IN THE UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF OHIO
WESTERN DIVISION AT DAYTON

CITY OF FAIRBORN, OHIO
44 WEST HEBBLE AVENUE
FAIRBORN, OHIO 45234

AND

BATH TOWNSHIP, OHIO
1006 YELLOW SPRINGS-FAIRFIELD RD
FAIRBORN, OHIO 45234

***Plaintiffs*,**

v.

UNITED STATES ENVIRONMENTAL
PROTECTION AGENCY
1200 PENNSYLVANIA AVE NW
WASHINGTON DC 20460

OHIO ENVIRONMENTAL PROTECTION
AGENCY,
50 WEST TOWN STREET
COLUMBUS, OHIO 43215

DOVETAIL ENERGY, LLC,
C/O CH&K AGENT SERVICE, INC.
STATUTORY AGENT
1 SOUTH MAIN STREET, SUITE 1300
DAYTON, OHIO 45402

and RENERGY INC.
C/O ALEXANDER RINGLER
STATUTORY AGENT
461 STATE ROUTE 61
MARENGO, OHIO 43334

Defendants.

Case No. ______________________

COMPLAINT

JURY TRIAL DEMANDED

Plaintiffs City of Fairborn, Ohio and Bath Township, Greene County, Ohio (collectively "Plaintiffs") bring this action pursuant to the citizen suit provision of the federal Clean Air Act, 42 U.S.C. § 7604, and aver as follows:

Nature of the Action

1. Plaintiffs bring this citizen suit action pursuant to Clean Air Act ("CAA") Section 304, 42 U.S.C. § 7604, and seek declaratory and injunctive relief, the assessment of civil penalties and an award of attorney fees and costs against Defendants Dovetail Energy LLC ("Dovetail") and Renergy Inc. ("Renergy") for violations of the CAA, Ohio's federally enforceable State Implementation Plan ("SIP") and Ohio law.

2. Renergy and/or Dovetail installed and own and operate an air contaminant source, a digestate lagoon, in Greene County, Ohio without first applying for and obtaining a permit-to-install and operate ("PTIO") in violation of federal and Ohio air pollution laws and are operating the aforementioned air contaminant source, a digestate lagoon, without employing the best available technology ("BAT") in violation of federal and Ohio air pollution laws. These provisions of Ohio law are part of Ohio's federally enforceable SIP and constitute ongoing violations of an emission standard or limitation under the CAA. 42 U.S.C. § 7602; 42 U.S.C. § 7604. Additionally, Renergy and/or Dovetail are operating the aforementioned air contaminant source, a digestate lagoon, without complying with Ohio's air toxic law, Ohio Admin. Code Chapter 3745-114, in violation of Ohio law, Ohio Revised Code 3704 *et. seq*.

3. Plaintiffs seek declaratory and injunctive relief, attorneys' fees and the assessment of civil penalties in the amount of $109,024 per day per violation against Defendants Renergy and Dovetail for their flagrant, protracted and ongoing violation of the CAA, Ohio's SIP and Ohio's

air laws by emitting the toxic air contaminant ammonia uncontrolled. 87 Fed. Reg 1676 (Jan. 12, 2022), (CAA civil penalty daily maximum).

4. Plaintiffs seek declaratory and injunctive relief and attorneys' fees against Defendants United States Environmental Protection Agency ("USEPA") and Ohio Environmental Protection Agency ("Ohio EPA") for failing to enforce provisions of the CAA, the federally enforceable provisions of Ohio's SIP and Ohio law (Defendant Ohio EPA) with respect to Renergy and Dovetail, which constitutes failure to perform nondiscretionary duties without unreasonable delay within the meaning of the CAA.

5. Defendants' violations of federal and state laws and regulations are ongoing, continuing, and/or capable of being repeated in the future.

6. Plaintiffs also seek such other relief as this Court deems just and proper.

Parties and Standing

7. The City of Fairborn is a municipality, incorporated under the laws of the State of Ohio, with a principal address of 44 West Hebble Avenue, Fairborn, Ohio 45324, in Greene County ("Fairborn"). Fairborn brings this action on behalf of Fairborn's citizens and residents. Fairborn is a "person" per Ohio's SIP and the CAA. Ohio R.C. 3704.01(O); Ohio Admin. Code 3745-31-01(RRRR); 42 U.S.C. § 7602(e).

8. Bath Township is a township, incorporated under the laws of the State of Ohio, with a principal address at 1006 Yellow Springs-Fairfield Road, Fairborn, Ohio 45324, in Greene County. Bath Township brings this action on behalf of its citizens and residents. Bath Township is a "person" per Ohio's SIP and the CAA. Ohio R.C. 3704.01(O); Ohio Admin. Code 3745-31-01 (RRRR); 42 U.S.C. § 7602(e).

9. Plaintiffs have standing to file this civil enforcement action under Section 304 of the Clean Air Act, 42 U.S.C. § 7604. The citizens and residents of both Plaintiffs have been, are being, and will be adversely affected by the ongoing, continuing, and/or future violations of federal and state laws and regulations by all Defendants. Specifically, Plaintiffs have been injured and damaged by Renergy and Dovetail's illegal and wrongful release of uncontrolled ammonia emissions from its digestate lagoon into the air. Such emissions and releases were and are emitted without first obtaining the necessary permits, reducing the emissions to best available technology levels and addressing the toxic nature of the emissions thus causing harm to Plaintiffs, including, but not limited to damage, degradation of health, injury to the right of peace, clean air and a healthy environment.

10. Defendant USEPA is the federal governmental agency charged with protecting the environment and public health and the task of taking various actions to implement and enforce the CAA, including those actions sought herein. USEPA is a "person" per Ohio law, Ohio's SIP and the CAA. Ohio R.C. 3704.01(O); Ohio Admin. Code 3745-31-01 (RRRR); 42 U.S.C. § 7602(e).

11. Defendant Ohio EPA is the Ohio governmental agency charged with protecting the environment and public health by ensuring compliance with environmental laws, including the CAA, Ohio's SIP and Ohio's state air pollution law and regulations. Ohio EPA is a "person" per Ohio law, Ohio's SIP and the CAA. Ohio R.C. 3704.01(O); Ohio Admin. Code 3745-31-01 (RRRR); 42 U.S.C. § 7602(e),

12. Dovetail is a limited liability company, organized and existing under the laws of the State of Ohio, with a principal place of business at 1156 Herr Road, Fairborn, Ohio 45324, in Greene County. Dovetail owns and/or operates the digestate lagoon at 1156 Herr Road, Fairborn,

Ohio 45324. Dovetail is a "person" per Ohio law, Ohio's SIP and the CAA. Ohio R.C. 3704.01(O); Ohio Admin. Code 3745-31-01 (RRRR); 42 U.S.C. § 7602(e).

13. Renergy Inc. is a for-profit corporation, incorporated under the laws of the State of Ohio, with a principal place of business at 461 State Route 61, Marengo, Ohio 43334, in Morrow County. Renergy owns and/or operates the digestate lagoon at 1156 Herr Road, Fairborn, Ohio 45324. Renergy is a "person" per Ohio law, Ohio's SIP and the CAA. Ohio R.C. 3704.01(O); Ohio Admin. Code 3745-31-01 (RRRR); 42 U.S.C. § 7602(e).

Jurisdiction, Notice and Venue

14. This Court has subject matter jurisdiction pursuant to 42 U.S.C. § 7604 (CAA citizen suit) and 28 U.S.C. §§ 1331 (federal question) and 1361 (compel federal officer to perform duty).

15. This Court has supplemental jurisdiction over the state law claims in this case per 28 U.S.C. § 1367 because those claims are so related to the claims in the action within this Court's original jurisdiction that they form part of the same case or controversy under Article III of the United States Constitution as they arise from a common nucleus of operative fact.

16. This Court may issue declaratory judgment and further relief pursuant to 20 U.S.C. §§ 2201 and 2202.

17. Per 42 U.S.C. § 7604(b) and 40 C.F.R. Part 54, Plaintiffs notified Defendants of the violations alleged herein and of Plaintiffs' intent to initiate the present action pursuant to CAA Section 304. This notice was provided via certified mail, federal express mail and electronic mail, posted February 14, 2022, and addressed to each Defendant. Each Defendant received notice, and proof of service of notice to each Defendant has been documented. A copy of the February 14, 2022 notice letter is attached as Exhibit 1 to this Complaint.

18. More than sixty (60) days have passed since Plaintiffs' notice was served pursuant to 42 U.S.C. § 7604(b). To date, the violations alleged have not ceased or been remedied.

19. Defendants USEPA and Ohio EPA have not commenced and/or are not diligently prosecuting a civil action in a court of the United States or the State of Ohio requiring Defendants Dovetail and Renergy to comply with the CAA, Ohio's SIP and Ohio law. 42 U.S.C. § 7604(B)(1)(b).

20. On April 13, 2022, counsel for Plaintiffs sent a letter to Ohio EPA notifying Ohio EPA that Plaintiffs must be involved in any negotiations between Defendants, and that any settlement with Renergy and Dovetail without the direct, substantive involvement of Plaintiffs would not constitute diligent prosecution by Ohio EPA. A copy of Plaintiffs' letter is attached as Exhibit 2 to this Complaint.

21. On April 14, 2022, Defendant Ohio EPA sent, via email, a letter to counsel for Plaintiffs clearly excluding Plaintiffs from any meaningful and substantive participation in negotiations regarding the violations set forth in the Plaintiff's February 14, 2022 CAA sixty (60) day notice letter. A copy of the State of Ohio's letter is attached as Exhibit 3 to this Complaint.

22. Thereafter, on Good Friday, and at the very end of Plaintiffs' sixty (60) day notice period, the State of Ohio Attorney General's Office (on behalf of Defendant Ohio EPA) hastily filed a complaint against Renergy and Dovetail in the Court of Common Pleas for Greene County, Ohio, dated April 15, 2022. A copy of the State of Ohio's complaint is attached as Exhibit 4 to this Complaint. The eleventh hour nature of Defendant Ohio EPA's action coupled with Ohio EPA's failure to allow Plaintiffs <u>any</u> participation, let alone meaningful and substantive participation, in any negotiations with Defendants Renergy and Dovetail does not constitute

diligent prosecution and does not bar this citizen suit action by Plaintiffs under 42 U.S.C. § 7604(b)(1)(B

23. This Court has personal jurisdiction over Defendants Renergy and Dovetail because both conduct business in the State of Ohio, and within this judicial district, including owning and/or operating a digester and digestate lagoon located at 1156 Herr Road, Fairborn, Ohio 45324 (collectively "Facility"), which is a stationary source/source of air contaminants. 42 U.S.C. § 7602(z); Ohio Admin. Code 3745-31-01(H),(I), (AAAAAA). This Court also has personal jurisdiction over Defendants USEPA and Ohio EPA as both are required to perform nondiscretionary duties within this Court's jurisdiction. 42 U.S.C. § 7604(a)(2), (c).

24. Venue in this Court is proper under 28 U.S.C. § 1391(b)(2) because the events or omissions giving rise to the claim occurred in this judicial district. 42 U.S.C. § 7604(c)(1). Defendants Renergy's and Dovetail's ownership and/or operation of the subject Facility and digestate lagoon, and Defendants USEPA's and Ohio EPA's failure to perform non-discretionary duties in connection with their failure to permit and regulate air contaminant emissions from the Facility's digestate lagoon is and has been causing harm in this state and judicial district.

Factual Background

25. Since 2014, Defendants Renergy and Dovetail have owned and operated an anaerobic biodigester located at 1156 Herr Fairborn, Ohio 45324, in Greene County, Ohio. The electricity generated by this biodigester allegedly powers operations on adjacent property. Electricity is also allegedly provided to the wholesale electric grid. Renergy and Dovetail identify their Facility operations in court filings as constituting a "public utility" as that term is defined in applicable provisions of the laws and regulations of the State of Ohio. Ohio Revised Code

4905.02; Ohio Admin Code 4901:1; *Dovetail Energy, LLC v. Bath Twp. Bd. of Zoning Appeals*, 183 N.E.3d 602, 605–06, 609–10 (Ohio Ct. App. 2022)

26. The Facility's biodigester processes various solid and liquid waste materials including food waste, biosolids, and hog manure to produce methane that is combusted to create electrical energy. When solid and liquid waste materials are fed into the digester, digestate—the digested solid and liquid waste materials in the digester—is discharged from the digester into a 5.5 million gallon lagoon that is and has been during all relevant times uncovered and open to the ambient air. The digestate lagoon at the Facility emits uncontrolled ammonia in NH_3 form ("Ammonia").

27. Beginning in 2014 when Renergy and Dovetail commenced operation of its Facility and digestate lagoon, the citizens of Plaintiffs began to routinely experience the impacts of Ammonia as well as strong and offensive odors from the Facility and digestate lagoon. From April 2017 through June 2021, Ohio EPA recorded more than 340 citizen complaints related to the Facility and digestate lagoon.

28. Ammonia is an air contaminant as that term is defined in Ohio's SIP and Ohio law. Ohio Admin. Code 3745-31-01. Ammonia is also a "toxic air contaminant" per Ohio law. Ohio Admin. Code 3745-114-01.

29. Ammonia exposure can cause eye, nose, lung and throat irritation, coughing, respiratory spasms, frothing at the mouth and asphyxiation. Upon information and belief, Renergy and Dovetail's digestate lagoon is emitting between 814 pounds and 3,400 pounds of Ammonia per day (i.e. 148-620 tons per year of Ammonia) without any controls or limitations on such emissions.

30. Defendants Renergy and Dovetail have been violating the federal CAA and Ohio's clean air laws for at least eight (8) years and continue to do so to date. Due to the egregious and blatant nature of their actions, Plaintiffs seek the statutory maximum penalty of $109,024 per violation for the approximately 2,920 days of violation (which are continuing in nature).

Count I

Installation and Operation of a New Source without a PTIO

31. Plaintiffs incorporate by reference and re-allege the allegations contained in paragraphs 1 through 30 above as if fully and separately set forth in this section of the complaint.

32. Ohio's SIP, incorporated into federal law, prohibits both the installation and operation of a new source of air contaminants without first applying for and obtaining a Permit to Install and Operate ("PTIO"). Ohio Admin. Code 3745-31-02 (incorporated into federal law at 80 FR 36477).

33. In 2014, Renergy and Dovetail installed and began operating a new source of air contaminants, a digestate lagoon, which has the potential to emit and does emit Ammonia, which is an air contaminant defined by Ohio Revised Code 3704.01, Ohio Admin. Code 3745-31-01 (H) and a toxic air contaminant listed in Ohio Admin. Code 3745-114-01.

34. Renergy and Dovetail installed and began operating the digestate lagoon at the Facility without first applying for a PTIO as required by Ohio's SIP at Ohio Admin. Code 3745-31-02.

35. On February 16, 2018, Renergy and Dovetail submitted an air pollution PTIO application to Ohio EPA for the Facility. The PTIO application identified only three air emission sources: 1) a digester tank with flare, 2) a "CAT 3516" engine, and 3) a "backup generator" engine.

36. The digestate lagoon was not identified by Renergy or Dovetail as a source of air contaminants. Upon information and belief, Renergy and Dovetail did not submit any emissions calculations for the digestate lagoon to justify any exemption from permitting requirements. Further, upon information and belief, Renergy and Dovetail did not submit any potential to emit, as that term is defined by Ohio Admin. Code 3745-31-01 (BBBBB), calculations with respect to Ammonia as it was required to do.

37. On April 9, 2018, Ohio EPA issued PTIO P0124072. This PTIO was later modified and replaced by PTIO P0127783 on April 15, 2020.

38. Neither PTIO P0124072 nor PTIO P0127783 identified the digestate lagoon as an air contaminant source and neither PTIO contained any substantive terms and/or conditions applicable to the digestate lagoon, including limitations on Ammonia emissions or requirements to control Ammonia emissions.

39. Defendants Renergy and Dovetail violated Ohio's federally enforceable SIP, Ohio Admin. Code 3745-31-02, by installing and operating the digestate lagoon which is a source of air contaminants (Ammonia) without first applying for and obtaining a PTIO. This violation is a continuing and on-going violation, and has been occurring since 2014.

40. Defendants Ohio EPA and USEPA have a nondiscretionary duty to enforce Ohio's SIP, which includes Ohio Admin. Code 3745-31-02. To date, Defendants Ohio EPA and USEPA have not adhered to this nondiscretionary duty by allowing Renergy and Dovetail to install and operate the digestate lagoon which is a source of air contaminants (Ammonia) without first applying for and obtaining a PTIO.

41. Plaintiffs are entitled to declaratory and injunctive relief against Defendants Renergy and Dovetail for their violations of Ohio Admin. Code 3745-31-02 and against Defendants USEPA and Ohio EPA for their failure to enforce Ohio's SIP.

42. Plaintiffs have incurred, and will continue to incur, attorneys' fees and court costs arising from the acts of Defendants and therefore seek the recovery of attorneys' fees and costs as the prevailing party in this action as well as civil penalties.

Count II

Operation of an Air Contaminant Source Without Employing BAT

43. Plaintiffs incorporate by reference and re-allege the allegations contained in paragraphs 1 through 42 above as if fully and separately set forth in this section of the complaint.

44. Ohio's SIP, incorporated into federal law, prohibits the operation of a source of air contaminants without first identifying and employing BAT to reduce air emissions. Ohio Admin. Code 3745-31-05(A)(3)(a) (incorporated into federal law at 84 FR 14874).

45. The digestate lagoon emits Ammonia, which is an air contaminant under Ohio Admin. Code 3745-31-01(H). The digestate lagoon is an air contaminant source under Ohio Admin. Code 3745-31-01(I)(3).

46. Ohio Admin. Code 3745-31-05(A)(3) requires that all sources of air contaminants, that have the potential to emit an air contaminant over ten (10) tons per year, employ BAT to reduce air emissions. "BAT" means "any combination of work practices, raw material specifications, throughput limitations, source design characteristics, an evaluation of the annualized cost per ton of air pollutant removed, and air pollution control devices that have been previously demonstrated to the director of environmental protection to operate satisfactorily in

[Ohio] or other states with similar air quality on substantially similar air pollution sources." Ohio Admin. Code 3745-31-01(T); Ohio Admin. Code 3745-31-05(A)(3).

47. Before a PTIO may be issued, Defendant Ohio EPA must determine that the installation and operation of the air contaminant source will employ BAT pursuant to Ohio Admin. Code 3745-31-05(A)(3).

48. Renergy and Dovetail installed and began operating the digestate lagoon at the Facility in 2014. The digestate lagoon was a new source of air contaminants (Ammonia).

49. On February 16, 2018, Renergy and/or Dovetail submitted an air pollution PTIO application to Ohio EPA for the Facility. On April 9, 2018, Ohio EPA issued to Renergy and/or Dovetail PTIO Number P0124072. This PTIO was later modified and replaced by PTIO Number P0127783 on April 15, 2020.

50. The PTIOs issued under the authority of USEPA and Ohio EPA to Renergy and/or Dovetail for emissions units at the Facility do not identify the digestate lagoon as an air contaminant source nor do they require implementation of BAT with respect to the digestate lagoon and its emissions of Ammonia.

51. The digestate lagoon has a potential to emit Ammonia that is greater than ten (10) tons per year (upon information and belief, the digestate lagoon has the potential to emit between 148-620 tons of Ammonia per year).

52. Renergy and Dovetail have not employed BAT in operating the digestate lagoon.

53. Ohio Admin. Code 3745-31-05(A) is a USEPA-approved regulation in the Ohio SIP at 84 FR 14874.

54. Defendants Renergy and Dovetail violated Ohio's federally enforceable SIP, Ohio Admin. Code 3745-31-05, by installing and operating the digestate lagoon, which is a source of

air contaminants (Ammonia) without first identifying and employing BAT. This violation is a continuing and on-going violation, and has been occurring since 2014.

55. Defendants Ohio EPA and USEPA have a nondiscretionary duty to enforce Ohio's SIP, which includes Ohio Admin. Code 3745-31-05. To date, Defendants Ohio EPA and USEPA have failed to perform this nondiscretionary duty by allowing Renergy and/or Dovetail to install and operate the digestate lagoon without employing BAT.

56. Plaintiffs are entitled to declaratory and injunctive relief against Defendants Renergy and Dovetail for their violations of Ohio Admin. Code 3745-31-05 and against Defendants USEPA and Ohio EPA for failure to enforce Ohio's SIP.

57. Plaintiffs have incurred, and will continue to incur, attorneys' fees and court costs arising from the acts of Defendants and therefore seek the recovery of attorneys' fees and costs as the prevailing party in this action as well as civil penalties.

Count Three

Installation and Operation of An Air Emissions Source without Following Ohio's Air Toxics Law (Pendent State Law Claim)

58. Plaintiffs incorporate by reference and re-allege the allegations contained in paragraphs 1 through 57 above as if fully and separately set forth in this section of the complaint.

59. The digestate lagoon emits Ammonia, and Ammonia is listed as a toxic air contaminant under Ohio Admin. Code 3745-114-01. The digestate lagoon is an air contaminant source under federal and Ohio law. Ohio Admin. Code 3745-31-01(I)(3).

60. The facts and claims of this Count arise from a common nucleus of operative fact in the same case and controversy. As such, this Court has supplemental jurisdiction over this Count per Article III of the United States Constitution. 28 U.S.C. § 1367.

61. Since 2014, Renergy and Dovetail have operated the digestate lagoon at its Facility. When installed in 2014, the digestate lagoon was a new source of air contaminants (Ammonia).

62. On February 16, 2018, Renergy and Dovetail submitted an air pollution PTIO application to Ohio EPA for the Facility.

63. Defendant Renergy's PTIO application did not provide any information relating to the digestate lagoon or its potential to emit Ammonia, nor did it provide any information that would allow Ohio EPA to determine the digestate lagoon's conformity with Ohio EPA's "*Review of New Sources of Air Toxics Emissions, Option A*," as required by Ohio Revised Code 3704.03(F)(4) and Ohio Admin. Code Chapter 3745-114.

64. On April 9, 2018, Ohio EPA issued to Renergy PTIO Number P0124072. This PTIO was later modified and replaced by PTIO Number P0127783 on April 15, 2020.

65. Renergy, Dovetail and Ohio EPA failed to calculate the maximum acceptable ground level concentration (MAGLC") of Ammonia and failed to conduct modeling related to the Ammonia emissions from the Facility's digestate lagoon. MAGLC calculations and modeling are required pursuant to Ohio Revised Code Section 3704.03(F)(4)(b); Ohio Admin. Code 3745-114.

66. Defendants Renergy and Dovetail violated Ohio Admin. Code 3745-114 by installing and operating a source of toxic air contaminants without first identifying the source as a source of toxic air contaminants and by failing to follow Ohio's air toxics law, including the requirement to perform air toxics modeling for Ammonia. Modeling assures that emissions of toxic air contaminants are at levels not harmful to human health and the environment. This violation is a continuing and on-going violation and has been occurring since 2014.

67. Defendant Ohio EPA has a nondiscretionary duty to enforce Ohio law, which includes Ohio Admin. Code Chapter 3745-114. To date, Defendant Ohio EPA has failed to

perform this nondiscretionary duty by allowing Renergy and Dovetail to install and operate a source of air contaminants without complying with Ohio's air toxics law, Ohio Revised Code 3704.03(F) and Ohio Admin. Code Chapter 3745-114.

68. Plaintiffs are entitled to declaratory and injunctive relief against Defendants Renergy and Dovetail for their violations of Ohio Admin. Code 3745-114 and against Defendant Ohio EPA for its failure to enforce Ohio law.

69. Plaintiffs have incurred, and will continue to incur, attorneys' fees and court costs arising from the acts of Defendants and therefore seek the recovery of attorneys' fees and costs as the prevailing party in this action.

Prayer for Relief

WHEREFORE, Plaintiffs respectfully request that this Court enter judgment against Defendants as follows:

A. Declare that Defendants USEPA's and Ohio EPA's failure to enforce the CAA and federally enforceable provisions of Ohio's SIP, including Ohio Admin. Code 3745-31-02 and 3745-31-05, constitute failure to perform nondiscretionary duties without unreasonable delay within the meaning of the CAA, 42 U.S.C. § 7604(b)(2);

B. Permanently enjoin Defendants USEPA and Ohio EPA from continuing to violate the CAA and the aforementioned federally-enforceable provisions of Ohio's SIP;

C. Declare that Defendant Ohio EPA has violated Ohio law for failing to enforce Ohio's air laws and regulations;

D. Permanently enjoin Defendant Ohio EPA from continuing to violate Ohio law;

E. Declare that Defendants Renergy and Dovetail have violated the CAA, federally enforceable provisions of Ohio's SIP, including Ohio Admin. Code 3745-31-02 and 3745-31-05, and other Ohio state law and regulations, including Ohio Revised Code Section 3704.03(F)(4) and Ohio Admin. Code Chapter 3745-114;

F. Permanently enjoin Defendants Renergy and Dovetail from continuing to violate the CAA and federally-enforceable provisions of Ohio's SIP, as well as Ohio's air pollution control law and regulations;

G. Require, in the form of injunction or mandamus, that prior to any additional Facility operations, Ohio EPA must issue a valid PTIO that requires BAT and regulates air toxic emissions for the digestate lagoon;

H. Award Plaintiffs their reasonable costs of litigation, including attorneys' fees, pursuant to 42 U.S.C. § 7604(d);

I. Retain jurisdiction over this action to ensure compliance with the Court's orders;

J. Impose maximum civil penalties of $109,024 per day, per violation against Defendants Renergy and Dovetail for the on-going violations of the CAA, Ohio's federally-enforceable SIP and Ohio law; and,

K. Grant such other relief as the Court deems just and proper.

JURY DEMAND

Plaintiffs demand a trial by jury on all issues so triable.

