

FACT SHEET: Requirements for the Treatment and Application of Digestate and Sewage Sludge (Biosolids)

- Cases of several countries

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Background

Waste is a resource from which not only materials and energy but also nutrients can and should be recycled or recovered. Recovery of nutrients from organic waste is typically done through biological treatment processes: composting and anaerobic digestion, producing nutrient-rich outputs such as compost and digestate. Along with improvements to treatment processes, the introduction of policies establishing a legal definition for “end of waste criteria” and providing clear guidelines for quality criteria, may further enhance the use in agriculture, forestry and landscaping of compost and digestate produced from biowaste.

Digestate is the material that remains after the treatment of biodegradable waste by the process of anaerobic digestion. The quality of the digestate depends on the quality of the feedstock and the technology or process used. The use of source separated biowaste (garden waste, food waste from households, commercial kitchen waste etc.) as an input-material provides a better quality digestate for agronomical uses than that obtained from mechanical treatment of mixed municipal waste.

Sewage sludge is the residual solid material remaining from the wastewater treatment process. Treated sewage sludge is normally referred to as “biosolids”. Sewage sludge can be recovered as a material via a number of different treatment processes. The most common treatment processes are Anaerobic Digestion and Composting.

Sewage sludge and digestate contain organic matter and essential plant nutrients required for plant growth such as Phosphorous (P), Nitrogen (N), Potassium (P) and Sulphur (S). However, they, especially sewage sludge, may also contain contaminants such as heavy metals, industrial chemicals, pharmaceuticals, nano particles, infectious pathogens, etc. Both anaerobic digestion and composting, depending on the effectiveness of the treatment process and the contamination levels of the feedstock, can result in the destruction of most organic contaminants to a sufficient level to allow the resulting material to be safely applied to land as a soil amendment material or used in agriculture as fertiliser. Land application of biologically treated waste is regulated in most countries to protect human health, the environment and soil functionality from detrimental impacts associated with potential contaminants.

Land application of treated sewage sludge (biosolids) and digestate is a means through which phosphorous, nitrogen, potassium, sulphur and organic matter can be returned to the soil, thereby leading to a more efficient closing of the nutrient cycle. Land application of organic waste can also contribute to the long-term stabilisation of carbon content in the soil (carbon sequestration), thereby decreasing atmospheric CO² levels.

Despite the above-mentioned benefits, there is a number of constraints associated with the use on land of waste based nutrients, including the already identified risks involved with contamination, the added costs for control and regulatory measures, associated odours, land application restrictions (such as climate, seasons, harvest), etc. An additional constraint to a more extensive use of waste-derived fertilisers is in fact the limited market demand for these products, mostly because of the current availability and affordability of chemical fertilisers. However, with the widespread recognition that phosphorus is unsustainably extracted, the recycling of nutrients from sludge is gaining more recognition and investigation in some EU¹ countries.

This fact sheet provides an overview of the different legislation and practices in several countries regarding the treatment and application on land of digestate and sewage sludge. This comes at a time when the European Union is investigating the establishment of End-of-Waste criteria for particular waste types, i.e. when certain wastes fulfill the status of a product (secondary raw material) and cease to be classified a waste. There are three basic positions relating to the use on land of sewage sludge and digestate around the world (also summarised in Figure 1 on page 11):

1. Legislation is in place outlining the criteria under which sewage sludge and/or digestate can be deemed a product to be used as a fertiliser/soil conditioner.
2. Can be applied to land but is still deemed a waste (waste legislation applies). The application may or may not be restricted.
3. Land application is not practised at all.

