to avoid disease spread.

Hazards from electrical equipment

Most AD plants are designed and built to produce electricity from methane. Some may be designed and built to produce biogas for injection to the gas transmission network, but regardless of plant type there will be electrical infrastructure on site that has the potential to be hazardous. Such equipment may include control equipment, CHP units, pumps, agitators, measuring instrumentation etc. If such equipment becomes faulty then it may present electrical hazards. Such electrical hazards include:

- Electric shock or arc through an individual's body or by an arc ash. This can occur if working too close to overhead powerlines, or if there are faulty electric cables on site.

- Danger from electric or magnetic fields that cause irritant effects in the human body. These are created by the circulation of induction currents caused by electric fields, induced current, or magnetic fields. These effects occur in a frequency range up to 30 kHz (low frequency range). An example of this would be electromagnetic, electrical and magnetic radiation from the generator of the CHP unit posing a danger to people with pacemakers.
- Danger of electric shock caused by the discharge of static electricity.

All workers coming into contact with electrical networks should have up to date electrical safety training. Training should be considered if the electrical network is being altered or upgraded. Refresher courses ensure experienced electrical operatives and professionals are on top of the latest health and safety guidelines and best practices.

Mechanical hazards

AD plants have a number of mechanical processes for the intake of feedstocks. Moving mechanical parts may pose hazards such as falling, impact, crushing, cutting etc. Such hazards mainly occur when working in the vicinity of rotating parts, around moving vehicles, or working at height. Repair and maintenance activities have the potential for accidents when inadequate protection measures are applied or when work practices are not adhered to.

When machine-related mechanical hazards cannot be eliminated through inherently safe design, they must then be reduced to an acceptable level, or the hazards that cause them must be isolated from the workers by guards that allow the minimum safety distances to be respected. Most of the risks related to mechanical hazards can be reduced to acceptable forces by applying a risk reduction strategy. If this is impossible, the hazards must be isolated from people by guards that maintain a safety distance between the danger zone and the people, with the main result being to reduce access to the danger zone.

Gas hazards

The main activity on an AD plant is to produce biogas from the feedstock. Biogas is a mixture of different gases and this mixture can vary depending on the feedstock mixture used to produce the gas. Common gases contained in biogas are shown in Table 1 below, along with what constitutes a hazardous atmosphere and what workplace exposure limits apply for each gas.

The workplace exposure limit (CoP Chemical Agents, HSA 2016) in Ireland or occupational exposure limit (OEL) is the time weighted average concentration of a substance in air at the workplace over a specified reference period at which no acute or chronic harm to the health of employees is expected to be caused. As a rule, the limit is set on the assumption that the exposure is for eight hours a day, five days a week over a working lifetime. The workplace exposure limit is specified in units of mg/m3 and ml/m3 (ppm).

Table 1: Gas Exposure Limits (Ireland) Code of Practice for Chemical Agents, HSA 2016

	Properties	Hazardous atmosphere	Workplace exposure limit (8 hour reference period)
CO_2	Colourless and odourless gas. Heavier than air.	8 % v / v, danger of asphyxiation.	5000 ppm
NH_3	Colourless and pungent-smelling gas. Lighter than air.	Above 30 – 40 ppm mucous membranes, respiratory tract and eyes become irritated. Above 1000 ppm breathing difficulties, potentially inducing loss of consciousness.	20 ppm
CH_4	Colourless, odourless gas. Lighter than air.	4.4–16.5%	1000 ppm
H_2S	Highly toxic, colourless gas. Heavier than air. Smells of rotten eggs	Above a concentration of 200 ppm the sense of smell becomes deadened and the gas is no longer perceived. Above 700 ppm, inhaling hydrogen sulphide can lead to respiratory arrest.	5 ppm

Explosion and fire hazards

One of the main hazards at an AD plant is the risk of explosion. Biogas is produced in the plant and is combusted to produce electricity. The mixture of gases can form an explosive atmosphere in certain areas of the plant. Such explosive atmospheres can ignite and cause extensive damage and serious or fatal injuries. Flammable substances come in forms other than gases too and can be in the form of vapours, mists or dusts.

It takes three factors to cause an explosive atmosphere:

- A flammable substance (in a distribution and concentration conducive to explosion)
- Oxygen (from air or other sources)
- A source of ignition (this could be a naked flame, static electricity, or electronic equipment)

There are two types of explosion possible in an AD plant; a detonation and a deflagration.

A detonation is a rapid combustion at the explosive limit of the flammable substance. The pressure this generated is lower than that generated by a deflagration, but it is still strong enough to destroy window panes. Some personal injuries are also likely.

The second kind of explosion is a deflagration, a form of explosion in which the propagation velocity of the reaction front is below the speed of sound in the respective medium and the combustion gas plumes flow in the opposite direction of propagation. This leads to an extremely powerful explosion which has enough pressure to damage or entirely destroy buildings, and cause serious or even fatal injuries.

The explosive range of biogas is between 6 and 22% v/v (concentration in the atmosphere). An explosion is likely at this range if there is the presence of an ignition source. In the case of pure methane the explosive range is between 4.4 and 16.5% v/v. The ignition temperatures for biogas and methane respectively are 700°C and 595°C. As the composition of biogas may vary, so too can the explosive range of the biogas. The explosive limits of a methane/carbon dioxide mixture (70% CH_4 – 30% CO_2) is shown in Figure 6 along with their trend (upper and lower limits). Gas-air mixtures above or below the explosive range do not ignite.

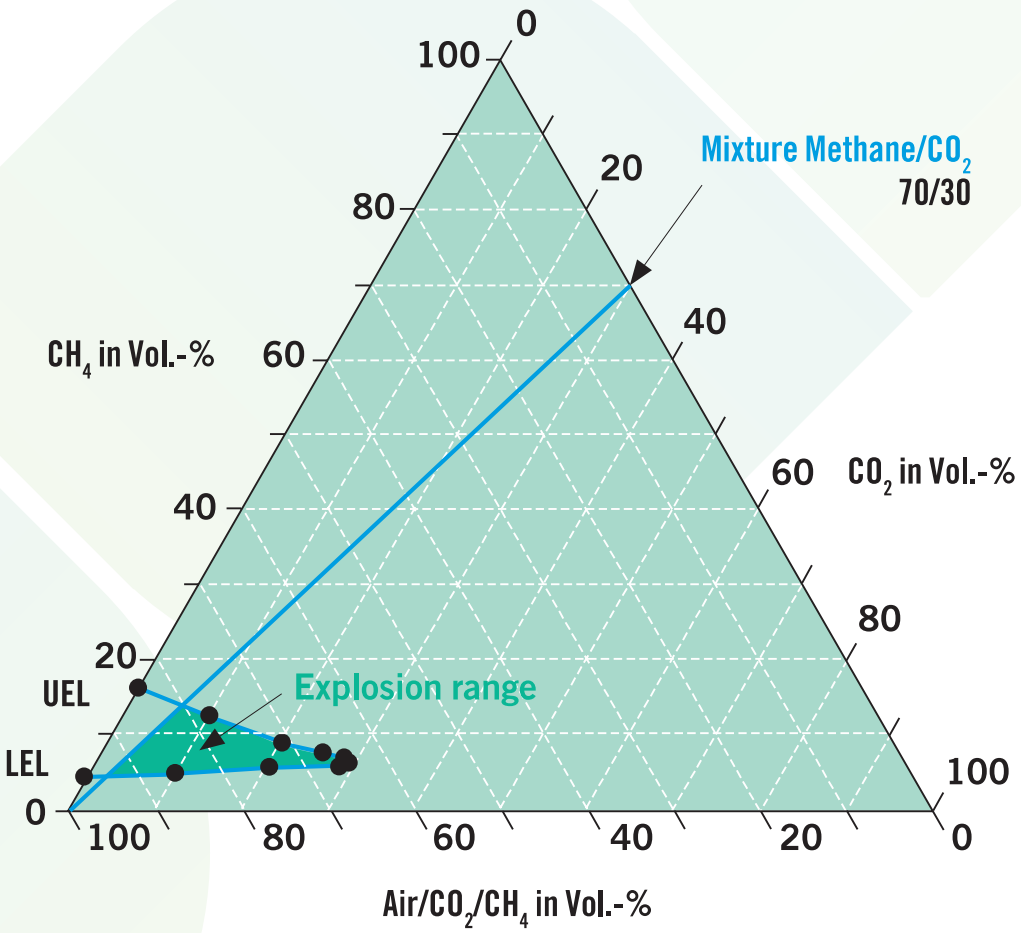


Figure 10: **The Fire Triangle**

PRIMARY EXPLOSIVE PROTECTION	Prevention of formation of explosive atmosphere ➤ Substitution, inert atmosphere, limitation of concentration, intensive ventilation
SECONDARY EXPLOSIVE PROTECTION	Prevention of ignition ➤ Explosive Zoning, preventing sorces of ignition, organisational measures
TERTIARY EXPLOSIVE PROTECTION	Reduction of explosion consequences ➤ Personal Protective Equipment (PPE), explsion supression, explosion pressure resistance ➤ Evacuation or enough distance

Figure 11: Explosion Mitigation Measures

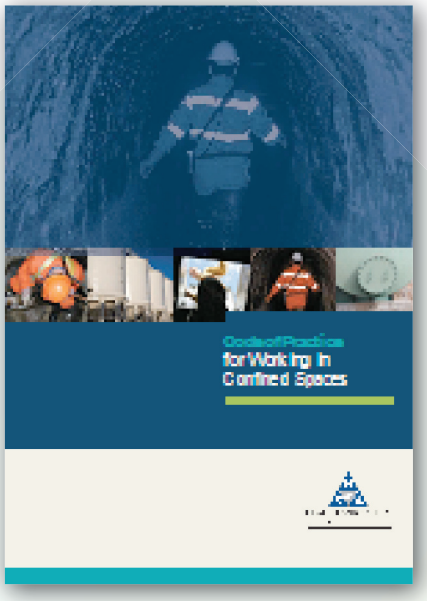
Sources of danger from the surrounding environment

Cognisance must be given to weather related and other environmental sources of danger. Site location can have a bearing on this, such as locating near a river that is liable to flood.

Hazards arising from bad work practice

As with any business there is the potential for hazards due to bad work practice from those involved in the plant or other unauthorised persons. Such bad practices can give rise to any of the hazards already covered. It is for this reason that good safety management is key in managing potential risk due to hazards.

III. Safety Management



There will always be hazards that are inherent to an AD plant and that cannot be fully designed out. For such hazards, it is important to have a safety management plan on site.

Safety management begins with the Safety Statement that each plant must have. Section 20 of the Safety, Health and Welfare at Work Act 2005 requires that an organisation produce a written programme to safeguard:

- the safety and health of employees while they work
- the safety and health of other people who might be at the workplace, including customers, visitors and members of the public

Further details on safety statements can be found on the HSA website (http://www.hsa.ie/eng/Topics/Managing_Health_and_Safety/Safety_Statement_and_Risk_Assessment/). In addition it is common practice for a company to have policies in place to deal with the major hazards associated within that workplace. On an AD plant some of the major hazards are as follows:

- Explosion
- Gases
- Confined Spaces

Each hazard identified on site should undergo a risk assessment and control or mitigation measures should be implemented based on the risk assessment. Details of how to carry out risk assessments are outlined on the HSA website.

Hazards associated with explosions have been covered in the previous section, but there are a number of ways to manage the risk from explosions. Risk Assessments should be carried out to determine zones on the plant that are susceptible to explosion risk and these should be clearly identified. Staff should be clearly briefed on how to work within these areas. Use of equipment that could be a source of ignition should be avoided and only ATEX approved equipment should be used within these areas.

Gases are another major source of hazards on AD plants. As well as the obvious risks of ignition and explosion there are also risks due to long term low level exposure. Work practices should be put in place to manage staff exposure to gases, and other mitigation measures identified within a risk assessment. Gas monitors and other such equipment form part of such mitigations and companies should be aware of the maintenance and calibration requirements of such equipment and all safety equipment.

Confined Spaces are a further major hazard on AD plants, and include any area that is enclosed and difficult to exit from quickly. Confined spaces can include intake areas, feedstock storage, digester tanks, digestate storage areas, etc. A full definition of what constitutes a confined space and other information is contained with the Confined Space Code of Practice on the HAS website (http://www.hsa.ie/eng/Topics/Confined_Spaces)

All information generated through risk assessment and the resultant work practices should be captured within the safety file and up to date copies should be kept within the site safety file. Every new employee that comes on site should be inducted onto site and be made aware of the safety statement and any policies and procedures contained within the safety file. Similarly, all visitors need to be inducted onto site and records kept within the safety file.

In order to ensure that effective safety management is taking place on site regular audits of the company's policies, procedures and work practices should be carried out internally, by line management and senior management. This will ensure that staff are correctly implementing the documented policies and procedures and allows for feedback to ensure that policies and procedures are fit for purpose and robust. Regular auditing is the main way to mitigate against the hazards arising from inappropriate behaviour. Records of all audits should be kept on the safety file, as well as actions arising out of those audits.

Safety management is considered best practice and the above is an outline of what may work. It is up to each company to decide how best to manage their own specific hazards and risks within their site, within the requirements of the legislation. One overriding action across all health and safety is the necessity to document and record what is taking place and to keep auditing, either formally or informally, the systems and procedures that are in place. The onus is on the company or developer to be aware of what is expected of them for proper health and safety management. Experienced operators will always try and design out any operational hazards and risks before the plant is constructed to reduce the burden of safety management during the operational phase and safe guard the staff that are present on site.