Dated: April 18, 2022

CITY OF FAIRBORN, OHIO

April Bott Moore

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BATH TOWNSHIP, OHIO

William H. Haak by April Bott Moore*

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* upon written authorization

CERTIFICATE OF SERVICE

The undersigned hereby certifies that a copy of the foregoing was served upon the following parties via this Court's electronic filing system and Civ. R. 4 this 18th day of April 2022.

Michael S. Regan, Administrator
regan.michael@epa.gov
United States Environmental Protection Agency
Mail Code: 1101A
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Debra Shore, Regional Administrator
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United States Environmental Protection Agency, Region V
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Merrick Garland, US Attorney General
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Laurie A. Stevenson, Director
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Dayton, Ohio 45402

Renergy Inc.
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461 State Route 61
Marengo, Ohio 43334

/s/ April Bott Moore
Attorney for City of Fairborn

Exhibit 1

HAAK LAW LLC
Environmental, Health & Safety
Legal and Consulting Services

William H. Haak
whh@haaklawllc.com
Tel: 216.772.3532

Via Certified Mail and Electronic Mail

February 14, 2022

Michael S. Regan, Administrator
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c/o CH&K Agent Service, Inc.
1 South Main Street – Suite 1300
Dayton, Ohio 45402

Renergy, Inc.
c/o Alexander Ringler, Statutory Agent
461 State Route 61
Marengo, Ohio 43334

Re: 60 Day Notice of Intent to File a Citizen Suit Under 42 U.S. Code 7604

Dear Administrator Regan, Regional Administrator Shore, Director Stevenson, *Et al.*:

This letter is being submitted on behalf of Bath Township, Greene County, Ohio and the City of Fairborn, Greene County, Ohio to notify you, pursuant to Section 304 of the Clean Air Act (CAA), 40 U.S. Code 7604, of their intent to sue the United States Environmental Protection Agency (USEPA), the Ohio Environmental Protection Agency (Ohio EPA), and both Dovetail Energy, LLC and Renergy, Inc. (collectively referred to hereinafter as "Renergy") for violations of the CAA. Specifically, USEPA and Ohio EPA have failed to perform non-discretionary duties in connection with permitting and regulating ammonia emissions to the ambient air from a 5.5 million gallon digestate storage lagoon operated by Renergy at 1156 Herr Road, Fairborn, Ohio. Renergy, in turn, installed and has operated this lagoon without a Permit to Install and Operate (PTIO) as required by Ohio's State Implementation Plan (SIP).

I. FACTUAL BACKGROUND

Since 2014, Renergy has owned and operated an anaerobic biodigester located at 1156 Herr Road within the City of Fairborn in Bath Township, Greene County, Ohio. The electricity generated by Renergy's biodigester allegedly powers operations on adjacent property(ies). Electricity is also allegedly provided to the wholesale electric grid. As such, Renergy identifies its operations as constituting a "public utility" as that term is defined in applicable provisions of the laws and regulations of the State of Ohio.

Renergy's biodigester processes various solid and liquid waste materials including food waste, biosolids, and hog manure to produce methane that is combusted to create electrical energy. When solid and liquid waste materials are fed into the digester, digestate (the digested solid and liquid waste materials in the digester) is discharged from the digester into a 5.5 million gallon lagoon that is uncovered and open to the ambient air. Renergy sometimes removes digestate from the lagoon for Ohio EPA-approved agricultural land application as fertilizer.

Beginning in 2014 when Renergy commenced operation of its Fairborn facility, the citizens of Bath Township and the City of Fairborn began to routinely experience strong and offensive odors believed to be emanating from Renergy's facility. From April of 2017 through June of 2021 alone, Ohio EPA recorded more than 340 citizen complaints with respect to Renergy's Fairborn facility. The vast majority of these complaints pertained to objectionable odors that the complainants attributed to Renergy (with the balance of the complaints pertaining to non-odor issues related to Renergy's operations).

II. CURRENT AIR PERMITTING OF RENERGY'S FAIRBORN FACILITY

On February 16, 2018 – four years after commencing operation – Renergy submitted an air pollution PTIO application (attached as Appendix A) to Ohio EPA for its Fairborn facility.[1] Along with its PTIO application, Renergy submitted an Ohio EPA Division of Air Pollution Control Emissions Activity Category (EAC) Form (attached as Appendix B). Renergy's PTIO application identified only three (3) emissions units: 1) a digester tank with flare; 2) a "CAT 3516" engine; and, 3) a "backup generator" engine. The digestate lagoon was <u>not</u> identified as an emissions unit. Renergy did not submit any potential to emit (PTE) calculations for the lagoon to justify an exemption from permitting requirements pursuant to Ohio Admin. Code Rule 3745-15-05, nor did Ohio EPA or the Regional Air Pollution Control Agency (RAPCA) request such calculations. Less than two months later, on April 9, 2018, Ohio EPA issued Renergy PTIO Number P0124072 (attached as Appendix C). Renergy's original PTIO was later modified and replaced by PTIO Number P0127783 (attached as Appendix D) on April 15, 2020. Neither PTIO identified the digestate lagoon as an air contaminant emissions unit, and neither PTIO contained any substantive terms and/or conditions applicable to the digestate lagoon.

---

[1] Renergy also operates two (2) facilities consisting of a biodigester and/or lagoons (or similar surface impoundments) in Delaware County, Ohio at 2135 Township Road 224, Ashley, Ohio and 2279 County Road 156, Cardington, Ohio. Renergy's two (2) lagoons/impoundments in Ashley total more than 31 million gallons, and seven (7) lagoons/impoundments in Cardington similarly total more than 31 million gallons.

III. THE "POTENTIAL TO EMIT" AMMONIA FROM RENERGY'S LAGOON

Technical papers regarding digestate storage lagoons indicate that such lagoons emit significant amounts of ammonia. The amount of ammonia emitted is a function of the total nitrogen in either the digester feedstock or in the digestate discharged to the lagoon. Emission factors have been published to enable both regulatory agencies and regulated entities to estimate with reasonable accuracy the ammonia PTE from the open storage of digestate generated by anaerobic digestion of waste at biodigester facilities. Sources of such emission factors include the following technical documents: 1) Bell, M.W., *et al*. *Ammonia emissions from an anaerobic digestion plant estimated using atmospheric measurements and dispersion modelling*. Waste Management, Elsevier (2016); and, 2) the European Environment Agency's *EMEP/EEA Air Pollutant Emission Inventory Guidebook 2019* and its discussion of emissions from the biological treatment of waste from anaerobic digestion at biogas facilities. (These papers are attached as Appendix E and Appendix F, respectively.)

Renergy represented in the EAC Form submitted along with the 2018 PTIO application for its digester that the maximum hourly feed rate for the digester is 4,950 gallons/hour consisting of: 2,925 gallons/hour of "food and wastewater"; 1,575 gallons/hour of "biosolids and wastewater"; and, 450 gallons/hour of hog manure. For purposes of calculating an ammonia PTE for the facility, these hourly throughputs represent the facility's maximum production rate. Based upon this maximum production rate coupled with total Kjeldahl nitrogen (TKN) and ammonia (NH_3) data from digestate discharge monitoring reports (DMRs) Renergy submitted to Ohio EPA pursuant to the Fairborn facility's Clean Water Act National Pollutant Discharge Elimination System Permit Number 1IN00305*AD, the digestate lagoon's ammonia PTE can be calculated several ways utilizing the emission factors published in the above-referenced papers.

A. Ammonia Emission Estimates Based Upon the Model Referenced in Table 3 of the Paper by Bell, M.W., *et al*:

Table 3 of the paper is entitled "*Intercomparison of the chemical composition and estimated emission rates of the Deerdykes digestate with different digestates reported in the literature. Deerdykes emission rates are calculated using the Borka et al. (2000) model.*" The NH_3 emission rates for this Table were calculated using the Borka *et al*. (2000) model. That model is defined in the following paragraph from the technical paper entitled "*Development of an Empirical Model for Ammonia Emissions from Slurry in Cattle Houses*":

> "From these simple regressions the following multi-factorial emission model was developed:
>
> $E = 17.254 * 1.060^{tS} * LD^{.274} * TAN$
> Legend:
> E emission [mg NH_3 m^{-2} hr^{-1}]
> LD air exchange rate [m^3 hr^{-1} m^{-2}]
> tS substrate temperature [°C]
> TAN NH_4^+ / NH_3-N-concentration of substrate [g N kg^{-1}]
>
> The control experiments and the calculated statistical error of the model showed that the uncertainty of the model does not exceed ±30 %."

In the DMR data submitted by Renergy for its Fairborn facility during the period from January 13, 2016 through November 8, 2021, the NH_3 values for the digestate varied from a low of 5,890 mg/kg (on September 22, 2016) to a high of 89,700 mg/kg or 89.7 g/kg (on February 10, 2016). The NH_3 values are believed to be the total ammoniacal concentrations in the digestate.[2]

In calculating the NH_3 emission rate from the lagoon, the substrate temperature was assumed to be 15.5 degrees C (60 degrees F). Also, the two highest air exchange rates used in the calculations for Table 3 were used (*i.e.*, alpha = 1.5 and alpha = 10). Since the digestate is stored in an uncovered lagoon, the actual air exchange rate for the lagoon would be expected to be much higher than the values used in these calculations.

The diameter of the Fairborn facility's lagoon is approximately 222 feet, and the surface area of the lagoon = $(3.14)(111\text{ ft})^2$ or $38{,}688\text{ ft}^2$, and $(38{,}688\text{ ft}^2)(.0929\text{ m}^2/\text{ft}^2) = 3{,}594\text{ m}^2$.

Calculation of the NH_3 emission for alpha = 1.5:
$E = 17.254 * 1.060^{tS} * LD^{.274} * TAN$
$= (17.254)(1.060^{15.5})(1.5^{.274})(89.7)\text{ mg } NH_3\text{ m}^{-2}\text{ hr}^{-1}$
$= (17.254)(2.47)(1.12)(89.7)\text{ mg } NH_3\text{ m}^{-2}\text{ h}^{-1}$
$= 4{,}282\text{ mg } NH_3\text{ m}^{-2}\text{ hr}^{-1}$
$(4{,}282\text{ mg } NH_3/\text{m}^2\text{ hr})(3{,}594\text{ m}^2)(\text{gr}/1{,}000\text{ mg})(\text{lb}/454\text{ gr})(24\text{ hr/day}) =$ **814 lbs NH_3/day**

or, alternatively

Calculation of the NH_3 emission for alpha = 10.0:
$E = 17.254 * 1.060^{tS} * LD^{.274} * TAN$
$= (17.254)(1.060^{15.5})(10.0^{.274})(89.7)\text{ mg } NH_3\text{ m}^{-2}\text{ hr}^{-1}$
$= (17.254)(2.47)(1.88)(89.7)\text{ mg } NH_3\text{ m}^{-2}\text{ hr}^{-1}$
$= 7{,}187\text{ mg } NH_3\text{ m}^{-2}\text{ hr}^{-1}$
$(7{,}187\text{ mg } NH_3/\text{m}^2\text{ hr})(3{,}594\text{ m}^2)(\text{gr}/1{,}000\text{ mg})(\text{lb}/454\text{ gr})(24\text{ hr/day}) =$ **1,365 lbs NH_3/day**

As mentioned above, both calculations assume air exchange rates that would be much lower than what would actually occur with an outdoor storage lagoon. Therefore, the calculated emission rates are conservatively low estimates of the daily ammonia PTE for the lagoon.

B. Ammonia Emission Estimates Based Upon the Emission Factor Contained in the *EMEP/EEA Air Pollutant Emission Inventory Guidebook 2019*

Table 3.3 of the Guidebook is entitled "*Table 3.3 Tier 2 EFs for source category 5.B.2 Biological treatment of waste — anaerobic digestion at biogas facilities; storage of digestate (open storage)*." Table 3.3 gives the following emission factor for the NH_3 emissions from the open storage of digestate:

$$NH_3\text{ emissions} = 0.0266\text{ kg } NH_3\text{-N per kg N in feedstock}$$

---

[2] Hill Laboratories, "*Nitrogen Species*" (https://www.hill-laboratories.com/assets/Documents/Technical-Notes/Environmental/Nitrogen-Species-Tech-note-34247v2View.pdf)

As previously stated, the maximum hourly feed rate for the Fairborn facility's digester is 4,950 gallons/hour consisting of: 2,925 gallons/hour of "food and wastewater"; 1,575 gallons/hour of "biosolids and wastewater"; and, 450 gallons/hour of hog manure. In the DMR data submitted by Renergy for its Fairborn facility during the period from January 13, 2016 through November 8, 2021, the TKN values for the digestate varied from a low of 11,000 mg/kg (on October 26, 2017) to a high of 129,000 mg/kg (on January 11, 2017). The TKN is a measure of the total nitrogen (N) in the sample.

The NH_3 emission factor is expressed in units of kg-NH_3 per kg N in the feedstock. The TKN values in Renergy's DMRs are for the digestate, not for the feedstock to the digester. For the calculation of the NH_3 emissions from the digestate lagoon, it has been assumed that the TKN values for the digestate lagoon represent the TKN values for the digester feedstock. This conservative assumption produces an artificially low ammonia emissions estimate because the TKN values for the feedstock would logically always be higher than the values for the digestate discharged from the digester to the lagoon.

Assuming (conservatively) that a gallon of digestate weighs the same as a gallon of water:

max. feed rate = (4,950 gallons/hour)(8.34 lbs/gallon)(1.0 kg/2.2 lbs) = 18,765 kg feed/hour
max. TKN at max. feed rate = (18,765 kg feed/hour)(129,000 mg TKN/kg feed)(1.0 kg TKN/106 mg TKN)
    = 2,421 kg TKN in feed/hour
    = (2,421 kg TKN in feed/hour)(24 hours/day) = 58,104 kg TKN max. in feed/day
NH_3 PTE = (0.0266 kg NH_3-N/kg N in feed)(58,104 kg TKN in feed/day)(2.2 lbs/kg) = **3,400 lbs NH_3/day**

Ammonia is an "air contaminant" as that term is defined in Ohio's SIP at Ohio Rev. Code 3704.01(B), and a "toxic air contaminant" pursuant to Ohio Admin. Code Rule 3745-114-01. Broadly, an air contaminant source is "*de minimis*" under Ohio's SIP at Ohio Rev. Code 3704.011(A) and Ohio Admin. Code Rule 3745-15-05 if emissions of particulate matter, nitrogen oxides, organic compounds, sulfur dioxide, carbon monoxide, lead, or any other air contaminant from that source do not exceed ten (10) pounds per day, and the source does not emit more than one (1) ton per year of hazardous air pollutants. In light of the foregoing calculations, Renergy's digestate lagoon is clearly not a *de minimis* source of ammonia.

IV. ALLEGED VIOLATIONS OF THE CAA

Bath Township and the City of Fairborn allege that USEPA, Ohio EPA, and/or Renergy have violated and continue to violate both the CAA and the State of Ohio's SIP as follows:

1. From 2014 to the present, Renergy has operated the digestate lagoon at its Fairborn facility as an air emissions source without a PTIO in violation of the State of Ohio's SIP. USEPA and Ohio EPA have allowed Renergy to install and operate its digestate lagoon in violation of Ohio Admin. Code Rule 3745-31-02 of the State of Ohio's SIP.

2. From 2014 to the present, Renergy has emitted ammonia from its digestate lagoon and has not complied with the Ohio EPA Division of Air Pollution Control's Air Toxics Policy (attached as Appendix G). USEPA and Ohio EPA have allowed Renergy to emit ammonia without complying with Ohio EPA's Air Toxics Policy and Ohio Admin. Code Rule 3745-114-01 of the State of Ohio's SIP.

3. From 2014 to the present, Renergy has operated its digestate lagoon – which is an air contaminant source installed on or after August 3, 2006 with an ammonia PTE greater than ten (10) tons per year – without employing "best available technology" (BAT) as that term is defined in the State of Ohio's SIP and as required by Ohio Admin. Code Rule 3745-31-05(A)(3). USEPA and Ohio EPA have allowed Renergy to operate its digestate lagoon during this time without employing BAT (which may include, but may not be limited to, a cover over the lagoon with secondary control consisting of a packed bed scrubber).

V. PARTIES GIVING NOTICE

The parties giving notice, including their full names, addresses and telephone numbers are as follows (note that the parties should be contacted through undersigned counsel):

Bath Township, Greene County, Ohio
1006 Yellow Springs-Fairfield Road
Fairborn, Ohio 45234
Phone: 937.878.0611

The City of Fairborn, Ohio
44 West Hebble Avenue
Fairborn, Ohio 45234
Phone: 937.754.3030

Counsel for both parties consent to electronic service whenever permissible. To the extent physical service is required by any applicable statute, regulation, or rules of procedure, both parties consent to service in care of April Bott Moore, Esq. at Taft Law (address, below).

VI. CONCLUSION

Unless the violations of the Clean Air Act and Ohio's SIP alleged above are promptly remedied, Bath Township and the City of Fairborn intend to file suit in the United States District Court for the Southern District of Ohio sixty (60) days after your receipt of this letter. Please contact either or both of the undersigned legal counsel for the parties to further discuss the bases for our claims, or to explore options for timely and amicable resolution of this matter in lieu of litigation.

Sincerely,

Will H. Haak
William H. Haak
Haak Law LLC
Cleveland, Ohio
Attorney for Bath Township
Phone: 216.772.3532
Email: whh@haaklawllc.com

Sincerely,

April Bott Moore
April Bott Moore*
Taft Law
65 E. State Street – Suite 1000
Columbus, Ohio 43215
Attorney for City of Fairborn
Phone: 614.221.2838
Email: abott@taftlaw.com
**Admitted to Practice in Ohio*

cc: Bob Hodanbosi, Ohio EPA, DAPC (robert.hodanbosi@epa.ohio.gov)
Mike Hopkins, Ohio EPA, DAPC (mike.hopkins@epa.ohio.gov)
Drew Bergman, Ohio EPA, Legal (drew.bergman@epa.ohio.gov)
Terry Finn, Esq., Attorney for Renergy, Inc. (tfinn@ralaw.com)

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Appendix A

Renergy 2018 PTIO Application

OhioEPA

Application for Permit to Install (PTI) and Permit to Install/Operate (PTIO)

Ohio Environmental Protection Agency
Lazarus Government Center
50 West Town Street, Suite 700
P.O. Box 1049
Columbus, Ohio 43216-1049

For EPA Use Only

Application Number ______

Date Received ______

RECEIVED
FEB 20 2018
REGIONAL AIR
POLLUTION CONTROL

Facility Information

Note: Application is incomplete if all **bolded** questions throughout the application are not completed.

Legal Facility Name Dovetail Energy, LLC

Alternate Name (if any) ______

Facility Physical Address 1146 Herr Rd

City, ZIP code Fairbon, 45324

County Greene

Facility ID 0829005027

Facility Description ______

NAICS Code 221117

Facility Latitude ______ degrees ______ minutes ______ seconds

Facility Longitude ______ degrees ______ minutes ______ seconds

Core Place ID (if known) ______

SCSC ID (if known) ______

Portable? ☐ Yes ☐ No

Portable Type ☐ Asphalt Plant ☐ Concrete Plant ☐ Generator ☐ Aggregate Processing ☐ Concrete Crusher ☐ Grinder ☐ Other

Initial Location County ______ If "Other", describe: ______

Contact Information

☐ No change to information on file.

❶ ☒ Billing ☒ Owner ☐ Primary ☐ Operator ☐ On-Site ☐ Responsible Official

	Dovetail Energy, LLC	(419) 253-5300		info@renergy.com
461 State Route 61		Marengo	OH	43334

❷ ☐ Billing ☐ Owner ☐ Primary ☐ Operator ☐ On-Site ☐ Responsible Official

❸ ☐ Billing ☐ Owner ☐ Primary ☐ Operator ☐ On-Site ☐ Responsible Official

❹ ☐ Billing ☐ Owner ☐ Primary ☐ Operator ☐ On-Site ☐ Responsible Official

❺ ☐ Billing ☐ Owner ☐ Primary ☐ Operator ☐ On-Site ☐ Responsible Official

❻ ☐ Billing ☐ Owner ☐ Primary ☐ Operator ☐ On-Site ☐ Responsible Official

OhioEPA

Division of Air Pollution Control
Application for Permit-to-Install or Permit-to-Install and Operate

Section I – General Application Information

This section should be filled out for each permit to install (PTI) or Permit to Install and Operate (PTIO) application. A PTI is required for all air contaminant sources (emissions units) installed or modified after January 1, 1974 that are subject to OAC Chapter 3745-77. A PTIO is required for all air contaminant sources (emissions units) that are not subject to OAC Chapter 3745-77 (Title V). See the application instructions for additional information.

For OEPA use only:	☐ Installation ☐ Modification ☐ Renewal	☐ Request Federally enforceable restrictions ☐ General Permit ☐ Other

1. Is the purpose of this application to transition from OAC Chapter 3745-77 (Title V) to OAC Chapter 3745-31 (PTIO)?

☐ yes ☒ no

2. **Establish PER Due Date** - Select an annual Permit Evaluation Report (PER) due date for this facility (does not apply to facilities subject to Title V, OAC Chapter 3745-77). If the PER has previously been established and a change is now desired, a PER Change Request form must be filed instead of selecting a date here.

Due Date:	For Time Period:
☒ February 15	January 1 through December 31
☐ May 15	April 1 through March 31
☐ August 15	July 1 through June 30
☐ November 15	October 1 through September 30

☐ PER not applicable (Title V) or due date already established
☐ PER Request Permit Change form attached

3. **Federal Rules Applicability** - Please check all of the appropriate boxes below.

New Source Performance Standards (NSPS) *New Source Performance Standards are listed under 40 CFR 60 - Standards of Performance for New Stationary Sources.*	☐ not affected ☐ unknown	☒ subject to Subpart: IIII ☐ exempt - explain below
National Emission Standards for Hazardous Air Pollutants (NESHAP) *National Emissions Standards for Hazardous Air Pollutants are listed under 40 CFR 61. (These include asbestos, benzene, beryllium, mercury, and vinyl chloride).*	☒ not affected ☐ unknown	☐ subject to Subpart: ________ ☐ subject, but exempt - explain below
Maximum Achievable Control Technology (MACT) *The Maximum Achievable Control Technology standards are listed under 40 CFR 63 and OAC rule 3745-31-28.*	☒ not affected ☐ unknown	☐ subject to Subpart: ________ ☐ subject, but exempt - explain below
Prevention of Significant Deterioration (PSD) *These rules are found under OAC rule 3745-31-10 through OAC rule 3745-31-20.*	☒ not affected ☐ unknown	☐ subject to regulation
Non-Attainment New Source Review *These rules are found under OAC rule 3745-31-21 through OAC rule 3745-31-27.*	☒ not affected ☐ unknown	☐ subject to regulation
112 (r) - Risk Management Plan *These rules are found under 40 CFR 68.*	☒ not affected ☐ unknown	☐ subject to regulation
Title IV (Acid Rain Requirements) *These rules are found under 40 CFR 72 and 40 CFR 73.*	☒ not affected ☐ unknown	☐ subject to regulation

Please explain why you checked "exempt" in this question for one or more federal rules. Identify each exemption and whether the entire facility and/or the specific air contaminant sources included in this permit application is exempted. Attach an additional page if necessary.

____

____

4. Express PTI/PTIO - Do you qualify for express PTI or PTIO processing?

☐ yes ☒ no

If yes, are you requesting express processing per OAC rule 3745-31-05?

☐ yes ☒ no

5. **Air Contaminant Sources in this Application** - Identify the air contaminant source(s) for which you are applying below. Attach additional pages if necessary. Section II of this application and an EAC form should be completed for each air contaminant source.

Emissions Unit ID*	**Company Equipment ID** (company's name for air contaminant source)	**Equipment Description** (List all equipment that are a part of this air contaminant source)
	Digester	Digester tank with flare
	Engine	CAT 3516
	Engine	Backup generator

* This ID would have been created when a previous air permit was issued. If no previous permits have been issued for this air contaminant source, leave this field blank. If this air contaminant source was previously identified in STARShip applications as a "Z" source (e.g., Z001), please provide that identification and a new ID will be assigned when the PTI/PTIO is issued.

6. Trade Secret Information - Is any information included in this application being claimed as a trade secret per Ohio Revised Code (ORC) 3704.08?