¹ European Union

Digestate

Requirements for treatment and application

COUNTRY	Is Digestate considered as a “product”?	Is the legal status as a “product” only restricted to some particular input? (e.g. farm waste, slurry)	Is there any obligation for post-treatment of Digestate through composting?	What are basic requirements for the application of Digestate? (e.g.: a permit? Communication? What elements must the communication include? Deep injection?)	What are the on-going discussions concerning environmental and agricultural issues and benefits pertaining to direct application/post-composting of Digestate?
AUSTRIA	<p>Generally NO</p> <p>YES, if composted according to the Austrian Compost Ordinance</p> <p>YES, if registered according to the Austrian Fertiliser Ordinance</p>	Input materials according to the Austrian Compost Ordinance and respectively the Austrian Fertiliser Ordinance	NO	Basic requirements on input materials (see column 2 and 3) and the EU Nitrate Framework Directive	Climate-relevant gases; Separation of Digestate (liquid/solid); Criteria for product-status
DENMARK	Yes, if only origin is from animal husbandry.	Only Digestate from animal husbandry is considered a product –the rules of fertiliser application apply.	No, but slightly different rules of sanitation.	Maximum 0.7 ton Total Solid per hectare and accounted for in the fertiliser accounts (nitrate directive etc.)	Currently there is no such discussion.

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	Under which conditions?				
		If stemming from biowaste, sludge etc. There is one directive covering sludge, Biowaste and Digestate.			
GREECE	Not considered in Greek legislation	Not considered in Greek legislation	Maturation is an obligation for composting (aerobic) facilities that include an intensive aeration step, according to CMD 114218/1997. So, maturation of Digestate (slurry/sludge coming out of the digester) is	Specifications for the use of “compost” in agriculture exist in CMD 114218/1997. Quality of compost is not defined into different classes and the “origin” of compost is not considered (whether it is from biowaste composting, from sludge composting, from Anaerobic Digestion, etc.). No effort has been made so far to use Digestate on farms.	Currently there is no such discussion.

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	Under which conditions?				
			considered “de-facto” necessary, though not included in legislation	Agricultural authorities (central and local) express their opinion during the EIA procedure of AD facilities	
ITALY	NO it is not, if digestate is from wastes (i.e. from biowaste, sludge etc.	There’s no nation-wide legal definition for digestate to be classified a product But if digestate comes from: •liquid slurry, •biomass of plants grown with this aim, •by-products from farming, then composting is not necessary and it is	YES: Composting is necessary for it to become a product if digestate comes from waste treatments; NO obligation if it comes as by-products	Permits and communications according to the EU Nitrate Directive Max 170 kgN/ha if digestate is from liquid slurry (applies only to nitrate vulnerable areas).	Waste/No waste; fertilisers or non fertilisers; Phytotoxicity; methane.
	It is a waste and must be composted to become a product and to be used as organic fertiliser, so to comply with Italian Fertiliser Law.				

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	Under which conditions?				
		possible to use it directly in agriculture.			
MALAYSIA	No legal definition. Not much digestate production. Only limited digestate from palm oil industry and the residue is used in their oil plantations or is burnt to produce steam.	Not applicable	NO	If it is within the Malaysian standards of disposal no permit is required.	Only palm oil industry is exploring this area to use the digestate for land farming.
NORWAY	Yes, given the quality class 0-3 under the Ordinance for organic fertiliser . The ordinance is under revision since spring 2010, but no new draft	Generally no restriction. Raw materials must also apply with quality class 3, regarding heavy metal content. Focus is on a general risk management through	No	Basic requirements (same as for waste based compost and sewage sludge) on <ul style="list-style-type: none"> •input materials •Quality (heavy metals, absents of organic pollutants and pharmaceuticals, hygienisation, stability, 	The existent ordinance is not well adjusted for the use of liquid or un-separated digestate. This is one of the expected changes in the revised

