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Program Manager, USDA/AMS/TM/NOP
Room 4008-So.
Ag Stop 0268
1400 Independence Avenue, SW.
Washington, DC 20250

Subject: Petition for Inclusion of Synthetic Substance on the National List of Allowed and Prohibited Substances

Attached to this letter is the petition of NEO Energy LLC ("NEO") for the inclusion of a synthetic substance on the National List of Allowed and Prohibited Substances ("National List"). Specifically, NEO is petitioning for the inclusion of Anaerobic Digestate - Food Waste (pH adjusted with Sulfuric acid. The amount of acid used shall not exceed the minimum needed to lower the pH to 3.5) in the National List as a plant and soil amendment under §205.601 (j).

NEO requests that the National Organic Program and the National Organic Standards Board review NEO's request for inclusion of the petitioned substance.

Please feel free to contact me should you require additional information in order to consider NEO's petition.

Respectfully submitted,

Anthony M. Callendrello
Chief Operating Officer
NEO Energy LLC

Petition Submitted by NEO Energy, LLC of Portsmouth, NH

Contact: Mr. Anthony Callendrello

Item A:

Petition for: Anaerobic Digestate - Food Waste (pH adjusted with Sulfuric acid. The amount of acid used shall not exceed the minimum needed to lower the pH to 3.5).

Category: Synthetic substance allowed for use in organic crop production

Section for inclusion of substance: §205.601 (j) As plant or soil amendments

Item B:

1. **Substance Common Name:**

   Anaerobic Digestate - Food Waste

2. **Manufacturer's Name and Contact Information:**

   NEO Energy, LLC
   1 New Hampshire Ave., Suite 207
   Portsmouth, NH 03801

   Contact: Anthony Callendrello
   Telephone: (603) 294-4850
   Email: acallendrello@neoenergyusa.com

3. **Intended/Current Use of Substance:**

   Intended Use of Substance

   The petitioned substance will be used solely as an organic fertilizer for the production of crops as well as use within the turf industry, including all landscape applications.

   Current Use of Anaerobic Digestate

   Anaerobic digestate is currently on the OMRI generic material list as allowed for use as crop materials. Two specific forms are listed; anaerobic digestate – plant and animal materials and anaerobic digestate – plant materials.

   OMRI provides the following information on these two anaerobic digestate materials.

Anaerobic digestate – plant materials
Status: Allowed
Class: Crop Fertilizers and Soil Amendments
Origin: Nonsynthetic
Description:
Products of anaerobic digestion processes are acceptable if made from only allowed plant-based feedstock materials. Anaerobic digestate must not contain more than $1x10^3$ (1,000) MPN fecal coliform per gram of digestate sampled and must not contain more than 3 MPN Salmonella per 4 grams of digestate sampled. See also ANAEROBIC DIGESTATE- PLANT AND ANIMAL MATERIALS
NOP Rule: 205.105(a); 205.203(c)

Anaerobic digestate – plant and animal materials
Status: Allowed with Restrictions
Class: Crop Fertilizers and Soil Amendments
Origin: Nonsynthetic
Description:
Products of anaerobic digestion produced with manure or other animal material feedstocks are subject to the same restrictions as raw, uncomposted manure. They may only be (i) applied to land used for a crop not intended for human consumption; (ii) incorporated into the soil not less than 120 days prior to the harvest of a product whose edible portion has direct contact with the soil surface or soil particles; or (iii) incorporated into the soil not less than 90 days prior to the harvest of a product whose edible portion does not have direct contact with the soil surface or soil particles. See also MANURE – RAW, UNCOMPOSTED.
NOP Rule: 205.105(a); 205.203(c)

Note that OMRI places restrictions on the application of anaerobic digestate – plant and animal materials equivalent to those placed on raw manures. The petitioner believes that anaerobic digestate produced as described in section 5 meets the criteria established by OMRI for Manure – processed, and would be an allowed crop material without restrictions.