☐ yes (A "non-confidential" version must also be submitted in order for this application to be deemed complete.)
☒ no

7. Permit Application Contact - Person to contact for questions about this application:

Name: Taylor Faecher
Title: Environmental Compliance Specialist
Address (Street, City/Township, State and Zip Code): 461 State Route 61 Marengo, OH 43334
Phone: (513) 476-1663
Fax:
E-mail: tfaecher@renergy.com

8. **Authorized Signature** – OAC rule 3745-31-04 states that applications for permits to install or permits to install and operate shall be signed:
   (1) In the case of a corporation, by a principal executive officer of at least the level of vice president, or his duly authorized representative, if such representative is responsible for the overall operation of the facility.
   (2) In the case of a partnership by a general partner.
   (3) In the case of sole proprietorship, by the proprietor, and
   (4) In the case of a municipal, state, federal or other governmental facility, by the principal executive officer, the ranking elected official, or other duly authorized employee.

Under OAC rule 3745-31-04, this signature shall constitute personal affirmation that all statements or assertions of fact made in the application are true and complete, comply fully with applicable state requirements, and shall subject the signatory to liability under applicable state laws forbidding false or misleading statements.

Authorized Signature (for facility)	2/16/18 Date
Alex Ringler Print Name	CEO Title

Section II - Specific Air Contaminant Source Information

Facility ID: ____________
Emissions Unit ID: ____________
Company Equipment ID: ____________

Digester + Flare

One copy of this section should be filled out for each air contaminant source (emissions unit) covered by this PTI/PTIO application identified in Section I, Question 5. See the application instructions for additional information.

1. **Air Contaminant Source Installation or Modification Schedule** – Check all that apply (must be completed regardless of date of installation or modification):

☐ New installation (for which construction has not yet begun, in accordance with OAC rule 3745-31-33). When will you begin to install the air contaminant source?

(month/year) ____________ **OR** 9 after installation permit has been issued

☒ Initial application for an air contaminant source already installed or under construction. Identify installation date or the date construction began (month/year) 10/2013 and the date operation began (month/year) 10/2013

☐ Modification to an existing air contaminant source/facility (for which modification has not yet begun) - List previous PTI or PTIO number(s) for air contaminant sources included in this application, if applicable, and describe the requested modification (attach an additional sheet, if necessary):

____

When will you begin to modify the air contaminant source? (month/year) ____________ **OR** 9 after modification permit has been issued

☐ Modification application for an air contaminant source which has been or is currently being modified. List previous PTI or PTIO number(s) for air contaminant sources included in this application, if applicable, and describe the requested modification (attach an additional sheet, if necessary):

____

Identify modification date or the date modification began (month/year) ____________ and the date operation began (month/year) ____________

☐ Reconstruction of an existing air contaminant source/facility. Please explain: ____________

____

☐ Renewal of an existing permit-to-operate (PTO) or PTIO

Identify the date operation began after installation or latest modification (month/year) ____________

☐ General Permit General Permit Category____________ General Permit Type ____________

Complete, sign and attach the appropriate Qualifying Criteria Document

☐ Other, please explain: ____________

Section II - Specific Air Contaminant Source Information

Facility ID: ________________
Emissions Unit ID: ______________
Company Equipment ID: ______________________

2. **SCC Codes** - List all Source Classification Code(s) (SCC) that describe the process(es) performed by this air contaminant source (e.g., 1-02-002-04).

________________ ________________ ________________ ________________ ________________

3. **Emissions Information** - The following table requests information needed to determine the applicable requirements and the compliance status of this air contaminant source with those requirements. Suggestions for how to estimate emissions may be found in the instructions to the Emissions Activity Category (EAC) forms required with this application. If you need further assistance, contact your District Office/Local Air Agency representative.
   - If total potential emissions of HAPs or any Toxic Air Contaminant (as identified in OAC rule 3745-114-01) are greater than 1 ton/yr, fill in the table for that (those) pollutant(s). For all other pollutants, if "Emissions before controls (max), lb/hr" multiplied by 24 hours/day is greater than 10 lbs/day, fill in the table for that pollutant.
   - Actual emissions are calculated including add-on control equipment. If you have no add-on control equipment, "Emissions before controls" will be the same as "Actual emissions".
   - Actual emissions and Requested Allowable should be based on operating 8760 hr/yr unless you are requesting federally enforceable operating restrictions to limit emissions. If so, calculate emissions based on requested operating restrictions and describe in your calculations.
   - If you use units other than lbs/hr or ton/yr, specify the units used (e.g., gr/dscf, lb/ton charged, lb/MMBtu, tons/12-months).
   - Requested Allowable (ton/yr) is often equivalent to Potential to Emit (PTE) as defined in OAC rule 3745-31-01 and OAC rule 3745-77-01.

Pollutant	Emissions before controls (max)* (lb/hr)	Actual emissions* (lb/hr)	Actual emissions* (ton/year)	Requested Allowable* (lb/hr)	Requested Allowable* (ton/year)
Particulate emissions (PE/PM) (formerly particulate matter, PM)					
PM # 10 microns in diameter (PE/PM$_{10}$)					
PM # 2.5 microns in diameter (PE/PM$_{2.5}$)					
Sulfur dioxide (SO$_2$)		2.23	7.32		
Nitrogen oxides (NO$_x$)		.99	3.24		
Carbon monoxide (CO)		5	14.79		
Organic compounds (OC)					
Volatile organic compounds (VOC)		8.28	27.19		
Lead (Pb)					
Total Hazardous Air Pollutants (HAPs)					
Highest single HAP:					
Toxic Air Contaminants (see instructions):					

* Provide your calculations as an attachment and explain how all process variables and emission factors were selected. Note the emission factor(s) employed and document origin. Example: AP-42, Table 4.4-3 (8/97); stack test, Method 5, 4/96; mass balance based on MSDS; etc.

4. **Best Available Technology (BAT)** - For each pollutant for which the Requested Allowable in the above table exceeds 10 tons per year, BAT, as defined in OAC 3745-31-01, is required. Describe what has been selected as BAT and the basis for the selection:

____

5. **Control Equipment** - Does this air contaminant source employ emissions control equipment?

☒ Yes - fill out the applicable information below.
☐ No - proceed to Question 6.

Section II - Specific Air Contaminant Source Information

Facility ID: ____________
Emissions Unit ID: ____________
Company Equipment ID: ____________

Select the type(s) of control equipment employed below (required data for selected control equipment in **bold**):

Pollutant abbreviations

PE/PM = Particulate emissions (formerly particulate matter)
PE/PM$_{2.5}$ = PM # 2.5 microns in diameter
VOC = Volatile organic compounds
NO$_x$ = Nitrogen oxides
PE/PM$_{10}$ = PM # 10 microns in diameter
OC = Organic compounds
SO$_2$ = Sulfur dioxide
CO = Carbon monoxide
Pb = Lead

☐ Adsorber
Manufacturer: ____________ Year installed: ________ **Your ID for control equipment** ____________
Describe this control equipment: ____________
Pollutant(s) controlled: ☐ PE/PM ☐ PE/PM$_{10}$ ☐ PE/PM$_{2.5}$ ☐ OC ☐ VOC
☐ SO$_2$ ☐ NO$_x$ ☐ CO ☐ Pb ☐ Other ____________
Estimated capture efficiency (%): ________ Basis for efficiency: ____________
Design control efficiency (%): ________ Basis for efficiency: ____________
Operating control efficiency (%): ________ Basis for efficiency: ____________
Type: ☐ **Fluidized Bed** ☐ **Fixed Bed** ☐ **Moving Bed** ☐ **Disposable** ☐ **Concentrator** ☐ **Other** ____________
Adsorption Media: ____________
For Fluidized Bed, Fixed Bed, Moving Bed and Disposable only:
Maximum design outlet organic compound concentration (ppmv): ____________
Media replacement frequency or regeneration cycle time (specify units): ____________
Maximum temperature of the media bed, after regeneration (including any cooling cycle): ____________
For Concentrator Only:
Design regeneration cycle time (minutes): ____________
Minimum desorption air stream temperature (°F): ____________
Rotational rate (revolutions/hour): ____________
Inlet gas flow rate (acfm): ____________ Outlet gas flow rate (acfm) : ____________
Inlet gas temperature (°F): ____________ Outlet gas temperature (°F): ____________
☐ **This is the only control equipment on this air contaminant source**
If not, this control equipment is: ☐ Primary ☐ Secondary ☐ Parallel
List all other air contaminant sources that are also vented to this control equipment: ____________
List all egress point IDs (from Table 7-A) associated with this control equipment: ____________

☐ Catalytic Converter
Manufacturer: ____________ Year installed: ________ **Your ID for control equipment** ____________
Describe this control equipment: ____________
Pollutant(s) controlled: ☐ PE/PM ☐ PE/PM$_{10}$ ☐ PE/PM$_{2.5}$ ☐ OC ☐ VOC
☐ SO$_2$ ☐ NO$_x$ ☐ CO ☐ Pb ☐ Other ____________
Estimated capture efficiency (%): ________ Basis for efficiency: ____________
Design control efficiency (%): ________ Basis for efficiency: ____________
Operating control efficiency (%): ________ Basis for efficiency: ____________
☐ **This is the only control equipment on this air contaminant source**
If not, this control equipment is: ☐ Primary ☐ Secondary ☐ Parallel
List all other air contaminant sources that are also vented to this control equipment: ____________
List all egress point IDs (from Table 7-A) associated with this control equipment: ____________

☐ Catalytic Incinerator
Manufacturer: ____________ Year installed: ________ **Your ID for control equipment** ____________
Describe this control equipment: ____________
Pollutant(s) controlled: ☐ PE/PM ☐ PE/PM$_{10}$ ☐ PE/PM$_{2.5}$ ☐ OC ☐ VOC
☐ SO$_2$ ☐ NO$_x$ ☐ CO ☐ Pb ☐ Other ____________
Estimated capture efficiency (%): ________ Basis for efficiency: ____________
Design control efficiency (%): ________ Basis for efficiency: ____________
Operating control efficiency (%): ________ Basis for efficiency: ____________
Combustion chamber residence time (seconds): ____________
Minimum temperature difference (°F) across catalyst during air contaminant source operation: ____________
Inlet gas flow rate (acfm): ____________ Outlet gas flow rate (acfm) : ____________
Minimum inlet gas temperature (°F): ____________ Outlet gas temperature (°F): ____________
☐ **This is the only control equipment on this air contaminant source**
If not, this control equipment is: ☐ Primary ☐ Secondary ☐ Parallel

List all other air contaminant sources that are also vented to this control equipment: ____________
List all egress point IDs (from Table 7-A) associated with this control equipment: ____________

☐ Condenser
Manufacturer: ____________ Year installed: ________ **Your ID for control equipment** ____________
Describe this control equipment: ____________
Pollutant(s) controlled: ☐ PE/PM ☐ PE/PM$_{10}$ ☐ PE/PM$_{2.5}$ ☐ OC ☐ VOC
☐ SO$_2$ ☐ NO$_x$ ☐ CO ☐ Pb ☐ Other ________
Estimated capture efficiency (%): ________ Basis for efficiency: ____________
Design control efficiency (%): ________ Basis for efficiency: ____________
Operating control efficiency (%): ________ Basis for efficiency: ____________
Type: ☐ **Indirect contact** ☐ **Direct contact** ☐ **Freeboard refrigeration device** ☐ **Other:** ____________
Maximum exhaust gas temperature (°F) during air contaminant source operation: ________
Coolant type: ____________
Design coolant temperature (°F): Minimum ________ Maximum ________
Design coolant flow rate (gpm): ____________
Inlet gas flow rate (acfm): ____________ Outlet gas flow rate (acfm) : ____________
Inlet gas temperature (°F): ____________
☐ **This is the only control equipment on this air contaminant source**
If not, this control equipment is: ☐ Primary ☐ Secondary ☐ Parallel
List all other air contaminant sources that are also vented to this control equipment: ____________
List all egress point IDs (from Table 7-A) associated with this control equipment: ____________

☐ Cyclone/Multiclone
Manufacturer: ____________ Year installed: ________ **Your ID for control equipment** ____________
Describe this control equipment: ____________
Pollutant(s) controlled: ☐ PE/PM ☐ PE/PM$_{10}$ ☐ PE/PM$_{2.5}$ ☐ OC ☐ VOC
☐ SO$_2$ ☐ NO$_x$ ☐ CO ☐ Pb ☐ Other ________
Estimated capture efficiency (%): ________ Basis for efficiency: ____________
Design control efficiency (%): ________ Basis for efficiency: ____________
Operating control efficiency (%): ________ Basis for efficiency: ____________
Type: ☐ **Simple** ☐ **Multiclone** ☐ **Rotoclone** ☐ **Other** ________
Operating pressure drop range (inches of water): Minimum: ________ Maximum: ________
Inlet gas flow rate (acfm): ____________ Outlet gas flow rate (acfm) : ____________
☐ **This is the only control equipment on this air contaminant source**
If not, this control equipment is: ☐ Primary ☐ Secondary ☐ Parallel
List all other air contaminant sources that are also vented to this control equipment: ____________
List all egress point IDs (from Table 7-A) associated with this control equipment: ____________

☐ Dry Scrubber
Manufacturer: ____________ Year installed: ________ **Your ID for control equipment** ____________
Describe this control equipment: ____________
Pollutant(s) controlled: ☐ PE/PM ☐ PE/PM$_{10}$ ☐ PE/PM$_{2.5}$ ☐ OC ☐ VOC
☐ SO$_2$ ☐ NO$_x$ ☐ CO ☐ Pb ☐ Other ________
Estimated capture efficiency (%): ________ Basis for efficiency: ____________
Design control efficiency (%): ________ Basis for efficiency: ____________
Operating control efficiency (%): ________ Basis for efficiency: ____________
Reagent(s) used: Type: ____________ **Injection rate(s):** ____________
Inlet gas flow rate (acfm): ____________ Outlet gas flow rate (acfm) : ____________
Inlet gas temperature (°F): ____________ Outlet gas temperature (°F): ____________
☐ **This is the only control equipment on this air contaminant source**
If not, this control equipment is: ☐ Primary ☐ Secondary ☐ Parallel
List all other air contaminant sources that are also vented to this control equipment: ____________
List all egress point IDs (from Table 7-A) associated with this control equipment: ____________

☐ Electrostatic Precipitator
Manufacturer: ____________ Year installed: ________ **Your ID for control equipment** ____________
Describe this control equipment: ____________
Pollutant(s) controlled: ☐ PE/PM ☐ PE/PM$_{10}$ ☐ PE/PM$_{2.5}$ ☐ OC ☐ VOC

List all other air contaminant sources that are also vented to this control equipment: ______
List all egress point IDs (from Table 7-A) associated with this control equipment: ______

☑ Flare
Manufacturer: Quasar Year installed: ? **Your ID for control equipment** F-001
Describe this control equipment: semi-encl biogas flare
Pollutant(s) controlled: ☐ PE/PM ☐ PE/PM$_{10}$ ☐ PE/PM$_{2.5}$ ☐ OC ☑ VOC
☑ SO$_2$ ☑ NO$_x$ ☑ CO ☐ Pb ☐ Other ______
Estimated capture efficiency (%): 99 Basis for efficiency: closed tank/gas piped to flare
Design control efficiency (%): 98 Basis for efficiency: mfg. AP-42, SOx < 500 ppmv in biogas
Operating control efficiency (%): ______ Basis for efficiency: ______
Type: ☐ **Enclosed** ☑ **Elevated (open)**
If Elevated (open): ☐ **Air-assisted** ☐ **Steam-assisted** ☑ **Non-assisted**
Ignition device: ☑ **Electric arc** ☐ **Pilot flame**
Flame presence sensor: ☑ **Yes** ☐ **No**
Inlet gas flow rate (acfm): ~450 Outlet gas flow rate (acfm): 21,600
Inlet gas temperature (°F): 60-70 Outlet gas temperature (°F): 1450
☐ **This is the only control equipment on this air contaminant source**
If not, this control equipment is: ☐ Primary ☐ Secondary ☒ Parallel
List all other air contaminant sources that are also vented to this control equipment: T-001, T-002
List all egress point IDs (from Table 7-A) associated with this control equipment: ______

☐ Fugitive Dust Suppression
Suppressant Type: ☐ **Water** ☐ **Chemical** ☐ **Calcium chloride** ☐ **Asphaltic cement** ☐ **Other** ______
Method of application: ______
Application rate (specify units): ______
Application frequency: ______
List all egress point IDs (from Table 7-B) associated with this control strategy: ______

☐ NOx Reduction Technology
Manufacturer: ______ Year installed: ______ **Your ID for control equipment** ______
Describe this control equipment: ______
Pollutant(s) controlled: ☐ PE/PM ☐ PE/PM$_{10}$ ☐ PE/PM$_{2.5}$ ☐ OC ☐ VOC
☐ SO$_2$ ☐ NO$_x$ ☐ CO ☐ Pb ☐ Other ______
Estimated capture efficiency (%): ______ Basis for efficiency: ______
Design control efficiency (%): ______ Basis for efficiency: ______
Operating control efficiency (%): ______ Basis for efficiency: ______
NOx Reduction Type: ☐ **Selective Catalytic** ☐ **Non-Selective Catalytic** ☐ **Selective Non-Catalytic**
Inlet temp.: ______ **Outlet temp.:** ______
Inlet gas flow rate (acfm): ______
For Selective types only:
 Reagent type: ______
 Reagent injection rate (specify units): ______
 Reagent slip (acfm): ______
☐ **This is the only control equipment on this air contaminant source**
If not, this control equipment is: ☐ Primary ☐ Secondary ☐ Parallel
List all other air contaminant sources that are also vented to this control equipment: ______
List all egress point IDs (from Table 7-A) associated with this control equipment: ______

☐ Passive Filter
Type: ☐ **Bin vent** ☐ **Paint booth filter** ☐ **Filter sock** ☐ **Other:** ______ **Your ID for filter** ______
Design control efficiency (%): ______ Basis for efficiency: ______
Change frequency: ______
Inlet gas flow rate (acfm): ______ Outlet gas flow rate (acfm): ______
List all egress point IDs (from Table 7-A) associated with this control equipment: ______

Section II - Specific Air Contaminant Source Information

Facility ID: ______
Emissions Unit ID: ______
Company Equipment ID: ______

☐ NOx Reduction Technology
Manufacturer: ______ Year installed: ______ **Your ID for control equipment** ______
Describe this control equipment: ______
Pollutant(s) controlled: ☐ PE/PM ☐ PE/PM_{10} ☐ PE/$PM_{2.5}$ ☐ OC ☐ VOC
☐ SO_2 ☐ NO_x ☐ CO ☐ Pb ☐ Other ______
Estimated capture efficiency (%): ______ Basis for efficiency: ______
Design control efficiency (%): ______ Basis for efficiency: ______
Operating control efficiency (%): ______ Basis for efficiency: ______
NOx Reduction Type: ☐ **Selective Catalytic** ☐ **Non-Selective Catalytic** ☐ **Selective Non-Catalytic**
Inlet temp.: ______ **Outlet temp.:** ______
Inlet gas flow rate (acfm): ______
For Selective types only:
Reagent type: ______
Reagent injection rate (specify units): ______
Reagent slip (acfm): ______
☐ **This is the only control equipment on this air contaminant source**
If not, this control equipment is: ☐ Primary ☐ Secondary ☐ Parallel
List all other air contaminant sources that are also vented to this control equipment: ______
List all egress point IDs (from Table 7-A) associated with this control equipment: ______

☐ Passive Filter
Type: ☐ **Bin vent** ☐ **Paint booth filter** ☐ **Filter sock** ☐ **Other:** ______ **Your ID for filter** ______
Design control efficiency (%): ______ Basis for efficiency: ______
Change frequency: ______
Inlet gas flow rate (acfm): ______ Outlet gas flow rate (acfm) : ______
List all egress point IDs (from Table 7-A) associated with this control equipment: ______

☐ Settling Chamber
Manufacturer: ______ Year installed: ______ **Your ID for control equipment** ______
Describe this control equipment: ______
Pollutant(s) controlled: ☐ PE/PM ☐ PE/PM_{10} ☐ PE/$PM_{2.5}$ ☐ OC ☐ VOC
☐ SO_2 ☐ NO_x ☐ CO ☐ Pb ☐ Other ______
Estimated capture efficiency (%): ______ Basis for efficiency: ______
Design control efficiency (%): ______ Basis for efficiency: ______
Operating control efficiency (%): ______ Basis for efficiency: ______
Length x Width x Height: ______
☐ **This is the only control equipment on this air contaminant source**
If not, this control equipment is: ☐ Primary ☐ Secondary ☐ Parallel
List all other air contaminant sources that are also vented to this control equipment: ______
List all egress point IDs (from Table 7-A) associated with this control equipment: ______

☐ Thermal Incinerator/Thermal Oxidizer
Manufacturer: ______ Year installed: ______ **Your ID for control equipment** ______
Describe this control equipment: ______
Pollutant(s) controlled: ☐ PE/PM ☐ PE/PM_{10} ☐ PE/$PM_{2.5}$ ☐ OC ☐ VOC
☐ SO_2 ☐ NO_x ☐ CO ☐ Pb ☐ Other ______
Estimated capture efficiency (%): ______ Basis for efficiency: ______
Design control efficiency (%): ______ Basis for efficiency: ______
Operating control efficiency (%): ______ Basis for efficiency: ______
Minimum operating temp. (°F) and sensor location: ______ (See application instructions)
Combustion chamber residence time (seconds): ______
Inlet gas flow rate (acfm): ______ Outlet gas flow rate (acfm) : ______
Inlet gas temperature (°F): ______ Outlet gas temperature (°F): ______
☐ **This is the only control equipment on this air contaminant source**
If not, this control equipment is: ☐ Primary ☐ Secondary ☐ Parallel
List all other air contaminant sources that are also vented to this control equipment: ______
List all egress point IDs (from Table 7-A) associated with this control equipment: ______

Facility ID: ____________
Emissions Unit ID: ____________
Company Equipment ID: ____________

☐ Wet Scrubber
Manufacturer: ____________ Year installed: ________ **Your ID for control equipment** ____________
Describe this control equipment: ____________
Pollutant(s) controlled: ☐ PE/PM ☐ PE/PM_{10} ☐ $PE/PM_{2.5}$ ☐ OC ☐ VOC
☐ SO_2 ☐ NO_x ☐ CO ☐ Pb ☐ Other ________
Estimated capture efficiency (%): ________ Basis for efficiency: ____________
Design control efficiency (%): ________ Basis for efficiency: ____________
Operating control efficiency (%): ________ Basis for efficiency: ____________
Operating pressure drop range (inches of water): Minimum: ________ **Maximum:** ________
Type: ☐ **Impingement** ☐ **Packed bed** ☐ **Spray chamber** ☐ **Venturi** ☐ **Other:** ________
pH range for scrubbing liquid: Minimum: ________ Maximum: ________
Is scrubber liquid recirculated? ☐ Yes ☐ No
Scrubber liquid flow rate (gal/min): ____________
Scrubber liquid supply pressure (psig): ________ NOTE: This item for spray chambers only.
Inlet gas flow rate (acfm): ________ Outlet gas flow rate (acfm) : ________
Inlet gas temperature (°F): ________ Outlet gas temperature (°F): ________
☐ **This is the only control equipment on this air contaminant source**
If not, this control equipment is: ☐ Primary ☐ Secondary ☐ Parallel
List all other air contaminant sources that are also vented to this control equipment: ____________
List all egress point IDs (from Table 7-A) associated with this control equipment: ____________

☐ Other
Type: describe ____________
Manufacturer: ____________ Year installed: ________ **Your ID for control equipment** ____________
Describe this control equipment: ____________
Pollutant(s) controlled: ☐ PE/PM ☐ PE/PM_{10} ☐ $PE/PM_{2.5}$ ☐ OC ☐ VOC
☐ SO_2 ☐ NO_x ☐ CO ☐ Pb ☐ Other ________
Estimated capture efficiency (%): ________ Basis for efficiency: ____________
Design control efficiency (%): ________ Basis for efficiency: ____________
Operating control efficiency (%): ________ Basis for efficiency: ____________
☐ **This is the only control equipment on this air contaminant source**
If not, this control equipment is: ☐ Primary ☐ Secondary ☐ Parallel
List all other air contaminant sources that are also vented to this control equipment: ____________
List all egress point IDs (from Table 7-A) associated with this control equipment: ____________

6. **Process Flow Diagram** - Attach a Process Flow Diagram to this application for this air contaminant source. See the application instructions for additional information.

7. **Modeling information: (Note: items in bold in Tables 7-A and/or 7-B, as applicable, are required even if the tables do not otherwise need to be completed. If applicable, all information is required.)** An air quality modeling analysis is required for PTIs and PTIOs for new installations or modifications, as defined in OAC rule 3745-31-01, where either the increase of toxic air contaminants from any air contaminant source or the increase of any other pollutant for all air contaminant sources combined exceed a threshold listed below. This analysis is to assure that the impact from the requested project will not exceed Ohio's Acceptable Incremental Impacts for criteria pollutants and/or Maximum Allowable Ground Level Concentrations (MAGLC) for toxic air contaminants. (See Ohio EPA, DAPC's Engineering Guide #69 for more information.) Permit requests that would have unacceptable impacts cannot be approved as proposed. See the line-by-line PTI/PTIO instructions for additional information.