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NORWAY (continued)	has been released.	internal control and quality criteria for the end product.		germs, impurities <ul style="list-style-type: none"> •Registration of product and reporting •Use according to quality class (0-3) •Declaration Special requirements for products based on sewage sludge <ul style="list-style-type: none"> •Communication prior to application (where local authority within two weeks can require changes) Also special demands for manure spread on “foreign” land	ordinance. Biogas plants under planning and in operation are exploring the possibilities for this use as it is considered to be the best way to: <ul style="list-style-type: none"> •Utilise all the fertilisers in agriculture and here give the best fertiliser value •With the utilisation in agriculture the phosphor-cycle can be closed. Other plants with

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	Under which conditions?				
					little agricultural land in the area (Western Norway) are considering the production of specialised organomineral fertiliser pellets from the digestate that can be transported to the areas with demand for (organic) fertilisers.
PORTUGAL	NO, if digestate is from wastes (i.e. from biowaste, sludge etc.) it must be composted	There’s no nation-wide definition as product concerning digestate	YES, otherwise it will be seen as an effluent /waste product to be treated.	Not defined	Waste/No waste; fertilisers or no fertilisers; Product hygienization requirements

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	Under which conditions?				
SCOTLAND	<p>The AD process and any digestate produced must be certified to conform to the standards contained in BSI PAS110:2010.</p> <p>The digestate must meet this standard without having to be blended with any other materials including other digestates, composts, materials, products or additives.</p> <p>The PAS 110:2010 certification process must be carried out by a third party accredited by</p>	<p>Only waste that conforms with the following criteria can be used to produce digestate:</p> <ul style="list-style-type: none"> • it is derived from animal or plant origin; and • it has been collected separately from other wastes and not combined with any other waste; and • it is capable of being decomposed by microorganisms or other soil-born organisms or enzymes; and • steps must have been taken to ensure no potentially polluting or toxic materials or products 	<p>The digestate must be used without requiring any further processing or recovery operations. They must not be used in quantities or reapplied on the same land at frequencies that will result in any risk of adverse impact on the environment or human health. Otherwise, this is likely to be regarded as a disposal operation</p>	<p>All non-waste regulatory controls must be complied with for the use of the digestates and they must be used in accordance with good practice. For use in agriculture, such requirements include:</p> <ul style="list-style-type: none"> • Prevention of Environmental Pollution From Agricultural Activity Code of good practice (PEPFAA code) • Four Point Plan • Nitrate Vulnerable Zones regulations (NVZ regulations). 	<p>Currently there is no such discussion.</p>

