

Input to EU JRC consultation on waste streams for possible definition of EU End-of-Waste criteria (EoW)

This submission has been prepared in close collaboration with Eureau (the European federation of national associations of water services <u>www.eureau.org</u>) and in consultation of the 100+ water operators and stakeholders who signed the joint letter on EU End-of-Waste status for materials recovered from waste waters, 3rd May 2021 (see <u>www.phosphorusplatform.eu/regulatory</u>).

Recovery for fertilising product applications is not covered in this input, because a process for EU EoW criteria for such applications is provided by the EU Fertilising Products Regulation 2019/1009.

This submission covers the following materials

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Fiches for other materials recovered from wastewater (not containing significant nutrients) are submitted by Eureau <u>bertrand.vallet@eureau.org</u> :

- Bioplastics (PHA, PLA)
- Cellulose (crude, fluff, pellets)
- "Kaumera" biopolymer

1) Minerals recovered from ashes

• Define which material this should be.

Recovered minerals (as salts or as aqueous mineral solutions), of "technical quality", that is compatible for sale into commodity chemical markets, recovered from ashes (of fly ashes) from incineration of municipal sewage sludge, municipal solid waste, biowastes or other non-hazardous wastes.

After sale as a "commodity chemical", there is no possibility of control or tracing of the use: after industrial processing, a commodity chemical could be used to produce industrial chemicals (e.g. plastic additives, flame retardants), components for batteries, ceramics, animal feed additives, human food...

Such recovered minerals include:

- Phosphorus salts or phosphoric acid
- Elemental phosphorus (P4)
- Potassium salts
- Calcium / magnesium / chloride solutions
- Do you consider this waste or material stream to be relevant for EoW or rather for by-product criteria?

EoW because incineration is a waste disposal process, not a production process

• 1 Current recovery, recycling and collection rates or generated/ used material amounts

Currently at the industrial roll-out stage. Several full scale production sites are currently under commissioning or construction:

- EasyMining Ash2Phos, phosphate salts, 60 000 t ash/y, Bitterfeld, Germany
- EasyMining Ash2Phos, phosphate salts, 30 000 t ashy, Helsingborg, Sweden
- Tecnicas Reunidas, phosphoric acid, 30 000 t ash/y, Soluthurn, Switzerland
- Remondis, phosphoric acid, 20 000 t ash/y, Hamburg
- EasyMining Ash2Salt, potassium salt recovery from municipal waste incineration ash, 135 000 t ash Stockholm
- Elemental P4: Flashphos (Uni Stuttgart, Italmatch), 2 t ash/day pilot planned with Horizon 2020 funding

A number of further plants recovering phosphate salts or phosphoric acid from sewage sludge incineration ash are expected to be built in coming years as a consequence of the legal obligation to recover phosphorus from sewage in Germany and Switzerland, voluntary ambitions (60 000 t ash/y plant announced in The Netherlands by HVC/SNB) or as a route to reduce or avoid landfill disposal costs for ashes (e.g. Denmark ...).

• 2 Number of identified uses

Sold as commodity chemicals, with a very wide range of industrial and-uses: fire safety, lubricants, pharmaceuticals, cleaning products, electronics, animal feed additives ...

• 3 Market value of byproduct/ waste, total €

For phosphorus recovery from sewage sludge incineration ash only:

- Total P in sewage sludge in EU = c. 300 ktP/y (Van Dijk et al. <u>https://doi.org/10.1016/j.scitotenv.2015.08.048</u>)
- Assuming c. 50% is incinerated, and chemical P-recovery from half of ash, with 90% P-recovery rate = 67 ktP/y
- Assuming recovered as market-grade technical phosphoric acid (estimated at very approximately 1000€/tonne-P₂O₅ = 3 200 €t/P) = **approx. 200 million** € / **year**.

For potassium recovery from municipal waste fly ash:

- Based on the fly ash amounts from municipal waste incinerators in the EU in 2018, the potential volume of recovered KCl is 112 500 ton / year (dry weight). The price forecast (<u>https://www.statista.com/statistics/469705/potassium-chloride-price-forecast/</u>) expects the price to be in the range of 200-300 Euro /ton. The potential market value / year based on this: **23-34 M Euro / year**. The potential value is probably higher due to increasing amounts of fly ash, and the recovered KCl can be valued higher due to lower CO2 footprint.