PART III
ANAEROBIC DIGESTION & ANIMAL BY-PRODUCT LEGISLATION

I. Background to Animal By-Product Regulations in Ireland

Outbreaks of animal diseases such as Bovine Spongiform Encephalopathy (BSE), Foot & Mouth, Swine Fever and others significantly increased the profile of these diseases in Europe over 15 years ago. In response, the European Commission adopted the Animal By-Product (ABP) Regulation (No 1774/2002-which has since been replaced by No 1069 of 2010) to ensure that all meat and other products of animal origin, which are processed by treatment technologies such as anaerobic digestion (AD), meet specific treatment standards for destroying potential pathogens. The provisions in the regulation have considerable impact on the anaerobic digestion industry in terms of the technology that can be used to process catering waste (food waste), foodstuff and other waste listed in Table 3.

The ABP regulations are not relevant to AD plants that only use the following non-ABP feedstocks in their process: waste water treatment plant sludge (e.g. sewage and dairy sludge), cereal grains, edible material of plant or vegetable origin, bread, dough, chocolate and grease trap waste.

The ABP legislation classifies 'animal by-products' under 3 categories; Category 1 – very high risk, Category 2 – high risk, and Category 3 – low risk. Specific materials that cannot be processed in AD plants are Category 1 Animal By-Products such as BSE, carcases and suspects, specified risk material and catering waste from international transport e.g. waste from aeroplanes.

Under the ABP Regulations, the Department of Agriculture, Food and the Marine (DAFM) considers applications for approval for different types of AD plants depending on the feedstocks used and the end use of products. DAFM classifies AD plants into nine different types.

Table 2 below outlines some of the common types of ABP plant licensed by the Department. A more detailed list can be found in the appendix of the Department's conditions document (CN11) (DAFM, 2014a). Type 1 AD plants are the most common in Ireland as they give greater flexibility on feedstocks and the use of digestate. In these plants, all the feedstocks are pasteurised.

Table 2: Common ABP Licensed Plants

ABP Plant Type	Processing Standard	Main Feedstocks	End Use of Digestate
1	70^{0}C, 12mm particle size for 1 hour	Category 2 (e.g. manures), category 3 catering waste	Land in Ireland and within the EU
9	none	Only manures from the farm on which the AD Plant is located. Non-ABP from the same farm e.g. grass silage	Land in Ireland only
8	none	Category 3 catering waste	Must be sent directly to incinerator/ landfill

The EU ABP Regulation (EC) 1069/2010 and it's implementing Regulation 142/2011 lays down the parameters that facilities using category 3 animal by-products must comply with. For example a Type 1 AD plant using Category 3 material as a feedstock must comply with the following minimum requirements:

- Maximum particle size before entering the pasteurisation tank: 12 mm;
- Minimum temperature of all material in the reactor: 70°C; and
- Minimum time in the reactor at 70°C (all material): 60 continuous minutes.

Under the ABP regulations, the Minister for Agriculture, Food and the Marine may grant an approval, attach conditions to an approval, revoke or vary a condition, withdraw an approval or refuse an application.

On 1st December 2006, the Minister for Agriculture, Food and the Marine established the ABP Forum with stakeholders from industry and other Government Departments/Agencies. The forum has met typically quarterly over the past 11 years and has been central to developing good policy and guidance in Ireland. To date there are 8 AD plants in Ireland with ABP approval that process manures, food waste, fish waste and industrial sludge.

Table 3: Examples of Catering Waste ABP, Foodstuffs ABP

Waste Stream	ABP Category
Domestic brown bin	Cat 3 Catering waste
Used cooking oil	Cat 3 Catering waste
Commercial brown bin from restaurants, hotels, hospitals and school kitchens	Cat 3 Catering waste
Restaurant within a shopping centre	Cat 3 Catering waste
Butcher within a supermarket complex	Cat 3 Raw foodstuff
Out of date raw meat from a fridge in a supermarket within a shopping centre	Cat 3 Raw foodstuff
Out of date cooked meat product from a fridge in supermarket within a shopping centre	Cat 3 Foodstuff

II. ABP Application Process

If a proposed AD plant wishes to accept and process ABP, then the plant owners are advised to approach DAFM to discuss the plant's design before construction and preferably before seeking planning permission and an EPA licence or a local authority Waste Permit.

The approval of an ABP plant is a two stage process. The first stage relates to the design of a plant. When DAFM agrees in principle to the design, then the second stage begins whereby the plant is built and DAFM validates the plant once all the procedures and HACCP are in place. The timeframe for the process is very much plant specific. However to speed up the process the DAFM would recommend that plant developers engage with them as early as possible.

The approval process outlined in this chapter relates to the most common AD plant, Type 1, which processes all feedstocks to 70°C, 12mm particle size for 1 hour. For other types of plant, where a processing standard does not have to be validated, there is a less stringent application process, as outlined in the DAFM conditions documents CN 9 (DAFM, 2014b) and 14 (DAFM, 2014c).

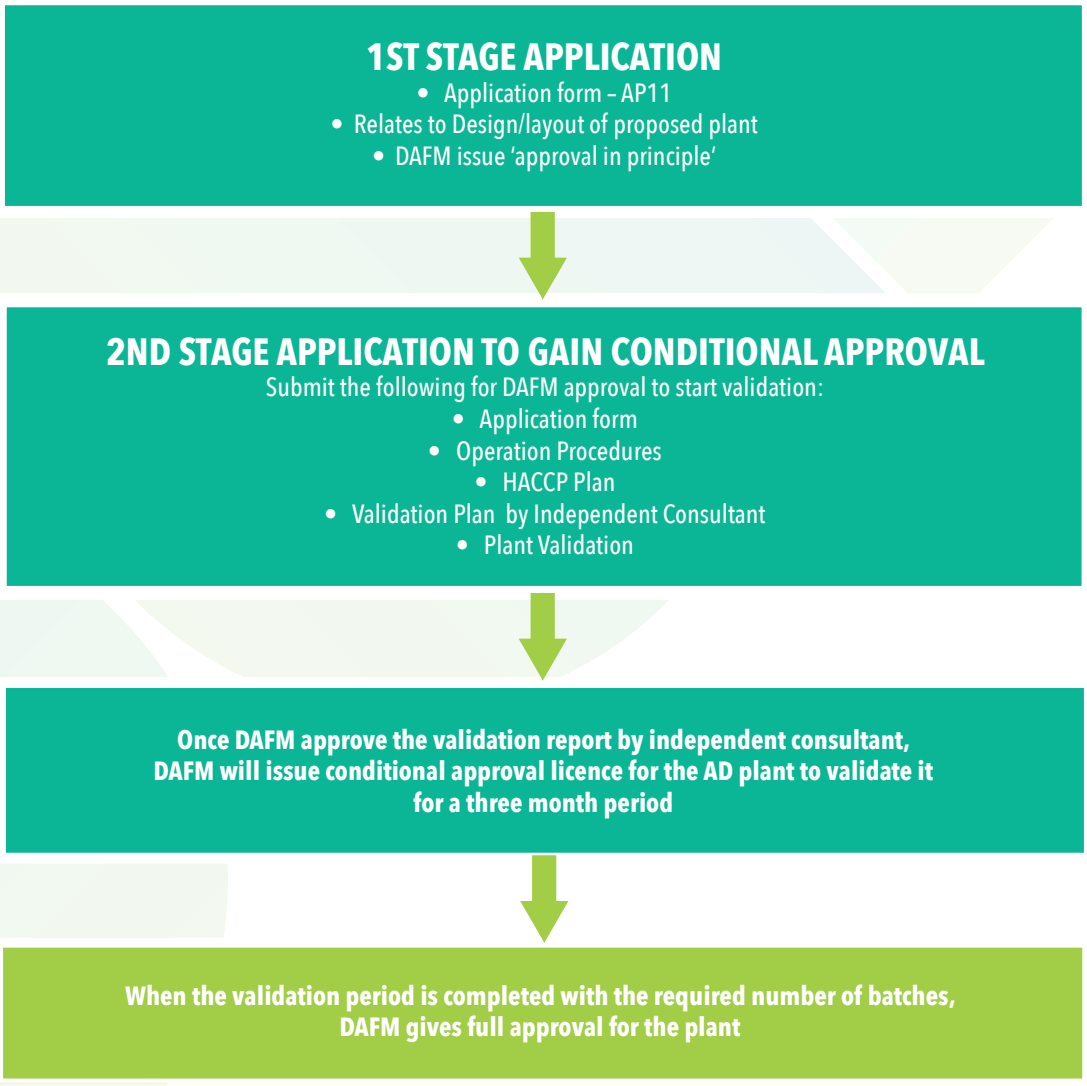


Figure 12: Overview of Approval Process

It is advised that a developer should have a meeting with DAFM before the first stage application is prepared.

The '1st stage application' provides information on the location, plant layout and processing technology/ parameters, as well as the intended feedstock and the intended end-use of the digestate. This stage is to ensure that plant design and processing procedures are in accordance with the Regulations, and to help identify and correct potential problems prior to capital expenditure.

Information required in the first stage application:

- General details (applicant, plant details & consultant)
- Location maps
- Site and plant plans – details on flow of material within plant
- Intended feedstock
- Non ABP material
- Intended use of digestate
- Processing standard
- Processing technology

Only applications that are completed in full will be assessed, therefore it is important to ensure that all required supporting documentation, such as maps, are attached. A decision regarding '1st stage approval in principle' will be issued to the developer by the DAFM following its assessment of the application.

In the event that a '1st stage approval in principle' is not granted, the developer will be notified of the decision in writing. If the developer wishes to proceed then a new completed application form must be submitted.

Construction of a new Plant should not commence until '1st stage approval in principle' has been granted by the Department of Agriculture, Food and Marine.

2nd Stage Application

The AD developer should engage with the DAFM in relation to second stage as they start construction of the plant, not when the plant is fully built. During the construction of the AD plant, the AD operator will have to submit a formal second stage application. As part of the second stage application, a validation plan detailing how the processing technology will be validated is prepared by an independent consultant with relevant AD experience.

All the operating procedures for the plant and the plant HACCP plan must also be submitted as part of the stage two application. The procedures will be verified as part of the validation process. The operating procedures need not be overly complicated, but should be effective to eliminate risk. The second stage application form should be submitted as early as possible to the DAFM during the construction of the plant. Once the second stage application is submitted, the DAFM will review the application and DAFM veterinary inspectors will visit the plant.

A decision regarding ''conditional approval for 3 months' will be issued to the plant operator after inspection of the plant. The conditional approval will permit the plant to commence the validation process. Acceptance and anaerobic digestion of animal by-products must not commence until the 'conditional approval' is granted.

The conditional approval only lasts for 3 months. If the validation period needs to be extended to get the required number of batches processed, the DAFM can extend it by another 3 three months- but this is the limit under the EU Regulations.

During the plant validation period and prior to final approval being granted, the DAFM will inspect and assess the plant's compliance with conditions and legislation.

During the validation period, a plant operator must be able to demonstrate:

- the consistent and competent management of the plant.
- a system capable of being operated satisfactorily in compliance with the conditions and legislative requirements on an on-going basis.
- plant processing validation procedures (where applicable.)
- plant operation of HACCP system. (A plant operator must be able to demonstrate satisfactory operation of the Plant HACCP and standard operating procedures).

During conditional approval (the validation phase), no digestate may be released from the AD plant until the plant is granted full approval or unless otherwise agreed with the DAFM.

The period for validation is 10 weeks and at least 10 batches must be processed during this period for a wet AD plant. When the required number of batches is done, the independent consultant will prepare a report which is submitted to the DAFM for review.

Based on the DAFM inspections and the submitted documentation where applicable, the plant will either be approved or not. Plants that are approved will be allocated an individual approval number and listed on the EU Commission website and the DAFM website.

Where the Minister decides that a plant should not be approved, the AD plant operator will be notified in writing of the proposed refusal and reasons for the decision will be detailed. The AD plant operator may appeal the proposed decision within 14 days of receiving the notice. On receipt of an appeal, the Minister may decide on the basis of proposed remedial action to defer a decision on the appeal until the remedial action is taken or refuse the appeal. The AD plant operator will be notified in writing of the decision.

Once your validation has been approved by DAFM, you can install the agreed number of temperature probes and officially open the plant to accept ABP material. You may at this stage sell digestate that has successfully passed all requirements during validation.

It is advisable not to advertise that your plant is open for business until you get full validation approval from DAFM as the DAFM does not consider your plant open until it has given full validation approval.

III. Key Requirements under ABP Conditions for a Type 1 Anaerobic Digestion Plant

A. Normal Operations with Full Approval

All approved plants will be subject to regular monitoring inspections each year by the DAFM Regional Veterinary Inspectors. The most significant action you must take post validation is to maintain all your records and adhere to all of the procedures agreed in your HACCP plan. The HACCP plan is the single most important document that the DAFM checks regularly at an AD plant.

In summary make sure the following is carried out:

- Maintain all records.
- Maintain and update your HACCP plan.
- Calibrate temperature probes once a year.
- In the event of a batch failing to meet temperature or failing a pathogens test, notify the DAFM and agree the course of action as outlined in your HACCP.
- Maintain all the cleaning and hygiene procedures outlined in the HACCP plan.
- Make sure all aspects of HACCP procedures are signed off.
- Maintain all records on the end-use of digestate.