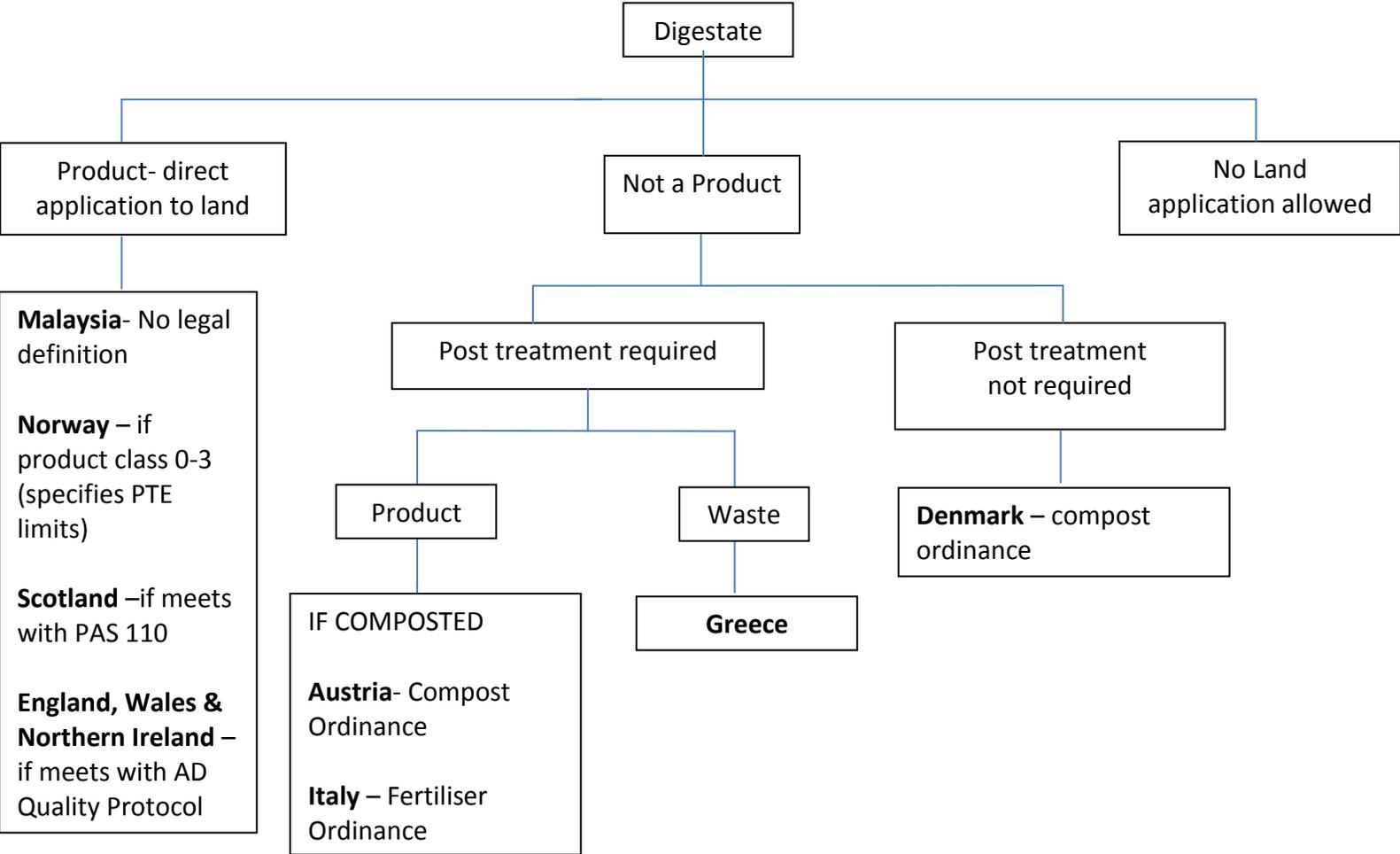
COUNTRY	Is Digestate considered as a “product”?	Is the legal status as a “product” only restricted to some particular input? (e.g. farm waste, slurry)	Is there any obligation for post-treatment of Digestate through composting?	What are basic requirements for the application of Digestate? (e.g.: a permit? Communication? What elements must the communication include? Deep injection?)	What are the on-going discussions concerning environmental and agricultural issues and benefits pertaining to direct application/post-composting of Digestate?
	Under which conditions?				
	the United Kingdom Accreditations Service.	are used, including invasive plant species •No waste from the leather industry (i.e. those listed in the European Waste Catalogue under chapter 04.01) or sludge from sewage treatment processes can be included as input material to the AD process producing digestate.	(i.e. a landfill).		
	If it meets with the “Anaerobic Digestion Quality Protocol: End of waste criteria for the production and use of quality outputs from anaerobic digestion of	Quality outputs from anaerobic digestion include the whole digestate, the separated fibre fraction and the separated liquor.	No pre-treatment. Designated market sectors: Quality Digestate must be destined for appropriate use	Records must be kept of all quality digestate produced using the anaerobic digester and also of all waste leaving the facility. For all quality Digestate, these records must correspond to the	Odours, biodegradability of bags used in separate collection schemes, pesticide residues, Clostridium spp.