For comparison, the estimated EU demand for « technical » phosphoric acid is c. 300 ktP/y (compared to the estimated potential for recovery from wastewater above c. 67 ktP/y)

- World phosphate rock production = a total of 17-24 MtP/y phosphorus (P) references are here <u>http://www.phosphorusplatform.eu/factsheet</u>
- 87% of world P use = fertilisers (references are here <u>http://www.phosphorusplatform.eu/factsheet</u>), and around 3% is used to produce P4 (reference = <u>www.phosphorusplatform.eu/Scope136</u>) so the rest (10%) is "technical phosphoric acid" going to animal feed, food phosphates, detergents, chemicals industry ...
- 10% x 20 MtP = 2 MtP = worldwide demand for technical phosphoric acid
- EU is c. 15% of world GDP (<u>https://www.statista.com/statistics/253512/share-of-the-eu-in-the-inflation-adjusted-global-gross-domestic-product/</u>)
- -> EU demand for P in technical phosphoric acid = 0.15 x 2 MtP/y = 300 ktP/y

• 4 Intra EU shipments

Critical. The commodity chemical industry operates at an international level. Mineral chemicals recovered are concentrated and will often be sold and transported across EU borders.

• 5 Exports outside the EU

Not relevant. The EU chemical industry market is active and sufficient for these materials.

• 6 Market success factors

• • 6a Purity

The processes cited above produce "technical quality" mineral salts, of considerably higher purity than commercial "green" phosphoric acid, achieving quality requirements for e.g. industrial applications or animal feed applications.

• • 6b CRM (where relevant)

The recovered phosphate salts or phosphoric acid correspond to the EU CRM "Phosphate Rock" The Flasphos P4 process corresponds to the EU CRM "Phosphorus"

• • 6c Evidence of demand

Commodity chemical market. Demand for many phosphate chemical applications is expected to remain buoyant or in expansion: non-halogen fire safety, batteries, animal feed, water purification, catalysts, electronics ... See www.phosphorusplatform.eu/Scope136

• 7 Existence of relevant product standards

Recognised industry / market specifications apply to commodity chemicals, covering both purity and (for acids) concentration. Different industry customers will have specific requirements.

The final product, after chemical industry processing, will be subject to relevant standards and quality requirements, e.g. animal feed (regulatory), electronics (strict industry requirements) ...

• 8 Existing national/regional EoW and/or by-product criteria

No EoW criteria. However, some companies operating such processes have obtained case-by-case EoW recognised by their Member State regulator, enabling placing on the market.

• 9 Low expected environmental/ human health impact

Sanitary safety is ensured because recovery is from incineration ashes.

These processes are "upcycling". Heavy metal contaminants in ashes are largely removed to specific streams for disposal. The ashes contain generally lower levels of heavy metals of concern (especially cadmium) compared to sedimentary phosphate rock. The production process and the recovered commodity phosphate are thus both "cleaner" than production of MGA (market grade acid = green acid) phosphoric acid from sedimentary phosphate rock.

See Life Cycle Analyses in Phos4You final Technical Report: <u>https://duepublico2.uni-due.de/receive/duepublico_mods_00074788</u>

and Phorwärts project LCAs summarised in www.phosphorusplatform.eu/eNews028

• Other policy considerations (if this material should be considered for by-product criteria, please provide evidence to support the fulfilment of the conditions from Art. 5 §1(a)-(d) of the Waste Framework Directive)

Reference could be made to the EU Fertilising Products Regulation (FPR) 2019/1009 STRUBIAS "Ash materials and derivates" criteria. If a product is safe to be spread on fields as a fertiliser (and obtain EoW as a fertilising product under the FPR) then it could be considered safe for use in industry as a commodity chemical.

Also the STRUBIAS requirements for incineration-generated contaminants could be read across (dioxins, PAH): that is, no use of ashes containing these above a certain limit, in order to prevent these specific contaminants entering the process chain.

2) Nitrogen minerals recovered from gases (offgases, stripping)

• Define which material this should be.

Nitrogen mineral salts or aqueous solutions, of "technical quality", that is compatible for sale into commodity chemical markets, recovered from offgases or air cleaning in sewage treatment, sewage sludge digestion or drying, or sewage sludge incineration, or in similar treatment processes for biowastes and agri-food wastes.

Similar materials are recovered from treatment of manure, including anaerobic digestion of manure, manure storage and stables offgas, but these require specific assessment because of Animal By Products Regulation implications.