Complete Tables 7-A and 7-C for stack emissions egress points and/or Table 7-B and 7-C for fugitive emissions egress points below if the requested allowable annual emission rate for this PTI or PTIO exceeds any of the following:

- Particulate Emissions (PE/PM_{10}): 10 tons per year
- Sulfur Dioxide (SO2): 25 tons per year
- Nitrogen Oxides (NOx): 25 tons per year
- Carbon Monoxide (CO): 100 tons per year
- Lead (Pb): 0.6 ton per year
- Toxic Air Contaminants: 1 ton per year. Toxic air contaminants are identified in OAC rule 3745-114-01.

Section II - Specific Air Contaminant Source Information

Facility ID: ____________
Emissions Unit ID: ____________
Company Equipment ID: ____________

Complete Table 7-A below for each stack emissions egress point. An egress point is a point at which emissions from an air contaminant source are released into the ambient (outside) air. List each individual egress point on a separate pair of lines. In each case, use the dimensions of the tallest nearby (or attached) building, building segment or structure.

Table 7-A, Stack Egress Point Information

❶ Company ID for the Egress Point	Type Code*	Dimensions or Diameter	Height from the Ground (ft)	Temp. at Max. Operation (F)	Flow Rate at Max. Operation (ACFM)	Minimum Distance to Fence Line (ft)
Company Description for the Egress Point	Shape: round, square, rectangular	Cross Sectional Area	Base Elevation (ft)	Building Height (ft)	Building Width (ft)	Building Length (ft)

❷ Company ID for the Egress Point	Type Code*	Dimensions or Diameter	Height from the Ground (ft)	Temp. at Max. Operation (F)	Flow Rate at Max. Operation (ACFM)	Minimum Distance to Fence Line (ft)
Company Description for the Egress Point	Shape: round, square, rectangular	Cross Sectional Area	Base Elevation (ft)	Building Height (ft)	Building Width (ft)	Building Length (ft)

❸ Company ID for the Egress Point	Type Code*	Dimensions or Diameter	Height from the Ground (ft)	Temp. at Max. Operation (F)	Flow Rate at Max. Operation (ACFM)	Minimum Distance to Fence Line (ft)
Company Description for the Egress Point	Shape: round, square, rectangular	Cross Sectional Area	Base Elevation (ft)	Building Height (ft)	Building Width (ft)	Building Length (ft)

❹ Company ID for the Egress Point	Type Code*	Dimensions or Diameter	Height from the Ground (ft)	Temp. at Max. Operation (F)	Flow Rate at Max. Operation (ACFM)	Minimum Distance to Fence Line (ft)
Company Description for the Egress Point	Shape: round, square, rectangular	Cross Sectional Area	Base Elevation (ft)	Building Height (ft)	Building Width (ft)	Building Length (ft)

*Type codes for stack egress points:

A. vertical stack (unobstructed): There are no obstructions to upward flow in or on the stack such as a rain cap.
B. vertical stack (obstructed): There are obstructions to the upward flow, such as a rain cap, which prevents or inhibits the air flow in a vertical direction.
C. non-vertical stack: The stack directs the air flow in a direction which is not directly upward.

Facility ID: ______________
Emissions Unit ID: ______________
Company Equipment ID: ______________

Complete Table 7-B below for each fugitive emissions egress point. List each individual egress point on a separate line. Refer to the description of the fugitive egress point types below the table for use in completing the type column of the table. For an air contaminant source with multiple fugitive emissions egress points, include only the primary egress points.

Table 7-B, Fugitive Egress Point Information

❶ **Company ID or Name for the Egress Point**	Type* (check one) ☐ Area ☐ Volume	Area Source Dimensions (Length x Width, in feet)	Volume Source Dimensions (Height x Width, in feet)
Company Description for the Egress Point	Release Height (ft)	Exit Gas Temp. (only if in excess of 100° F) (° F)	Minimum Distance to the Fence Line (ft)

❷ **Company ID or Name for the Egress Point**	Type* (check one) ☐ Area ☐ Volume	Area Source Dimensions (Length x Width, in feet)	Volume Source Dimensions (Height x Width, in feet)
Company Description for the Egress Point	Release Height (ft)	Exit Gas Temp. (only if in excess of 100° F) (° F)	Minimum Distance to the Fence Line (ft)

❸ **Company ID or Name for the Egress Point**	Type* (check one) ☐ Area ☐ Volume	Area Source Dimensions (Length x Width, in feet)	Volume Source Dimensions (Height x Width, in feet)
Company Description for the Egress Point	Release Height (ft)	Exit Gas Temp. (only if in excess of 100° F) (° F)	Minimum Distance to the Fence Line (ft)

*Types for fugitive egress point:

Area: an open fugitive source characterized as a horizontal area (L x W) with a release height. For irregular surfaces such as storage piles, enter dimensions of an average cross section; release height is entered as half of the maximum pile height. For process sources such as crushers, use the process opening (e.g., area of crusher hopper opening) and ignore material handling and storage emissions points.

Volume: an unpowered vertical opening, such as a window or roof monitor, characterized as a vertical area (W x H) with a release height, measured at the midpoint of the opening. Multiple openings in a building may be averaged, if necessary.

Use the same Company Name or ID for the Egress Point in Table 7-C that was used in Table 7-A or 7-B. See the line-by-line PTI/PTIO instructions for additional information.

Table 7-C, Egress Point Location

Company Name or ID for the Egress Point (as identified above)	Egress Point Latitude			Egress Point Longitude		
	deg	min	sec	deg	min	sec
	deg	min	sec	deg	min	sec
	deg	min	sec	deg	min	sec
	deg	min	sec	deg	min	sec
	deg	min	sec	deg	min	sec

Facility ID: ____________
Emissions Unit ID: ____________
Company Equipment ID: ____________

8. Request for Enforceable Restrictions - As part of this permit application, do you wish to propose voluntary restrictions to limit emissions in order to avoid specific requirements listed below, (i.e., are you requesting state-only enforceable limits or state and federally enforceable limits to obtain synthetic minor status)?

☐ yes
☐ no
☒ not sure - please contact me to discuss whether this affects the facility.

If yes, why are you requesting enforceable restrictions? Check all that apply.

☐ a. to avoid being a major Title V source (see OAC rule 3745-77-01 and OAC rule 3745-31)
☐ b. to avoid being a major MACT source (see OAC rule 3745-31-01)
☐ c. to avoid being a major stationary source (see OAC rule 3745-31-01)
☐ d. to avoid being a major modification (see OAC rule 3745-31-01)
☐ e. to avoid an air dispersion modeling requirement (see Engineering Guide # 69)
☐ f. to avoid BAT requirements (see OAC rule 3745-31-05(A)(3)(b))
☐ g. to avoid another requirement. Describe: ____________

If you checked a., b. or c., please attach a facility-wide potential to emit (PTE) analysis (for each pollutant) and synthetic minor strategy to this application. (See application instructions for definition of PTE.) If you checked d., please attach a net emission change analysis to this application. If you checked e., f. or g., please attach a description of the restrictions proposed and how compliance with those restrictions will be verified.

9. Continuous Emissions Monitoring – Does this air contaminant source utilize any continuous emissions monitoring (CEM) equipment for indicating or demonstrating compliance? This does not include continuous parametric monitoring systems.

☐ yes ☒ no

If yes, complete the following information.

Company Name or ID for the Egress Point ____________

CEM Description____________

This CEM monitors (check all that apply):

9 Opacity 9 Flow 9 CO 9 NOx 9 SO_2 9 THC 9 HCl 9 HF 9 H_2S 9 TRS 9 CO_2 9 O_2 9 PM

10. **EAC Forms** - The appropriate Emissions Activity Category (EAC) form(s) must be completed and attached for each air contaminant source unless a general permit is being requested. At least one complete EAC form must be submitted for each air contaminant source for the application to be considered complete. Refer to the list attached to the application instructions. Please indicate which EAC form corresponds to this air contaminant source.

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Appendix B

Renergy 2018 EAC Form

FOR OHIO EPA USE
FACILITY ID: ____________

EMISSIONS ACTIVITY CATEGORY FORM
GENERAL PROCESS OPERATION

Digester

This form is to be completed for each process operation when there is no specific emissions activity category (EAC) form applicable. If there is more than one end product for this process, copy and complete this form for each additional product (see instructions). Several State/Federal regulations which may apply to process operations are listed in the instructions. Note that there may be other regulations which apply to this emissions unit which are not included in this list.

1. Reason this form is being submitted (Check one)

☑ New Permit ☐ Renewal or Modification of Air Permit Number(s) (e.g. P001)____________

2. Maximum Operating Schedule: 24 hours per day; 365 days per year

If the schedule is less than 24 hours/day or 365 days/year, what limits the schedule to less than maximum? See instructions for examples. Service, Biogas Availability, Feedstock Availability

3. End product of this process: Electricity & Fertilizer

4. Per Minute ~~Hourly~~ production rates (indicate appropriate units). Please see the instructions for clarification of "Maximum" and "Average" for new versus existing operations:

Hourly	Rate	Units (e.g., widgets)
Average production	35	gpm
Maximum production	75	gpm

5. Annual production rates (indicate appropriate units) Please see the instructions for clarification of "Maximum" and "Actual" for new versus existing operations:

Annual	Rate	Units (e.g., widgets)
Actual production	18M	Gallons
Maximum production	39M	Gallons

6. Type of operation (please check one):

☑ Continuous
☐ Batch (please complete items below)

Minimum cycle* time (minutes): _______
Minimum time between cycles (minutes): _______
Maximum number of cycles per daily 24 hour period: _______
(Note: include cycle time and set up/clean up time.)

*"Cycle" refers to the time the equipment is in operation.

7. Materials used in process at maximum hourly production rate (add rows/pages as needed):

Material	Physical State at Standard Conditions	Principle Use	Amount**
Food & Washwater	5% TS	Feedstock	2925 gallons
Biosolids & Wastewater	20% TS	Feedstock	1575 gallons
Manure (Hog)	2% TS	Feedstock	450 gallons

** Please indicate the amount **and** rate (e.g., lbs/hr, gallons/hr, lbs/cycle, etc.).

8. Please provide a narrative description of the process below (e.g., coating of metal parts using high VOC content coatings for the manufacture of widgets; emissions controlled by thermal oxidizer...):

Conversion of organic waste materials into energy and soil amendment products through anaerobic digestion.

FOR OHIO EPA USE
FACILITY ID: ____________
EU ID: ______ Application #: ________

EMISSIONS ACTIVITY CATEGORY FORM
INTERNAL COMBUSTION ENGINES OR TURBINES

This form is to be completed for each reciprocating engines or turbines. State/Federal regulations which may apply to internal combustion engines are listed in the instructions. Note that there may be other regulations which apply to this emissions unit which are not included in this list.

1. Maximum Operating Schedule: ~~365~~ 24 hours per day; ~~24~~ 365 days per year

If the schedule is less than 24 hours/day or 365 days/year, what limits the schedule to less than maximum? See instructions for examples. Service Intervals, Biogas Availability

2. Engine type: ☐ Turbine ☑ Reciprocating

3. Purpose of engine: ☐ Driving pump or compressor ☑ Driving electrical generator

4. Normal use of engine: ☐ Emergency only ☑ Non-emergency

5. Engine Manufacturer: Caterpillar Model No: 3516

Model Year: 2008 Serial Number: M1025131103

Date engine was ordered from the manufacturer: 10/1/2012

Date engine was first installed at any location by any operator/facility: 10/25/2013

Has the manufacturer certified the engine to meet any emissions standards? ☐ No ☐ Yes

If yes, which Part and paragraph and/or Table and/or Tier has been met? ____________

Will the engine be operated under the conditions the manufacturer has identified as necessary to meet these standards? ☐ No ☑ Yes

6. Type of ignition: ☐ compression (diesel) ☑ spark

7. Displacement (for reciprocating engines only):

____________ (Liters/cylinder, for compression ignition)

____________ (cubic centimeters, for spark ignition)

8. Engine exhaust configuration (for turbines only):

☐ simple cycle *(no heat recovery)*
☐ regenerative cycle *(heat recovery to preheat combustion air)*
☐ cogeneration cycle *(heat recovered to produce steam)*
☐ combined cycle *(heat recovered to produce steam which drives generator)*

9. Input capacities (million BTU/hr): Rated: 9.78 Maximum 9.78 Normal ________

Supplemental burner (duct burner) input capacity, if equipped (million BTU/hr):

Rated:________ Maximum ________ Normal ________

10. Output capacities (Horsepower): Rated: 1,341 Maximum 1341 Normal 1150

(Kilowatts): Rated: 1,000 Maximum 1,000 Normal 925

(lbs steam/hr)*: Rated: ________ Maximum ________ Normal ________

**(for cogeneration or combined cycle units only)*

11. Type of fuel fired (check all that apply):

☐ single fuel
☐ dual fuel
☐ gasoline
☐ No. 2 oil, low-sulfur
☐ No. 2 oil, high-sulfur
☐ propane
☐ natural gas
☐ diesel
☐ other, explain ________________
☐ landfill gas
☒ digester gas

12. Complete the following table for all fuels identified in question 11 that are used for the engine and any supplemental (duct) burners, if equipped:

Fuel	Heat Content (BTU/unit)	wt.% Ash	wt.% Sulfur	Fuel Usage		
				Estimated Maximum Per Year	Normal Per Hour	Max. Per Hour
Nat. gas	BTU/cu ft		gr/scf	cu ft	cu ft	cu ft
No. 2 oil	BTU/gal			gal	gal	gal
Gasoline	BTU/gal			gal	gal	gal
Diesel	BTU/gal			gal	gal	gal
Landfill/digester gas	550 BTU/cu ft		ppm	155,577,600 cu ft	17,760 cu ft	17,760 cu ft
Other (show units)						
List supplemental (duct) burner fuel and information below (show units):						

13. Type of combustion cycle (check all that apply):

☐ 2-stroke
☐ rich-burn
☒ 4-stroke
☐ lean-burn
☐ carbureted
☐ fuel injected
☐ other, explain ________________

14. Emissions control techniques (check all that apply):

☐ prestratified charge
☐ air/fuel ratio
☐ catalytic oxidation
☐ preignition chamber combustion (PCC)
☐ other, explain ________________
☐ nonselective catalytic reduction (NSCR)
☐ selective catalytic reduction (SCR)
☐ 2-stage rich/lean combustion
☐ water/steam injection
☐ injection timing retard
☐ 2-stage lean/lean combustion
☐ diesel particulate filter

For each emissions control technique checked above, explain what pollutants are controlled by each technique: ________________

15. Has the engine been modified or reconstructed since its manufacture date: ☐ No ☒ Yes

If Yes, explain:

Modified to support combustion with biogas

FOR OHIO EPA USE
FACILITY ID: ____________

EMISSIONS ACTIVITY CATEGORY FORM
FUEL BURNING OPERATION - Flare

This form is to be completed for each fuel burning operation. State/Federal regulations which may apply to fuel burning operations are listed in the instructions. Note that there may be other regulations which apply to this emissions unit which are not included in this list.

1. Reason this form is being submitted (check one)

☒ New Permit ☐ Renewal or Modification of Air Permit Number(s) (e.g. B001)____________

2. Maximum Operating Schedule: 24 hours per day; 365 days per year

If the schedule is less than 24 hours/day or 365 days/year, what limits the schedule to less than maximum? See instructions for examples. ____________

3. Input Capacity (million Btu/hr):

Rated *(Indicate units if other than mmBtu/hr)*	Maximum *(Indicate units if other than mmBtu/hr)*	Normal *(Indicate units if other than mmBtu/hr)*
14.52	14.52	14.52

4. Output Capacity:

Rated *(lb steam/hr)*	Maximum *(lb steam/hr)*	Normal *(lb steam/hr)*

☒ Not applicable - operation does not produce steam.

5. Percent of Operating Time Used for:

Process: 100 %
Space Heat: ______ %

6. Type of Draft (check one):

☐ Natural ☐ Induced ☒ Forced

7. Type of combustion monitoring (check one):

☒ Fuel/Air Ratio ☐ Oxygen ☐ None

☐ Other (describe) ______________________________

8. Type of Fuel Fired (complete all that apply):

Fuel*	Fired as...	Min. Heat Content (Btu/unit)	Max. % Ash	Max. % Sulfur	Max. Annual Fuel Use	Average Hourly Fuel Use	Maximum Hourly Fuel Use
Coal	☐ Primary ☐ Backup				tons	lbs	lbs
No. 2 Fuel Oil	☐ Primary ☐ Backup				gal	gal	gal
No. 6 Fuel Oil	☐ Primary ☐ Backup				gal	gal	gal
Other** Oil	☐ Primary ☐ Backup				gal	gal	gal
Natural Gas	☐ Primary ☐ Backup		▨		ft^3	ft^3	ft^3
Wood	☐ Primary ☐ Backup				tons	lbs	lbs
LPG	☐ Primary ☐ Backup		▨		gal	gal	gal
Other** Biogas	☒ Primary ☐ Backup	550 BTU/SCF			173,448,000 cu. ft	14,850 cu. ft./hr	19,800 cu. ft./hr
Other**	☐ Primary ☐ Backup						

* Please identify all combinations of fuels that are co-fired: ______________________________

** Identify other fuel(s): ______________________________

Coal-Fired Units

9. Type of Coal Firing (check one):

☐ Pulverized-Wet Bottom ☐ Hand-Fired ☐ Chain Grate ☐ Traveling Grate
☐ Pulverized-Dry Bottom ☐ Cyclones ☐ Spreader Stoker ☐ Fluidized Bed
☐ Underfeed Stoker ☐ Other (describe) ______________________________

10. Flyash Reinjection:

☐ Yes ☐ No

11. Overfire Air:

☐ Yes ☐ No

Oil-Fired Units

12. Oil Preheater:

☐ Yes - Indicate Temperature: _____ deg. F

☐ No

Appendix C

Renergy PTIO Number P0124072

Ohio
Ohio Environmental
Protection Agency

John R. Kasich, Governor
Mary Taylor, Lt. Governor
Craig W. Butler, Director

4/9/2018

<u>Certified Mail</u>

No	TOXIC REVIEW
No	SYNTHETIC MINOR TO AVOID MAJOR NSR
No	CEMS
No	MACT/GACT
Yes	NSPS
No	NESHAPS
No	NETTING
No	MODELING SUBMITTED
No	SYNTHETIC MINOR TO AVOID TITLE V
No	FEDERALLY ENFORCABLE PTIO (FEPTIO)
No	SYNTHETIC MINOR TO AVOID MAJOR GHG

LLC Dovetail Energy
Dovetail Energy, LLC
461 State Route 61
Marengo, OH 43334

RE: FINAL AIR POLLUTION PERMIT-TO-INSTALL AND OPERATE
Facility ID: 0829065027
Permit Number: P0124072
Permit Type: Initial Installation
County: Greene

Dear Permit Holder:

Enclosed please find a final Ohio Environmental Protection Agency (EPA) Air Pollution Permit-to-Install and Operate (PTIO) which will allow you to install, modify, and/or operate the described emissions unit(s) in the manner indicated in the permit. Because this permit contains conditions and restrictions, please read it very carefully. In this letter you will find the information on the following topics:

- **How to appeal this permit**
- **How to save money, reduce pollution and reduce energy consumption**
- **How to give us feedback on your permitting experience**
- **How to get an electronic copy of your permit**
- **What should you do if you notice a spill or environmental emergency?**

How to appeal this permit

The issuance of this PTIO is a final action of the Director and may be appealed to the Environmental Review Appeals Commission pursuant to Section 3745.04 of the Ohio Revised Code. The appeal must be in writing and set forth the action complained of and the grounds upon which the appeal is based. The appeal must be filed with the Commission within thirty (30) days after notice of the Director's action. The appeal must be accompanied by a filing fee of $70.00, made payable to "Ohio Treasurer Josh Mandel," which the Commission, in its discretion, may reduce if by affidavit you demonstrate that payment of the full amount of the fee would cause extreme hardship. Notice of the filing of the appeal shall be filed with the Director within three (3) days of filing with the Commission. Ohio EPA requests that a copy of the appeal be served upon the Ohio Attorney General's Office, Environmental Enforcement Section. An appeal may be filed with the Environmental Review Appeals Commission at the following address:

Environmental Review Appeals Commission
30 East Broad Street, 4th Floor
Columbus, OH 43215

How to save money, reduce pollution and reduce energy consumption

The Ohio EPA is encouraging companies to investigate pollution prevention and energy conservation. Not only will this reduce pollution and energy consumption, but it can also save you money. If you would like to learn ways you can save money while protecting the environment, please contact our Office of Compliance Assistance and Pollution Prevention at (614) 644-3469. Additionally, all or a portion of the capital expenditures related to installing air pollution control equipment under this permit may be eligible for financing and State tax exemptions through the Ohio Air Quality Development Authority (OAQDA) under Ohio Revised Code Section 3706. For more information, see the OAQDA website: www.ohioairquality.org/clean_air

How to give us feedback on your permitting experience

Please complete a survey at www.epa.ohio.gov/survey.aspx and give us feedback on your permitting experience. We value your opinion.

How to get an electronic copy of your permit

This permit can be accessed electronically via the eBusiness Center: Air Services in Microsoft Word format or in Adobe PDF on the Division of Air Pollution Control (DAPC) Web page, www.epa.ohio.gov/dapc by clicking the "Search for Permits" link under the Permitting topic on the Programs tab.

What should you do if you notice a spill or environmental emergency?

Any spill or environmental emergency which may endanger human health or the environment should be reported to the Emergency Response 24-HOUR EMERGENCY SPILL HOTLINE toll-free at (800) 282-9378. Report non-emergency complaints to the appropriate district office or local air agency.

If you have any questions regarding your permit, please contact Regional Air Pollution Control Agency at (937)225-4435 or the Office of Compliance Assistance and Pollution Prevention at (614) 644-3469.

Sincerely,

Michael E. Hopkins

Michael E. Hopkins, P.E.
Assistant Chief, Permitting Section, DAPC

Cc: RAPCA

Ohio

Ohio Environmental
Protection Agency

FINAL

Division of Air Pollution Control
Permit-to-Install and Operate

for

Dovetail Energy, LLC

Facility ID:	0829065027
Permit Number:	P0124072
Permit Type:	Initial Installation
Issued:	4/9/2018
Effective:	4/9/2018
Expiration:	4/9/2028

Ohio
Ohio Environmental
Protection Agency

Division of Air Pollution Control
Permit-to-Install and Operate
for
Dovetail Energy, LLC

Table of Contents

Authorization

Facility ID:	0829065027
Application Number(s):	A0060067
Permit Number:	P0124072
Permit Description:	Initial Permit to Install and Operate (PTIO) for an existing anaerobic digester with a flare used to burn excess digester gas and an existing Spark Ignition (SI) Internal Combustion Engine (ICE) that burns digester gas from an anaerobic digester. Historically operated under an agricultural exemption.
Permit Type:	Initial Installation
Permit Fee:	$800.00
Issue Date:	4/9/2018
Effective Date:	4/9/2018
Expiration Date:	4/9/2028
Permit Evaluation Report (PER) Annual Date:	Jan 1 - Dec 31, Due Feb 15

This document constitutes issuance to:

Dovetail Energy, LLC
1146 Herr Road
Fairborn, OH 45324

of a Permit-to-Install and Operate for the emissions unit(s) identified on the following page.

Ohio Environmental Protection Agency (EPA) District Office or local air agency responsible for processing and administering your permit:

Regional Air Pollution Control Agency
117 South Main St.
Dayton, OH 45422-1280
(937)225-4435

The above named entity is hereby granted this Permit-to-Install and Operate for the air contaminant source(s) (emissions unit(s)) listed in this section pursuant to Chapter 3745-31 of the Ohio Administrative Code. Issuance of this permit does not constitute expressed or implied approval or agreement that, if constructed or modified in accordance with the plans included in the application, the described emissions unit(s) will operate in compliance with applicable State and federal laws and regulations.

This permit is granted subject to the conditions attached hereto.

Ohio Environmental Protection Agency

Craig W. Butler
Director

Authorization (continued)

Permit Number:	P0124072
Permit Description:	Initial Permit to Install and Operate (PTIO) for an existing anaerobic digester with a flare used to burn excess digester gas and an existing Spark Ignition (SI) Internal Combustion Engine (ICE) that burns digester gas from an anaerobic digester. Historically operated under an agricultural exemption.

Permits for the following Emissions Unit(s) or groups of Emissions Units are in this document as indicated below:

Emissions Unit ID:	**B001**
Company Equipment ID:	CAT 3516
Superseded Permit Number:	
General Permit Category and Type:	Not Applicable
Emissions Unit ID:	**P001**
Company Equipment ID:	Digester
Superseded Permit Number:	
General Permit Category and Type:	Not Applicable

A. Standard Terms and Conditions

1. **What does this permit-to-install and operate ("PTIO") allow me to do?**

This permit allows you to install and operate the emissions unit(s) identified in this PTIO. You must install and operate the unit(s) in accordance with the application you submitted and all the terms and conditions contained in this PTIO, including emission limits and those terms that ensure compliance with the emission limits (for example, operating, recordkeeping and monitoring requirements).