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	Under which conditions?				
UNITED KINGDOM (England and Wales only).	<p>source-segregated biodegradable waste”. The specified standard is BSI PAS 110.</p> <p>Producers must demonstrate compliance with the requirements of this Quality Protocol and of the approved standard. Compliance can be demonstrated from an approved certification body operating according to scheme rules agreed with the Environment Agency. The approved certification body must also obtain accreditation on an annual basis from</p>	<p>If these criteria are met, quality outputs from anaerobic digestion will normally be regarded as having been fully recovered and to have ceased to be waste.</p> <p>Quality digestate will normally be regarded as having ceased to be waste, and therefore no longer subject to waste management controls, provided it:</p> <ul style="list-style-type: none"> •has been produced using only those source-segregated input materials listed in (this means that it is for defined input wastes that have been collected 	<p>within one or more of the following market sectors:</p> <ul style="list-style-type: none"> •agriculture, forestry and soil/field-grown horticulture; and • land restoration (where only separated fibre can be used). <p>If good practice is followed, the Environment Agency considers that quality Digestate will not pose a risk to</p>	<p>supply documentation issued to the customer (see Appendix G). The following details of the destination of the quality Digestate must be kept:</p> <ul style="list-style-type: none"> •date; •quantity of weight/volume and batch assessment/certification code(s); •name and address of receiving business/establishment; and •designated market sector. <p>To demonstrate that the material is used in the right way and that the environment is protected, the land manager receiving</p>	

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	Under which conditions?				
UNITED KINGDOM (England and Wales only).	the United Kingdom Accreditation Service (UKAS) to BS EN 45011: 1998	separately); <ul style="list-style-type: none"> • meets the requirements of an approved standard; and • is destined for appropriate use in one of the designated market sectors. <p>The standard is BSI PAS 110</p>	human health or the environment in the quantities and frequencies at which they are likely to be applied in these sectors. Good practice means that anyone who uses the quality Digestate takes account of all potential environmental issues such as application rates, impacts on soil function, potential for water pollution, etc.	the quality Digestate is responsible for ensuring that: <ul style="list-style-type: none"> • records are established, retained and made available to the certification body as defined by guidelines. 	

Digestate: options of use diagram

Figure 1- Schematic overview of legislative framework regulating the application of digestate on land.



Sewage Sludge

Requirements for treatment and application

Country	Is sewage sludge used on farmlands?	Any legal obligation on “pre-treatment”? What are main restrictions on use? (Seasonal, crop-specific, soil-specific, etc.)	What types of treatment are considered legally suitable? (e.g. liming, composting, thermal treatment, anaerobic digestion)	What is the general (or official) position/opinion of farmers, or farmers’ associations?	What are the on-going main discussions concerning environmental and agricultural issues and benefits pertaining to application of sludge? (e.g. odours, pathogens, pollutants, release of N, etc.)
AUSTRIA	YES (with the exception of some regions, e.g. Salzburg, Tirol)	YES (with regional differences) Seasonal Crop and soil-specific (heavy metals) N/P demand of plants	Stabilisation Liming Composting Anaerobic digestion Thermal treatment (drying and incineration) (Reed beds)	Accepted, when used within legal frameworks	Hygienic aspects (pathogens, organic pollutants) and micro-pollutants
DENMARK	Yes	Sanitation, heavy metal limits and organic pollutants	<ul style="list-style-type: none"> •If no treatment it must not be used •If stabilised (liming etc.) it must be used if ploughed down within 6 hours and not on 	There is in general confidence in the control today.	In Denmark ground water is used for drinking the main skepticism comes from this front, this is also due to technology