Ammonia is removed as gas, from liquids (e.g. digestates), by stripping (increasing pH, with and without chemicals), and then recovered.

Ammonia or NO_x/N₂O in offgases is recovered by condensation, dissolving in water or reaction with acid, to produce aqueous solution of ammonia or nitrogen salts, or solid nitrogen salts.

Such minerals include:

- Ammonia solution
- Ammonium sulphates
- Ammonium nitrate

After sale as a "commodity chemical", there is no control and no tracing of the use: after industrial processing, such nitrogen minerals are used to produce industrial chemicals, animal feed additives,

• Do you consider this waste or material stream to be relevant for EoW or rather for by-product criteria?

EoW because sewage treatment and sludge incineration are not production processes.

• 1 Current recovery, recycling and collection rates or generated/ used material amounts

Currently at the industrial implementation stage or full scale operation

- Yara / VEAS Oslo, ammonium nitrate recovery from sewage sludge digester offgas, c 500 tN/y
- Waterleau New Energy, Ypres (BE), ammonium recovery from liquid digestate stripping, c 725 t/y (12% N), used for flue gas cleaning
- Nijhuis AECO-NAR, plant at Schaap, Friesland, The Netherlands https://www.nijhuisindustries.com/solutions/resource-recovery/aeco-nar
- Several other biogas plants using similar processes are currently using the recovered nitrogen salts as fertilising products, but could switch to non-fertiliser uses

• 2 Number of identified uses

Sold as commodity chemicals, with a very wide range of industrial uses, e.g. fire extinguishers, plant protection, ...

• 3 Market value of byproduct/ waste, total €

Potential N recovery from the wastewater treatment plant itself

- NOx emissions from municipal wastewater treatment = 70 230 g Nitrous oxide per person per year source: <u>https://www.ipcc-nggip.iges.or.jp/public/gp/bgp/5_2_CH4_N2O_Waste_Water.pdf</u> taken from WRc Converts to: 45 145 gN / person/y
- 750 M people in Europe. Assuming 50% connected to sewage works with N recovery (larger works only) =
 375 M people
- Assume 75% nitrous oxide removal with N recovery in works with N-recovery, in context of water companies' "net zero 2030" policy
- ---> 13 41ktN/y ---> assume mid-range = 25 ktN/y

Potential N recovery from sewage sludge treatment

- 750 million population in EU
- c. 10gN/person/day in sewage
- ---> 2 745 kN/y in EU sewage
- approx. 5 7 % of sewage works inflow N is in liquid outflow from sewage sludge anaerobic digester (references: Ekama 2011 <u>http://www.wrc.org.za/wp-content/uploads/mdocs/1620-1-111.PDF</u> and Resource Recovery from Water: Principles and Application, book, Rabaey et al., IWA Publishing, to be published 2022)
- assume 5% of inflow N in digestate, 50% of EU population connected to sewage works with anaerobic sludge digestion and ammonia recovery from digestate, 75% N recovery
- ---> 51 ktN/y

Total c. 75 ktN/y

Price for ammonia-N = c. 300€/t <u>https://ihsmarkit.com/products/fertilizers-ammonia.html</u>

Potential market value of recovered N from municipal wastewater in Europe = c. 23 million € per year

This does not take into account probably larger potential for recovery of N from offgases from digestates from other organic wastes (manure, biomass), agri-food industry wastewaters, etc.

• 4 Intra EU shipments

Critical. The commodity chemical industry operates at an EU level. Mineral chemicals recovered are concentrated and will often be sold and transported across borders.

• 5 Exports outside the EU

Not relevant. The EU chemical industry market is active and sufficient for these materials.

• 6 Market success factors

• • 6a Purity

The processes cited above produce "technical quality" mineral salts, of high purity. Recovery is from offgas (not from the liquid waste stream) means low contaminant transfer.

• • 6b CRM (where relevant)

No.

• • 6c Evidence of demand

Commodity chemical market.

• 7 Existence of relevant product standards

Commodity chemicals. Different industry customers will have specific requirements

• 8 Existing national/regional EoW and/or by-product criteria

No EoW criteria.

• 9 Low expected environmental/ human health impact

Recovery is from offgas (not from the liquid waste stream) means low contaminant transfer.