When the DAFM inspects a site it likes to audit the plant's records. It prefers an operator to have a folder containing all the details for that batch e.g. feedstock acceptance forms, all time temperature records, pathogen analysis results report, records on end-use of digestate.

B. HACCP (Hazard Analysis Critical Control Point) Plan

The HACCP process was initially developed for food consumed by NASA astronauts to make sure that the food they consumed would not make them sick during their missions. Subsequently, this planning process has been widely adopted by the food industry and is now being used by the AD industry as a way to ensure compliance with the ABP regulations.

An AD plant must have a flow diagram, as this makes the whole process easy to follow for both an inspector and for operators on the ground. Critical Control Points (CCPs) should be marked on this plan at the various stages in the digestion process as necessary. Relevant CCPs must at least include the processing standard (time/temperature parameters) to be met.

Procedures for monitoring these key CCPs are fairly self-explanatory. One person, preferably the site manager, should be nominated as having responsibility for supervising any corrective actions undertaken. These procedures and actions must be documented.

CCP locations need to be highlighted by use of signs posted within the plant so as to remind operators of the importance of the procedures at these points in the process.

The key CCP (processing standard) defines the plant into two areas – Dirty and Clean. The area utilised before the processing step is known as the dirty area and that after the processing step is known as the clean area. The idea is that there is no cross contamination of raw unprocessed ABP with processed ABP material. The processing step (pasteurisation) may be either at the start of the process or at the end. A sample pictogram, for reference, shows the pasteurisation step at the end of the process see Figure 13.

Plant Layout: 'Dirty Area'

The 'dirty' area of the plant is where raw feedstock materials are accepted and prepared for digestion. These areas include:

- Reception Shed - the reception area for wastes to be digested must be in a fully enclosed lockable area where no vermin or birds can gain access to the raw feedstock materials.
- All facilities should have a dedicated loading shovel for moving material in the dirty area.
- A specific area for cleaning/steam washing waste delivery vehicles is required.
- AD Digestion Tanks, the digestion tanks should be located in an area next to the reception area.
- Pasteurisation Shed, this building would include the pasteurisation tanks to make sure the feedstock meets the processing standard.

Plant Layout: 'Clean Area'

When feedstock materials have reached their required time and temperature processing standard, the digested materials can be moved into storage tanks in a 'clean area'.

- Pasteurised material needs to be stored separately and away from the reception area to prevent cross-contamination with raw material.
- It is important that there is no re-contamination from leachate and material from the dirty area into the clean area.

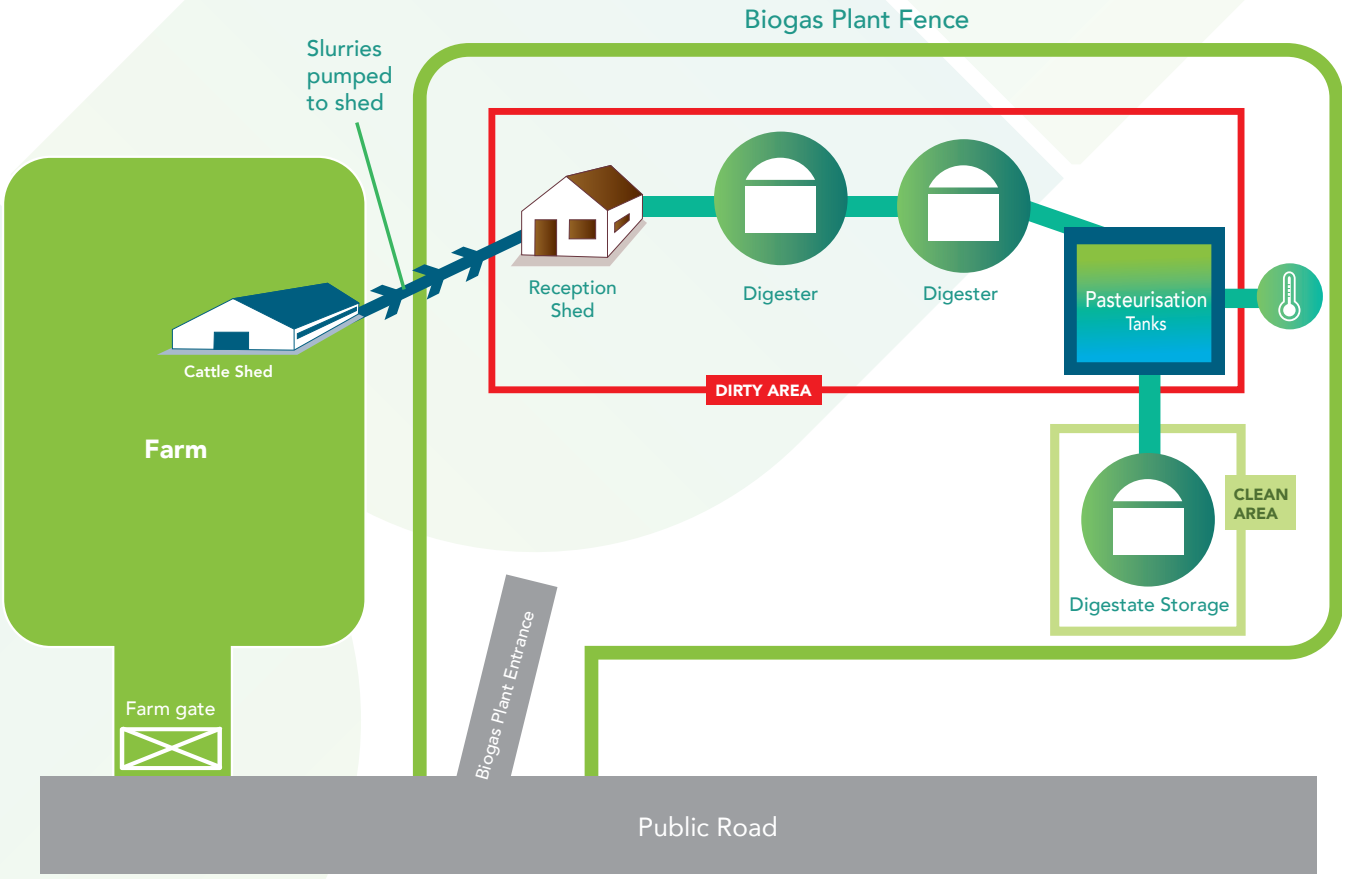


Figure 13: Diagram Layout of Typical AD Plant

C. Initial Reception / Processing of ABPs

- Animal by-products must be processed as soon as possible after arrival, preferably within 24 hours.
- All initial processing of raw material (shredding or mixing) must be done indoors.
- This dirty area must be constructed with smooth walls and floors with adequate drainage of fluids.

D. Cleaning

- Instead of using disinfectants at an AD plant, use a steam cleaner. A steam cleaner does not use disinfectants.
- Cleaning procedures must be documented and established for all parts of the premises.
- In the case of non-compliance due to samples of process product failing to meet pathogen reduction requirements, the plant must be thoroughly disinfected under supervision of the DAFM.
- Hygiene control must include regular inspections of the environment and equipment. Inspection schedules and results must be documented.

E. Vermin Control

- Preventive measures against birds, rodents, insects or other vermin must be taken.
- A fully documented pest-control programme must be implemented throughout the whole plant.
- Any problems encountered must be dealt with immediately and documented.
- In cases where an outside company is being employed, the number and frequency of visits and checks should be outlined. Ideally, a company should be visiting the plant at regular intervals.

F. Probe Calibration

- Time and temperature measuring probes must be calibrated by a specialised thirty party company once a year.
- AD plant operators may also do their own periodic calibration and this is acceptable as long as an independent agency or organisation is employed annually.

G. Thermographs

- Thermographs should be labelled with each unique batch number.
- Two hard copy thermographs are maintained, the first detailing the time/temperature profile of the batch from the time the pasteurisation tank is filled until after the transformation parameters have been achieved, and the second detailing the time/temperature profile during the period when the transformation parameters are achieved, i.e. the expanded graph, to demonstrate that no temperature fluctuations occurred below the minimum temperature requirements.
- For the second expanded graph, temperatures are plotted against time in a manner which demonstrates no greater than 5 minute temperature readings. The thermographs are recorded in real time and are tamperproof.
- The thermographs are signed off by a plant operator and verified by the plant manager as typically this is the critical control point in the HACCP plan. Alternatively, an electronic signature with a time stamp can be used.

H. Digestate Storage

- Processed digestate must be handled and stored at the plant in such a way as to prevent recontamination.
- It must be stored away from the intake area and operators must ensure that a one-way system of material flow is in operation at the site in order to prevent recontamination of processed products.

I. Batch Monitoring

- All batches must be monitored as they move through the plant.
- If a batch fails pathogen testing or fails to reach the time/ temperature parameters, then the tracking system should help the operator pinpoint the batch before leaving the plant.
- Failed batches should be landfilled or recirculated through the plant for reprocessing.

J. End-Use of Digestate

The ABP Regulations in Ireland state the following for ABP digestate use:

- Digestate can be spread on land, subject to keeping farmed animals off the field for 21 days.
- Silage crops or hay cannot be made from a crop grown on land on where digestate consisting of or containing Category 3 material has been spread during the previous 21 days.
- Commercial Documents are required for digestate sent to all business users (e.g. landscapers, farmers), excluding hobby gardeners.
- A 'Notification Form of Digestate Users' must be completed where digestate is applied onto agricultural land.
- Landscapers using digestate are exempt from registration as an end user.

K. Records

All records relating to all aspects of the AD process must be kept on site for a minimum period of three years. These records must be available for inspection by an authorised officer from the DAFM and must include:

- Thermographs relating to the AD pasteurisation process to ensure that the minimum parameters are met.
- Records for all batches of animal by-products delivered to or collected by the plant. In the case of Category 3 material other than catering waste, the commercial documents for each batch must be kept by the plant.
- The pest control plan and all relevant documentation.
- Cleaning procedures and all relevant documentation.
- Hygiene control plan and cleaning schedules.
- Equipment repair and calibration records.
- Sampling procedures and schedules as well as laboratory results for all samples taken.
- A system to ensure traceability for all batches of digestate produced and dispatched from the plant must be in place. This must detail the source of the raw material, all relevant processing records, and the date of dispatch and intended end-use of the finished digestate product.
- A system of hazard analysis and critical control points (HACCP) plan for the plant. This plan must identify the critical control points and establish and implement methods for monitoring and checking these points. All non-compliances and the corrective actions taken in each instance must also be recorded.

L. Non-Compliance

In a situation where samples do not comply with the standards in the ABP regulations, the following procedure must be adhered to:

- DAFM must be notified immediately.
- The operator of the plant must determine or establish the cause of the failure.
- The contaminated batch and any in-contact material must be re-processed or disposed of under the supervision of DAFM. In the case of facilities where the only animal by-product being processed is catering waste, contaminated batches may be sent directly to landfill or recycled back through the plant for reprocessing.
- No material suspected of being contaminated may be removed from the plant without the prior approval of DAFM.
- Records relating to the contaminated material must be investigated. Appropriate decontamination and cleaning procedures must be followed.

IV. Feedback from the DAFM

As part of this project, a meeting with the relevant staff in the DAFM was held to discuss their experience to date of applications received and to provide key learning points to future applicants. The DAFM has received 20 AD plants applications for first stage approval. Of these, 8 are now fully approved ABP plants, while 9 are still at a stage 1.

The common mistakes in first stage applications:

- Missing maps
- Not enough information
- Incorrect information
- Generally people go to their Local Authority and get planning permission first and then go to DAFM. DAFM might have requirements that affect planning permission and it is advised that developers should seek the DAFM first stage approval and planning permission in tandem.

  DAFM advice for all new potential developers is to have an initial meeting with DAFM to discuss first stage requirements.

The common mistakes in second stage application:

- HACCP is not correct
- The validation plan has not been prepared by an independent consultant
- Operating procedures are not correct
- Process flow is not correct

  A key piece of advice from the DAFM is for plant operators to engage in the second stage application process as soon as possible as there can be delays. A common mistake is that developers only engage with the DAFM once all construction is complete. A developer might have tight timeframes in which to be operational which do not align with DAFM availability. The time to engage with the DAFM is when a developer is starting to build.

The main issues with applications:

- Timelines: developers construct an AD plant without acknowledging the importance of ABP requirements, resulting in delays in getting the plant operational.
- Engagement: Not engaging with DAFM early may result in design alterations to comply with ABP conditions.
- Conditions: Non-adherence to the conditions document and resultant mistakes, causing commissioning delays.
- 5 year limit for first stage: there is now a 5 year limit for construction from date of approval. Potentially, a developer who received approval might decide not to start building, during the interceding years the DAFM Guideline has changed and the developer has not kept up to date with Guidelines.
- Future Proof Design: When AD plants, not processing ABP material, are being designed and constructed, the developer needs to future proof the design of the plant in case they decide to take in ABP material in the future.

PART IV
ANAEROBIC DIGESTION & WASTE LEGISLATION

I. Licencing and Permitting:

All operators or potential operators of an Anaerobic Digestion facility require a consent to operate in the form of either a permit from the Local Authority or a licence from the Environmental Protection Agency (EPA). Whether a permit or a licence is required is determined by the capacity of the plant although there may be exemptions to this as outlined in Appendix II, however clarification on this should be sought from the EPA.