2. **Who is responsible for complying with this permit?**

The person identified on the "Authorization" page, above, is responsible for complying with this permit until the permit is revoked, terminated, or transferred. "Person" means a person, firm, corporation, association, or partnership. The words "you," "your," or "permittee" refer to the "person" identified on the "Authorization" page above.

The permit applies only to the emissions unit(s) identified in the permit. If you install or modify any other equipment that requires an air permit, you must apply for an additional PTIO(s) for these sources.

3. **What records must I keep under this permit?**

You must keep all records required by this permit, including monitoring data, test results, strip-chart recordings, calibration data, maintenance records, and any other record required by this permit for five years from the date the record was created. You can keep these records electronically, provided they can be made available to Ohio EPA during an inspection at the facility. Failure to make requested records available to Ohio EPA upon request is a violation of this permit requirement.

4. **What are my permit fees and when do I pay them?**

There are two fees associated with permitted air contaminant sources in Ohio:

PTIO fee. This one-time fee is based on a fee schedule in accordance with Ohio Revised Code (ORC) section 3745.11, or based on a time and materials charge for permit application review and permit processing if required by the Director.

You will be sent an invoice for this fee after you receive this PTIO and payment is due within 30 days of the invoice date. You are required to pay the fee for this PTIO even if you do not install or modify your operations as authorized by this permit.

Annual emissions fee. Ohio EPA will assess a separate fee based on the total annual emissions from your facility. You self-report your emissions in accordance with Ohio Administrative Code (OAC) Chapter 3745-78. This fee assessed is based on a fee schedule in ORC section 3745.11 and funds Ohio EPA's permit compliance oversight activities. For facilities that are permitted as synthetic minor sources, the fee schedule is adjusted annually for inflation. Ohio EPA will notify you when it is time to report your emissions and to pay your annual emission fees.

5. **When does my PTIO expire, and when do I need to submit my renewal application?**

This permit expires on the date identified at the beginning of this permit document (see "Authorization" page above) and you must submit a renewal application to renew the permit. Ohio EPA will send a renewal notice to you approximately six months prior to the expiration date of this permit. However, it is very important that you submit a complete renewal permit application (postmarked prior to expiration of this permit) even if you do not receive the renewal notice.

If a complete renewal application is submitted before the expiration date, Ohio EPA considers this a timely application for purposes of ORC section 119.06, and you are authorized to continue operating the emissions unit(s) covered by this permit beyond the expiration date of this permit until final action is taken by Ohio EPA on the renewal application.

6. **What happens to this permit if my project is delayed or I do not install or modify my source?**

This PTIO expires 18 months after the issue date identified on the "Authorization" page above unless otherwise specified if you have not (1) started constructing the new or modified emission sources identified in this permit, or (2) entered into a binding contract to undertake such construction. This deadline can be extended by up to 12 months, provided you apply to Ohio EPA for this extension within a reasonable time before the 18-month period has ended and you can show good cause for any such extension.

7. **What reports must I submit under this permit?**

An annual permit evaluation report (PER) is required in addition to any malfunction reporting required by OAC rule 3745-15-06 or other specific rule-based reporting requirement identified in this permit. Your PER due date is identified in the Authorization section of this permit.

8. **If I am required to obtain a Title V operating permit in the future, what happens to the operating provisions and PER obligations under this permit?**

If you are required to obtain a Title V permit under OAC Chapter 3745-77 in the future, the permit-to-operate portion of this permit will be superseded by the issued Title V permit. From the effective date of the Title V permit forward, this PTIO will effectively become a PTI (permit-to-install) in accordance with OAC rule 3745-31-02(B). The following terms and conditions of this permit will no longer be applicable after issuance of the Title V permit: Section B, Term 1.b) and Section C, for each emissions unit, Term a)(2).

The PER requirements in this permit remain effective until the date the Title V permit is issued and is effective, and cease to apply after the effective date of the Title V permit. The final PER obligation will cover operations up to the effective date of the Title V permit and must be submitted on or before the submission deadline identified in this permit on the last day prior to the effective date of the Title V permit.

9. **What are my obligations when I perform scheduled maintenance on air pollution control equipment?**

You must perform scheduled maintenance of air pollution control equipment in accordance with OAC rule 3745-15-06(A). If scheduled maintenance requires shutting down or bypassing any air pollution control equipment, you must also shut down the emissions unit(s) served by the air pollution control equipment during maintenance, unless the conditions of OAC rule 3745-15-06(A)(3) are met. Any emissions that exceed permitted amount(s) under this permit (unless specifically exempted by rule) must be reported as deviations in the annual permit evaluation report (PER), including nonexempt excess emissions that occur during approved scheduled maintenance.

10. Do I have to report malfunctions of emissions units or air pollution control equipment? If so, how must I report?

If you have a reportable malfunction of any emissions unit(s) or any associated air pollution control system, you must report this to the [DO/LAA] in accordance with OAC rule 3745-15-06(B). Malfunctions that must be reported are those that result in emissions that exceed permitted emission levels. It is your responsibility to evaluate control equipment breakdowns and operational upsets to determine if a reportable malfunction has occurred.

If you have a malfunction, but determine that it is not a reportable malfunction under OAC rule 3745-15-06(B), it is recommended that you maintain records associated with control equipment breakdown or process upsets. Although it is not a requirement of this permit, Ohio EPA recommends that you maintain records for non-reportable malfunctions.

11. Can Ohio EPA or my local air agency inspect the facility where the emission unit(s) is/are located?

Yes. Under Ohio law, the Director or his authorized representative may inspect the facility, conduct tests, examine records or reports to determine compliance with air pollution laws and regulations and the terms and conditions of this permit. You must provide, within a reasonable time, any information Ohio EPA requests either verbally or in writing.

12. What happens if one or more emissions units operated under this permit is/are shut down permanently?

Ohio EPA can terminate the permit terms associated with any permanently shut down emissions unit. "Shut down" means the emissions unit has been physically removed from service or has been altered in such a way that it can no longer operate without a subsequent "modification" or "installation" as defined in OAC Chapter 3745-31.

You should notify Ohio EPA of any emissions unit that is permanently shut down by submitting a certification that identifies the date on which the emissions unit was permanently shut down. The certification must be submitted by an authorized official from the facility. You cannot continue to operate an emission unit once the certification has been submitted to Ohio EPA by the authorized official.

You must comply with all recordkeeping and reporting for any permanently shut down emissions unit in accordance with the provisions of the permit, regulations or laws that were enforceable during the period of operation, such as the requirement to submit a PER, air fee emission report, or malfunction report. You must also keep all records relating to any permanently shutdown emissions unit, generated while the emissions unit was in operation, for at least five years from the date the record was generated.

Again, you cannot resume operation of any emissions unit certified by the authorized official as being permanently shut down without first applying for and obtaining a permit pursuant to OAC Chapter 3745-31.

13. Can I transfer this permit to a new owner or operator?

You can transfer this permit to a new owner or operator. If you transfer the permit, you must follow the procedures in OAC Chapter 3745-31, including notifying Ohio EPA or the local air agency of the change in ownership or operator. Any transferee of this permit must assume the responsibilities of the transferor permit holder.

14. Does compliance with this permit constitute compliance with OAC rule 3745-15-07, "air pollution nuisance"?

This permit and OAC rule 3745-15-07 prohibit operation of the air contaminant source(s) regulated under this permit in a manner that causes a nuisance. Ohio EPA can require additional controls or modification of the requirements of this permit through enforcement orders or judicial enforcement action if, upon investigation, Ohio EPA determines existing operations are causing a nuisance.

15. What happens if a portion of this permit is determined to be invalid?

If a portion of this permit is determined to be invalid, the remainder of the terms and conditions remain valid and enforceable. The exception is where the enforceability of terms and conditions are dependent on the term or condition that was declared invalid.

B. Facility-Wide Terms and Conditions

1. This permit document constitutes a permit-to-install issued in accordance with ORC 3704.03(F) and a permit-to-operate issued in accordance with ORC 3704.03(G).

   a) For the purpose of a permit-to-install document, the facility-wide terms and conditions identified below are federally enforceable with the exception of those listed below which are enforceable under state law only.

      (1) None.

   b) For the purpose of a permit-to-operate document, the facility-wide terms and conditions identified below are enforceable under state law only with the exception of those listed below which are federally enforceable.

      (1) None.

2. The emissions unit contained in this permit is subject to 40 CFR Part 60, Subpart JJJJ. The complete NSPS requirements, including the NSPS General Provisions may be accessed via the internet from the Electronic Code of Federal Regulations (e-CFR) website http://ecfr.gpoaccess.gov or by contacting the Ohio EPA District Office or Local Air Agency.

3. The Ohio EPA has determined that this facility may be applicable to the requirements of an area source MACT/GACT rule that the Ohio EPA does not have the delegated authority to implement. Although Ohio EPA has determined that an area source MACT (also known as the GACT) may apply, at this time Ohio EPA does not have the authority to enforce this standard. Instead, U.S. EPA has the authority to enforce this standard. Please be advised that all requirements associated with these rules are in effect and are enforceable by U.S. EPA. For more information on the area source rules, please refer to the follow U.S. EPA website: http://www.epa.gov/ttn/atw/area/arearules.html

   The area source rule that applies is 40 CFR Part 63, Subpart ZZZZ.

C. Emissions Unit Terms and Conditions

1. B001, CAT 3516

Operations, Property and/or Equipment Description:

9.78 mmBtu/hr, 4-stroke lean burn (4SLB), spark ignition (SI) non-emergency internal combustion engine (ICE) fired by natural gas and digester gas, rated 1,340 Hp, driving an electrical generator. Manufactured 2008. Installed 2012.

a) This permit document constitutes a permit-to-install issued in accordance with ORC 3704.03(F) and a permit-to-operate issued in accordance with ORC 3704.03(G).

(1) For the purpose of a permit-to-install document, the emissions unit terms and conditions identified below are federally enforceable with the exception of those listed below which are enforceable under state law only.

a. d)(5).

(2) For the purpose of a permit-to-operate document, the emissions unit terms and conditions identified below are enforceable under state law only with the exception of those listed below which are federally enforceable.

a. None.

b) Applicable Emissions Limitations and/or Control Requirements

(1) The specific operation(s), property, and/or equipment that constitute each emissions unit along with the applicable rules and/or requirements and with the applicable emissions limitations and/or control measures are identified below. Emissions from each unit shall not exceed the listed limitations, and the listed control measures shall be specified in narrative form following the table.

	Applicable Rules/Requirements	Applicable Emissions Limitations/Control Measures
a.	OAC rule 3745-31-05(A)(3) and ORC 3704.03(T)	The nitrogen oxides (NOx), carbon monoxide (CO), and volatile organic compound (VOC) standards established pursuant to this rule are equivalent to the standards established in 40 CFR Part 60, Subpart JJJJ. Emissions of sulfur dioxide (SO2) shall not exceed 0.33 pounds per million Btu (lb/mmBtu). See c)(1), c)(2) and c)(3).
b.	OAC rule 3745-31-05(A)(3), as effective June 30, 2008	Particulate emissions shall not exceed 0.61 pounds per hour and 2.66 tons per year. See b)(2)a.

	Applicable Rules/Requirements	Applicable Emissions Limitations/Control Measures
c.	OAC rule 3745-31-05(A)(3)(a)(ii), as effective June 30, 2008	The Best Available Technology (BAT) requirements under 3745-31-05(A) do not apply to the particulate emissions (PE) since the potential to emit is less than 10 tons per year. See b)(2)b.
d.	OAC rule 3745-17-11(B)(5)(b)	Particulate emissions shall not exceed 0.062 pound/million Btu actual heat input.
e.	OAC rule 3745-17-07(A)(1)	Visible PE from any stack serving this emissions unit shall not exceed 20% opacity as a 6-minute average, except as provided by the rule.
f.	40 CFR Part 60, Subpart JJJJ [In accordance with 40 CFR 60.4230(a)(4)(ii), this emissions unit is a spark ignition lean burn engine greater than or equal to 500 horsepower (HP) and less than 1,350 HP]	The exhaust emissions from this engine shall not exceed the following: **When burning digester gas:** Emissions of nitrogen oxides (NO_X) shall not exceed 3.0 gram per horsepower–hour (g/hp-hr) or 220 ppmvd at 15% O_2. Emissions of carbon monoxide (CO) shall not exceed 5.0 g/hp-hr or 610 ppmvd at 15% O_2. Emissions of volatile organic compounds (VOC) shall not exceed 1.0 g/hp-hr or 80 ppmvd at 15% O_2. **When burning natural gas:** Emissions of nitrogen oxides (NO_X) shall not exceed 2.0 gram per horsepower–hour (g/hp-hr) or 160 ppmvd at 15% O_2. Emissions of carbon monoxide (CO) shall not exceed 4.0 g/hp-hr or 540 ppmvd at 15% O_2. Emissions of volatile organic compounds (VOC) shall not exceed 1.0 g/hp-hr or 86 ppmvd at 15% O_2. See b)(2)c and b)(2)d.
g.	40 CFR 60.1 – 19 (40 CFR 60.4246)	Table 3 to Subpart JJJJ of 40 CFR Part 60 – Applicability of Subpart A to Subpart

	Applicable Rules/Requirements	Applicable Emissions Limitations/Control Measures
		JJJJ shows which parts of the General Provisions in 40 CFR 60.1-19 apply.

(2) Additional Terms and Conditions

a. This Best Available Technology (BAT) emission limit applies until U.S. EPA approves Ohio Administrative Code (OAC) paragraph 3745-31-05(A)(3)(a)(ii) (the less than 10 tons per year BAT exemption) into the Ohio State Implementation Plan (SIP).

b. These requirements apply once U.S. EPA approves OAC rule 3745-31-05(A)(3)(a)(ii) (the less than 10 tons per year BAT exemption) into the Ohio State Implementation Plan (SIP).

c. The spark ignition (SI) internal combustion engine (ICE) is subject to and shall be operated in compliance with the requirements of 40 CFR Part 60, Subpart JJJJ, the standards of performance for stationary SI ICE. The engine shall be certified by the manufacturer to meet the applicable limits of 40 CFR 60.4231.

If the engine was not certified at the factory, the emission standard for the "owner/operator" should be referenced as from 60.4233(e).

d. The permittee shall comply with the applicable requirements under 40 CFR Part 60, Subpart JJJJ, including the following sections.

60.4233(e)	Emission standards
60.4243(b)	Demonstrate compliance

c) Operational Restrictions

(1) The permittee shall burn only natural gas, or digester gas with a minimum heat content of 500 Btu / scf, in this emissions unit.

(2) Digester gas combusted in this emissions unit shall not exceed 1,000 parts per million on a volume basis (ppm_v) of hydrogen sulfide.

d) Monitoring and/or Recordkeeping Requirements

(1) The permittee shall perform daily checks, when the emissions unit is in operation firing digester gas and when the weather conditions allow, for any visible particulate emissions from the stack serving this emissions unit. The presence or absence of any visible emissions shall be noted in an operations log. If visible emissions are observed, the permittee shall also note the following in the operations log:

a. the color of the emissions;

b. whether the emissions are representative of normal operations;

c. if the emissions are not representative of normal operations, the cause of the abnormal emissions;

d. the total duration of any visible emission incident; and

e. any corrective actions taken to minimize or eliminate the visible emissions.

If visible emissions are present, a visible emission incident has occurred. The observer does not have to document the exact start and end times for the visible emission incident under item (d) above or continue the daily check until the incident has ended. The observer may indicate that the visible emission incident was continuous during the observation period (or, if known, continuous during the operation of the emissions unit). With respect to the documentation of corrective actions, the observer may indicate that no corrective actions were taken if the visible emissions were representative of normal operations, or specify the minor corrective actions that were taken to ensure that the emissions unit continued to operate under normal conditions, or specify the corrective actions that were taken to eliminate abnormal visible emissions.

(2) For each day during which the permittee burns a fuel other than natural gas and/or digester gas, the permittee shall maintain a record of the type and quantity of fuel burned in this emissions unit.

(3) The permittee shall maintain monthly records of the natural gas and digester gas fuel usage in this unit in millions of standard cubic feet (MMSCF).

(4) The permittee shall comply with the applicable monitoring and record keeping requirements under 40 CFR Part 60, Subpart JJJJ, including the following sections.

60.4243(e)	Emergency operations, special record keeping
60.4245(a)	Record keeping requirements

(5) Modeling to demonstrate compliance with, the Toxic Air Contaminant Statute, ORC 3704.03(F)(4)(b), was not necessary because the emissions units maximum annual emissions for each toxic air contaminant, as defined in OAC rule 3745-114-01, will be less than 1.0 ton per year. OAC Chapter 3745-31 requires permittees to apply for and obtain a new or modified permit to install prior to making a "modification" as defined by OAC rule 3745-31-01. The permittee is hereby advised that changes in the composition of the materials, or use of new materials, that would cause the emissions of any toxic air contaminant to increase to above 1.0 ton per year may require the permittee to apply for and obtain a new permit to install.

(6) The permittee shall monitor and record hydrogen sulfide concentrations when operating the emissions unit with digester gas using one of the two following options:

Option 1: Weekly sampling using a gas detector tube or portable gas monitoring meter. The permittee shall perform monitoring in accordance with the manufacturer's instructions for use of the associated sampling system. Any deviations from the manufacturer's instructions should be recorded with the concentration results of the sampling.

Option 2: Continuous digester gas monitoring system. The permittee may install a sampling and analysis system to continuously monitor and record the H_2S content of the digester gas. The permittee shall properly install, operate, and maintain a continuous digester gas H_2S monitoring device and recorder that measures and records the H_2S concentrations in the digester gas when the emissions unit is in operation, including periods of startup and shutdown. The H_2S monitoring device and recorder shall be capable of satisfying the performance requirements specified in 40 CFR Part 60, Appendix B, Performance Specification 5 and shall be capable of accurately measuring the H_2S concentration. The H_2S monitoring device and recorder shall be installed, calibrated, operated, and maintained in accordance with the manufacturer's recommendations, instructions, and the operating manuals, with any modifications deemed necessary by the permittee.

Whenever the monitored value for hydrogen sulfide exceeds the lower limit of the accuracy of the monitoring system as measured by either of the above monitoring options, the permittee shall promptly investigate the cause of the deviation. The permittee shall maintain records of the following information for each investigation:

a. the date and time the deviation began;

b. the magnitude of the deviation at that time;

c. the date the investigation was conducted;

d. the name(s) of the personnel who conducted the investigation; and

e. the findings and recommendations.

In response to each required investigation to determine the cause of a deviation, the permittee shall take prompt corrective action to bring the hydrogen sulfide concentration below the maximum limit specified in this permit, unless the permittee determines that corrective action is not necessary and documents the reasons for that determination and the date and time the deviation ended. The permittee shall maintain records of the following information for each corrective action taken:

f. a description of the corrective action;

g. the date the corrective action was completed;

h. the date and time the deviation ended;

i. the total period of time (in minutes) during which there was a deviation;

j. hydrogen sulfide readings immediately after the corrective action was implemented; and

k. the name(s) of the personnel who performed the work.

Investigation and records required by this paragraph do not eliminate the need to comply with the requirements of OAC rule 3745-15-06 if it is determined that a malfunction has occurred.

(7) The permittee shall maintain monthly records of the heat content of the digester gas, in Btu / scf.

e) Reporting Requirements

(1) The reports required by this permit may be submitted through the Ohio EPA's eBusiness Center: Air Services online web portal; or they may be mailed as a hard copy to the appropriate district office or local air agency.

(2) The permittee shall submit an annual Permit Evaluation Report (PER) to the Ohio EPA District Office or Local Air Agency by the due date identified in the Authorization section of this permit. The PER shall cover a reporting period of no more than twelve months for each air contaminant source identified in this permit.

(3) The permittee shall identify the following information in the annual permit evaluation report in accordance with the monitoring requirements in d)(1), d)(2), d)(6) and d)(7):

a. all periods of time during which the permittee burns a fuel other than natural gas or digester gas in this emissions unit and the type and quantity of fuel burned;

b. each month during which digester gas with a minimum heat content of less than 500 Btu / scf was burned in this emissions unit;

c. each period during which digester gas containing an H_2S concentration greater than allowed by 1,000 ppmv was burned;

d. all days during which any visible particulate emissions were observed from the stack serving this emissions unit; and,

e. any corrective actions taken to minimize or eliminate the visible particulate emissions.

(4) The permittee shall submit reports and such other notifications to the Ohio EPA as are required pursuant to 40 CFR Part 60, Subpart JJJJ, per the following sections:

60.4245(c)	Reporting requirements
60.4245(d)	Reporting requirements

These reports and other such notifications shall be submitted to the Ohio EPA District Office or Local Air Agency.

f) Testing Requirements

(1) Compliance with the Emissions Limitations and/or Control Requirements specified in section b) of these terms and conditions shall be determined in accordance with the following methods:

a. Emissions limitation:

NO_x emissions shall not exceed 3.0 g/hp-hr or 220 ppmvd at 15% O2 while burning digester gas and 2.0 g/hp-hr or 160 ppmvd at 15% O2 while burning natural gas.

Applicable Compliance Method:

If required, compliance with the NOx emission limitation shall be determined in accordance with U.S. EPA Reference Methods 1-4 and 7E of 40 CFR Part 60, Appendix A.

b. Emissions Limitation:

CO emissions shall not exceed 5.0 g/hp-hr or 610 ppmvd at 15% O2 while burning digester gas and 4.0 g/hp-hr or 540 ppmvd at 15% O2 while burning natural gas.

Applicable Compliance Method:

If required, compliance with the CO emission limitation shall be determined in accordance with U.S. EPA Reference Methods 1-4 and 10 of 40 CFR Part 60, Appendix A.

c. Emissions Limitation:

VOC emissions shall not exceed 1.0 g/hp-hr or 80 ppmvd at 15% O2 while burning digester gas and 1.0 g/hp-hr or 86 ppmvd at 15% O2 while burning natural gas.

Applicable Compliance Method:

If required, compliance with the VOC emission limitation shall be determined in accordance with U.S. EPA Reference Methods 1-4 and 25 or 25A, as applicable, of 40 CFR Part 60, Appendix A.

d. Emissions Limitation:

Particulate emissions shall not exceed 0.61 pounds per hour and 2.66 tons per year.

Particulate emissions shall not exceed 0.062 pounds per million BTU actual heat input

Applicable Compliance Method:

If required, compliance with the particulate emissions limitation shall be determined in accordance with U.S. EPA Reference Methods 1-4 and 5, as applicable, of 40 CFR Part 60, Appendix A.

e. Emissions Limitation:

Sulfur dioxide (SO_2) emissions shall not exceed 0.33 lb/mmBtu.

Applicable Compliance Method:

The permittee shall demonstrate compliance with the emissions limitation through the required monitoring and recordkeeping in d)(6) and using the following equation:

E = (1 / digester gas heat content in Btu/scf) * (10^6 Btu / 1 mmBtu) * (H_2S ppmv / 1,000,000) * 0.088 lb H_2S/ft3 H_2S * 1.88 lb SO_2/lb H_2S = SO_2 lb/mmBtu

Where:

E = SO_2 emissions rate, lb/mmBtu

Digester gas heat content = average heat content of digester gas in Btu/scf from d)(7).

H_2S ppm_v = average concentration of H_2S in digester gas, from d)(6).

If required, sulfur dioxide emissions shall be determined according to test Methods 1 - 4, and 6 as set forth in 40 CFR, Part 60 Appendix A.

f. Emissions Limitation:

Visible particulate emissions shall not exceed 20% opacity as a six-minute average, except as provided by rule.

Applicable Compliance Method:

If required, compliance with the stack visible particulate emissions limitation shall be determined through visible emissions observations performed in accordance with U.S. EPA Method 9.