N-recovery from offgas avoids emissions to air of ammonia (ammonia emissions are limited under the National Emissions Ceilings Directive because they generate particulate air pollution) and of NO_x/N_2O (greenhouse gases).

Recovery of nitrogen compounds avoids, by substitution, significant energy consumption, greenhouse emissions and natural gas consumption in production of nitrogen salts by the Haber-Bosch process: EU average CO₂-eq. per tonne N, from Hoxha & Christersen, IFS Proceedings 805, 2018 https://www.fertilizerseurope.com/wp-content/uploads/2020/01/The-carbon-footprint-of-fertilizer-production_Regional-reference-values.pdf

• Other policy considerations (if this material should be considered for by-product criteria, please provide evidence to support the fulfilment of the conditions from Art. 5 §1(a)-(d) of the Waste Framework Directive)

Reference could be made to the EU Fertilising Products Regulation (FPR) 2019/1009 proposed CMC-WWW (1b) criteria.

3) Minerals recovered from wastewater aqueous phase

• Define which material this should be.

Mineral salts or aqueous mineral solutions, of "technical quality", that is compatible for sale into commodity chemical markets, recovered in the aqueous phases of municipal wastewater treatment or sewage sludge processing.

Such minerals include:

- Precipitated phosphates (struvite, calcium phosphates, vivianite ...) used directly as such (e.g. R&D underway into use of struvite or vivianite as flame retardants)
- Mineral solutions separated by membranes
- Do you consider this waste or material stream to be relevant for EoW or rather for by-product criteria?

EoW because sewage treatment and sludge incineration are not production processes.

• 1 Current recovery, recycling and collection rates or generated/ used material amounts

Recovery of precipitated phosphates such as struvite is operation at full scale in tens of installations worldwide, but today use is as a fertilising product, for which End-of-Waste status can be provided by the EU Fertilising Products Regulation 2019/1009.

An industrial ViviMag pilot plant will be tested at several locations producing circa 200 kg vivianite (iron(II) phosphate) per day in 2022. Projections estimate that 100-200 kton/year of vivianite could be produced If the technology is rolled out across Europe.

• 2 Number of identified uses

Industrial (non fertilising product) use of recovered materials is currently at the R&D level only

Possible uses for recovered minerals include fire safety, H_2S control in anaerobic digesters, coagulants, industrial commodity chemicals.

• 3 Market value of byproduct/ waste, total €

Currently at the R&D level only

• 4 Intra EU shipments

Currently at the R&D level only

• 5 Exports outside the EU

Not relevant. Uses will be in EU industries.

• 6 Market success factors

• • 6a Purity

Currently at the R&D level only.

Pilot tests for vivianite show purity > 95% and provide initial data on contaminants.

• • 6b CRM (where relevant)

No.

• • 6c Evidence of demand

Currently at the R&D level only

• 7 Existence of relevant product standards

Different industry customers will have specific requirements

• 8 Existing national/regional EoW and/or by-product criteria

No EoW criteria.

• 9 Low expected environmental/ human health impact

Appropriate industrial use will ensure environmental/health safety.

• Other policy considerations (if this material should be considered for by-product criteria, please provide evidence to support the fulfilment of the conditions from Art. 5 §1(a)-(d) of the Waste Framework Directive)

4) Algae and aquatic plant biomass grown on waste inputs

• Define which material this should be.

Biomass of algae and microalgae, bacteria and aquatic plant (e.g. *Lemna*) grown using wastewater and/or offgas CO₂ as support and feed inputs, and thus also materials extracted from or released by this biomass (e.g. proteins extracted from bacteria).

Also aquatic biomass resulting removed from e.g. canals or beach cleaning, or lake/river eutrophication remediation.

The objective of limiting to "aquatic plants" is to exclude biomass of willow trees or *Phragmites* grown with sewage sludge as an input, or indeed grass or maize grown on fields on which sewage biosolids are used as fertiliser.

Input wastewaters include municipal wastewater and possibly also biofuel processing discharge liquor, food industry wastewater, digestate from AD of food waste and biomass ... Input of manure and animal by-products would require specific assessment of regulatory authorisation and sanitary safety.

Below we use the term "algae" to cover both microalgae and macroalgae.

There is a strong potential for development of algae production, from intensive to extensive (vertical reactors, biofilm systems, raceways, ponds and lagoons) to treat municipal wastewater (in particular for nutrient and organic carbon removal, disinfection), whilst at the same time recovering nutrients (P, N, K ...) and organic carbon for valorisation.