Manure - processed
Status: Allowed
Class: Crop Fertilizers and Soil Amendments
Origin: Nonsynthetic
Description:
Manure products treated so that all portions of the product, without causing combustion, reach a minimum temperature of either 150° F (66° C) for at least one hour or 165° F (74° C), and are dried to a maximum moisture level of 12%; or an equivalent heating and drying process could be used. Processed manure may be used as a supplement to a soil building program without a specific interval between application and harvest. Processed manure products must not contain more than $1x10^3$ (1,000)

MPN fecal coliform per gram of processed manure sampled and must not contain more than 3 MPN Salmonella per 4 grams of processed manure sample. See also MANURE ASH; MANURE – RAW, UNCOMPOSTED. See Glossary for definition of "manure."

Liquid fish products (pH adjusted with sulfuric, citric or phosphoric acid, provided the amount of acid not exceed the minimum needed to lower the pH to 3.5) is a synthetic substance allowed for use as a plant and soil amendment in organic crop production (NOP 205.601(j)(7)).

4. A List of Handling/Processing Procedures for Which the Substance will be used:

The petitioned substance's sole use will be as an organic fertilizer which will be applied in any and all cropping applications as well as landscape, turf and ornamental programs. The stabilized liquid organic material will undergo evaporative and high temperature drying procedures resulting in a dry powdered material with moisture content less than 8.0%. The dried powdered material is considered the "primary" product which is intended to be re-hydrated on site and applied in any and all spray/liquid application procedures including fertigation, drip tape and mechanized sprayer apparatus. A "secondary" product will be derived from the primary powdered product by granulation into fertilizer sized dry pellets intended for use as a dry application through drop or rotary spreaders.

Both the powdered/spray and granulated products will carry the same application rate per acre, with that rate designed for specific applications. However, typical application rates will range from 0.1 to 1.0 lbs. nitrogen/1000 sq. ft.

5. The source of the substance and a detailed description of its manufacturing or process procedures from basic component to the final product:

The anaerobic digestion of food waste is becoming more common in the United States with a number of digesters operating or announced that will digest only food waste (no manures or sewage sludge). The food waste that is digested may come from a variety of sources, but in all cases is material that either was intended for human consumption or is a byproduct of preparing food for human consumption. Typical sources of such material include; restaurants, supermarkets, food processors and preparers, farms, residential source separated waste and institutions such as hospitals, colleges and nursing homes.

The Biogas Opportunities Roadmap issued by the USDA, EPA and DOE in August 2014 ("Biogas Roadmap") identified the many benefits of biogas systems including; providing a renewable source of energy, driving economic growth cutting methane emissions to reduce greenhouse gas emissions, other environmental benefits and enhancing resilient communities. The agencies indicated in the Biogas Roadmap that "Recovered nutrients offer an opportunity to create a "value added" product that can be sold off-site as an organic amendment or as an organic fertilizer."(*Biogas Roadmap, page 13)* The Biogas

Roadmap also developed a series of actions to be taken by the sponsoring agencies to achieve the development potential for biogas projects. One of the actions to be taken by USDA, DOE and EPA is to "strengthen the markets for value-added, non-energy products, such as recovered nutrients". (*Biogas Roadmap, page 23)*

Anaerobically digesting food waste is a three stage, contained process which involves hydrolysis, acetogenesis and methanogenesis carried out by groups of anaerobic bacteria (such bacteria are not produced by any excluded method, as defined under section 205.2 of the USDA organic regulation. The digestion process results in the production of biogas comprised of approximately 50-70% methane, 30-40% carbon dioxide and trace amounts of other constituents such as hydrogen sulfide, hydrogen, nitrogen and siloxanes.

Ferric chloride may be added during the digestion process to prevent the generation of odorous reduced sulfur compounds that would otherwise be present in the biogas. Reduced sulfur compounds present in the biogas would result in the generation of sulfur oxides emissions during combustion in an internal combustion engine. The use of ferric chloride ensures that the biogas produced is usable as a fuel for renewable power generation or as a pipeline quality addition to natural gas. The ferric chloride is introduced at very low dosage rates (a maximum of 0.048 pounds per pound of material treated in the anaerobic digester). Any sulfide present in the material treated is converted to insoluble and innocuous iron sulfide (at a maximum rate of 0.046 pounds per pound of digestate) in the final product.