A facility that can accept up to 10,000 tonnes per annum of biowaste requires a Waste Facility Permit issued by the relevant Local Authority under the Waste Management Act 1996 as amended, and the Waste Management (Facility Permit and Registration) Regulations, 2007, as amended. The class of activity permitted is Class 8 which allows:

> *The reception, storage and biological treatment of biowaste at a facility where –*
> *The maximum amount of compost and biowaste held at the facility does not exceed 6000 cubic metres at any one time, and the annual intake shall not exceed 10,000 tonnes.*

Any facility proposing to accept an annual tonnage above 10,000 tonnes must apply to the EPA for an Industrial Emissions licence. This licence is issued under the EPA Act of 1992 and the Environmental Protection Agency (Industrial Emissions) (Licencing) Regulations, 2013.

The class of activity licenced is:

11.4 (b) *'Recovery, or a mix of recovery and disposal, of non-hazardous waste with a capacity exceeding 75 tonnes per day involving one or more of the following activities, (other than activities to which the Urban Waste Water Treatment Regulations 2001 (S.I. No. 254 of 2001) apply):*
(i) biological treatment;'

The regulations also state:

11.4 (c) *'Notwithstanding clause (b), when the only waste treatment activity carried out is anaerobic digestion, the capacity threshold for that activity shall be 100 tonnes per day.'*

It is important to note that the threshold in respect of an EPA Industrial Emissions Licence refers to the capacity of the plant rather than the actual amount of material being processed. Depending upon the feedstock mix the facility may not reach the threshold for IED or EPA licencing.

If unsure as to which type of authorisation is required an applicant may request the EPA to determine this in accordance with Article 11 of the Waste Management (Facility Permit and Registration) Regulations, 2007, as amended in 2008. The EPA may consult with a Local Authority in reaching its determination. An application for an Article 11 determination must be made online using the EPA's website and will take 15 working days from submission to waste authorisation determination.

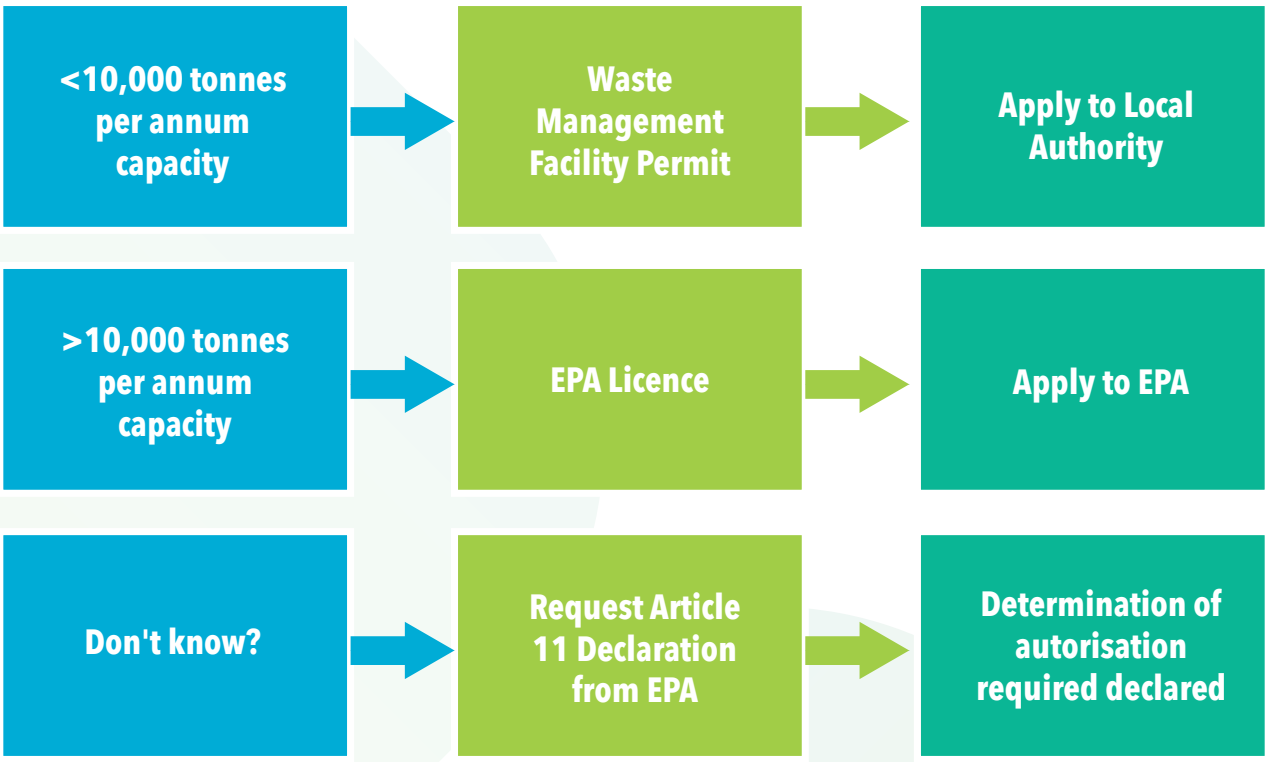


Figure 14: Deciding if You Need a Permit or a Licence

A. Applying for a Waste Facility Permit:

An application for a Waste Facility Permit requires that the appropriate application form be filled out and submitted to the Local Authority in whose area the plant is located. The application form is based upon the Waste Management (Facility Permit and Registration) Regulations 2007, as amended and Article 10 of these Regulations specifies the required information about the applicant and the activity in order to allow the Local Authority to make a determination whether to grant or refuse the permit. Most Local Authorities attach Guidance Notes to their Application Form.

It is generally advised for an applicant to have a pre-application consultation with the Local Authority prior to making an application for a Waste Facility Permit. The application form seeks information that will allow the Local Authority to make a decision whether to grant or refuse a permit on the basis of a number of criteria such as whether the applicant is a 'fit and proper person', the waste types proposed at the facility, whether the application contains enough information to assess the risks to the environment (if any) from the activity, whether the proposed facility is suitable for the proposed activity and any other information that the Local Authority performing its statutory role may require.

A 'fit and proper' person is defined in the legislation and relates to whether the applicant (who could be an individual, limited company or partnership) has had any previous convictions for waste related activities, is of sufficient financial standing to operate a facility of the size and nature of the one proposed and has sufficient technical knowledge to operate such a facility.

Once the Local Authority deems that the application complies with the regulations (see Appendix II C) they will acknowledge receipt of a valid application. The Local Authority then has up to 40 working days in which to make a decision. However, if further information or clarification is sought by the Local Authority, the time for making a decision is 25 working days from the date of receipt of the response from the applicant. If there is a submission by any person or body or a requirement for groundwater investigation, then the time for determining the application is 25 days from receipt of such submission or report (EPA, 2008).

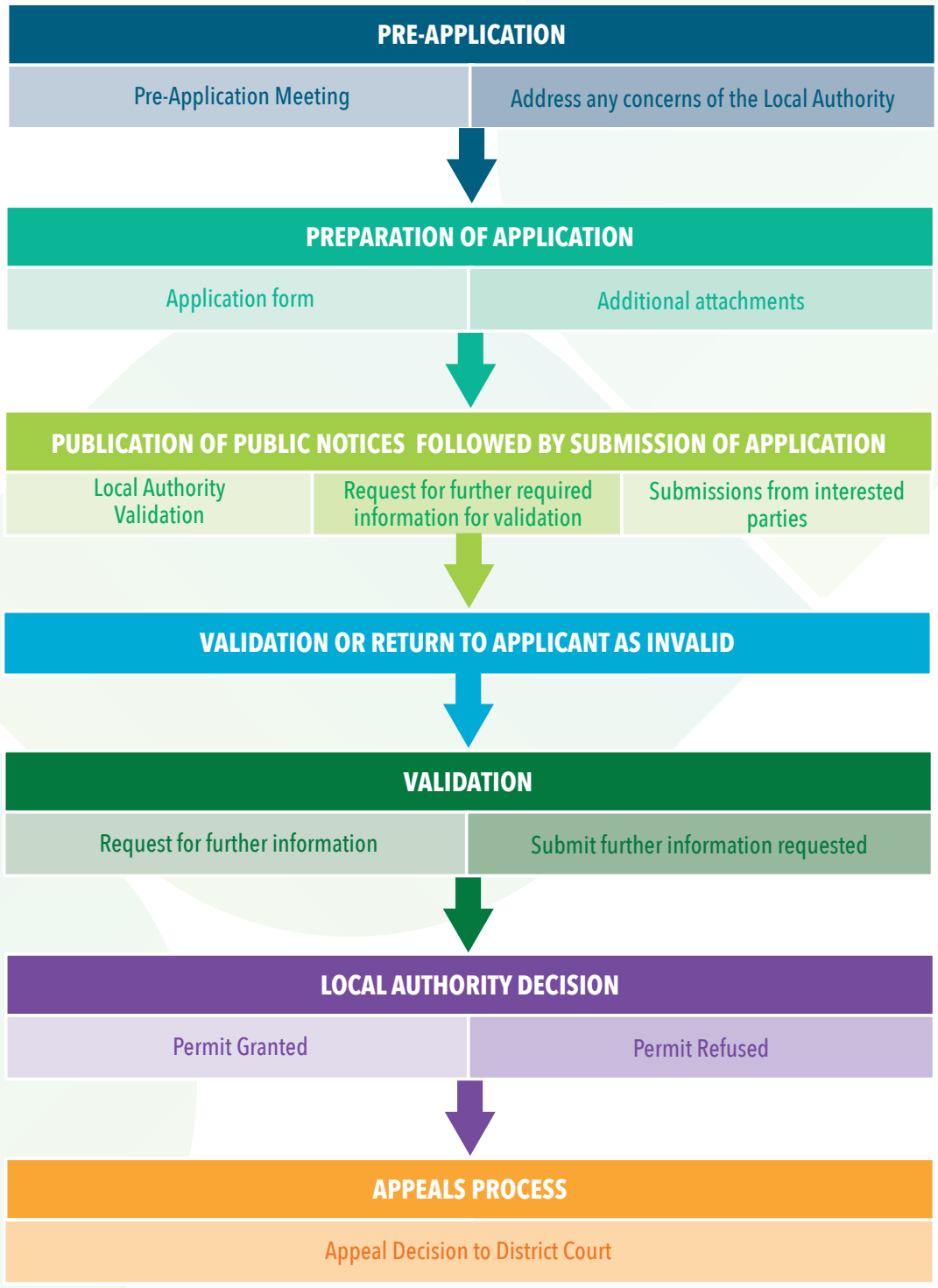


Figure 15: Permit Application Process Summarised

If the Local Authority deems that the application is incomplete they may either return the application to the applicant or seek further information in order to complete the application. Which course of action is taken would normally be dictated by the level of information supplied in the first instance.

Following the receipt of a valid application the Local Authority notifies the applicant that a valid application has been received. Submissions from members of the public may be made and will be taken into account during the permitting process. The applicant will be notified in writing that a submission has been received and that the submission may be inspected in the principal office of the Local Authority from a specified date. Written responses to such submissions may be sought from the applicant.

The Local Authority will then make a decision whether to grant or refuse the permit. Reasons for refusal generally relate to the Local Authority not regarding the applicant as a 'fit and proper person', the correct planning permission not being in place or the Local Authority being of the opinion that the facility as proposed may be a risk to the environment. Once granted the Waste Facility Permit comes into force and is normally valid for five years.

Conditions Attached to a Waste Facility Permit

General Conditions:
All Waste Facility Permits have common conditions detailing the scope of the permit and the permitted classes of activities in accordance with Part I of the Third Schedule of the Waste Management (Facility Permit & Registration) Regulations, 2007, as amended. Three articles of S.I 821 of 2007 as amended provide for conditions of a permit, namely Article 19 '*Conditions which shall be attached to a waste facility permit', Article 20 'Conditions which may be attached to a waste facility permit' and Article 21 'Conditions relating to the operation of mobile plant'.* A local authority can include any condition it deems necessary, but it has a duty to impose conditions that are a requirement of the Regulations and certain Community Acts. Thus conditions of permits may differ between Local Authorities.

A list of definitions (glossary of terms) is included at the beginning of each permit to ensure that there is no misinterpretation of words used.

The following general conditions are common to all waste facility permits:
Scope – this condition includes the permit number, address, permitted activities, expiry date, quantity of waste permitted, and details of facility permit boundary. It specifies that there is an obligation on the permit holder to notify the Local Authority in respect of any changes or non-compliances or incidents that may have occurred.

Management - this condition relates to the management of the activity and each permit holder is required to employ a suitably qualified and experienced facility manager and that the facility manager or a suitably qualified and experienced deputy must be on site at all times during the facility's operation. It is the permit holder's responsibility to demonstrate that the facility manager is suitably qualified or experienced.

This condition also requires the permit holder to put in place a series of procedures that reflects the operation of the facility such as waste inspection, waste acceptance, waste quarantine procedures and corrective actions to be taken in the event that a condition of the permit not being complied with.

Record keeping - the permit holder is required to maintain a register of all wastes incoming and outgoing with all appropriate details. The permit holder is also required to maintain a register of all persons supplying waste to the facility. The condition requires the reporting of an environmental incident (defined in the glossary of terms) to be reported as set out in the permit.