Country	Is sewage sludge used on farmlands?	Any legal obligation on “pre-treatment”? What are main restrictions on use? (Seasonal, crop-specific, soil-specific, etc.)	What types of treatment are considered legally suitable? (e.g. liming, composting, thermal treatment, anaerobic digestion)	What is the general (or official) position/opinion of farmers, or farmers’ associations?	What are the on-going main discussions concerning environmental and agricultural issues and benefits pertaining to application of sludge? (e.g. odours, pathogens, pollutants, release of N, etc.)
			<p>eatable crops, in gardening or residential areas</p> <ul style="list-style-type: none"> •If controlled composted (55 degree 14 days) the rule of ploughing down does not apply (see above) •If Controlled Sanitized (70 degree for one our) (can be by composting) no sanitary restrictions apply 		<p>suppliers who want to burn the sludge; they are very active trying to discredit sludge. Authorities see the importance of recycling Phosphor a limited resource in 50 years from now.</p>
GREECE	Not officially.	Main legislation is the CMD 80568/4225/1991 (Dir. 86/278/EC) and the CMD 114218/1997. Application of non-treated sludge is not allowed on farms.	No limitation as long as the “ <i>process significantly reduces biodegradable content and health dangers</i> ”	No official opinion has been expressed. Unofficially it is expected that farmers have a “negative” opinion	All the above are ongoing issues, especially because legislation is quite old (1991, 1997)

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		Treatment is defined as: <i>“biological, chemical or thermal treatment, long-term storage, or any other process that significantly reduces biodegradable content and health dangers”</i>			
ITALY	<p>YES, but only low quantity of total production.</p> <p>From total Sewage Sludge production about 10-15% are used and another 10-15% used as fertilisers after composting.</p>	<p>Sewage Sludge is a waste. Hence legal obligation refer to waste Laws</p> <p>Use: according to waste legislation no more than 15t/ha dm in three-year period and no application during growing period (i.e. only</p>	Composting, anaerobic digestion, biological treatment, Chemical treatment, Heat-treatment	<p>There is no official position of the association but the general opinion is very critical. For the farmers the main element of doubt is the “status” of waste.</p> <p>Doubts do not apply when Sewage Sludge</p>	<p>Organic pollutants (main topic of discussion)</p> <p>Type of treatments suitable for Sewage Sludge</p>

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ITALY (Continued)		<p>when no culture is taking place.</p> <p>Restrictions: maximum level of heavy metal content in soil and in sewage sludge.</p> <p>-----</p> <p>Composted Sewage Sludge can be used on farmlands as a fertilizers (it’s compost = product) without restrictions.</p>		has been composted (it then has the status of product)	
MALAYSIA	Not used at all officially.	Restricted to non-food crop use, principally for forestry and	Mesophilic anaerobic digestion and thermophilic aerobic	No official statement.	Treated sludge does not comply with discharge standards due to

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		<p>horticulture Basic guidelines exist.</p> <p>Legal requirements exist for sludge treatment but only limited large scale plants do this.</p>	<p>digestion.</p> <p>Liquid sludge storage</p> <p>Sewage treatment process</p> <p>Lime stabilisation of liquid sludge</p> <p>Dewatering and storage Conditions for the treatment process exist.</p> <p>Currently sludge undergoes sewage treatment process and then it is dewatered on sand beds. Dried sludge is discarded into landfills.</p>		<p>treatment facilities not designed to comply with the absolute standards and level of maintenance was not satisfactory.</p> <p>Government plans to introduce more large centralized WWT plants, so that biogas production could be initiated. There is interest in sludge utilization for landscaping.</p>

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			Only 2 plants have facilities to use anaerobic digestion of sludge to produce biogas.		
NORWAY	Yes, over 60 % of treated sludge (biosolids) production is recycled to agriculture mainly for the production of cereals in the east/south east parts of Norway	Yes, stabilisation and disinfection (hygienisation) of all biosolids are required prior to land application. In addition, biosolids must be ploughed-in when applied to arable land. When biosolids are used as an ingredient in a by- product, the requirements apply to both biosolids before	The following processes have been validated against their ability to inactivate viable helminth eggs which is the crucial hygienisation requirement in Norway : Pre-pasteurisation, Thermophilic aerobic pre-treatment, Thermophilic anaerobic digestion,	Accepted, when used within legal frameworks. Recent risk assessment under the direction of the Norwegian Food Safety Committee has confirmed this general opinion.	During the past 2 -3 years the use of phosphate fertilisers on agricultural land has come into national focus due to the considerable increase of the total phosphorous content in the soil and must be reduced according to new fertilising standards. In addition, the current implementation of the