Valorisation can include:

- energy production (e.g. anaerobic digestion), for which EU EoW is not appropriate as use will generally be local
- use as or incorporation into organic fertilisers or biostimulants, for which EoW should be dealt with under the Fertilising Products Regulation,
- applications higher in the waste hierarchy, either using the biomass as such (e.g. after drying or stabilisation) or after processing or extraction of specific materials (lipids, proteins, pigments, vitamins ...): animal feed, human food ingredients and additives, chemicals, bioplastics and composites, cosmetics, pharmaceuticals, biofuels (in each case, subject to relevant regulatory constraints, industry requirements, sanitary and safety standards).

For these higher value applications, EU EoW status of the algal biomass is critical to enable transport, trading and downstream processing.

Information and references for this material stream, and discussion of its End-of-Waste status, are here (May 2021): www.phosphorusplatform.eu/Scope140

• Do you consider this waste or material stream to be relevant for EoW or rather for by-product criteria?

Such biomass is not a By-Product.

We underline, however, that the waste or not-waste status of such biomass is today unclear. If it is explicitly clarified that such biomass (grown using wastewater or offgas CO_2 as 'feedstock' inputs) is not waste, then EU EoW criteria are not necessary, but other safety criteria and transparency processes must be ensured, because such biomass can potentially contain contaminants or pathogens from the input waste streams. It is important that this clarification of status be EU, in order to ensure a level playing field between operators in different countries, and to enable a market for technology suppliers and investors (difficult to market a process which generates a "waste" in one member state and a "non-waste" in others)

1 Current recovery, recycling and collection rates or generated/ used material amounts

A number of full-scale installations are today operational, using (micro)algae or *Lemnaceae*, to treat wastewaters, with strong current development. Use of algae to trap offgas CO₂ has also been tested full scale and offers potential for energy-intensive industries (e.g. cement plants, see www.phosphorusplatform.eu/Scope140 p.9) but also for urban air quality improvement (e.g. Scope140 p.9) but also for urban air quality improvement (e.g. Scope140 p.9) but also for urban air quality improvement (e.g. Scope140 p.9) but also for urban air quality improvement (e.g. Scope140 p.9) but also for urban air quality improvement (e.g. Scope140 p.9) but also for urban air quality improvement (e.g. Scope140 p.9) but also for urban air quality improvement (e.g. Scope140 p.9) but also for urban air quality improvement (e.g. www.phosphorusplatform.eu/Scope140 p.9) but also for urban air quality improvement (e.g. www.phosphorusplatform.eu/Scope140 p.9) but also for urban air quality improvement (e.g. www.phosphorusplatform.eu/Scope140 p.9) but also for urban air quality improvement (e.g. www.phosphorusplatform.eu/Scope140 p.9) but also for urban air quality improvement (e.g. www.phosphorusplatform.eu/Scope140 p.9) but also for urban air quality improvement (e.g. <a href="https://www.phosphorusplatf

Potential for algae biomass production from municipal wastewater for the EU is c. 210 000 tDM/y.

This estimate is derived as follows:

- yearly production of algae in sewage treatment: 10 kgDM/y/population equivalent
- algae cultivation for 10% of Southern Europe's population (210 million = FR, IT, ES, GR, PT, HR, AL, SI, MK, CY, ME, MT).

For example, Aqualia, Spain, today operates 6 ha of algal raceway ponds (total at three sites: Chiclana, Merida, Hellin), treating municipal wastewater of total c. 30 000 p.e (population equivalent), and producing c. 100 tDM//ha/y of algae (see: EU projects: ALL-Gas <u>www.all-gas.eu</u> and SABANA <u>https://cordis.europa.eu/project/id/727874</u>).

EU (macro)algae biomass production 2016 was estimated by the European Commission (JRC) at 90 kt/y fresh weight biomass, as follows:

https://publications.jrc.ec.europa.eu/repository/handle/JRC118214 (JRC 2019)

and https://doi.org/10.3389/fmars.2020.626389 (JRC 2021)

- 32.67 Mt 2016 worldwide (fresh weight)
- Of which 0.28% is EU = 90 kt/y (fresh weight)
- Assuming 10% dry matter in fresh weight
- That is EU production of algae = c. 9 000 t/y dry matter

From this, JRC estimated that 98% was from harvesting from nature (e.g. seaweed), so EU cultivated production of MACROalgae is estimated at c. 900 tDM/y. JRC (2021) also estimated EU MICROalgae production at c. 320 t/y DW (182 t DW + 142 t DW *Spirulina*).