Site infrastructure - requires a facility notice board to be erected and the details required include name and telephone number of the facility, opening hours, out of hours contact details permit number and where environmental information relating to the facility can be found. All infrastructure required by the permit or specified in the application process should be installed. There are requirements to have all tanks, pipes drums and storage areas bunded and tested. Silt traps and interceptors are likely to be required to be installed on surface water lines. Facility security is required to prevent unauthorised access. A site office is required and usually a weighbridge and wheel wash are specified.

Material acceptance and handling - specifies the wastes (by European Waste Catalogue EWC Code) that are acceptable at the facility and usually states that no other wastes are acceptable. It will usually state the times of waste acceptance and conditions relating to handling and storage of incoming material.

Monitoring and emissions - the permit conditions address the potential for noise, odour, dust, litter and discharges to water and specifies the steps to be taken to avoid such nuisances being created and the remedial action to be taken if fugitive emissions occur. This section will also set out any monitoring that is required to be carried out by the permit holder.

Accident prevention and emergency response procedure - specifies measures to be taken by the licensee to prevent accidents and in the event of an emergency.

Closure Restoration and Aftercare – specifies measures to be taken in the event of the closure of the site and surrender of the permit.

Financial provisions – specifies payments to the Local Authority and financial provisions to be put in place in the event of an unplanned closure.

Specific Conditions:

Specific conditions contained within Waste Facility Permits relating to Anaerobic Digestion generally, but don't always, include:

- Seeking agreement for design from the Department of Agriculture, Food and the Marine (DAFM) and ongoing compliance with requirements from the DAFM to include clean and dirty areas and stock proof fencing.
- Containment of digestate and wastewater in a manner that will prevent accidental discharge to groundwater and surface water. Maintaining adequate duty and standby capacities. Provide high level alarms on wastewater tanks.
- Conditions regarding the landspreading of digestate and provision of nutrient management plans to include nutrient mass balance. Maintaining records of all material entering and leaving the facility. Maintain a digestate register including location of field where spread.
- Provision of a telemetry system to control all anaerobic digestion processes.
- Digestate quality standards.
- Environmental controls such as efficiency testing of the biogas boiler and CHP plant. Odour controls. Emissions controls. Provision of an auxiliary flare. Fugitive emissions of unburned biogas to be minimised.

Therefore, for consistency it is recommended that all Waste Facility Permits for the purpose of Anaerobic Digestion should contain the following specific conditions:

- Depending on the feedstocks used the treatment process requires pasteurisation. The process requirements for AD plants treating ABP materials are outlined in the animal by product regulations. The typically processing standard for ABP materials is 70°C, I hour with a minimum 12mm particle size. Full approval to be sought from and compliance with any processing conditions set by the DAFM.
- Containment of all liquids within tanks that are bunded with 110% of storage capacity and all containers above 1000 litres capacity be fitted with a high-level alarm.
- Digestate should be landspread in accordance with a nutrient management plan.
- Monitoring frequency and parameters to be set based upon the potential for emissions or discharges from the facility and the sensitivity of potential receptors.
- Unlike the compost standard I.S. 441, there is currently no national standard for digestate. Further work needs to be done to develop this standard. In the absence of a national standard the following is recommended:
    - Follow the microbial parameters in the ABP regulations (E. coli and Salmonella)
    - Measure metal parameters such as Cadmium, Copper, Chromium, Nickel, Lead, Mercury and Zinc.

Review of a Waste Facility Permit:

Waste Facility Permits are generally issued for a period of 5 years duration. A permit may be renewed through what is known as the review process. A review may also be initiated by the permitting authority. The same application form is used for the review application as for the new application. The differences between the new application and review application are as follows:

- If an application to have a permit reviewed is made at least 60 working days before the expiry date of the existing permit, then the existing permit will remain in force until a decision is made on the review application.
- If there are no material changes to the activities proposed in the review, then there is no requirement for a site notice or newspaper notice.
- The fees payable to the Local Authority for a review permit are 50% of those for the initial application.
- It should be noted that if an application for a review is not made at least 60 working days before the expiry date of the existing permit then it is treated as a new application and will have to follow the application procedure in full and incur the full fees for a new application, in which case the existing permit will expire on the expiry date.
- Amendments to a permit may be sought without initiating a review of the permit however, the scope of the amendment must be discussed and deemed appropriate under the scope of amendment by the Local Authority prior to the changes been made at the facility.

B. Applying for a Licence from the Environmental Protection Agency:

Preparing the Application

It is recommended that any prospective applicant hold a pre-application meeting with the EPA to discuss the proposed project. The EPA will advise the applicant on the issues that need to be addressed in the application such as emissions, odour and when the Industrial Emissions Regulations apply.

It should be noted that the Medium Combustion Plants Directive EU 2015/2193, which applies to plants producing between 1 and 50 Megawatt thermal, was due to be transposed into Irish Legislation in December 2017 and will require that emission limit values be set in accordance with this legislation.

The EPA has recently introduced an online application process for licensing. This process would initially appear more complex than the previous paper based application however it is designed to ensure comprehensive information is submitted and should reduce the further information requests from the EPA and therefore lead to faster decisions.

In order to make an application an applicant must register an account with EDEN (the EPA's licence management web portal) and have access granted by the EPA prior to the commencement of the application process. The on-line application itself is made up of three main elements:

1. Structured responses

Answers are entered into a data fields on the on-line web-form, e.g., a box for entry of a specific answer, a Yes/No option or a dropdown pick list. This is an interactive form, so based upon answers given additional questions may be required (or not required) to be completed. For example, particular questions will be generated based on selection of the classes of activities. There are 11 main sections to the on-line form and various sub sections. The form is automatically saved so information is not lost.

2. Attachment template documents

These are documents that must be downloaded, completed, and uploaded in the application form once completed e.g. details of emissions, energy usage etc. There are 25 documents to download & upload as part of the application, it is possible that not all 25 will need to be completed as some are specific to landfill but expect to complete a minimum of 20. The EPA have stated that the Attachment Templates have been designed to obtain information in a standard format to assist applicants to provide the required detail and the EPA to standardise the assessment process.

3. Additional attachments

This is where supporting information is required. It must be uploaded into the on-line application form in an appropriate format. Examples of supporting information include impact assessment reports, baseline report, appropriate assessment screening or natura impact assessment, site drawings, details of planning history and demonstration of compliance with Best Available Techniques (BAT). Other supporting documentation may be requested on a case by case basis by the EPA.

BAT and BREF:

The use of Best Available Techniques (BAT) is now mandatory for EPA licenced facilities. The EPA have produced a series of BAT Guidance notes and BAT Reference documents (BREFs). BAT is described in the EPA Guidance notes as:

- *Best* means the most effective technique that achieves a high general level of environmental protection.

- *Available techniques* mean those techniques developed on a scale which allows implementation in the relevant class of activity under economically and technically viable conditions, taking into consideration the costs and advantages, whether or not the techniques are used or produced within the State, as long as they are reasonably accessible to the person carrying on the activity.
- *Techniques* includes both the technology used and the way in which the installation is designed, built, managed, maintained, operated and decommissioned.

All licence applications must demonstrate that they have taken BAT into account and that the facility will be constructed, operated and managed to the highest standards as set out in these BAT notes. The most relevant BAT reference document for Anaerobic Digestion is the *Best Available Techniques (BAT) Reference Document for Waste Treatment*, which is currently at the final draft stage (October 2017) with the European Commission (EC JRC, 2017).

However, it is recommended that any prospective applicant also review the BAT conclusions on Energy, Storage and Monitoring prior to completing an application.

C. Environmental Impact Assessment:

Projects which exceed certain thresholds as set out in the amended Environmental Impact Assessment Directive (2014/52/EU) require an Environmental Impact Assessment to be carried out and an Environmental Impact Assessment Report (EIAr) to be written. In general, this will apply to an Anaerobic Digestion facility with a capacity of 25,000 tonnes per annum or higher but this should be confirmed at the pre-planning or pre-application stages because other factors have to be taken into account such as existing activities on site, nearby (cumulative) activities or the sensitivity of the location of the proposed facility and the planning authority or the EPA may request a sub-threshold EIA.

The EIAr is an assessment of the known or potential impacts of the proposed development on the environment under the headings of population and human health, biodiversity, land, soil, water air and climate, material assets, cultural heritage and the landscape. It must also look at the interaction between all of these. The EIAr should be written by competent experts and should clearly set out why the development will not have any impact on the environment or, if there is a potential impact, propose mitigation measures that will eliminate this impact or reduce it to a slight or imperceptible level. The preparation of an EIAr must include consultation with designated Statutory Bodies and there must be public consultation in the form of a site notice and a newspaper notice at a minimum. In addition, as part of the EIA process, alternatives must be evaluated in the form of alternative technology, alternative location and alternative design.

The EPA has produced draft *Guidelines on the Information to be contained in Environmental Impact Assessment Reports 2017* (EPA, 2017c) which are available on their website.

Baseline Report:

For industrial activities regulated by the IED, Article 22(2) of Chapter II of the IED states that:

"Where the activity involves the use, production or release of relevant hazardous substances and having regard to the possibility of soil and groundwater contamination at the site of the installation, the operator shall prepare and submit to the competent authority a baseline report before starting operation of an installation or before a permit for an installation is updated for the first time after 7 January 2013.

The baseline report shall contain the information necessary to determine the extent of soil and groundwater contamination (if any) so as to make a quantified comparison with the condition of the soil and groundwater upon definitive cessation of activities.

Appropriate Assessment:

An Appropriate Assessment screening report is required to accompany all planning, permit or licence applications. Member States are required to designate Special Areas of Conservation (SACs) and Special Protected Areas (SPAs) under the EU Habitats and Birds Directives, respectively. SACs and SPAs are collectively known as Natura 2000 sites. An 'Appropriate Assessment' (AA) is a required assessment to determine the likelihood of significant impacts, based on best scientific knowledge, of any plans or projects on Natura 2000 sites. A screening for AA determines whether a plan or project, either alone or in combination with other plans and projects, is likely to have significant effects on a Natura 2000 site, in view of its conservation objectives. If the screening report determines that there is the potential for impact, then a full Natura Impact Assessment must be carried out to look at possible impacts and mitigation measures. If impacts on a Natura 2000 site cannot be ruled out after the completion of a Natura Impact Assessment, then the competent authority are obliged to refuse permission (DoEHLG (2009) Appropriate Assessment of Plans & Projects - Guidance for Planning Authorities).

Submission of Application and Decision Process

On completion of the on-line application form a PDF copy can be requested and emailed to the applicant (this can be requested at any stage of the application process to track progress). One hard copy of the application must still be submitted the EPA.

Once the applicant has the submission ready they must advertise their intention to apply in an approved newspaper (this list is available from the EPA). A site notice must be erected at the site of the proposed facility. The text of these notices must be in the format supplied by the EPA which are in compliance with the legislation.

Following the submission of the application, the EPA will advise all of the statutory consultees and takes account of any responses that it may receive. At the same time the EPA will assess the application for compliance with the legislation and level of detail that will allow it to make a decision. Following this process, the inspector makes a recommendation that is sent to the Board of the EPA for approval. The Board determines the application and the proposed decision (PD) is sent to all parties. The parties then have 28 days to make an objection and if appropriate request an oral hearing. If there are no objections the licence is issued as a Final Decision (FD). If there are objections either by the applicant or a third party the EPA will decide whether an oral hearing is required. They will appoint a technical committee to determine the objection and the technical committee reports to the Board of the Agency with its recommendations. The Board then issues the Final Decision which is notified to all parties. Once the FD is issued, parties (the applicant and/or objectors) have 8 weeks within which to apply for judicial review.