After the creation of biogas, a liquid/solid slurry end product ("digestate") remains that is approximately 5% solids and contains nutrients derived from the food waste. In certain cases, the digestate is applied to crops as a liquid. While acceptable, this use of liquid digestate is of limited value to users for a number of reasons. First, the cost of transporting liquids requires that the user of the liquid digestate be close to the digester, which is not always the case for food waste digesters that are generally located in more populated areas. Second, the liquid digestate is a dilute nutrient. These two deficiencies can be addressed by stabilizing and processing that stabilized digestate.

Liquid digestate leaves the digesters at pH levels between 7.0 and 9.0. At these alkaline pH levels, the digestate is highly unstable due to continued microbial activity which, over time, reduces nutrient levels as well as releases ammonia, carbon dioxide and methane gases. To avoid this situation, the digestate will be stabilized by adding sulfuric acid to reduce the pH level to between 4.5 and 3.5 to inhibit microbial activities. The sulfuric acid will be added to liquid digestate as it leaves the digesters under a controlled mechanical injection system to ensure excess acid is not used and optimum pH levels attained. Other acids such as citric acid have been considered; however, the amounts that would need to be added to the digestate are significantly higher than for sulfuric acid and would result in dilution and therefore reduced nutrient content of the final product.

The additional benefit of adding sulfuric acid to the digestate is the fixing of ammonia that would normally have been emitted as an air pollutant during the processing of the digestate. The fixed ammonia will be available in the final product as a plant nutrient.

The stabilized liquid digestate is then filtered to remove fibrous particles. The filtered digestate undergoes a two-step drying process; evaporation to approximately 20% solids and a final drying process to create a final product that is approximately 95% solids.

6. <u>A summary of any available previous reviews by State or private certification programs or other organizations of the petitioned substance:</u>

OMRI
Anaerobic Digestate - plant materials
Status: Allowed
Class: Crop Fertilizers and Soil Amendments
Origin: Nonsynthetic
Description:
Products of anaerobic digestion processes are acceptable if made from only allowed plant-based feedstock materials. Anaerobic digestate must not contain more than 1x103 (1,000) MPN fecal coliform per gram of digestate sampled and must not contain more than 3 MPN Salmonella per 4 grams of digestate sampled. See also ANAEROBIC DIGESTATE- PLANT AND ANIMAL MATERIALS
NOP Rule: 7 CFR 205.105(a), 7 CFR 205.203(c)

OMRI
Anaerobic Digestate - plant and animal materials
Status: Allowed with Restrictions
Class: Crop Fertilizers and Soil Amendments
Origin: Nonsynthetic
Description:
Products of anaerobic digestion produced with manure or other animal material feedstocks are subject to the same restrictions as raw, uncomposted manure. They may only be (i) applied to land used for a crop not intended for human consumption; (ii) incorporated into the soil not less than 120 days prior to the harvest of a product whose edible portion has direct contact with the soil surface or soil particles; or (iii) incorporated into the soil not less than 90 days prior to the harvest of a product whose edible portion does not have direct contact with the soil surface or soil particles. See also MANURE – RAW, UNCOMPOSTED.
NOP Rule: 7 CFR 205.105(a), 7 CFR 205.203(c)

UK Product Certification of AD Liquid Digestate:

BSI PAS 110 – eliminates waste management control costs

BSI PAS 110 is a voluntary national quality specification for biofertiliser, made available to AD operators throughout England, Wales and Scotland from February 2010, and forms part of the Anaerobic Digestion Quality Protocol.

Biofertiliser from a BSI PAS 110 accredited AD plant will be classified as a product rather than a waste. The spreading of this product is not subject to waste management controls, which greatly simplifies the marketing and spreading of the biofertiliser.