It should be noted that part of today's algae production is used to produce fertilising products (crop "biostimulants" which improve plant nutrient uptake or other crop health, resilience and productivity traits), an application for which End-of-Waste can be ensured by the EU Fertilising Products Regulation. Other applications are however growing (see above). For some of these applications, the regulatory, industry and consumer acceptance of wastewater-fed algae for such applications remains to be clarified, but End-of-Waste status is necessary for this.

• 2 Number of identified uses

Animal feed, either as such after drying – stabilisation, or after extraction of e.g. lipids, proteins

Bioplastics through direct extraction of polymers, or extraction after additional fermentation processes.

Extraction of chemicals: lipids, proteins, cellulose, pigments

Production of biofuels using the specific fractions (lipids-biodiesel, carbohydrates-bioethanol) or the whole biomass by different routes (Bio-oils-hydrothermal liquefaction, biomethane-anaerobic digestion)

3 Market value of byproduct/ waste, total €

Value of algae biomass can range from c. 5 €/tDM to c. 5 000 €/tDM, depending on the end-use, which can depend on quality, composition and safety:

For animal feed, the value of algae biomass is can be up to c. 2 000 €/tDM.

For bioplastics and similar, the value of algae biomass can be up to 1 000 €/tDM depending on the composition.

For chemicals, the value of algal biomass is up to 1 000 €/tDM.

For biofuels, there are no safety restrictions but the value of the biomass is up to 200 €/tDM

For pharmaceuticals, cosmetics or human food ingredients, values can be significantly higher, but there are significant societal acceptance, regulatory and safety questions for using wastewater-fed algae for such markets. Total global market for algae-derived products for food applications worldwide (largely from algae cultivated using virgin inputs, not wastewater): c. 2.7 billion € (source: https://www.ristorazioneitalianamagazine.it/alghe-business-alimenti/)

Market value estimate for 210 000 tDM/y algae produced from wastewater, based on an average price of 500 €/tDM = c. 100 €/y (for EU)

• 4 Intra EU shipments

Where produced biomass is not used for direct energy production (combustion, AD) or as a fertilising product, then it will be entering EU-wide added value processing chains, where transport across national borders is likely. Transport may concern chemicals extracted from the biomass, but also dried or stabilised biomass to a specialist processing site.

• 5 Exports outside the EU

May not be relevant. Uses will be mainly in EU industries.

- 6 Market success factors
- • 6a Purity

Variable depending on intended application. Generally, extraction and purification processes will ensure quality of chemicals recovered from biomass.

• • 6b CRM (where relevant)

Biomass production valorises secondary phosphorus (CRM "Phosphate Rock") in waste streams.

• • 6c Evidence of demand

Downstream industries are well established: biofuels, proteins, lipids ... There high demand for algae biomass for animal feed, agriculture and biomaterials applications, but at present production capacity is not able to cover this demand.

• 7 Existence of relevant product standards

Standardisation mandate M/547 on algae and algae-based products or intermediates and CEN Technical Committee CEN/TC 454: algae and algae products.

• 8 Existing national/regional EoW and/or by-product criteria

No EoW criteria.

• 9 Low expected environmental/ human health impact

Contaminant levels in algae biomass grown on waste streams are generally low. Algae can be effective in biodegrading and so removing e.g. pharmaceuticals. Outdoor algae production systems are also effective in removing pathogens (solar disinfection).

Monitoring and extraction / purification must however ensure that levels of contaminants and pathogens are compatible with safety in intended uses.

Use of algae to treat wastewater and to remove nutrients (phosphorus, nitrogen) contributes to water quality and to eutrophication prevention, as well as reducing greenhouse emissions and chemicals and energy consumption compared to other wastewater treatment systems. Use of wastewater and/or offgas CO2 to "feed" algae biomass production, reduces resources consumption and greenhouse emissions compared to conventional biomass production.

• Other policy considerations (if this material should be considered for by-product criteria, please provide evidence to support the fulfilment of the conditions from Art. 5 §1(a)-(d) of the Waste Framework Directive)

EU "Algae Initiative" currently under definition (DG MARE).