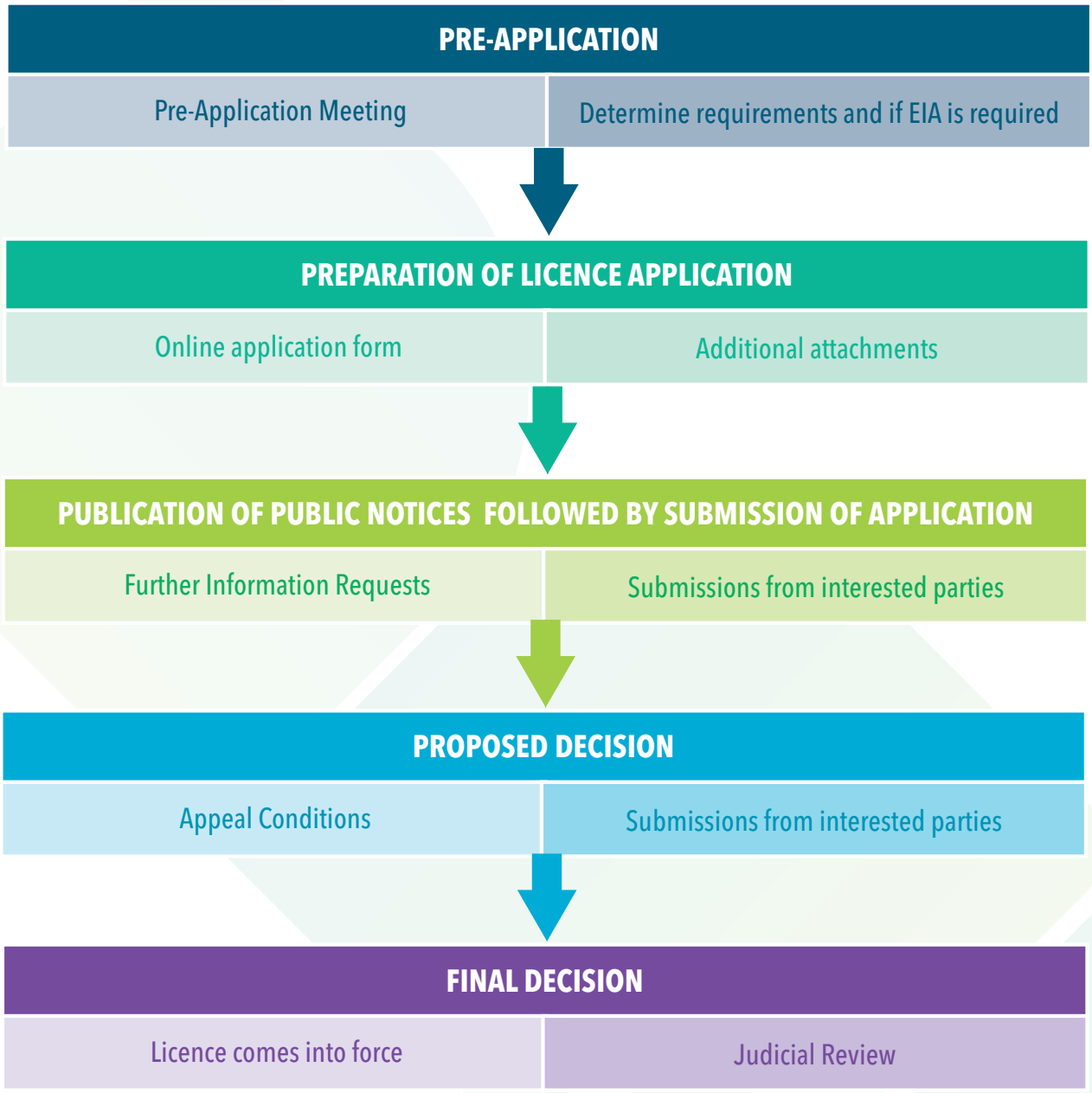


Figure 16: EPA Licence Application Process Summarised

Licence Conditions

EPA licence conditions will generally fall under the following headings:

- Scope – this defines what is permitted under the licence and the limitations.
- Management – this condition clearly sets out the management requirements in the context of people, procedures and systems.
- Infrastructure and Operations – details the requirements of the licence regarding infrastructure including capacity, maintenance and testing.
- Interpretation – this condition clarifies any limit values specified by the licence.
- Emissions – provides limits for emissions from the facility.
- Control and Monitoring – this condition specifies the required treatment and monitoring of emissions.

- Resource Use and Energy Efficiency – specifies conditions that will provide efficient energy and resource use in site operations.
- Materials Handling – determines how materials handling should take place on the site to provide for protection of the environment.
- Accident Prevention and Emergency Response – specifies measures to be taken by the licensee to prevent accidents and in the event of an emergency.
- Closure Restoration and Aftercare – specifies the conditions required in the event of the closure of the facility.
- Financial Charges and Provisions – details the financial charges payable to the EPA and the financial provisions required by the licence (see next section).

In addition, licenses contain appendices which detail the monitoring points, frequency, parameters, emission limit values as well as reporting requirements. The wording of each licence condition is site specific.

Once issued an EPA licence can only be altered and/or amended in one of three ways:

- A request for approval submitted to the Office of Environmental Enforcement via the EPA's web portal EDEN. Generally, requests for approval refer to relatively minor changes such as new raw materials, new minor emission points or trials of new products or processes. The application submission must contain a screening report (i.e. why the applicant believes the change can be accommodated by this method) and overview diagrams, and tables from the licence application form as appropriate.
- A licence amendment either technical or clerical. A clerical amendment can be used to facilitate changing a typographical error and a technical amendment may be used to change a condition or schedule to a licence if there is no proposed change to emissions or storage capacity. An application for both clerical and technical amendments must be made via EDEN. A technical amendment request must contain a screening report, screening report for appropriate assessment, planning permission (if required), updated site boundary map, Irish Water approval for changes to emissions to sewer (if required), and overview diagrams and tables from the licence application form as appropriate.
- A licence review is required when significant changes are proposed such as changes in the classes of activity or changes to processes which have main emission points. A licence review application follows the same process as a new application. A review may be initiated by the licensee but also by the EPA for reasons such as to provide for changes to the legislation. Fees for review applications are 50% of the standard application fee (unless the review is initiated by the EPA in which case there is no fee). The EPA has published a schedule of fees on their website.

The EPA has produced a guidance document entitled '*EPA Guidance for Licensees on Requests for Alterations to the installation/facility*' which deals with these changes in more detail.

II. Financial Provision:

All operators of Anaerobic Digestion facilities whether permitted or licenced are required to put in place a financial provision to cover the cost of any potential environmental liabilities that may arise as a result of the operation of the facility. These are generally divided into two types namely known liabilities and unknown liabilities.

Known liabilities generally cover the cost of a planned closure and remediation of the site which would result in the site being restored to its previous use or potential future use with no outstanding environmental issues. Such planned closure may include removal of any waste from the site, decommissioning of all plant and machinery and any site repairs or demolition that may be required. The cost estimate for a planned closure process is known variously as a Closure Restoration and Aftercare Management Plan (CRAMP) or Decommissioning Management Plan (DMP).

Unknown liabilities usually refer to environmental incidents that cause pollution but may also occur as a result of the operator becoming insolvent. The type of incident may vary from a fire to release of digestate or leachate into a watercourse. The process by which the risk is assessed and costed for a particular facility is called an Environmental Liabilities Risk Assessment (ELRA). The EPA have produced a guidance document, which is available on their website, entitled '*Guidance on assessing and costing environmental liabilities'* (EPA, 2014). In assessing potential unknown liabilities, the 'worst case scenario' must be modelled and costed. In other words, if a fire is deemed to be the highest risk, the ELRA should also include any potential release of leachate or digestate to a watercourse as a result of the fire and include clean-up and monitoring costs in the financial provision.

The amount of the financial provision is required to be agreed with the permitting authority or the EPA. This can be a significant amount of money depending on the risks identified and it remains on the company's balance sheet as a financial liability for its lifetime. Once agreed with either the Local Authority or the EPA the mechanism for putting in place a financial provision can be one of the following:

- A secured fund or escrow account in favour of the Local Authority or the EPA.
- A bank guaranteed bond payable on demand by the Local Authority or the EPA.
- A parent company guarantee – this is normally only accepted from subsidiaries of multi-national companies.
- A charge on property owned by the permit holder or licensee.
- Environmental liabilities insurance.

However, in practice the first two options above tend to be preferred options in most cases. A guidance note entitled *Guidance on Financial Provision for Environmental Liabilities* (EPA, 2015) has been produced by the EPA and is available on their website.

Future Outlook for the Anaerobic Digestion in Ireland

Ireland is forecast to fail to meet RES targets by 2020, which would result in a substantial financial burden somewhere in the region of 100 million Euros a year per each 1% Ireland is off the target. However, Ireland is still lagging behind its European counterparts with regard to anaerobic digestion (AD) deployment, ranking 20th position among the EU28 countries, largely due to inadequate policy and support, despite all the cross-sectoral benefits provided by AD. This may well result in a major missed opportunity, should the current political trend prevail.

A stimulating regulatory and financial framework will have a big influence on the successful and widespread development of AD plants in Ireland. The most significant development constraint in Ireland has been an ongoing lack of economic viability for developers and investors. Improved fiscal incentives are urgently required to enhance the attractiveness of AD in Ireland for investors.

In contrast to this a stimulating regulatory and financial framework has had a big influence on the successful and widespread development of AD facilities in many other European countries.

As a result of the tariff being too low in Ireland, there have been few applications for support under REFIT 3 by AD plant developers. Consequently, the Department of Communications, Energy and Natural Resources (DCENR) reduced the allowance under REFIT 3 for AD from 50MW to 15MW, reallocating the budget for 35MW to biomass instead. The REFIT 3 scheme closed on 31st December 2015 and there is currently no replacement scheme in place to support electricity generation from biogas, which has exacerbated uncertainty in the market and further destabilised investor confidence.

In December 2017, the Minister announced that heat from biogas will receive the Renewable Heat Incentive (RHI), subject to State Aid approval. The situation regarding supports for electricity from AD and biomethane injection into the gas grid remains undetermined. In 2018, it is expected that the Government will make a decision on whether to support AD via electricity or biomethane. If the Government does support AD, it likely would be late 2019 before the scheme would be open to applicants.

AD provides a wide range of cross sectoral benefits, decision makers should consider these potential benefits in strategic policy going forward:

- AD is a proven and environmentally friendly technology that can deliver multiple energy, climate, environmental, societal and economic benefits.
- AD can help Ireland achieve its renewable energy targets for 2020 across all sectors, heat, electricity, transport and agriculture. This can be achieved with no impact on the food supply capability in Ireland, and no significant change in land use.
- The use of biogas from AD to provide pipeline quality renewable natural gas can enable us to meet the Renewable transport target (Re-T) using our natural gas pipeline, a significantly underutilised national resource.
- The challenge facing the agriculture sector to moderate its GHG emissions (32% of Ireland's total) and convert to a low carbon sector in the context of major growth to achieve the Food Wise 2025 targets, could be addressed by AD, with the added benefit of significant job creation in the rural economy, additional farm income stream and better control of energy costs for farmers and the wider economy.

APPENDIX

APPENDIX I

A. Glossary, conversion units and abbreviations

Glossary of General Terms Relating to AD

Acid: Traditionally considered any chemical compound that, when dissolved in water, gives a solution with a pH less than 7.0

Ammonia: A gaseous compound of hydrogen and nitrogen, NH3, with a pungent smell and taste.

Anaerobic bacteria: Micro-organisms that live and reproduce in an environment containing no "free" or dissolved oxygen. Used for anaerobic digestion.

Anaerobic digestion: A microbiological process of decomposition of organic matter, in the complete absence of oxygen, carried out by the concerted action of a wide range of micro-organisms. Anaerobic digestion (AD) has two main end products: *biogas* (a gas consisting of a mixture of methane, carbon dioxide and other gases and trace elements) and *digestate* (the digested substrate). The AD process is common to many natural environments and it is applied today to produce biogas in airproof reactor tanks, commonly named digesters.

Batch feed: A process by which the reactor is filled with feedstock in discrete amounts, rather than continuously.

Biochemical conversion: The use of biochemical processes to produce fuels and chemicals from organic sources.

Bioenergy (Syn. Biomass energy): Useful, renewable energy produced from organic matter. The conversion into energy of the carbohydrates in organic matter. Organic matter may either be used directly as a fuel or processed into liquids and gases.

Biogas: A combustible gas derived from decomposing biological waste under anaerobic conditions. Biogas normally consists of 50-60% methane

Biological Oxygen Demand (BOD): Chemical procedure for determining how fast biological organisms use up oxygen in a body of water.

Biomass feedstock: Organic matter available on a renewable basis. Biomass includes forest and mill residues, agricultural crops and wastes, wood and wood wastes, animal wastes, livestock operation residues, aquatic plants, fast-growing trees and plants, and municipal and industrial wastes.

Bioreactor (Syn. Digester): Device for optimising the anaerobic digestion of biomass and/ or animal manure, and possibly to recover biogas for energy production.

Capacity: The maximum power that a machine or system can produce or carry safely (The maximum instantaneous output of a resource under specific conditions). The capacity of generating equipment is generally expressed in kilowatts or megawatts.

Chips: Woody material cut into short, thin wafers. Chips are used as a raw material for pulping and fibreboard or as biomass fuel.

Centralised Anaerobic digestion (CAD): Supplying slurry from several animal farms to a centrally located biogas plant, to be co-digested with other suitable feedstock.

Co-generation: see combined heat and power generation (CHP)

Combined heat and power generation (CHP)(Syn. Co-generation): The sequential production of electricity and useful thermal energy from a common fuel source. Reject heat from industrial processes can be used to power an electric generator (bottoming cycle). Conversely, surplus heat from an electric generating plant can be used for industrial processes, or space and water heating purposes (topping cycle).

CO_2 –equivalents: CO_2 equivalent is a unit used to standardise measurements of. For example, tonne for tonne, methane is a greenhouse gas that is 21 times more powerful than carbon dioxide in causing the global greenhouse effect. Therefore one tonne of methane represents 21 tonnes of CO_2 equivalent.

Dedicated Energy Crops: (DEC) Crops grown specifically for their fuel value. These include food crops such as grass and corn, and non-food crops such as poplar trees and silage.

Digestate: The treated/ digested effluent from the AD process.

Digestion: see Anaerobic Digestion

Effluent: The liquid or gas discharged from a process or chemical reactor, usually containing digestate from that process.

Emissions: Fumes or gases emitted from chemical and biochemical processes I this case from the anaerobic digestion process. They include carbon dioxide, methane and nitrous oxide, which cause most of the global greenhouse effect.

Energy balance: Quantify the energy used and produced by the process.

Feedstock: Any material which is converted to another form or product.

Fermentation: see Anaerobic Digestion

Fossil fuel: Solid, liquid, or gaseous fuels formed in the ground after millions of years by chemical and physical changes in plant and animal residues under high temperature and pressure. Crude oil, natural gas, and coal are fossil fuels.

Fuel cell: A device that converts the energy of a fuel directly to electricity and heat, without combustion.