7. <u>Information regarding EPA, FDA and State Regulatory authority registrations including registration numbers:</u>

See Section 6 above for the OMRI definitions of anaerobic digestate.

The USDA Food Waste Challenge provides the following definition of food waste:

How does USDA define food waste in the context of the Challenge?

There are many definitions of food loss and waste. For example, the Food and Agricultural Organization of the United Nations uses food "loss" to refer to reductions in edible food mass during production, post-harvest and processing. It uses food "waste" to refer to reductions at the retail and consumer levels. USDA's Economic Research Service (ERS) defines food loss as the edible amount of food, postharvest, that is available for human consumption but is not consumed for any reason. It includes cooking loss and natural shrinkage (for example, moisture loss); loss from mold, pests, or inadequate climate control; and food waste, where food waste is defined (by ERS) as the component of food loss that occurs when an edible item goes unconsumed, as in food discarded by retailers due to color or appearance and plate waste by consumers. For the U.S. Food Waste Challenge, USDA is adopting the convention of using the general term "food waste" to describe reductions in *edible* food mass anywhere along the food chain. In some of the statistics and activities surrounding recycling, the term "waste" is stretched to include non-edible (by humans) parts of food such as banana peels, bones, and egg shells. (http://www.usda.gov/oce/foodwaste/faqs.htm)

<u>Massachusetts</u>
Massachusetts has established rules (310 CMR 19.000) for the food waste disposal ban that took effect on October 1, 2014.

310 CMR 19.006 - Definitions
Commercial Organic Material means food material and vegetative material from any entity that generates more than one ton of those materials for solid waste disposal per week, but excludes material from a residence.

Food Material means material produced from human or animal food production, preparation and consumption activities and which consists of, but is not limited to, fruits, vegetables, grains, and fish and animal products and byproducts.

California
California agencies have established a number of definitions for “food waste”.

Title 14, CCR, §17852 (a)(20) (Current CalRecycle definition)
FOOD MATERIAL means any material that was acquired for animal or human consumption, is separated from the municipal solid waste stream, and that does not meet the definition of "agricultural material." Food material may include material from food facilities as defined in
Health and Safety Code section 113785, grocery stores, institutional cafeterias (such as, prisons, schools and hospitals) or residential food scrap collection.

State Water Resources Control Board Draft Statewide Order for Composting Facilities
FOOD WASTE means wastes derived from pre-and post-processed plants and animals (excluding those wastes generated at rending (sic) facilities) for the explicit creation of foods for human and/or animal consumption. This includes, but may not be limited to, those foods and scraps processed or produced at restaurants, hospitals, food distributors, schools and residences.

South Coast Air Quality Management District Rule 1133
FOOD WASTE is any food scraps collected from the food service industry, grocery stores or residential food scrap collection. Foodwaste also includes foodwaste that is chipped and ground. Foodwaste mixed with greenwaste is considered foodwaste (1133.0)

FOOD WASTE means any pre-or post-consumer food scraps collected from the food service industry, grocery stores or residential food scrap collection. Foodwaste also includes food scraps that are chipped and ground. (1133.3)

San Joaquin Valley Unified Air Pollution Control District Rule 4565 and 4566
FOOD MATERIAL food scraps collected from the food processing industry, food service industry, grocery stores or residential food scrap collection. Food material also includes food material that is chipped or ground.

8. The Chemical Abstract Service (CAS) number or other product numbers of the substance and labels of products that contain the petitioned substance.

The petitioned substance, processed anaerobic digestate – food waste, does not have a CAS or other product number. The anaerobic digestion of source separated food waste and subsequent production of organic and bio-fertilizers is at a very nascent stage of development within the U.S. and, as such, there are virtually no examples or developed products in the marketplace at this time. There is, however, a multitude of examples of the use of food waste-derived liquid digestate applied to agricultural and landscape situations within the UK and EU.

The petitioned substance contains the attributes described on the specification sheet provided as Attachment A to this petition.