(2) The permittee shall conduct, or have conducted, emission testing for this emissions unit in accordance with the procedures specified in 40 CFR 60.4244 and the following requirements:

a. The emission testing shall be conducted within 180 days after issuance of the permit. Subsequent performance testing shall be conducted every 8,760 hours of engine operation or 3 years, whichever comes first.

b. Each performance test conducted shall be conducted within 10% and 100% peak (or the highest achievable) load and according to the requirements in 40 CFR 60.8 and under specific conditions that are specified by Table 2 of Subpart JJJJ.

c. The following test method(s) shall be employed, in accordance with Table 2 of Subpart JJJJ, to demonstrate compliance with the allowable mass emission rates:

   i. Method 1 or 1A of 40 CFR Part 60, Appendix A to select the sampling port location and the number of traverse points.

   ii. Method 2 or 2C of 40 CFR Part 60, Appendix A or Method 19 of 40 CFR Part 60, Appendix A to determine the exhaust flowrate of the engine.

   iii. Method 3, 3A, or 3B of 40 CFR Part 60, Appendix A to measure O_2 at the exhaust stack.

   iv. Method 4 of 40 CFR Part 60, Appendix A or Method 320 of 40 CFR Part 63, Appendix A to measure the moisture content at the exhaust stack.

   v. Method 7E of 40 CFR Part 60, Appendix A or Method 320 of 40 CFR Part 63, Appendix A to measure NOx at the exhaust stack.

   vi. Method 10 of 40 CFR Part 60, Appendix A or Method 320 of 40 CFR Part 63, Appendix A to measure CO at the exhaust stack.

   vii. Method 25A with Method 18 (for methane or ethane determination and subsequent subtraction from THC determined via Method 25A) of 40 CFR Part 60, Appendix A; or Method 25A fitted with a hydrocarbon cutter as described in 40 CFR 1065.265; or Method 18 of 40 CFR 60, Appendix A; or Method 320 of 40 CFR Part 63, Appendix A to measure VOC at the exhaust stack.

d. During the emission testing, the emissions unit shall be operated under operational conditions approved in advance by the appropriate Ohio EPA District Office or local air agency. Operational conditions that may need to be approved include, but are not limited to, the production rate, the type of material processed, material make-up (digester gas or natural gas, etc.), or control equipment operational limitations (power output, fuel consumption rate, etc.). In general, testing shall be done under "worst case" conditions expected during the life of the permit. As part of the information provided in the "Intent to Test" notification form described below, the permittee shall provide a description of the emissions unit operational conditions they will meet during the emissions testing and describe why they believe "worst case" operating conditions will be met. Prior to conducting the test(s), the permittee shall confirm with the appropriate Ohio EPA District Office or local air agency that the proposed operating conditions constitute "worst case". Failure to test under the approved conditions may result in Ohio EPA not accepting the test results as a demonstration of compliance.

e. Not later than 60 days prior to the proposed test date(s), the permittee shall submit an "Intent to Test" notification to the appropriate Ohio EPA District Office or local air agency. The "Intent to Test" notification shall describe in detail the proposed test methods and procedures, the emissions unit operating parameters, the time(s) and date(s) of the test(s), and the person(s) who will be conducting the test(s). Failure to submit such notification for review and approval prior to the test(s) may result in the Ohio EPA District Office's or local air agency's refusal to accept the results of the emission test(s).

f. Personnel from the appropriate Ohio EPA District Office or local air agency shall be permitted to witness the test(s), examine the testing equipment, and acquire data and information necessary to ensure that the operation of the emissions unit and the testing procedures provide a valid characterization of the emissions from the emissions unit and/or the performance of the control equipment.

g. A comprehensive written report on the results of the emission test(s) shall be signed by the person or persons responsible for the tests and submitted to the appropriate Ohio EPA District Office or local air agency within 30 days following completion of the test(s). The permittee may request additional time for the submittal of the written report, where warranted, with prior approval from the appropriate Ohio EPA District Office or local air agency.

g) Miscellaneous Requirements

(1) None.

2. P001, Digester with flare

Operations, Property and/or Equipment Description:

750 kGal Digester with 14.52 mmBtu/hr flare fueled by biogas and natural gas

a) This permit document constitutes a permit-to-install issued in accordance with ORC 3704.03(F) and a permit-to-operate issued in accordance with ORC 3704.03(G).

(1) For the purpose of a permit-to-install document, the emissions unit terms and conditions identified below are federally enforceable with the exception of those listed below which are enforceable under state law only.

a. None.

(2) For the purpose of a permit-to-operate document, the emissions unit terms and conditions identified below are enforceable under state law only with the exception of those listed below which are federally enforceable.

a. None.

b) Applicable Emissions Limitations and/or Control Requirements

(1) The specific operation(s), property, and/or equipment that constitute each emissions unit along with the applicable rules and/or requirements and with the applicable emissions limitations and/or control measures are identified below. Emissions from each unit shall not exceed the listed limitations, and the listed control measures shall be specified in narrative form following the table.

	Applicable Rules/Requirements	Applicable Emissions Limitations/Control Measures
a.	OAC rule 3745-31-05(A)(3) and ORC 3704.03(T)	Emissions of carbon monoxide (CO) shall not exceed 0.31 pounds per million BTU (lb/mmBtu). Emissions of volatile organic compounds (VOC) shall not exceed 0.66 lb/mmBtu. Emissions of sulfur dioxide (SO_2) shall not exceed 0.33 lb/mmBtu. See c)(1) and c)(2).
b.	OAC rule 3745-31-05(A)(3), as effective June 30, 2008	Emissions of nitrogen oxides (NO_x) shall not exceed 0.068 lb/mmBtu. See b)(2)a and b)(2)g.
c.	OAC rule 3745-31-05(A)(3)(a)(ii), as effective June 30, 2008	The Best Available Technology (BAT) requirements under OAC rule 3745-31-05(A)(3) do not apply to the NOx emissions from this air contaminant

	Applicable Rules/Requirements	Applicable Emissions Limitations/Control Measures
		source since the potential to emit is less than 10 tons/year. See b)(2)b.
d.	OAC rule 3745-17-11(B)	See b)(2)e.
e.	OAC rule 3745-17-07(A)	See b)(2)f.
f.	OAC rule 3745-18-06(E)	The emission limitations of this rule are less stringent than the emission limitations established by OAC rule 3745-31-05(A)(3).

(2) Additional Terms and Conditions

a. This Best Available Technology (BAT) emission limit applies until U.S. EPA approves Ohio Administrative Code (OAC) paragraph 3745-31-05(A)(3)(a)(ii) (the less than 10 tons per year BAT exemption) into the Ohio State Implementation Plan (SIP).

b. These requirements apply once U.S. EPA approves OAC paragraph 3745-31-05(A)(3)(a)(ii) (the less than 10 tons per year BAT exemption) as part of the Ohio SIP.

c. The emissions from the digestion process shall be vented to the flare so as not to allow biogas pressure to build in any tank that would induce emergency venting through tank pressure relief valves to the atmosphere and the combined heat and power unit is not firing digester gas.

d. Anaerobic digesters, including all associated equipment and grounds, shall be designed, operated, and maintained so as to prevent the emission of objectionable odors.

e. The uncontrolled mass rate of particulate emissions from this emissions unit is less than 10 pounds per hour. Pursuant to OAC rule 3745-17-11(A)(2)(a)(ii), Figure II of OAC rule 3745-17-11 does not apply. In addition, Table I of OAC rule 3745-17-11 does not apply because the process weight rate is equal to zero. Process weight is defined in OAC rule 3745-17-01(B)(17).

f. This emissions unit is exempt from the visible PE limitations specified in OAC rule 3745-17-07(A) pursuant to OAC rule 3745-17-07(A)(3)(h) because the emissions unit is not subject to the requirements of OAC rule 3745-17-11.

g. The NO_x emissions limitations were developed to reflect the potential to emit for this emissions unit. Therefore, monitoring, recordkeeping, and reporting requirements are not necessary to demonstrate compliance with these emissions limitations.

h. The permittee shall properly install, operate, and maintain a device to continuously monitor the flare pilot flame or electric arc ignition when the emissions unit is in operation. The monitoring device and any recorder shall be installed, calibrated, operated, and maintained in accordance with the manufacturers recommendations, instructions, and operating manuals.

c) Operational Restrictions

(1) Digester gas combusted in the flare serving this emissions unit shall not exceed 1,000 parts per million on a volume basis (ppm_v) of hydrogen sulfide.

(2) Digester gas combusted in the flare serving this emissions unit shall not have a heat content less than 500 Btu/scf.

(3) The permittee shall use an ultraviolet (UV) flame eye detector to monitor for the presence of a flame and an electric arc ignition system.

d) Monitoring and/or Recordkeeping Requirements

(1) The permittee shall monitor and record hydrogen sulfide concentrations when operating the emissions unit with digester gas using one of the two following options:

Option 1: Weekly sampling using a gas detector tube or portable gas monitoring meter. The permittee shall perform monitoring in accordance with the manufacturer's instructions for use of the associated sampling system. Any deviations from the manufacturer's instructions should be recorded with the concentration results of the sampling.

Option 2: Continuous digester gas monitoring system. The permittee may install a sampling and analysis system to continuously monitor and record the H_2S content of the digester gas. The permittee shall properly install, operate, and maintain a continuous digester gas H_2S monitoring device and recorder that measures and records the H_2S concentrations in the digester gas when the emissions unit is in operation, including periods of startup and shutdown. The H_2S monitoring device and recorder shall be capable of satisfying the performance requirements specified in 40 CFR Part 60, Appendix B, Performance Specification 5 and shall be capable of accurately measuring the H_2S concentration. The H_2S monitoring device and recorder shall be installed, calibrated, operated, and maintained in accordance with the manufacturer's recommendations, instructions, and the operating manuals, with any modifications deemed necessary by the permittee.

Whenever the monitored value for hydrogen sulfide exceeds the lower limit of the accuracy of the monitoring system as measured by either of the above monitoring options, the permittee shall promptly investigate the cause of the deviation. The permittee shall maintain records of the following information for each investigation:

a. the date and time the deviation began;

b. the magnitude of the deviation at that time;

c. the date the investigation was conducted;

d. the name(s) of the personnel who conducted the investigation; and

e. the findings and recommendations.

In response to each required investigation to determine the cause of a deviation, the permittee shall take prompt corrective action to bring the hydrogen sulfide concentration below the maximum limit specified in this permit, unless the permittee determines that corrective action is not necessary and documents the reasons for that determination and the date and time the deviation ended. The permittee shall maintain records of the following information for each corrective action taken:

f. a description of the corrective action;

g. the date the corrective action was completed;

h. the date and time the deviation ended;

i. the total period of time (in minutes) during which there was a deviation;

j. hydrogen sulfide readings immediately after the corrective action was implemented; and

k. the name(s) of the personnel who performed the work.

Investigation and records required by this paragraph do not eliminate the need to comply with the requirements of OAC rule 3745-15-06 if it is determined that a malfunction has occurred.

(2) The permittee shall maintain monthly records of the heat content of the digester gas, in Btu/scf.

(3) The permittee shall maintain daily records of all periods of time during which the electric arc system was inoperable or there was no flare pilot flame when digester gas was present in the feedstock equilibrium tank, primary digester, or dual-purpose tank, and the combined heat and power unit was not firing digester gas.

(4) The permittee shall monitor and record the volume of digester gas flared in standard cubic feet per year, and shall calculate and record the annual heat input to the flare in million Btu.

e) Reporting Requirements

(1) The reports required by this permit may be submitted through the Ohio EPA's eBusiness Center: Air Services online web portal; or they may be mailed as a hard copy to the appropriate district office or local air agency.

(2) The permittee shall submit the PER in the form and manner provided by the director by the due date identified in the Authorization section of this permit. The PER shall cover a reporting period of no more than twelve-months for each air contaminant source identified in this permit.

(3) The permittee shall identify the following information in the annual PER in accordance with the monitoring requirements in d)(1), d)(2) and d)(3):

a. all periods of time during which the flare's electric arc ignition system was not functioning properly or there was no flare pilot flame when digester gas was present in the feedstock equilibrium tank, primary digester, or dual-purpose tank, and the combined heat and power unit was not firing digester gas;

b. any monthly record showing that digester gas with a minimum heat content of less than 500 Btu / scf was burned in this emissions unit; and,

c. each period during which digester gas containing an H_2S concentration greater than allowed by c)(1) was burned.

f) Testing Requirements

(1) Compliance with the Emissions Limitations and/or Control Requirements specified in section b) of these terms and conditions shall be determined in accordance with the following methods:

a. Emissions limitation:

Emissions of CO shall not exceed 0.31 lb/mmBtu.

Applicable compliance method:

Compliance shall be demonstrated using the emissions factor for CO from U.S. EPA reference document AP-42, Fifth Edition, Compilation of Air Pollution Emission Factors, Section 13.5 Table 13.5-2 (02/18).

If required, the permittee shall demonstrate compliance with applicable emission limitations through emission testing performed in accordance with 40 CFR Part 60, Appendix A, Methods 1-4 and 40 CFR Part 60, Appendix A, Reference Method 10.

b. Emissions limitation:

Emissions of VOC shall not exceed 0.66 lb/mmBtu.

Applicable compliance method:

Compliance shall be demonstrated using the emissions factor for VOC from U.S. EPA reference document AP-42, Fifth Edition, Compilation of Air Pollution Emission Factors, Section 13.5 Table 13.5-2 (02/18).

If required, the permittee shall demonstrate compliance with applicable emission limitations through emission testing performed in accordance with 40 CFR Part 60, Appendix A, Methods 1-4 and 40 CFR Part 60, Appendix A Reference Method 25A.

c. Emissions limitation:

Emissions of NOx shall not exceed 0.068 lb/mmBtu.

Applicable compliance method:

Compliance shall be demonstrated using the emissions factor for NOx from U.S. EPA reference document AP-42, Fifth Edition, Compilation of Air Pollution Emission Factors, Section 13.5 Table 13.5-1 (02/18).

If required, the permittee shall demonstrate compliance with applicable emission limitations through emission testing performed in accordance with 40 CFR Part 60, Appendix A, Methods 1-4 and 40 CFR Part 60, Appendix A Reference Method 7E

d. Emissions Limitation:

Emissions of SO_2 shall not exceed 0.33 lb/mmBtu.

Applicable Compliance Method:

The permittee shall demonstrate compliance with the emissions limitation through the required monitoring and recordkeeping in d)(1) and using the following equation:

$E = (10^6 \text{Btu} / 1 \text{ mmBtu}) * (1 / \text{digester gas heat content}) * (H_2S \text{ ppm}_v / 1{,}000{,}000) * 0.088 \text{ lb } H_2S/\text{ft}^3 \, H_2S * 1.88 \text{ lb } SO_2/\text{lb } H_2S = SO_2 \text{ lb/mmBtu}$

Where:

E = SO_2 emissions rate, lb/mmBtu

Digester gas heat content = average heat content of digester gas in Btu/scf from d)(2).

H_2S ppm$_v$ = average concentration of H_2S in digester gas, from d)(1)

If required, sulfur dioxide emissions shall be determined according to test Methods 1 - 4, and 6 as set forth in 40 CFR, Part 60 Appendix A.

e. If required, the permittee shall confirm, through the applicable methods and procedures specified in 40 CFR Part 60.18, that the flare's exit velocity and the net heating value of the digester gas conform to the maximum design values specified by the flare manufacturer.

g) Miscellaneous Requirements

(1) None.

Appendix D

Renergy PTIO Number P0127783

Ohio
Ohio Environmental
Protection Agency

Mike DeWine, Governor
Jon Husted, Lt. Governor
Laurie A. Stevenson, Director

1/15/2020

Certified Mail

No	TOXIC REVIEW
No	SYNTHETIC MINOR TO AVOID MAJOR NSR
No	CEMS
No	MACT/GACT
Yes	NSPS
No	NESHAPS
No	NETTING
No	MODELING SUBMITTED
No	SYNTHETIC MINOR TO AVOID TITLE V
No	FEDERALLY ENFORCABLE PTIO (FEPTIO)
No	SYNTHETIC MINOR TO AVOID MAJOR GHG

LLC Dovetail Energy
Dovetail Energy, LLC
461 State Route 61
Marengo, OH 43334

RE: FINAL AIR POLLUTION PERMIT-TO-INSTALL AND OPERATE
Facility ID: 0829065027
Permit Number: P0127783
Permit Type: Administrative Modification
County: Greene

Dear Permit Holder:

Enclosed please find a final Ohio Environmental Protection Agency (EPA) Air Pollution Permit-to-Install and Operate (PTIO) which will allow you to install, modify, and/or operate the described emissions unit(s) in the manner indicated in the permit. Because this permit contains conditions and restrictions, please read it very carefully. In this letter you will find the information on the following topics:

- **How to appeal this permit**
- **How to save money, reduce pollution and reduce energy consumption**
- **How to give us feedback on your permitting experience**
- **How to get an electronic copy of your permit**
- **What should you do if you notice a spill or environmental emergency?**

How to appeal this permit

The issuance of this PTIO is a final action of the Director and may be appealed to the Environmental Review Appeals Commission pursuant to Section 3745.04 of the Ohio Revised Code. The appeal must be in writing and set forth the action complained of and the grounds upon which the appeal is based. The appeal must be filed with the Commission within thirty (30) days after notice of the Director's action. The appeal must be accompanied by a filing fee of $70.00, made payable to "Ohio Treasurer Robert Sprague," which the Commission, in its discretion, may reduce if by affidavit you demonstrate that payment of the full amount of the fee would cause extreme hardship. Notice of the filing of the appeal shall be filed with the Director within three (3) days of filing with the Commission. Ohio EPA requests that a copy of the appeal be served upon the Ohio Attorney General's Office, Environmental Enforcement Section. An appeal may be filed with the Environmental Review Appeals Commission at the following address:

Environmental Review Appeals Commission
30 East Broad Street, 4th Floor
Columbus, OH 43215

How to save money, reduce pollution and reduce energy consumption

The Ohio EPA is encouraging companies to investigate pollution prevention and energy conservation. Not only will this reduce pollution and energy consumption, but it can also save you money. If you would like to learn ways you can save money while protecting the environment, please contact our Office of Compliance Assistance and Pollution Prevention at (614) 644-3469. Additionally, all or a portion of the capital expenditures related to installing air pollution control equipment under this permit may be eligible for financing and State tax exemptions through the Ohio Air Quality Development Authority (OAQDA) under Ohio Revised Code Section 3706. For more information, see the OAQDA website: www.ohioairquality.org/clean_air

How to give us feedback on your permitting experience

Please complete a survey at www.epa.ohio.gov/survey.aspx and give us feedback on your permitting experience. We value your opinion.

How to get an electronic copy of your permit

This permit can be accessed electronically via the eBusiness Center: Air Services in Microsoft Word format or in Adobe PDF on the Division of Air Pollution Control (DAPC) Web page, www.epa.ohio.gov/dapc by clicking the "Search for Permits" link under the Permitting topic on the Programs tab.

What should you do if you notice a spill or environmental emergency?

Any spill or environmental emergency which may endanger human health or the environment should be reported to the Emergency Response 24-HOUR EMERGENCY SPILL HOTLINE toll-free at (800) 282-9378. Report non-emergency complaints to the appropriate district office or local air agency.

If you have any questions regarding your permit, please contact Regional Air Pollution Control Agency at (937)225-4435 or the Office of Compliance Assistance and Pollution Prevention at (614) 644-3469.

Sincerely,

Michael E. Hopkins

Michael E. Hopkins, P.E.
Assistant Chief, Permitting Section, DAPC

cc: RAPCA

Ohio
Ohio Environmental
Protection Agency

FINAL

Division of Air Pollution Control
Permit-to-Install and Operate
for
Dovetail Energy, LLC

Facility ID:	0829065027
Permit Number:	P0127783
Permit Type:	Administrative Modification
Issued:	1/15/2020
Effective:	1/15/2020
Expiration:	4/9/2028

Ohio
Ohio Environmental
Protection Agency

Division of Air Pollution Control
Permit-to-Install and Operate
for
Dovetail Energy, LLC

Table of Contents

Ohio Environmental
Protection Agency

Authorization

Facility ID:	0829065027
Application Number(s):	M0006043
Permit Number:	P0127783
Permit Description:	Administrative modification for changes in parametric monitoring requirements with no increase in emissions limitations.
Permit Type:	Administrative Modification
Permit Fee:	$100.00
Issue Date:	1/15/2020
Effective Date:	1/15/2020
Expiration Date:	4/9/2028

Permit Evaluation Report (PER) Annual Date: Jan 1 - Dec 31, Due Feb 15

This document constitutes issuance to:

Dovetail Energy, LLC
1156 Herr Rd
Fairborn, OH 45324

of a Permit-to-Install and Operate for the emissions unit(s) identified on the following page.

Ohio Environmental Protection Agency (EPA) District Office or local air agency responsible for processing and administering your permit:

Regional Air Pollution Control Agency
117 South Main St.
Dayton, OH 45422-1280
(937)225-4435

The above named entity is hereby granted this Permit-to-Install and Operate for the air contaminant source(s) (emissions unit(s)) listed in this section pursuant to Chapter 3745-31 of the Ohio Administrative Code. Issuance of this permit does not constitute expressed or implied approval or agreement that, if constructed or modified in accordance with the plans included in the application, the described emissions unit(s) will operate in compliance with applicable State and federal laws and regulations.

This permit is granted subject to the conditions attached hereto.

Ohio Environmental Protection Agency

Laurie A. Stevenson

Laurie A. Stevenson
Director

Authorization (continued)

Permit Number:	P0127783
Permit Description:	Administrative modification for changes in parametric monitoring requirements with no increase in emissions limitations.

Permits for the following Emissions Unit(s) or groups of Emissions Units are in this document as indicated below:

Emissions Unit ID:	**B001**
Company Equipment ID:	CAT 3516
Superseded Permit Number:	P0124072
General Permit Category and Type:	Not Applicable

A. Standard Terms and Conditions

1. **What does this permit-to-install and operate ("PTIO") allow me to do?**

This permit allows you to install and operate the emissions unit(s) identified in this PTIO. You must install and operate the unit(s) in accordance with the application you submitted and all the terms and conditions contained in this PTIO, including emission limits and those terms that ensure compliance with the emission limits (for example, operating, recordkeeping and monitoring requirements).

2. **Who is responsible for complying with this permit?**

The person identified on the "Authorization" page, above, is responsible for complying with this permit until the permit is revoked, terminated, or transferred. "Person" means a person, firm, corporation, association, or partnership. The words "you," "your," or "permittee" refer to the "person" identified on the "Authorization" page above.

The permit applies only to the emissions unit(s) identified in the permit. If you install or modify any other equipment that requires an air permit, you must apply for an additional PTIO(s) for these sources.

3. **What records must I keep under this permit?**

You must keep all records required by this permit, including monitoring data, test results, strip-chart recordings, calibration data, maintenance records, and any other record required by this permit for five years from the date the record was created. You can keep these records electronically, provided they can be made available to Ohio EPA during an inspection at the facility. Failure to make requested records available to Ohio EPA upon request is a violation of this permit requirement.

4. **What are my permit fees and when do I pay them?**

There are two fees associated with permitted air contaminant sources in Ohio:

PTIO fee. This one-time fee is based on a fee schedule in accordance with Ohio Revised Code (ORC) section 3745.11, or based on a time and materials charge for permit application review and permit processing if required by the Director.

You will be sent an invoice for this fee after you receive this PTIO and payment is due within 30 days of the invoice date. You are required to pay the fee for this PTIO even if you do not install or modify your operations as authorized by this permit.

Annual emissions fee. Ohio EPA will assess a separate fee based on the total annual emissions from your facility. You self-report your emissions in accordance with Ohio Administrative Code (OAC) Chapter 3745-78. This fee assessed is based on a fee schedule in ORC section 3745.11 and funds Ohio EPA's permit compliance oversight activities. For facilities that are permitted as synthetic minor sources, the fee schedule is adjusted annually for inflation. Ohio EPA will notify you when it is time to report your emissions and to pay your annual emission fees.

5. **When does my PTIO expire, and when do I need to submit my renewal application?**

This permit expires on the date identified at the beginning of this permit document (see "Authorization" page above) and you must submit a renewal application to renew the permit. Ohio EPA will send a renewal notice to you approximately six months prior to the expiration date of this permit. However, it is very important that you submit a complete renewal permit application (postmarked prior to expiration of this permit) even if you do not receive the renewal notice.

If a complete renewal application is submitted before the expiration date, Ohio EPA considers this a timely application for purposes of ORC section 119.06, and you are authorized to continue operating the emissions unit(s) covered by this permit beyond the expiration date of this permit until final action is taken by Ohio EPA on the renewal application.

6. **What happens to this permit if my project is delayed or I do not install or modify my source?**

This PTIO expires 18 months after the issue date identified on the "Authorization" page above unless otherwise specified if you have not (1) started constructing the new or modified emission sources identified in this permit, or (2) entered into a binding contract to undertake such construction. This deadline can be extended by up to 12 months, provided you apply to Ohio EPA for this extension within a reasonable time before the 18-month period has ended and you can show good cause for any such extension.

7. **What reports must I submit under this permit?**

An annual permit evaluation report (PER) is required in addition to any malfunction reporting required by OAC rule 3745-15-06 or other specific rule-based reporting requirement identified in this permit. Your PER due date is identified in the Authorization section of this permit.

8. **If I am required to obtain a Title V operating permit in the future, what happens to the operating provisions and PER obligations under this permit?**

If you are required to obtain a Title V permit under OAC Chapter 3745-77 in the future, the permit-to-operate portion of this permit will be superseded by the issued Title V permit. From the effective date of the Title V permit forward, this PTIO will effectively become a PTI (permit-to-install) in accordance with OAC rule 3745-31-02(B). The following terms and conditions of this permit will no longer be applicable after issuance of the Title V permit: Section B, Term 1.b) and Section C, for each emissions unit, Term a)(2).

The PER requirements in this permit remain effective until the date the Title V permit is issued and is effective, and cease to apply after the effective date of the Title V permit. The final PER obligation will cover operations up to the effective date of the Title V permit and must be submitted on or before the submission deadline identified in this permit on the last day prior to the effective date of the Title V permit.