Gas turbine (syn. Combustion turbine): A turbine that converts the energy of hot compressed gases (produced by burning fuel in compressed air) into mechanical power. The used fuel is normally natural gas or fuel oil.

Gasification: The process in which a solid fuel is converted into a gas; also known as pyrolitic distillation or pyrolysis.

Gigawatt (GW): A measure of electric capacity equal to 1 billion watts or 1 million kilowatts.

Global warming: A gradual warming of the Earth's atmosphere reportedly caused by the burning of fossil fuels and industrial pollutants.

Generator: A device for converting mechanical energy to electrical energy.

Greenhouse gas (GHG): Gases that trap the heat of the sun in the Earth's atmosphere, producing the greenhouse effect. The two major greenhouse gases are water vapor and carbon dioxide. Other greenhouse gases include methane, ozone, chlorofluorocarbons, and nitrous oxide.

Grid: The electric utility companies' transmission and distribution system that links power plants to customers through high power transmission line service

Grid system: An arrangement of power lines connecting power plants and consumers over a large area.

Heat exchanger: Device built for efficient heat transfer from one fluid to another, whether the fluids are separated by a solid wall so that they never mix or the fluids are directly contacted.

Heat transfer efficiency: Useful heat output released/ actual heat produced in the firebox.

Heating value: The maximum amount of energy that is available from burning a substance.

Installed capacity: The total capacity of electrical generation devices in a power station or system.

Joule (J): Metric unit of energy, equivalent to the work done by a force of one Newton applied over a distance of one meter. 1 joule (J) = 0,239 calories; 1 calorie (cal) = 4,187 J.

Kilovolt (kV): 1 000 volts. The amount of electric force carried through a high-voltage transmission line is measured in kilovolts.

Kilowatt (kW): A measure of electrical power equal to 1 000 watts. 1 kW = 3,413Btu/hr = 1,341 horsepower.

Kilowatt-hour (kWh): The most commonly-used unit of measure telling the amount of electricity consumed over time. It means one kilowatt of electricity supplied for one hour.

Mesophilic digestion: Anaerobic digestion which takes place optimally around optimally around 30°-40°C

Methane (CH4): A flammable, explosive, colourless, odourless, tasteless gas that is slightly soluble in water and soluble in alcohol and ether; boils at –161,6°C and freezes at –182,5°C. It is formed in marshes and swamps from decaying organic matter, and is a major explosion hazard underground. Methane is a major constituent (up to 97%) of natural gas, and is used as a source of petrochemicals and as a fuel.

Mini-grid: An integrated local generation, transmission and distribution system serving numerous customers.

Municipal solid waste (MSW): All types of solid waste generated by a community (households and commercial establishments).

Photosynthesis: Process by which chlorophyll-containing cells in green plants concert incident light to chemical energy, capturing carbon dioxide in the form of carbohydrates.

Pilot scale: The size of a system between the small laboratory model size (bench scale) and a full-size system.

Power: The amount of work done or energy transferred per unit of time.

Process heat: Heat used in an industrial process

pH: An expression of the intensity of the alkaline or acidic strength of water. Values range from 0-14, where 0 is the most acidic, 14 is the most alkaline and 7 is neutral.

Plant: A facility containing prime movers, electric generators, and other equipment for producing electric energy.

Renewable resources: Naturally replenished, but flow-limited energy sources. They are virtually inexhaustible in duration, but limited in the amount of energy available per unit of time. Renewable energy resources include: biomass, hydro, geothermal, solar and wind. In the future they will include the use of ocean thermal, wave, and tidal action technologies. Utility renewable resource applications include bulk electricity generation, onsite electricity generation, distributed electricity generation, non-grid connected generation, and demand-reduction (energy efficiency) technologies.

Renewable energy: see Bioenergy

Sludge: Biosolids separated from liquids during processing. Sludge may contain up to 97% water by volume.

Substrate: see Biomass feedstock

Sustainable: An ecosystem condition in which biodiversity, renewability and resource productivity are maintained over time.

Total solids (Syn. Dry solid): The residue remaining when water is evaporated away from the residue and dried under heat.

Thermophilic digestion: Anaerobic digestion which takes place optimally around 50°C-60°C.

Turbine: A machine for converting the heat energy in steam or high temperature gas into mechanical energy. In a turbine, a high velocity flow of steam or gas passes through successive rows of radial blades fastened to a central shaft.

Volatile solids (VS): Those solids in water or other liquids that are lost on ignition of the dry solids at 550°C.

Volatile fatty acids (VFA): These are acids that are produced by microbes in the silage from sugars and other carbohydrate sources. By definition they are volatile, which means that they will volatilise in air, depending on temperature. These are the first degradation product of anaerobic digestion prior to methane creation.

Volts: A unit of electrical pressure. It measures the force or push of electricity.

Watt (W): A standard unit of measure (SI System) for the rate at which energy is consumed by equipment or the rate at which energy moves from onelocation to another. It is also the standard unit of measure for electrical power. The term 'kW' stands for "kilowatt" or 1 000 watts. The term 'MW' stands for "Megawatt" or 1 000 000 watts.

Conversion units

Kilowatt (kW) = 1 000 Watts
Megawatt (MW) = 1 000 kW
Gigawatt (GW) = 1 million kW
Terawatt (TW) = 1 thousand million kW
1 Joule (J) = 1 Watt second = 278 x 10^-6 Wh
1Wh = 3 600 J
1 cal = 4,18 J
1 British Thermal Unit (BTU) = 1 055 J
1 cubic meter (m^3) = 1 000 liter (L)
1 bar = 100 000 pascal (Pa)
1 millibar = 100 Pa
1 psi = 6894,76 Pa
1 torr = 133,32 Pa
1 millimeter mercury (0°C) = 133,32 Pa
1 hectopascal (hPa) = 100 Pa

Abbreviations

AD – Anaerobic digestion
BOD – Biological oxygen demand
CHP – Combined heat and power
C:N ratio – Carbon to nitrogen ratio
COD – Chemical oxygen demand
CoP – Code of Practice
DEC – Dedicated energy crops
DM – Dry matter
FF – Fresh feedstock
GHG – Greenhouse gases
HRT – Hydraulic retention time
kWh – Kilowatt hour
kWhel – Electrical kilowatt hour
MGRT – Minimum guaranteed retention time
N-P – Nitrogen to phosphorus
NPK –Nitrogen, phosphorus and potassium
ODM – Organic fraction of dry matter
ppm – Parts per million (1ppm = 0,0001%)
RD&D – Research development and demonstration
TLV – Threshold limit value
TS – Total solids
VFA – Volatile fatty acids
VS – Volatile solids

B. USEFUL CONTACTS LIST

Department of Agriculture, Food and the Marine
Animal By-Products Section, Department of Agriculture, Fisheries and Food, Pavilion B, Grattan Business Centre, Portlaoise, Co. Laois. Tel: 057-8694343, 057-8694345.
http://www.agriculture.gov.ie/agri-foodindustry/animalbyproducts/.

Sustainable Energy Authority of Ireland
Wilton Park House, Wilton Place, Dublin 2, Co. Dublin
Tel: 01-8082100
https://www.seai.ie/sustainable-solutions/renewable-energy/bioenergy/

Environmental Protection Agency
PO Box 3000, Johnstown Castle Estate Wexford.
Tel: 053-916 0600
www.epa.ie

Department of Communications, Climate Action and Environment
29-31 Adelaide Road, Dublin, D02 X285
Tel: 01 678 2000
https://www.dccae.gov.ie/en-ie/energy/topics/Renewable-Energy/Pages/default.aspx

Commission for Regulation of Utilities
The Grain House, The Exchange, Belgard Square North, Dublin 24, D24 PXW0
Tel: 01 4000800
www.cru.ie

Health and Safety Authority
The Metropolitan Building, James Joyce Street, Dublin 1, D01 K0Y8
Tel: 01 614 7000
www.hsa.ie

APPENDIX II

A. References, Photos, Figures & Tables

REFERENCES

Part I

Bord Gáis (2010), *The Future of Renewable Gas in Ireland*

Department of Agriculture, Food and the Marine (2015), *Food Wise 2025*

Environmental Protection Agency (2009), *Municipal Solid Waste – Pre-treatment & Residuals Management*

Environmental Protection Agency (2017a), *Ireland's Provisional Greenhouse Gas Emissions 1990-2016*

Environmental Protection Agency (2017b), *Ireland's Projected Greenhouse Gas Emissions 2016 – 2035*

Sustainable Energy Authority of Ireland (2017a), *Energy in Ireland 1990 to 2016*

Sustainable Energy Authority of Ireland *(2017b) Assessment of Cost and Benefits of Biogas and Biomethane in Ireland, Report prepared for SEAI by: Ricardo Energy & Environment*

Part II

www.hsa.ie/eng/Legislation

www.irishstatutebook.ie

www.hsa.ie/eng/Your_Industry/Construction/Construction_Duty_Holders/Client

www.hsa.ie/eng/Your_Industry/Construction/Construction

www.hsa.ie/eng/Publications_and_Forms/Publications/Construction/Guidelines_on_the_Procurement_Design_and_Management_Requirements_of_the_Safety_health_and Welfare_at_Work_Construction_Regulations_2013_Updated.html

The OSH Framework Directive (89/391/EEC-OSH)

Code of Practice for Chemical Agents, HSA 2016

www.hsa.ie/eng/Topics/Managing_Health_and_Safety/Safety_Statement_and_Risk_Assessment/

Section 20 of the Safety, Health and Welfare at Work Act 2005

www.hsa.ie/eng/Topics/Confined_Spaces

Part III

Commission Regulation (EU) No 142/2011 of 25 February 2011 implementing Regulation (EC) No 1069/2009 of the European Parliament and of the Council laying down health rules as regards animal by-products not intended for human consumption and implementing Council Directive 97/78/EC as regards certain samples and items exempt from veterinary checks at the border under that Directive.

Commission Regulation (EC) No 1069/2009 of the European Parliament and of the Council of 21 October 2009 laying down health rules as regards animal by-products and derived products not intended for human consumption and repealing Regulation (EC) No 1774/2002 (Animal by-Products Regulation) http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:300:0001:0033:EN:PDF

Department of Agriculture, Food and the Marine (2014a) *CN11 Conditions Document for Biogas Plants transforming Animal By-Products in Ireland*
https://www.agriculture.gov.ie/media/migration/foodindustrydevelopmenttrademarkets/animalbyproducts/applicationformsconditionsforabpprocessingoperations/conditionsforms/CN11ApprovalOperationBiogasPlants200617.pdf

Department of Agriculture, Food and the Marine (2014b) *CN9 Conditions Document for On Farm Biogas Plants own ABP*
https://www.agriculture.gov.ie/media/migration/foodindustrydevelopmenttrademarkets/animalbyproducts/applicationformsconditionsforabpprocessingoperations/conditionsforms/CN9160916.pdf

Department of Agriculture, Food and the Marine (2014c) *CN14 Conditions Document for a 'Type 8' Composting-Biogas plant in Ireland*
https://www.agriculture.gov.ie/media/migration/foodindustrydevelopmenttrademarkets/animalbyproducts/applicationformsconditionsforabpprocessingoperations/conditionsforms/CN14160916.pdf

Part IV

Directive (EU) 2015/2193 of the European Parliament and the Council of 25 November 2015 on the limitation of emissions of certain pollutants into the air from medium combustion plants (Medium Combustion Plant (MCP) Directive).

DoEHLG (2009) Appropriate Assessment of Plans & Projects - Guidance for Planning Authorities.

Environmental Protection Agency (2008) *Guidance Manual Waste Facility Permit and Registration Regulations 2008 (amended 2012).*

Environmental Protection Agency (2014) *Guidance on assessing and costing environmental liabilities*. EPA, Office of Environmental Enforcement.

Environmental Protection Agency (2015) *Guidance on Financial Provision for Environmental Liabilities* EPA, Office of Environmental Enforcement.

Environmental Protection Agency (2017c) *Guidelines on the Information to be contained in Environmental Impact Assessment Reports.* Draft August 2017.

Environmental Protection Agency (Industrial Emissions) (Licencing) Regulations 2013, (S.I. No. 137 of 2013).

European Commission Joint Research Centre (2017) *Draft Best Available Techniques (BAT) Reference Document for Waste Treatment. Industrial Emissions Directive 2010/75/EU (Integrated Pollution Prevention and Control).*

The Industrial Emissions Directive (IED) 2010/75/EU.

Irish Standard 441:2011 National Standard for Compost Quality

Waste Management (Facility Permit and Registration) Regulations 2007 (amended 2008). S.I. 821 of 2007 and S.I. 86 of 2008.

Waste Management Act 1996 as amended.

PHOTOS

FIGURES

TABLES

B. Animal By-Product reference to guidance documents and links

The regulations changed frequently and it is important to keep to updated. The Department of Agriculture, Food and the Marine (DAFM) has an updated ABP webpage on http://www.agriculture.gov.ie/agri-foodindustry/animalbyproducts. This website is a set of frequently asked questions and the latest version of application forms.

Application forms and conditions are available from the Animal By-Products Section, Department of Agriculture, Fisheries and Food, Pavilion B, Grattan Business Centre, Portlaoise, Co. Laois. Tel: 057-8694343, 057-8694345 or alternatively most application forms and conditions are available on the DAFM website (links below).