Anaerobic digestate is currently on the OMRI generic material list as allowed for use as crop materials. Two specific forms are listed; anaerobic digestate – plant and animal materials and anaerobic digestate – plant materials. Neither of these products is processed as described in this petition. However, petitioner believes that this substance is similar to liquid fish products, a substance that is processed using the same chemical, sulfuric acid that is used during the processing of the petitioned substance and in some cases is dried using the same process as the petitioned substance to form spray-dried fish hydrolysate.

The acid used to stabilize the petitioned substance is the same as used by the liquid fish product (can be adjusted with sulfuric, citric or phosphoric acid) and that product is listed under the NOP as a synthetic substance allowed for use in organic crop production 7CFR 205.601((j)(7).

9. The substance's physical properties and chemical mode of interaction

a. The effects of the substance on biological and chemical interactions in the agroecosystem:

If the petitioned substance is applied, without excessive runoff to surface and groundwater and the product does not exceed the minimum level of acid needed to lower the pH to 3.5, adverse biological or chemical interaction on the surrounding environment would not be expected.

If applied as intended, the petitioned substance will not cause any adverse biological of chemical interactions but will have strong positive effects on biological systems within the agroecosystem. Applications of the petitioned substance will increase soil microbial populations, diversity and activities due to the levels of bioactive components acting as a growth media. Plants will respond similarly with increases in root/shoot growth due to applications of mineral macro and micronutrients.

b. The toxicity and mode of action of the substance and of its breakdown products or any contaminants, and their persistence and areas of concentration in the environment.

Anaerobic digestate from food waste is a reflection of the various fractions of source separated food waste that was digested. The food waste was produced during growing, sales and distribution or by the consumer. In all cases the food was intended for human consumption and is not expected to contain toxic materials.

The digestion is mediated by anaerobic bacteria which break down whole food first into larger natural biochemical components such as protein, simple and complex carbohydrates, fats, lipids, amino acids and various other natural secondary compounds. These larger bio-molecules are further broken down to release the complete range of essential mineral macro and micronutrients as well as accumulations of simple natural compounds such as amino acids, lipids and simple carbohydrates. During the digestion process, 60-80% of the carbon associated with the food waste is broken down to biogas (methane) and carbon dioxide.

The mode of action of all these compounds are involved in metabolic growth processes for both soil microorganisms as well as plants. Digestate along with all breakdown compounds are not considered "contaminants" since most are taken up and utilized by soil microorganisms and plants. What is not accumulated and used by the soil biosphere and plants will be transformed into soil humates which naturally attain levels of 1-3% in the soil. Humates will persist for extended periods depending upon soil environmental conditions but will eventually be further broken down by soil microbes into essential mineral nutrients, carbon dioxide or other bio-chemicals which will enter natural soil cycles. There is no toxicity associated with digestate or contaminants of any kind that will persist in the environment.

c. The probability of environmental contamination during manufacture, use, misuse or disposal of such substance:

Sulfuric acid used as part of the processing of the anaerobic digestate from food waste has the potential to cause harm to the environment if misused or improperly disposed. Environmental contamination by this product during manufacture is considered extremely low since the process takes place within steel tanks and within buildings that contain noise, odors and any spills of material. The facility for the manufacturing of the petitioned substance will undergo environmental review and permitting by state and local authorities prior to construction to ensure that the facility meets all applicable federal, state and local standards.

Application rates of liquid digestate for all crops would not exceed 1.0 lb. of nitrogen per 1000 sq. ft. or 43.5 lbs N/acre for each individual application. The amount of nitrogen in the processed anaerobic digestate will dictate what volumes of the product will be applied per acre. Significant over-applications would be considered misuse. If, however, an over-application of 2 or 3 times that recommended, it would not pose a significant contamination since all components of the processed anaerobic digestate are organically derived and are all part of the soil food web. Nutrients found in runoff from improperly or excessively applied product can cause algae growth in surface water. Excess

algae can, in turn, use up oxygen in the water, potentially harming fish and other aquatic animals.

d. The effects of the substance on human health:

It is expected that the process proposed for the petitioned substance will reduce the toxicity to humans of unprocessed anaerobic digestate (an allowed substance) by reducing the production of ammonia gas during the anaerobic digestion process as well as effectively pasteurizing the liquid digestate and high temperature drying above 300 degrees C.