9. **What are my obligations when I perform scheduled maintenance on air pollution control equipment?**

You must perform scheduled maintenance of air pollution control equipment in accordance with OAC rule 3745-15-06(A). If scheduled maintenance requires shutting down or bypassing any air pollution control equipment, you must also shut down the emissions unit(s) served by the air pollution control equipment during maintenance, unless the conditions of OAC rule 3745-15-06(A)(3) are met. Any emissions that exceed permitted amount(s) under this permit (unless specifically exempted by rule) must be reported as deviations in the annual permit evaluation report (PER), including nonexempt excess emissions that occur during approved scheduled maintenance.

10. Do I have to report malfunctions of emissions units or air pollution control equipment? If so, how must I report?

If you have a reportable malfunction of any emissions unit(s) or any associated air pollution control system, you must report this to the District Office or Local Air Agency in accordance with OAC rule 3745-15-06(B). Malfunctions that must be reported are those that result in emissions that exceed permitted emission levels. It is your responsibility to evaluate control equipment breakdowns and operational upsets to determine if a reportable malfunction has occurred.

If you have a malfunction, but determine that it is not a reportable malfunction under OAC rule 3745-15-06(B), it is recommended that you maintain records associated with control equipment breakdown or process upsets. Although it is not a requirement of this permit, Ohio EPA recommends that you maintain records for non-reportable malfunctions.

11. Can Ohio EPA or my local air agency inspect the facility where the emission unit(s) is/are located?

Yes. Under Ohio law, the Director or his authorized representative may inspect the facility, conduct tests, examine records or reports to determine compliance with air pollution laws and regulations and the terms and conditions of this permit. You must provide, within a reasonable time, any information Ohio EPA requests either verbally or in writing.

12. What happens if one or more emissions units operated under this permit is/are shut down permanently?

Ohio EPA can terminate the permit terms associated with any permanently shut down emissions unit. "Shut down" means the emissions unit has been physically removed from service or has been altered in such a way that it can no longer operate without a subsequent "modification" or "installation" as defined in OAC Chapter 3745-31.

You should notify Ohio EPA of any emissions unit that is permanently shut down by submitting a certification that identifies the date on which the emissions unit was permanently shut down. The certification must be submitted by an authorized official from the facility. You cannot continue to operate an emission unit once the certification has been submitted to Ohio EPA by the authorized official.

You must comply with all recordkeeping and reporting for any permanently shut down emissions unit in accordance with the provisions of the permit, regulations or laws that were enforceable during the period of operation, such as the requirement to submit a PER, air fee emission report, or malfunction report. You must also keep all records relating to any permanently shutdown emissions unit, generated while the emissions unit was in operation, for at least five years from the date the record was generated.

Again, you cannot resume operation of any emissions unit certified by the authorized official as being permanently shut down without first applying for and obtaining a permit pursuant to OAC Chapter 3745-31.

13. Can I transfer this permit to a new owner or operator?

You can transfer this permit to a new owner or operator. If you transfer the permit, you must follow the procedures in OAC Chapter 3745-31, including notifying Ohio EPA or the local air agency of the change in ownership or operator. Any transferee of this permit must assume the responsibilities of the transferor permit holder.

14. Does compliance with this permit constitute compliance with OAC rule 3745-15-07, "air pollution nuisance"?

This permit and OAC rule 3745-15-07 prohibit operation of the air contaminant source(s) regulated under this permit in a manner that causes a nuisance. Ohio EPA can require additional controls or modification of the requirements of this permit through enforcement orders or judicial enforcement action if, upon investigation, Ohio EPA determines existing operations are causing a nuisance.

15. What happens if a portion of this permit is determined to be invalid?

If a portion of this permit is determined to be invalid, the remainder of the terms and conditions remain valid and enforceable. The exception is where the enforceability of terms and conditions are dependent on the term or condition that was declared invalid.

B. Facility-Wide Terms and Conditions

1. This permit document constitutes a permit-to-install issued in accordance with ORC 3704.03(F) and a permit-to-operate issued in accordance with ORC 3704.03(G).

   a) For the purpose of a permit-to-install document, the facility-wide terms and conditions identified below are federally enforceable with the exception of those listed below which are enforceable under state law only.

      (1) None.

   b) For the purpose of a permit-to-operate document, the facility-wide terms and conditions identified below are enforceable under state law only with the exception of those listed below which are federally enforceable.

      (1) None.

C. Emissions Unit Terms and Conditions

1. B001, CAT 3516

Operations, Property and/or Equipment Description:

9.78 mmBtu/hr, 4-stroke lean burn (4SLB), spark ignition (SI) non-emergency internal combustion engine (ICE) fired by natural gas and digester gas, rated 1,340 Hp, driving an electrical generator. Manufactured 2008. Installed 2012.

a) This permit document constitutes a permit-to-install issued in accordance with ORC 3704.03(F) and a permit-to-operate issued in accordance with ORC 3704.03(G).

(1) For the purpose of a permit-to-install document, the emissions unit terms and conditions identified below are federally enforceable with the exception of those listed below which are enforceable under state law only.

a. D)(5).

(2) For the purpose of a permit-to-operate document, the emissions unit terms and conditions identified below are enforceable under state law only with the exception of those listed below which are federally enforceable.

a. None.

b) Applicable Emissions Limitations and/or Control Requirements

(1) The specific operation(s), property, and/or equipment that constitute each emissions unit along with the applicable rules and/or requirements and with the applicable emissions limitations and/or control measures are identified below. Emissions from each unit shall not exceed the listed limitations, and the listed control measures shall be specified in narrative form following the table.

	Applicable Rules/Requirements	Applicable Emissions Limitations/Control Measures
a.	OAC rule 3745-31-05(A)(3) and ORC 3704.03(T)	The nitrogen oxides (NOx), carbon monoxide (CO), and volatile organic compound (VOC) standards established pursuant to this rule are equivalent to the standards established in 40 CFR Part 60, Subpart JJJJ. Emissions of sulfur dioxide (SO2) shall not exceed 0.33 pounds per million Btu (lb/mmBtu). See c)(1), c)(2) and c)(3).
c.	OAC rule 3745-31-05(A)(3)(a)(ii)	The Best Available Technology (BAT) requirements under 3745-31-05(A) do not apply to the particulate emissions (PE) since the potential to emit is less than 10 tons per year.

	Applicable Rules/Requirements	Applicable Emissions Limitations/Control Measures
d.	OAC rule 3745-17-11(B)(5)(b)	Particulate emissions shall not exceed 0.062 pound/million Btu actual heat input.
e.	OAC rule 3745-17-07(A)(1)	Visible PE from any stack serving this emissions unit shall not exceed 20% opacity as a 6-minute average, except as provided by the rule.
f.	40 CFR Part 60, Subpart JJJJ [In accordance with 40 CFR 60.4230(a)(4)(ii), this emissions unit is a spark ignition lean burn engine greater than or equal to 500 horsepower (HP) and less than 1,350 HP]	The exhaust emissions from this engine shall not exceed the following: **When burning digester gas:** Emissions of nitrogen oxides (NO_X) shall not exceed 3.0 gram per horsepower–hour (g/hp-hr) or 220 ppmvd at 15% O_2. Emissions of carbon monoxide (CO) shall not exceed 5.0 g/hp-hr or 610 ppmvd at 15% O_2. Emissions of volatile organic compounds (VOC) shall not exceed 1.0 g/hp-hr or 80 ppmvd at 15% O_2. **When burning natural gas:** Emissions of nitrogen oxides (NO_X) shall not exceed 2.0 gram per horsepower–hour (g/hp-hr) or 160 ppmvd at 15% O_2. Emissions of carbon monoxide (CO) shall not exceed 4.0 g/hp-hr or 540 ppmvd at 15% O_2. Emissions of volatile organic compounds (VOC) shall not exceed 1.0 g/hp-hr or 86 ppmvd at 15% O_2. See b)(2)a and b)(2)b.
g.	40 CFR 60.1 – 19 (40 CFR 60.4246)	Table 3 to Subpart JJJJ of 40 CFR Part 60 – Applicability of Subpart A to Subpart JJJJ shows which parts of the General Provisions in 40 CFR 60.1-19 apply.

(2) Additional Terms and Conditions

a. The spark ignition (SI) internal combustion engine (ICE) is subject to and shall be operated in compliance with the requirements of 40 CFR Part 60, Subpart JJJJ, the standards of performance for stationary SI ICE. The engine shall be certified by the manufacturer to meet the applicable limits of 40 CFR 60.4231.

If the engine was not certified at the factory, the emission standard for the "owner/operator" should be referenced as from 60.4233(e).

b. The permittee shall comply with the applicable requirements under 40 CFR Part 60, Subpart JJJJ, including the following sections.

60.4233(e)	Emission standards
60.4243(b)	Demonstrate compliance

c) Operational Restrictions

(1) The permittee shall burn only natural gas, or digester gas with a minimum heat content of 500 Btu / scf, in this emissions unit.

(2) Digester gas combusted in this emissions unit shall not exceed 1,000 parts per million on a volume basis (ppm_v) of hydrogen sulfide.

d) Monitoring and/or Recordkeeping Requirements

(1) The permittee shall perform weekly checks, when the emissions unit is in operation firing digester gas and when the weather conditions allow, for any visible particulate emissions from the stack serving this emissions unit. The presence or absence of any visible emissions shall be noted in an operations log. If visible emissions are observed, the permittee shall also note the following in the operations log:

a. the color of the emissions;

b. whether the emissions are representative of normal operations;

c. if the emissions are not representative of normal operations, the cause of the abnormal emissions;

d. the total duration of any visible emission incident; and

e. any corrective actions taken to minimize or eliminate the visible emissions.

If visible emissions are present, a visible emission incident has occurred. The observer does not have to document the exact start and end times for the visible emission incident under item (d) above or continue the daily check until the incident has ended. The observer may indicate that the visible emission incident was continuous during the observation period (or, if known, continuous during the operation of the emissions unit).

With respect to the documentation of corrective actions, the observer may indicate that no corrective actions were taken if the visible emissions were representative of normal operations or specify the minor corrective actions that were taken to ensure that the emissions unit continued to operate under normal conditions or specify the corrective actions that were taken to eliminate abnormal visible emissions.

(2) For each day during which the permittee burns a fuel other than natural gas and/or digester gas, the permittee shall maintain a record of the type and quantity of fuel burned in this emissions unit.

(3) The permittee shall maintain monthly records of the natural gas and digester gas fuel usage in this unit in millions of standard cubic feet (MMSCF).

(4) The permittee shall comply with the applicable monitoring and record keeping requirements under 40 CFR Part 60, Subpart JJJJ, including the following sections.

60.4243(e)	Emergency operations, special record keeping
60.4245(a)	Record keeping requirements

(5) Modeling to demonstrate compliance with, the Toxic Air Contaminant Statute, ORC 3704.03(F)(4)(b), was not necessary because the emissions units maximum annual emissions for each toxic air contaminant, as defined in OAC rule 3745-114-01, will be less than 1.0 ton per year. OAC Chapter 3745-31 requires permittees to apply for and obtain a new or modified permit to install prior to making a "modification" as defined by OAC rule 3745-31-01. The permittee is hereby advised that changes in the composition of the materials, or use of new materials, that would cause the emissions of any toxic air contaminant to increase to above 1.0 ton per year may require the permittee to apply for and obtain a new permit to install.

(6) The permittee shall monitor and record hydrogen sulfide concentrations when operating the emissions unit with digester gas using one of the two following options:

Option 1: Weekly sampling using a gas detector tube or portable gas monitoring meter. The permittee shall perform monitoring in accordance with the manufacturer's instructions for use of the associated sampling system. Any deviations from the manufacturer's instructions should be recorded with the concentration results of the sampling.

Option 2: Continuous digester gas monitoring system. The permittee may install a sampling and analysis system to continuously monitor and record the H_2S content of the digester gas. The permittee shall properly install, operate, and maintain a continuous digester gas H_2S monitoring device and recorder that measures and records the H_2S concentrations in the digester gas when the emissions unit is in operation, including periods of startup and shutdown. The H_2S monitoring device and recorder shall be capable of satisfying the performance requirements specified in 40 CFR Part 60, Appendix B, Performance Specification 5 and shall be capable of accurately measuring the H_2S concentration. The H_2S monitoring device and recorder shall be installed, calibrated, operated, and maintained in accordance with the manufacturer's recommendations, instructions, and the operating manuals, with any modifications deemed necessary by the permittee.

Whenever the monitored value for hydrogen sulfide exceeds the lower limit of the accuracy of the monitoring system as measured by either of the above monitoring options, the permittee shall promptly investigate the cause of the deviation. The permittee shall maintain records of the following information for each investigation:

a. the date and time the deviation began;

b. the magnitude of the deviation at that time;

c. the date the investigation was conducted;

d. the name(s) of the personnel who conducted the investigation; and

e. the findings and recommendations.

In response to each required investigation to determine the cause of a deviation, the permittee shall take prompt corrective action to bring the hydrogen sulfide concentration below the maximum limit specified in this permit, unless the permittee determines that corrective action is not necessary and documents the reasons for that determination and the date and time the deviation ended. The permittee shall maintain records of the following information for each corrective action taken:

f. a description of the corrective action;

g. the date the corrective action was completed;

h. the date and time the deviation ended;

i. the total period of time (in minutes) during which there was a deviation;

j. hydrogen sulfide readings immediately after the corrective action was implemented; and

k. the name(s) of the personnel who performed the work.

Investigation and records required by this paragraph do not eliminate the need to comply with the requirements of OAC rule 3745-15-06 if it is determined that a malfunction has occurred.

(7) The permittee shall maintain monthly records of the heat content of the digester gas, in Btu / scf.

e) Reporting Requirements

(1) The reports required by this permit may be submitted through the Ohio EPA's eBusiness Center: Air Services online web portal; or they may be mailed as a hard copy to the appropriate district office or local air agency.

(2) The permittee shall submit an annual Permit Evaluation Report (PER) to the Ohio EPA District Office or Local Air Agency by the due date identified in the Authorization section of this permit. The PER shall cover a reporting period of no more than twelve months for each air contaminant source identified in this permit.

(3) The permittee shall identify the following information in the annual permit evaluation report in accordance with the monitoring requirements in d)(1), d)(2), d)(6) and d)(7):

a. all periods of time during which the permittee burns a fuel other than natural gas or digester gas in this emissions unit and the type and quantity of fuel burned;

b. each month during which digester gas with a minimum heat content of less than 500 Btu / scf was burned in this emissions unit;

c. each period during which digester gas containing an H_2S concentration greater than allowed by 1,000 ppmv was burned;

d. all days during which any visible particulate emissions were observed from the stack serving this emissions unit; and,

e. any corrective actions taken to minimize or eliminate the visible particulate emissions.

(4) The permittee shall submit reports and such other notifications to the Ohio EPA as are required pursuant to 40 CFR Part 60, Subpart JJJJ, per the following sections:

60.4245(c)	Reporting requirements
60.4245(d)	Reporting requirements

(5) These reports and other such notifications shall be submitted to the Ohio EPA District Office or Local Air Agency.

f) Testing Requirements

(1) Compliance with the Emissions Limitations and/or Control Requirements specified in section b) of these terms and conditions shall be determined in accordance with the following methods:

a. Emissions limitation:

NO$_x$ emissions shall not exceed 3.0 g/hp-hr or 220 ppmvd at 15% O2 while burning digester gas and 2.0 g/hp-hr or 160 ppmvd at 15% O2 while burning natural gas.

Applicable Compliance Method:

If required, compliance with the NOx emission limitation shall be determined in accordance with U.S. EPA Reference Methods 1-4 and 7E of 40 CFR Part 60, Appendix A.

b. Emissions Limitation:

CO emissions shall not exceed 5.0 g/hp-hr or 610 ppmvd at 15% O2 while burning digester gas and 4.0 g/hp-hr or 540 ppmvd at 15% O2 while burning natural gas.

Applicable Compliance Method:

If required, compliance with the CO emission limitation shall be determined in accordance with U.S. EPA Reference Methods 1-4 and 10 of 40 CFR Part 60, Appendix A.

c. Emissions Limitation:

VOC emissions shall not exceed 1.0 g/hp-hr or 80 ppmvd at 15% O2 while burning digester gas and 1.0 g/hp-hr or 86 ppmvd at 15% O2 while burning natural gas.

Applicable Compliance Method:

If required, compliance with the VOC emission limitation shall be determined in accordance with U.S. EPA Reference Methods 1-4 and 25 or 25A, as applicable, of 40 CFR Part 60, Appendix A.

d. Emissions Limitation:

Particulate emissions shall not exceed 0.61 pounds per hour and 2.66 tons per year.

Particulate emissions shall not exceed 0.062 pounds per million BTU actual heat input

Applicable Compliance Method:

If required, compliance with the particulate emissions limitation shall be determined in accordance with U.S. EPA Reference Methods 1-4 and 5, as applicable, of 40 CFR Part 60, Appendix A.

e. Emissions Limitation:

Sulfur dioxide (SO_2) emissions shall not exceed 0.33 lb/mmBtu.

Applicable Compliance Method:

The permittee shall demonstrate compliance with the emissions limitation through the required monitoring and recordkeeping in d)(6) and using the following equation:

E = (1 / digester gas heat content in Btu/scf) * (10^6 Btu / 1 mmBtu) * (H_2S ppmv / 1,000,000) * 0.088 lb H_2S/ft3 H_2S * 1.88 lb SO_2/lb H_2S = SO_2 lb/mmBtu

Where:

E = SO_2 emissions rate, lb/mmBtu

Digester gas heat content = average heat content of digester gas in Btu/scf from d)(7).

H_2S ppm_v = average concentration of H_2S in digester gas, from d)(6).

If required, sulfur dioxide emissions shall be determined according to test Methods 1 - 4, and 6 as set forth in 40 CFR, Part 60 Appendix A.

f. Emissions Limitation:

Visible particulate emissions shall not exceed 20% opacity as a six-minute average, except as provided by rule.

Applicable Compliance Method:

If required, compliance with the stack visible particulate emissions limitation shall be determined through visible emissions observations performed in accordance with U.S. EPA Method 9.

(2) The permittee shall conduct, or have conducted, emission testing for this emissions unit in accordance with the procedures specified in 40 CFR 60.4244 and the following requirements:

a. Performance testing shall be conducted every 8,760 hours of engine operation or 3 years, whichever comes first.

b. Each performance test conducted shall be conducted within 10% and 100% peak (or the highest achievable) load and according to the requirements in 40 CFR 60.8 and under specific conditions that are specified by Table 2 of Subpart JJJJ.

c. The following test method(s) shall be employed, in accordance with Table 2 of Subpart JJJJ, to demonstrate compliance with the allowable mass emission rates:

i. Method 1 or 1A of 40 CFR Part 60, Appendix A to select the sampling port location and the number of traverse points.

ii. Method 2 or 2C of 40 CFR Part 60, Appendix A or Method 19 of 40 CFR Part 60, Appendix A to determine the exhaust flowrate of the engine.

iii. Method 3, 3A, or 3B of 40 CFR Part 60, Appendix A to measure O_2 at the exhaust stack.

iv. Method 4 of 40 CFR Part 60, Appendix A or Method 320 of 40 CFR Part 63, Appendix A to measure the moisture content at the exhaust stack.

v. Method 7E of 40 CFR Part 60, Appendix A or Method 320 of 40 CFR Part 63, Appendix A to measure NOx at the exhaust stack.

vi. Method 10 of 40 CFR Part 60, Appendix A or Method 320 of 40 CFR Part 63, Appendix A to measure CO at the exhaust stack.

vii. Method 25A with Method 18 (for methane or ethane determination and subsequent subtraction from THC determined via Method 25A) of 40 CFR Part 60, Appendix A; or Method 25A fitted with a hydrocarbon cutter as described in 40 CFR 1065.265; or Method 18 of 40 CFR 60, Appendix A; or Method 320 of 40 CFR Part 63, Appendix A to measure VOC at the exhaust stack.

d. During the emission testing, the emissions unit shall be operated under operational conditions approved in advance by the appropriate Ohio EPA District Office or local air agency. Operational conditions that may need to be approved include, but are not limited to, the production rate, the type of material processed, material make-up (digester gas or natural gas, etc.), or control equipment operational limitations (power output, fuel consumption rate, etc.). In general, testing shall be done under “worst case” conditions expected during the life of the permit. As part of the information provided in the “Intent to Test” notification form described below, the permittee shall provide a description of the emissions unit operational conditions they will meet during the emissions testing and describe why they believe “worst case” operating conditions will be met. Prior to conducting the test(s), the permittee shall confirm with the appropriate Ohio EPA District Office or local air agency that the proposed operating conditions constitute “worst case”. Failure to test under the approved conditions may result in Ohio EPA not accepting the test results as a demonstration of compliance.

e. Not later than 60 days prior to the proposed test date(s), the permittee shall submit an "Intent to Test" notification to the appropriate Ohio EPA District Office or local air agency. The "Intent to Test" notification shall describe in detail the proposed test methods and procedures, the emissions unit operating parameters, the time(s) and date(s) of the test(s), and the person(s) who will be conducting the test(s). Failure to submit such notification for review and approval prior to the test(s) may result in the Ohio EPA District Office's or local air agency's refusal to accept the results of the emission test(s).

f. Personnel from the appropriate Ohio EPA District Office or local air agency shall be permitted to witness the test(s), examine the testing equipment, and acquire data and information necessary to ensure that the operation of the emissions unit and the testing procedures provide a valid characterization of the emissions from the emissions unit and/or the performance of the control equipment.

g. A comprehensive written report on the results of the emission test(s) shall be signed by the person or persons responsible for the tests and submitted to the appropriate Ohio EPA District Office or local air agency within 30 days following completion of the test(s). The permittee may request additional time for the submittal of the written report, where warranted, with prior approval from the appropriate Ohio EPA District Office or local air agency.

g) Miscellaneous Requirements

(1) None.

Appendix E

Bell, M.W., *et al.* Paper

Ammonia emissions from an anaerobic digestion plant estimated using atmospheric measurements and dispersion modelling

Michaël Bell, Y. Sim Tang, Ulrike Dragosits, Christophe Flechard, Paul Ward, Christine F. Braban

To cite this version:

Michaël Bell, Y. Sim Tang, Ulrike Dragosits, Christophe Flechard, Paul Ward, et al.. Ammonia emissions from an anaerobic digestion plant estimated using atmospheric measurements and dispersion modelling. Waste Management, Elsevier, 2016, 56, pp.113-124. 10.1016/j.wasman.2016.06.002 . hal-02635699

HAL Id: hal-02635699

https://hal.inrae.fr/hal-02635699

Submitted on 27 May 2020

Waste Management xxx (2016) xxx–xxx

Contents lists available at ScienceDirect

Waste Management

journal homepage: www.elsevier.com/locate/wasman

Ammonia emissions from an anaerobic digestion plant estimated using atmospheric measurements and dispersion modelling

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ARTICLE INFO

Article history:
Received 8 February 2016
Revised 1 June 2016
Accepted 1 June 2016
Available online xxxx

Keywords:
Anaerobic digestion
Ammonia emissions
Atmospheric dispersion modelling
Atmospheric concentration measurements

ABSTRACT

Anaerobic digestion (AD) is becoming increasingly implemented within organic waste treatment operations. The storage and processing of large volumes of organic wastes through AD has been identified as a significant source of ammonia (NH_3) emissions, however the totality of ammonia emissions from an AD plant have not been previously quantified. The emissions from an AD plant processing food waste were estimated through integrating ambient NH_3 concentration measurements, atmospheric dispersion modelling, and comparison with published emission factors (EFs). Two dispersion models (ADMS and a backwards Lagrangian stochastic (bLS) model) were applied to calculate emission estimates. The bLS model (WindTrax) was used to back-calculate a total (top-down) emission rate for the AD plant from a point of continuous NH_3 measurement downwind from the plant. The back-calculated emission rates were then input to the ADMS forward dispersion model to make predictions of air NH_3 concentrations around the site, and evaluated against weekly passive sampler NH_3 measurements.

As an alternative approach emission rates from individual sources within the plant were initially estimated by applying literature EFs to the available site parameters concerning the chemical composition of waste materials, room air concentrations, ventilation rates, etc. The individual emission rates were input to ADMS and later tuned by fitting the simulated ambient concentrations to the observed (passive sampler) concentration field, which gave an excellent match to measurements after an iterative process. The total emission from the AD plant thus estimated by a bottom-up approach was 16.8 ± 1.8 mg s^{-1}, which was significantly higher than the back-calculated top-down estimate (7.4 ± 0.78 mg s^{-1}). The bottom-up approach offered a more realistic treatment of the source distribution within the plant area, while the complexity of the site was not ideally suited to the bLS method, thus the bottom-up method is believed to give a better estimate of emissions. The storage of solid digestate and the aerobic treatment of liquid effluents at the site were the greatest sources of NH_3 emissions.

1. Introduction

Anaerobic Digestion (AD) is an organic waste treatment technology that is seen as a viable means to recover heat and electricity from organic waste streams such as animal slurry and food wastes (e.g. Wulf et al., 2006). During AD processing organic matter is microbially decomposed in the absence of oxygen to recover biogas and a nutrient-rich digestate which is often used as an organic fertiliser (Pain et al., 1990). The biogas (a mixture of approximately 2/3 methane and 1/3 carbon dioxide) produced can be sold as an energy fuel or combusted on-site to produce renewable heat and/or electricity.