Stage 1 – On Farm Biogas Plant

AP09 Application Form for First Stage Approval to operate an on-farm Biogas plant
https://www.agriculture.gov.ie/media/migration/foodindustrydevelopmenttrademarkets/animalbyproducts/applicationformsconditionsforabpprocessingoperations/applicationforms/AP09150916.pdf

Stage 2- On Farm Biogas Plant

AP09A Application form for conditional approval to treat ABPs in an on-farm Biogas Plant
https://www.agriculture.gov.ie/media/migration/foodindustrydevelopmenttrademarkets/animalbyproducts/applicationformsconditionsforabpprocessingoperations/applicationforms/AP09A150916.pdf

Stage 1- Biogas Plant

AP11 Application Form for First Stage Approval to operate a Biogas Plant
https://www.agriculture.gov.ie/media/migration/foodindustrydevelopmenttrademarkets/animalbyproducts/applicationformsconditionsforabpprocessingoperations/applicationforms/AP11150916.pdf

Stage 2 Application Form- Biogas Plant

AP11A Application form for approval to operate as a Biogas plant
https://www.agriculture.gov.ie/media/migration/foodindustrydevelopmenttrademarkets/animalbyproducts/applicationformsconditionsforabpprocessingoperations/applicationforms/AP11AAppApprovalOperateBiogasPlant290517.pdf

CN9 Conditions Document for On Farm Biogas Plants own ABP

https://www.agriculture.gov.ie/media/migration/foodindustrydevelopmenttrademarkets/animalbyproducts/applicationformsconditionsforabpprocessingoperations/conditionsforms/CN9160916.pdf

CN11 Conditions Document for Biogas Plants transforming Animal By-Products in Ireland

https://www.agriculture.gov.ie/media/migration/foodindustrydevelopmenttrademarkets/animalbyproducts/applicationformsconditionsforabpprocessingoperations/conditionsforms/CN11ApprovalOperationBiogasPlants200617.pdf

CN14 Conditions Document for a Type 8 Composting-Biogas plant in Ireland

https://www.agriculture.gov.ie/media/migration/foodindustrydevelopmenttrademarkets/animalbyproducts/applicationformsconditionsforabpprocessingoperations/conditionsforms/CN14160916.pdf

C. Anaerobic Digestion Waste Permit Application Checklist

Information to be included where applicable	Article of Regulations S.I. 821 of 2007	Included
Completed application form (and specified number of copies)	10(1)	YES ☐ NO ☐ N/A ☐
Company Number and copy of the appropriate certificate issued by the Companies Registration Office	10(1)(h)	YES ☐ NO ☐ N/A ☐
Provide specified Company Registration or Trade Name	10(1)(i)	YES ☐ NO ☐ N/A ☐
Evidence of legal interest in land if owner i.e. land folio number and map. Where the applicant is not the owner of the land (leaseholder, tenant, prospective purchaser) a letter of consent by way of a legal agreement between the owner and the applicant consenting to the use of the land for the purposes of a Waste Facility, or lease agreement.	10(1)(c)	YES ☐ NO ☐ N/A ☐
Details of any court hearing/s, case/s, nature of the offence/s and any penalties or requirements imposed by the court	10(1)(dd),(ee)	YES ☐ NO ☐ N/A ☐
Where the applicant is a person or partnership, include details of any such conviction where the person or partner was at any time within the last 10 years prior to this application, a director, manager, company secretary or similar officer for a body corporate.	10(2)(b)	YES ☐ NO ☐ N/A ☐
Evidence of the applicant's ability to meet the financial commitments or liabilities which will be entered into or incurred by the person(s) in carrying on the activity or in ceasing to carry on the activity at the facility. Attach evidence of insurances.	10(1)(s)	YES ☐ NO ☐ N/A ☐
Certificate/declaration of exemption from the relevant planning authority	10(1)(t)	YES ☐ NO ☐ N/A ☐
Article 11 declaration issued by the Environmental Protection Agency	10(1)(u), 11	YES ☐ NO ☐ N/A ☐
Copy of Environmental Impact Statement where disposal or recovery activities are greater than 25,000 tonnes	10(1)(cc)	YES ☐ NO ☐ N/A ☐
Facility closure plan, purpose of fill and supporting statement as to the purpose of land development/improvement (Classes 5 & 6 only)	10(1)(x)	YES ☐ NO ☐ N/A ☐
Arrangements for the off-site recovery/disposal of wastes	10(1)(bb)	YES ☐ NO ☐ N/A ☐
Details of any application made to the Minister for Agriculture and Food for veterinary authorisation for the facility (Class 8 only)	10(1)(w)	YES ☐ NO ☐ N/A ☐
Details of any Natura 2000, Ramsar or other designated site where the facility is located within	10(1)(x)	YES ☐ NO ☐ N/A ☐

Flood study where site is located in the immediate catchment of a water course	10(1)(aa)	YES ☐	NO ☐	N/A ☐
Details of any discussions or correspondence with Minister of the Environment, Heritage and Local Government and/or National Parks and Wildlife Service	10(1)(z)	YES ☐	NO ☐	N/A ☐
Details of biodiversity of the land	10(1)(y)	YES ☐	NO ☐	N/A ☐
Signed and original Statutory Declaration	10(1)(cc)	YES ☐	NO ☐	N/A ☐
Signed and original Financial Declaration	10(1)(cc)	YES ☐	NO ☐	N/A ☐
A copy of the relevant page from the newspaper in which notice was published	10(3)(a)	YES ☐	NO ☐	N/A ☐
A copy of the text of the notice erected or fixed	10(3)(b)	YES ☐	NO ☐	N/A ☐
Copy of tax clearance issued by the Revenue Commissioners or appropriate certificate from the relevant tax authority for non-domiciled applicants	10(3)(d)	YES ☐	NO ☐	N/A ☐
Application fee in accordance with article 42 and as specified in the fifth schedule of the regulations	10(3)(f)	YES ☐	NO ☐	N/A ☐
Maps and Drawings				
Ordnance Survey Discovery Series Sheet (1:50,000)	10(3)(c)	YES ☐	NO ☐	N/A ☐
Site location map at appropriate scale to include: a clear delineation of the site boundaries, site notice locations, Ordnance Survey Sheet Reference Number(s), Elevation Levels and Ordnance Datum used, Dimensions (metres) and Orientation of North Point	10(3)(c)	YES ☐	NO ☐	N/A ☐
Proposed site layout with a clear delineation of the site boundaries, ordnance survey sheet reference number(s), elevations levels (metres) and Ordnance datum used, dimensions (metres) and orientation of North point	10(3)(c)	YES ☐	NO ☐	N/A ☐
Additional copy of the proposed layout plan of the facility at an appropriate scale to include where applicable: site entrance, waste storage areas, waste treatment areas, site drainage including interceptor, site office, weighbridge, traffic flow, nature of surfacing within the facility, emission points, monitoring points and site notice locations	10(3)(c)	YES ☐	NO ☐	N/A ☐
Topographical survey to provide existing and proposed surface levels & cross sectional drawings (Classes 5 & 6 only)	10(1)(x)	YES ☐	NO ☐	N/A ☐

D. Exemptions to Waste Permit/License Requirements

There are a possible number of exemptions in relation to waste permits, but it is complicated and the Environmental Protection Agency should be contacted at first instance to clarify the status of a future biogas development.

The takeaway message is that an **AD plant with capacity >100 tonnes of waste per day will likely require an Industrial Emissions Licence** (IEL). Anything smaller than that, treating faecal matter and grass silage, will likely not require a waste authorisation.

THE DETAIL:

1. Waste versus non-waste:

First it needs to be clarified whether the inputs of the on-farm AD process are waste, non-waste or a mixture of waste and non-waste. **If the AD process only treats non-waste inputs then no waste authorisation is required** for this process. Grass silage produced for the purposes of generating biogas would not be classified as waste.

If waste or a mixture of waste and non-waste is used then a waste authorisation will be required for the activity, subject to any exemptions below.

2. Potential need for an Industrial Emission Licence:

Activity Class 11.4(b)(i) of the First Schedule of the Environmental Protection Act 1992, as amended, requires an Industrial Emissions Licence for the anaerobic digestion of non-hazardous waste where the recovery activity has the capacity exceeding 100 tonnes per day (the threshold is stated in 11.4(c)). If the activity is below this threshold, see 3;

3. Potential need for a Waste Licence or Waste Facility Permit:

i. Section 51 of the Waste Management Act 1996, as amended, does provide an exemption from the need for waste authorisation under the WMA for "…the recovery of sludge for use in agriculture". Something to note regarding this exemption is that both sludge and agriculture are defined in the Waste Management (Facility Permit and Registration) Regulations 2007, as amended, as follows:

"Sludge" means –
a) Residual sludge from sewage plants treating domestic or urban waste waters and from other sewage plants treating waste waters of a composition similar to domestic and urban waste waters,
b) Residual sludge from septic tanks and other similar installations for the treatment of sludge, or
c) Residual sludge from sewage plants other than those referred to in (a) and (b).

"Agriculture" means the growing of all types of commercial food crops, including food crops for stock-rearing purposes.
So this exemption is not relevant for on-farm slurry and grass silage.

ii. Section 3(1)(g) of the WMA states that the Act shall not apply to:
Faecal matter, if not covered by subsection (2)(b), straw and other natural non-hazardous agricultural or forestry

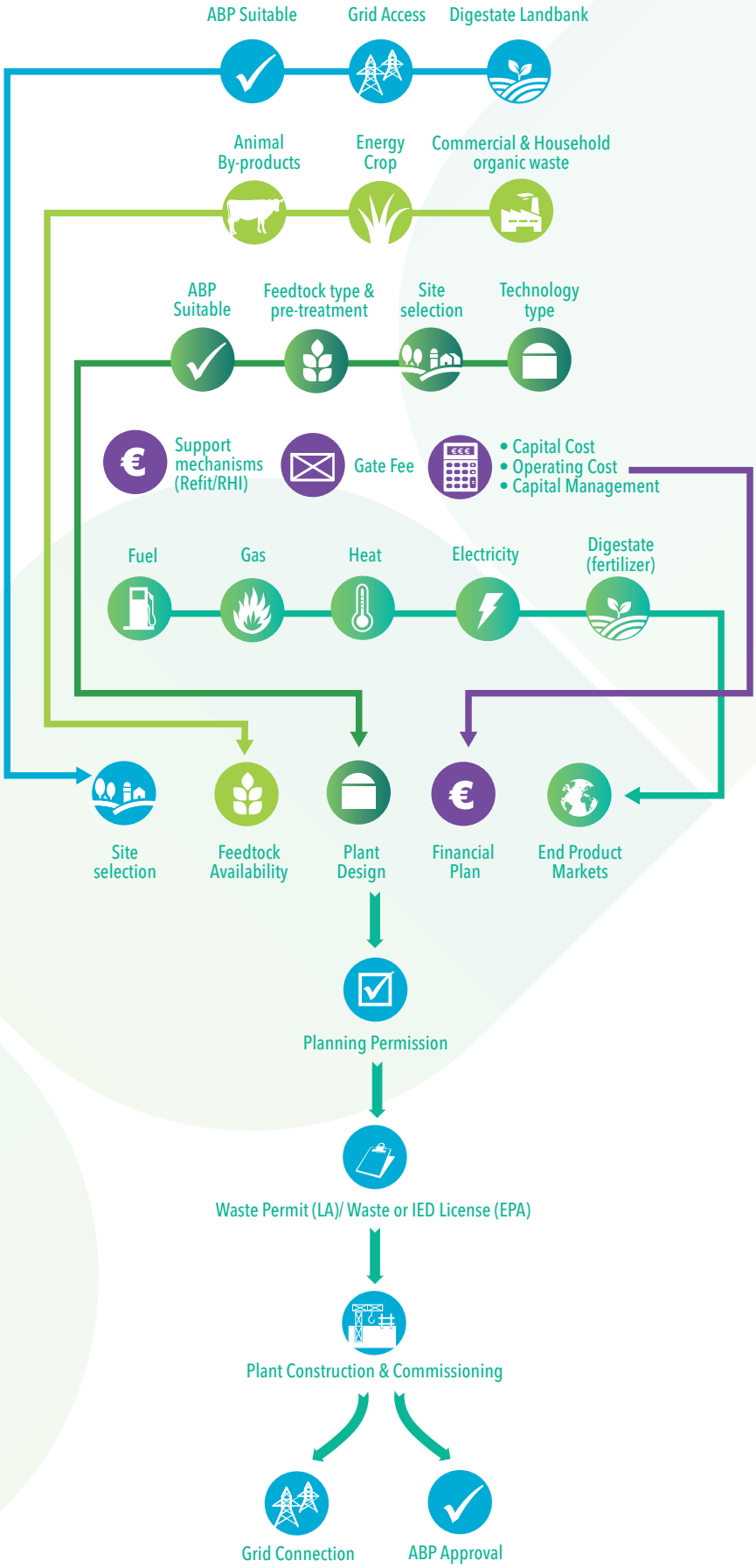
material used in farming, forestry of for the production of energy from such biomass through processes or methods which do not harm the environment or endanger human health.

So this exemption will be relevant for on-farm slurry and grass silage.

A waste authorisation under the WMA is not required if an operator could demonstrate that the above conditions are met.

iii. Sections 3 and 51 provide exemptions from the need for waste authorisation under the WMA only. If the exemption conditions above have been met there remains the potential for larger activities to require an Industrial Emissions Licence as per point 2 above.

KEY STEPS TO BUILDING A BIOGAS PLANT



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