NEO Energy received a letter dated September 16, 2011 from Dr. Lars Angenent, of Cornell University that confirmed the absence of pathogens in dried digestate produced solely from food waste. That process did not involve stabilized food waste digestate as is now the subject of this petition, but Dr. Angenent's conclusions regarding the absence pathogens is still applicable.

In that letter, Dr. Angenent concluded:

First, food scraps and food manufacturing byproducts do not contain the same types or concentrations of pathogens as manure or human bio-solids. In general, food scraps from schools, restaurants, and supermarkets and byproducts from food manufacturing processes are kept clean and the pathogen levels will be very low when they arrive at an anaerobic digester facility. In the unlikely event that food scraps were to contain undesirable pathogens, the anaerobic digestion process will reduce the populations of those pathogens by large percentage due to the long residence times in the digesters. From our own research, we have found that the biological community indigesters is typically very different from the substrate, and if substrate contains pathogens they do not further grow because the digester selects for bacteria that are useful in the digestion process and these are typically nonpathogenic. Thus, solid material remaining after the anaerobic digestion process (digestate) from food waste is safe for land application. If the digestate comes from human or animal waste treatment this conclusion may not be valid.

Second, NEO's plan to dry the digestate at [105 degrees] Fahrenheit [Note that NEO is now proposing to dry the digestate at approximately 300 degrees C providing even more comprehensive pathogen destruction]*will further ensure that no pathogens remain after the anaerobic digestion process. As an alternative, composting of the digestate is an equally effective alternative solution to drying for pathogen destruction. These pathogens do not survive the higher temperatures of these two process alternatives*.

In all, there is no threat caused by the land application of food waste digestate to humans, animals, or the environment if applied in accordance with nutrient

management best practices. Land application of dried digestate is a beneficial solution to any agricultural operation in the region. The dried digestate will not pose any pathogen threat to humans, animals, crops, or others that come into contact with the material.

e. The effects of the substance on soil organisms (including the salt index and solubility of the soil), crops and livestock:

If the petitioned substance is applied, without excessive runoff to surface and groundwater and the product does not exceed the minimum level of acid needed to lower the pH to 3.5, adverse biological or chemical interaction on the surrounding environment would not be expected.

If applied as intended, the petitioned substance will not cause any adverse biological of chemical interactions but will have strong positive effects on crops. Applications of the petitioned substance will increase soil microbial populations, diversity and activities due to the levels of bioactive components acting as a growth media. Plants will respond similarly with increases in root/shoot growth due to applications of mineral macro and micronutrients. The petitioned substance will not have any significant effects on the salt index or solubility of the soil.

10. Safety information including a Material Safety Data Sheet (MSDS) and a substance report from the National Institute of Environmental Health Studies

There is no MSDS or substance report for raw anaerobic digestate or processed anaerobic digestate from food waste.

11. Research information about the substance

Since the number of anaerobic digesters recycling source separated food waste within the U.S. is small (but growing), there are no comprehensive research reports on the use of the substance as a liquid applied digestate and, especially no reports on the use of dried food waste digestate reported within the U.S. There are, however, a number of reports and reviews from the UK, EU and Canada which will be presented here.

WRAP (Waste and Resources Action Programme) UK

WRAP conducted a comprehensive study of digestate enhancement technologies and techniques, *Enhancement and treatment of digestates from anaerobic digestion, WRAP, November 2012.*(*http://www.wrap.org.uk/sites/files/wrap/Digestates%20from%20Anaerobic%20Digestion%20A%20review%20of%20enhancement%20techniques%20and%20novel%20digestate%20products_0.pdf)*

The WRAP study identified the situation associated with the current practice of land applying liquid digestate:

- The majority of digestate produced in the UK is spread to local agricultural land as fertilizer
- Although this is a good use of the nutrients within the digestate, the value of the digestate to the producer is low
- Once the costs of transportation and spreading are taken into account the digestate value can be close to zero, and may even be a cost to the producer.