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		mixing as well as to the final mixture. Apart from heavy metal standards biosolids shall not contain <i>Salmonella</i> sp., infective helminth eggs, and less than 2500 grams of faecal coliforms per gram dry solids.	Lime conditioning + vacuum drying, Lime treatment (Quick lime addition to dewatered sludge, Thermal drying.		EU Water Framework Directive (2000/60/EC) will have a large impact on phosphate fertilisers due to targets on reducing nutrient discharges to watercourses.
PORTUGAL	YES	YES Main legislation is the Law 276/2009, 2 nd October Seasonal Crop and soil-specific (heavy metals) N/P demand of plants	Stabilization Liming Composting Anaerobic digestion Thermal treatment	Accepted, when used within legal frameworks	Heavy metals limits

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UNITED KINGDOM	Yes	No – but there is a voluntary Safe Sludge Matrix, which sets out consists of a table of crop types, together with clear guidance on the minimum acceptable level of treatment for any sewage sludge (often referred to as biosolids) based product which may be applied to that crop or rotation.	Based on pathogen reduction. Two categories: Conventionally treated: These rely on biological, chemical or heat treatment. The most common form of treatment is anaerobic digestion. Conventionally treated sludge has been subjected to defined treatment processes and standards that ensure at least 99% of pathogens have been destroyed. Enhanced treatment: Enhanced treated		

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			sludge will be free from <i>Salmonella</i> and will have been treated so as to ensure that 99.9999% pathogens have been destroyed (a 6 log reduction).		

Discussion & Conclusions

The treatment and land application practices of digestate and sewage sludge vary considerably from country to country. In some regions biowaste undergoes advanced treatment and land application is common, whereas in other regions anaerobic digestion is unusual and sewage sludge is disposed as waste.

It is widely recognised that essential plant nutrients such as P, K, N and S and organic matter are available and can be recovered from biowaste streams. Less known in practice but largely discussed is the carbon-sink effect: the application of treated organic waste can have a mitigating effect with respect to the carbon levels in the atmosphere. The carbon-sink effect is due to the long-term sequestration of carbon in soil when stabilised organic matter (i.e. humic substances) contained in compost and digestate is applied on soil. Additional future drivers for systematic recovery of nutrients from biowaste include the low levels of P in soils and the fact that P nutrient is a limited natural resource. In this regard, recycling of biowaste as a nutrient source represents a sustainable solution for closing the nutrient cycle of several other essential plant nutrients besides P. Hence, moving towards source separation of biowaste, energy recovery through anaerobic digestion, material recovery through composting and the diversion of biowaste from landfills all encourage the recycling of nutrients from waste.

Parallel to the harnessing of essential plant nutrients and organic matter from biowaste streams, the use on land of digestate and sewage sludge has however some implications on human health, environmental protection and soil functionality. Due to the contaminants contained in biowaste streams, heavy metals, pharmaceuticals, pathogens, etc., substantial knowledge and care is needed to ensure a fully sustainable recycling of nutrients present in sewage sludge and digestate, not causing short or long term harmful effect on people and the environment.

According to this ISWA fact sheet, most countries where land application is practised have in place regulations or guidelines defining the quality levels to be fulfilled for a safe application. These criteria are typically based on heavy metals and pathogen contents, and apply to the input materials and/or the final product. In these contexts, regulations or guidelines also exist for the land application of waste based nutrients. Future development requires the establishment of “end of waste criteria” for waste based nutrients such as compost and digestate. “End of waste criteria” should be met by products that do not cause harm to human health and the environment. Therefore end of waste criteria are likely to lead to restrictions on input material and/or the final product derived from anaerobic digestion and composting treatment processes.