The WRAP study then reviewed a number of technologies and techniques to improve the value of digestate as a fertilizer. One of the techniques reviewed was the evaporation of stabilized digestate using the same technique as will be used to make the petitioned substance. From page 15 of the WRAP report,

Digestate Concentration (Evaporation)
To concentrate digestate or increase dry solids content, evaporation can be applied. Evaporation utilises thermal energy (heat) to release the moisture within the digestate and increase both nutrient and solids concentration. Unlike the drying techniques discussed above, evaporation aims to retain the nutrients and a proportion of the moisture contained within the digestate. Evaporation is typically utilised for liquor or whole digestate treatment.

The final solids concentration will be dependent on the desired product, but concentrations of up to 20% ds can be achieved. As with thermal drying, high temperatures will cause ammonia to be released. This can be overcome by decreasing the pH of the digestate, typically with acid dosing, prior to evaporation (HRS Heat Exchangers, 2010). This approach allows the digestate liquor to be converted into a concentrated fertiliser.

12. Petition Justification Statement

a. Why is the synthetic substance necessary for the production or handling of an organic product

The petitioned substance is necessary to offer an alternative to organic growers that provides relatively high nitrogen content plus all of the other beneficial attributes of organic fertilizers. Key to the value of the product to growers is the stability of the product achieved by the addition of small amounts of sulfuric acid during the processing of the digestate as necessary to reduce the pH level down to 4.5 (but not under 3.5). A reduction in pH to these levels will totally inhibit residual microbial activity and the resultant buildup of various metabolic gases in transport and shelf containers which would not only reduce shelf life and produce unacceptable odors, but also pose a potential safety risk. Finally, a reduction in pH levels will almost completely transform significant ammonia gas

levels in the liquid digestate into the stable ammonium ion again reducing noxious odors as well as increasing the nutrient value of the product.

b. Describe any non-synthetic substances, synthetic substances on the National List or alternative cultural methods that could be used in place of the petitioned synthetic substance

The only other substances that compare to the petitioned product are powdered/granulated fish hydrolysate and kelp hydrolysates. Both of these materials can be re-suspended in water and subsequently applied in spray/liquid applications like the petitioned substance. Like the petitioned product, these other dry organic fertilizers are not meant or cannot be solubilized or suspended in water for successful spray/liquid applications.

c. Describe the beneficial effects to the environment, human health, or farm ecosystem from the use of the synthetic substance that support its use instead of the use of a non-synthetic substance or alternative cultural methods

The use of the petitioned substance can be considered highly compatible with sustainable agricultural practices when considering the recycling value of the food waste source material that is being converted into usable biogas/electricity and a potentially high quality organic fertilizer (1,3,5,6,10). The diverse nature of the source food waste results in the petitioned substance containing virtually all the mineral and organic nutrients needed to promote a plant and soil ecosystem (1,4,8,9). This diversity distinguishes the petitioned substance from all other similar organic fertilizers.

The use of the petitioned substance can be considered highly compatible with sustainable agricultural practices when considering the recycling value of the food waste source material that is being converted into biogas (methane, electricity) and a potentially high value organic fertilizer (2,7,9). The beneficial aspects that make this material unique are as follows:

- The extremely diverse nature of the food waste is reflected in the petitioned substance by retaining all the essential macro and micronutrients as well as high levels of primary and secondary biochemical compounds that are bioactive within the plant/soil system (1,8). There are no other organic fertilizers that we are aware of that have this wide range of mineral and biochemical components.
- The dry powdered characteristics allow for safe, easy and economical transportation and sale (11).
- The solubility and ability to re-suspend in water allow for not only traditional spreader application (when granulated) but all systems of spray/liquid application as well.

- The consistently low C/N ratio (lower than 3.0) makes the petitioned substance one of the most rapid acting in terms of plant response as well as increasing the diversity and activities of soil microbial populations.

The production of the petitioned substance provides a number of environmental benefits (see also http://www.epa.gov/agstar/anaerobic/faq.html).

- Recycling of food waste that would otherwise be disposed of in landfills and creating methane, a greenhouse gas 21 times as potent as CO_2. Anaerobic digestion and the subsequent use of that gas as fuel destroys methane and displaces fossil fuel used for the generation of power or as transportation fuel (2,3,6).
- The dried form of the petitioned substance reduces the fuel use associated with the transportation of digestate, allowing a broader market to be reached (11) and reducing greenhouse gas emissions from transportation of digestate nutrients.
- Reduction in the use of synthetic fertilizers http://www.epa.gov/agstar/anaerobic/faq.html
- Reduction in atmospheric emissions of ammonia associated with digestate handling and application

References:

1. Abubaker, J. 2012. Effect of fertilization with biogas residues on crop yield, soil microbiology and greenhouse gas emissions. Ph.D Thesis, Swedish University of Agricultural Sciences, Uppsala, Sweden.

2. Anaerobic Digestion Strategy and Action Plan, Annual Report on Progress 2011/12, July 2012. p. 13. [www.de-fra.gov.uk/publications/files/pb13788-ad-2012-progress.pdf

3. Bougnom, B.P., Niederkofler, C., Knapp, B.A., Stimpfl, E. & Insam, H. (2012).Residues from renewable energy production: Their value for fertilizing pastures. Biomass and Bioenergy 39(0), 290-295.

4. Digestate & Compost in Agriculture project - Overview [www.wrap.org.uk/ content/digestate-compost-agriculture]

5. Haraldsen, T.K., Andersen, U., Krogstad, T. & Sørheim, R. (2011).Liquid digestate from anaerobic treatment of source-separated household waste as fertilizer to barley. Waste Management & Research 29(12), 1271-1276.

6. Kocar, G. (2008). Anaerobic digesters: From waste to energy crops as an alternative energy source. Energy Sources, Part A:Recovery, Utilization, and Environmental Effects30(7), 660-669

7. Kvasauskas, M. & Baltrėnas, P. (2008).Anaerobic recycling of organic waste and recovery of biogas. Ekologija54 (1), 57-63.

8. la Cour Jansen, J., Spliid, H., Hansen, T.L., Svärd, Å. & Christensen, T.H. (2004).Assessment of sampling and chemical analysis of source-separated organic household waste. Waste Management 24(6), 541-549.

9. Matrix of Research & Development Work, Anaerobic Digestion and Composting Research Network - UK (AD-CORN-UK), 3 November 2011.[www.biogas-info.co.uk/images/PDFs/ research.pd

10. Svensson, K., Odlare, M. & Pell, M. (2004): The fertilizing effects of compost and biogas residues from source separated household waste. Journal of Agricultural Science 142, pp. 461-467.

11. Alexander, R. (2012): Digestate Utilization in the U.S. BioCycle January 2012, Vol. 53, No. 1, p. 56

Attachment A - Sample Specification Sheet

PowerUp Fertilizer 8-1-2 NPK Guaranteed Analysis

Model No. XXXX

Total Nitrogen ----------8%

6.8% Ammoniacal nitrogen

6.8% Water soluble nitrogen

1.2% Other nitrogen

Available Phosphate----------P_2O_5-----1.0%

Soluble Potash----------K_2O------2.0%

Calcium -------2.0%

Magnesium---0.1%

Sulfur----------5.0%

Iron----------2.0%

Micronutrients

Manganese----95ppm

Copper----------117ppm

Zinc----------0.7%

Boron----------12ppm

Source of nutrients derived from ---------- anaerobically digested food waste

Fine granular powdered fertilizer ----------50lbs. (22.68Kg)

<u>Directions for use</u>

Dissolve in water at a rate of 39lbs per 100 gallons of water to apply at a rate of ¼ lb N per 4 gallons/1000 sq. ft.

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Made in USA