AD has been developed to provide multiple environmental benefits in waste processing, including replacement of fossil fuels with biogas, diversion of waste from landfill, and the abatement of methane (CH_4) emissions from manure storage (Maranon et al., 2011). AD is becoming increasingly attractive for farmers and municipalities and is underpinned in national and international policy objectives (e.g. European Commission, 2009). Anaerobically digested manure is associated with a reduction in odours and pathogens (Chynoweth et al., 1999; Hansen et al., 2006), and also an increased fraction of plant-available ammonium and nitrate in the digestate itself (Möller and Stinner, 2009). Digestion typically causes an increase in pH, thus digester effluents can be ideally suited to fertilise acid soils (Kvasauskas and Baltrenas, 2009).

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http://dx.doi.org/10.1016/j.wasman.2016.06.002
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However, as the fraction of ammoniacal nitrogen is greater within the effluent mixture, there is a higher potential for N losses through ammonia (NH_3) volatilisation. Further, the elevated pH of digestate produces favourable thermodynamic conditions for the conversion of ammonium (NH_4^+) to NH_3 within solution, which increases NH_3 emissions (Pain et al., 1990; Hansen et al., 2005). AD plants are generally centralised locations where organic wastes are delivered, stored and processed in high volume, concentrating distributed sources of NH_3 emissions. Reduced nitrogen (NH_x) has become one of the dominant atmospheric pollutants in Western Europe due to the significant decreases in sulphur emissions and significant decreases in nitrogen oxide emissions through the implementation of catalytic converters. Ammonia contributes to the acidification and eutrophication of ecosystems (e.g. Vestreng and Storen, 2000; Bobbink et al., 2010; Nihlgard, 1985; Draaijers et al., 1989) and formation of particulate matter (PM2.5), which is recognised to have an adverse effect on respiratory and cardiovascular health (Lillyman et al., 2009).

Emissions of NH_3 in the UK (and worldwide) are generally dominated by the contribution from the agricultural sector (e.g. Misselbrook et al., 2000) originating from livestock housings, slurry stores, field application of organic manure and mineral fertilisers and grazing (Hill et al., 2008). Relative to unprocessed livestock manure, increased volatilisation of NH_3 has been measured following the application of anaerobically digested manures to agricultural fields (Clemens et al., 2006; Pain et al., 1990). Studies concerning gaseous emissions from AD plants have so far mostly focussed on greenhouse gases (GHG), and in particular the abatement or release of methane (e.g. Møller et al., 2009; Flesch et al., 2011; Liebetrau et al., 2013). However NH_3 emissions were measured from an AD plant in a life cycle analysis study carried out by Cumby et al. (2005). Fugitive emissions from the waste reception area were directly measured, but emissions from the storage of digestate were not measured. Clemens et al. (2006) investigated the treatment of animal slurries and co-digestion of mixed substrates through AD, and found NH_3 emissions from digested slurry to be twice as high as untreated slurry during a 140 day summer storage experiment.

Cumby et al. (2005) identified the key areas of NH_3 emission from AD plants as: (a) the waste reception and pre-processing area, where the organic waste substrates are delivered and passed into the input stream, and (b) the digestate storage area, which holds the final product of the AD process (separated or unseparated) before further processing or use as biofertiliser. The scale of NH_3 volatilisation is determined by environmental and substrate parameters including temperature, pH, ventilation and ammoniacal N concentration (TAN) (e.g. Hansen et al., 2005). NH_3 emissions are also dependent on site management practices concerning the handling, storage and treatment of organic wastes. For example, Whelan and Villa (2010) demonstrated in laboratory chamber experiments that NH_3 emissions from food waste digestate could be limited by covering storage facilities and increasing the depth to surface ratio, (maintaining a high concentration of NH_3 above the surface) despite an inherent propensity for volatilisation due to an elevated pH and NH_3:NH_4^+ ratio.

In situ NH_3 emissions from the whole of the AD plant site have not been previously measured, therefore through integrated atmospheric measurement and dispersion modelling methods the objectives of this study were to quantify and characterise the individual and overall sources of NH_3 emissions at a food waste AD plant in central Scotland.

2. Materials and methods

2.1. Site description

The experiment took place from May-July 2014 at the Deerdykes AD plant, located near Cumbernauld (55°55′28N, 4°03′24W), south of the Westfield Industrial Estate and approximately 250 m North of Mollinsburn. Constructed in 2010, the plant processes about 30,000 t yr^{-1} of a mixture co-mingled green/catering wastes from municipal collections, biodegradable industrial sludges and Category 3 animal by-products (animal materials with low-risk of infectious diseases). The AD plant comprises an inner concrete courtyard with several tall tanks and buildings (up to 6 m in height), (Figs. 1 and 2). At

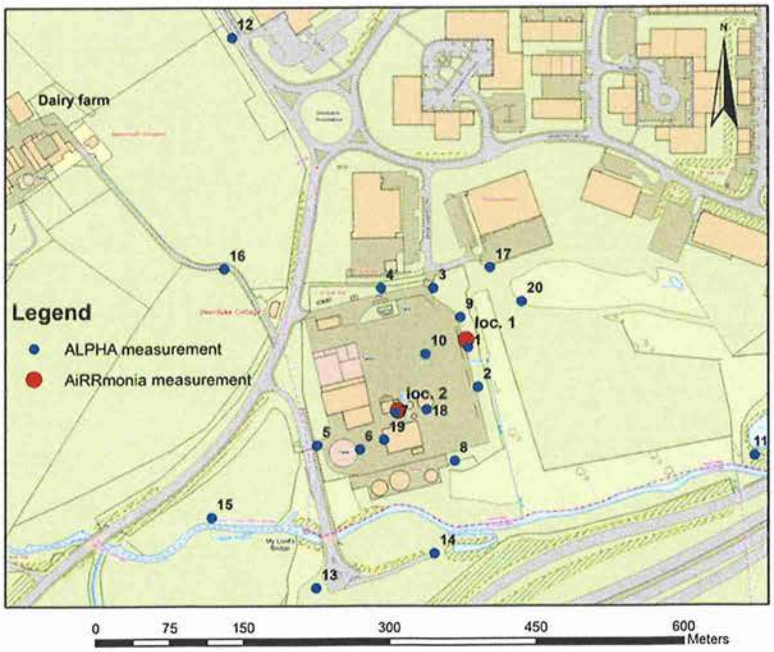

Fig. 1. Map of area surrounding the Deerdykes AD plant showing locations of passive ALPHA and continuous AiRRmonia NH_3 measurement sites. Samplers were predominantly aligned to the SW–NE axis of the site, in line with the prevailing wind direction.

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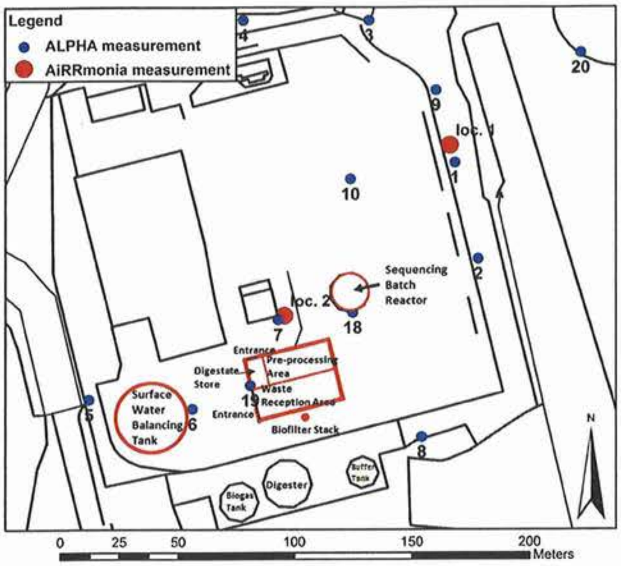

Fig. 2. Map of the central area at the Deerdykes AD showing location of passive (ALPHA) and continuous (AiRRmonia) measurements and the key sources of NH_3 (outlined in red). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

the perimeter of the plant is a screening bund 2–3 m in height, partly surrounded by a tree belt and hedgerows with agricultural land, woodland and an industrial park beyond.

Wastes are delivered to the AD plant in both liquid and solid form, Fig. 3 summarises the processes and pathways for solid and liquid waste streams on the site. The solid wastes are delivered to the floor inside the waste reception area, and transferred to equipment that will shred and decontaminate the waste within an adjacent pre-processing area located within the same central waste reception building (WRB) (Fig. 3). Liquids and sludges are offloaded to a separate subterranean tank, before being pumped into the anaerobic digestion process via a buffer tank. Waste inputs are mixed with recycled, anaerobically treated and diluted process liquor to form a 15% dry matter slurry which is transferred into the AD unit operating within the mesophilic temperature range (37 °C) on a semi-continuous basis. The biogas released during AD (primarily methane and carbon dioxide) is withdrawn from the digester headspace and combusted on-site to recover electricity. The digested sludge (digestate) displaced from the bioreactor is dewatered and separated into liquid and solid fractions. Solids are stored within the digestate storage section of the WRB before agricultural use as biofertiliser. The liquor expressed from the sludge that isn't recycled to the AD unit is sent for treatment within a large sequencing batch reactor (SBR), before discharge to sewer. A multi-stage process creates the aerobic and anaerobic conditions needed to induce nitrification and denitrification, converting ammoniacal nitrogen to nitrite and nitrate and further reducing residual biological oxygen demand.

Solid digestate at Deerdykes is stored in shallow, wide heaps within the digestate storage area, with an average depth (z) of less than 1 m. The store is not ventilated, and the entrance is only opened up approximately two to three times per week to extract the digestate. A loader transfers the digestate into a container for haulage off site. Within the digestate storage area, the digestate pile typically covers the floor area, which is 60 m^2. However the surface of the digestate is not smooth; the surface area available for volatilisation was estimated to be increased by roughness by a factor of 5–10. The roughness factor(s) were applied to the source area to scale emissions accordingly in ADMS dispersion modelling.

Other components of the AD plant relevant to NH_3 emissions include the Surface Water Balancing Tank (SWBT) which captures surface water runoff and spillages to mitigate pollution. The waste reception area and pre-processing area are located within mechanically ventilated sections of the WRB, where extracted room air is discharged via a biofilter system designed to limit emissions of odorous compounds. The digestate storage area of the WRB is not connected to the biofilter system.

2.2. Ammonia measurements

Three NH_3 measurement techniques were applied: time-integrated sampling with passive diffusion ALPHA (Adapted Low-cost Passive High Adsorption) samplers (Tang et al., 2001), continuous on-line NH_3 analysis using a trace gas analyser (AiRRmonia, ECN, 2003, Mechatronics, NL) and instantaneous/snap measurements made with a portable NH_3 gas analyser (Micro 5, www.calgarysense.com).

2.2.1. Passive sampler measurements

ALPHA samplers have been extensively used (UK National Ammonia Monitoring Network, Vogt et al., 2013; Theobald et al., 2013; Riddick et al., 2014), and performed well in inter-comparison studies (Puchalski et al., 2011). Six ALPHA measurement periods in total were carried out at the site from 15/05/2014 to 10/07/2014. Sampler exposure durations ranged

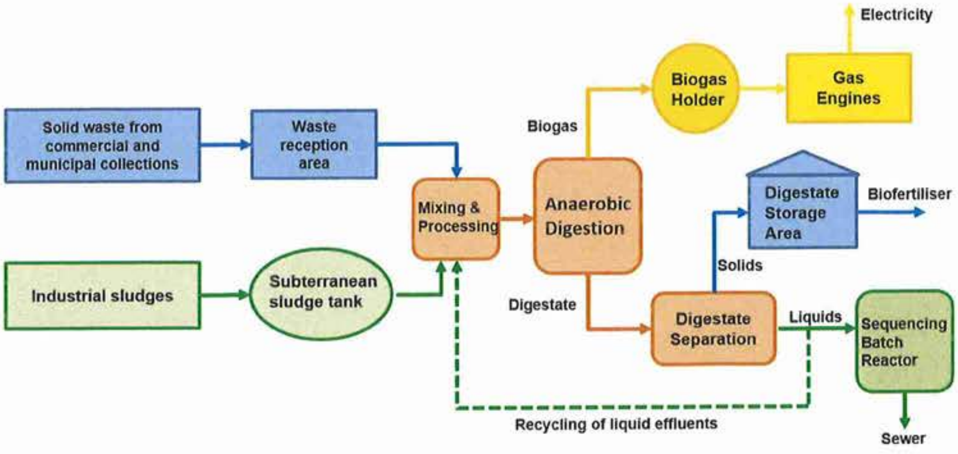

Fig. 3. Schematic diagram of pathways of solid and liquid wastes through AD plant.

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between 6 and 14 days. ALPHA samplers were deployed in triplicate at 20 locations across the site at a 1.5 m height (Fig. 1). Citric acid coated filter papers from the samplers were extracted in 3 ml deionised water, and analysed for NH_4^+ by the AMmonium Flow Injection Analysis system (AMFIA) (Wyers et al., 1993). Laboratory blanks were subtracted from samples and field blanks were used to check for contamination.

2.2.2. High temporal resolution continuous measurements

On-line continuous NH_3 concentration measurements were made with an AiRRmonia gas analyser. The continuous analyser was strategically deployed sequentially at two locations as shown in Fig. 2. The first measurement location, (28/05–26/06) was 100 m northwest of the AD plant along the axis of the prevailing wind direction (Loc. 1), while the second (27/06–16/07) was within the inner courtyard at the plant, 20 m from the entrance to the digestate store (Loc. 2). Air was sampled at a rate of 1 l min^{-1} and NH_3 diffused through a gas-permeable membrane into a stripping solution (converts NH_3 to NH_4^+ ions). Ammonium ions passed through into a detector block through an ion-selective membrane where the conductivity was measured. Liquid phase calibration of the conductivity cell was carried out in the field every 6 days with 0, 50 and 500 ppb NH_4^+ solutions and showed good stability over the periods of measurement. The AiRRmonia instrument was housed within a weather-proof container, where measurements were recorded every minute by the in-built datalogger, and later averaged at 10, 30 and 60 min periods for analysis.

2.2.3. Indoor NH_3 measurements

The gas alert Micro 5 portable multi-gas analyser was used to provide point measurements of room air concentrations inside the digestate store, preprocessing area and waste reception area at the site. By contrast to the ALPHA and AiRRmonia measurements in ambient outdoor air, the limit of detection for the Micro 5 device was much higher, of the order of 1 ppm (0.7 mg m^{-3}), as opposed to roughly 0.1 μg m^{-3} for ALPHA and AiRRmonia measurements. Yet the Micro 5 was suitable for the task due to high indoor concentrations. Measurements were weekly, characterising the observed NH_3 concentrations. It was not possible to install the Micro 5 due to lack of power outlets in the relevant buildings.

2.3. Meteorological and ancillary measurements

Standard meteorological measurements (wind speed, wind direction, temperature, relative humidity and rainfall) were provided by a citizen-operated local weather station in Cumbernauld (www.cumbernauld-weather.co.uk), located 1.6 km to the north-east of the site. These meteorological measurements were recorded by a Davis Vantage Pro2 system (www.davisnet.com). Cloud cover data, for use as a proxy atmospheric stability parameter with the ADMS meteorological pre-processor, was obtained from Glasgow Bishopton surface observation station which is 24 km from the site. The temperature was recorded inside the digestate store between 27/06/2014 and 06/07/2014 using a Tiny Tag data logger (www.geminidataloggers.com).

2.4. Atmospheric modelling

2.4.1. Lagrangian stochastic (bLS) dispersion model

The backward Langrangian stochastic (bLS) dispersion model "WindTrax", described in detail in Flesch et al. (2004) and available at www.thunderbeachscientific.com was used to infer the total emission from the AD plant. The basic WindTrax equations are summarised below. The model in this work was configured to release 5×10^4 "fluid particles" backwards from a concentration receptor, the fraction of which intersect the source area derives a dispersion coefficient D. This dispersion coefficient gives the flux of NH_3 emitted from the source, (Q, μg m^{-2} s^{-1}) using the measured rise in concentration C above background C_b (in μg m^{-3}), by the relationship:

$$Q = (C - C_b) * D \tag{1}$$

where D is retrieved by the model as the number of source area interactions (N_{source}) and the thousands of trajectories (N) generated by the model from the receptor locations, along with the associated vertical velocity of each interaction (w_o) (see Eq. (2), and details in Flesch et al., 2004).

$$D = \frac{1}{N} \sum N_{source} \left| \frac{2}{w_o} \right| \tag{2}$$

Continuous NH_3 concentration data from the AiRRmonia measurements were averaged over 1 h periods. The AiRRmonia and meteorological data were filtered to measurements where the AD plant was directly upwind of the AiRRmonia gas analyser (wind direction 210–235°). This was sufficient so that at least 50% of the calculated plume trajectories covered the emission area. The input data was also filtered to remove calibration periods and known conditions where the inverse dispersion model is known to become inaccurate (Flesch et al., 2005). These conditions included low winds (where frictional velocity (μ^*) was less than 0.15 m s^{-1}) and strongly stable/unstable atmospheric stratification ($L < 10$ m).

Standard hourly meteorological measurements were input to WindTrax for the first measurement period (28/05–26/06). Including the following variables: NH_3 concentration at 2 m height (C μg/m^3), background concentration (C_b μg m^{-3}), wind speed (μ, m s^{-1}), wind direction (WD, °), and ADMS-calculated Monin-Obukhov length (L). To determine a background concentration (C_b) for the site, the AiRRmonia concentration measurements were filtered to strictly upwind (320–180°) periods. The model retrieved emission estimates from the AD plant for each 60 min timestep satisfying the measurement criteria, relying on the assumption that the downwind concentrations are directly proportional to the source emission rate. Thus for a perfect dispersion model under homogeneous conditions the real emission rate can be derived from the simulated concentration (C_{sim}) using the emission rate Q_{sim} (Eq. (3)).

$$Q = \frac{(C - C_b)}{(C/Q)_{sim}} \tag{3}$$

The Deerdykes AD facility presents complications for inverse dispersion calculations. Buildings and structures generate complex wind movements, and the relative intensity of all the emission sources is unknown. However studies using the inverse dispersion method have demonstrated insensitivity to these complications if measurements are taken far enough downwind (Flesch et al., 2005, 2011; McGinn et al., 2006). Two criteria are proposed by Flesch et al. (2005): (1) the downwind distance of the concentration sensor should be a minimum of ten times the height of the largest wind obstacle, and (2) roughly two times the maximum distance between potential sources. The Deerdykes facility meets the first criterion (waste reception building height is 6.4 m, distance to nearest source is 70 m) but not the second (distance between SWBT and SBR is 80 m). Therefore for intercomparison a second dispersion modelling method has been applied to estimate emissions.

2.4.2. ADMS dispersion modelling

Source strengths may be determined by assigning an arbitrary emission rate to a dispersion model and scaling the modelled concentrations to the measured values (above background) by

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Table 1
ADMS model inputs.

Variable	Units	Configuration/parameterisation	Value
Wind speed	$m\,s^{-1}$	Building configuration	–
Wind direction	°	Grid area (10 m spaced)	900 × 700 m
Rain	$mm\,h^{-1}$	Passive sampler locations	–
Temperature	°C	Surface roughness (z_0)[a]	0.2–1 m
Relative humidity	%	Dry deposition rate[b]	$0.02\ m\,s^{-1}$
Cloud cover	Oktas (8ths)	Washout coefficient[c]	$9 \times 10^{-6}\ s^{-1}$

[a] Gridded surface roughness file.
[b] Environment Agency (2010).
[c] CLAG (1994).

applying a correction factor (e.g. Hill et al., 2008; Faulkner et al., 2007; Theobald et al., 2013). A variant of this technique was applied with the Atmospheric Dispersion Modelling System (ADMS) (Carruthers et al., 1994). ADMS is an "advanced generation" Gaussian dispersion model, modified from the basic Gaussian equation to take into account vertical profiles of boundary layer parameters and continuous stability functions (Holmes and Morawska, 2006). These modifications lead to improved predictions of vertical and horizontal concentration distribution profiles under a range of stability conditions (Theobald et al., 2012). The ADMS-Urban version used also features a complex terrain module which can accommodate for a domain of variable roughness lengths (z_0), and include the dimensions of individual buildings to simulate concentrations where there are building effects. The ADMS model was configured with the input data listed in Table 1.

2.4.3. Modelling scenarios

The objective of the modelling scenarios was to test different source area treatments and modelling methods, and evaluate predictions against passive sampler measurements. Three scenarios were set up to investigate and evaluate different emissions estimates for the AD plant. A key objective was to find an emission estimate (model + emission inventory) that performs well in reproducing observed concentrations but also finds a balance with the conceptual model of emissions from the AD, arguments for which are developed from on-site investigations and published emission factors. All of the scenarios used the ADMS forward dispersion model to predict the long-term average concentrations across a 900 × 700 m model domain at a 10 × 10 m resolution. Each scenario used the meteorological data (inputs) and ALPHA NH_3 concentration measurements (verification data) corresponding to four sets of weekly ALPHA measurements (28/05–26/06).

Scenarios included:

(1) Top-down emission estimate of total emissions by bLS method, assuming homogeneous source area.
(2) Bottom-up estimates of individually defined sources, determined using theoretical methods and the available AD plant parameters. These include: published emission factors from the literature, room air concentration measurements (Micro 5), site parameters such as biofilter air flow rate and estimated scrubbing efficiency, chemical analysis of solid and liquid effluents obtained from the AD plant and assumptions regarding the ventilation rate of buildings.
(3) Optimised emission rates were derived following iteration of individual emission estimates (Scenario 2) to match simulated concentrations with ALPHA measurements, whilst taking into account site parameters.

2.4.4. Model performance evaluation

Evaluation of model performance requires a statistical comparison of concentration predictions (C_p) with observed values (C_o). To evaluate ADMS predictions against ALPHA measurements for each scenario, the five performance measures suggested by Chang and Hanna (2004) are used:

$$\text{Fractional bias}:\ \mathrm{FB} = \frac{2(\overline{C_o} - \overline{C_p})}{(\overline{C_o} + \overline{C_p})} \tag{4}$$

$$\text{Geometric mean bias}:\ \mathrm{MG} = \exp(\overline{\ln C_o} - \overline{\ln C_p}) \tag{5}$$

$$\text{Normalised mean square error}:\ \mathrm{NMSE} = \frac{\overline{(C_o - C_p)^2}}{\overline{C_o}\,\overline{C_p}} \tag{6}$$

$$\text{Geometric variance}:\ \mathrm{VG} = \exp[\overline{(\ln C_o - \ln C_p)^2}] \tag{7}$$

$$\mathrm{FAC2} = \text{fraction of data that satisfy}:\ 0.5 \leqslant \frac{C_p}{C_o} \leqslant 2 \tag{8}$$

Note overbars denote the mean of each dataset.

The NMSE, VG and FAC2 are composite measures that take into account the both bias and scatter in the predicted values relative to the observations, while the FB and MG are measures of model bias and describe the tendency of the model to over or under-predict observed concentrations. Chang and Hanna (2004) have suggested ranges for the five performance indices that indicate acceptable model performance. The ranges suggested are: $FB < 0.3$, $0.7 < MG < 1.3$, $NMSE < 1.5$, $VG < 4$ and $FAC2 > 50\%$.

2.5. Theoretical estimation of emissions based on site parameters

Chemical analysis of digestion substrates and digestate is routinely carried out at various stages of the AD process by the plant operators. Some of these data (NH_4-N content, pH) were made available for the estimation of emissions, by applying to EFs within the literature along with other operational parameters such as ventilation rates, surface areas, and indoor room air concentration measurements made with the Micro 5.

Empirical relationships based upon the regression of NH_3 emissions against influencing parameters such as temperature, NH_4-N content, pH and air ventilation rates can give default predictions of NH_3 emission rates when limited parameters are available for calculation (e.g. Jarvis, 1993; Ross et al., 2002). The model of Borka et al. (2000) describes the emissions of NH_3 (E, $mg\,m^{-2}\,h^{-1}$) from manure in livestock buildings, and was developed from the regression of substrate temperature (TS, °C), air exchange rate (LD, $m^3\,h^{-1}\,m^{-2}$), and NH_4-N content (TAN, $g\,N\,kg^{-1}$) (Eq. (9)), in controlled experiments within respiration chambers. This emission model has been applied to estimate emissions from the storage of solid fraction digestate at Deerdykes.

$$E = 17.254 * 1.060^{\mathrm{TS}} * \mathrm{LD}^{0.274} * \ \mathrm{TAN} \tag{9}$$

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3. Results

A summary of the NH_3 measurements taken at the site is hereafter presented. The NH_3 measurements include firstly those taken with the AiRRmonia gas analyser, which initially was placed 100 m NE of the AD plant to operate nearly continuously from (28/05 to 26/06). The second period of continuous measurement placed the AiRRmonia analyser outside of the digestate storage area, which was expected to be the major source of NH_3 at the site. The following section summarises the NH_3 concentration distribution as measured by the weekly sampling network of ALPHA samplers placed at 20 locations around the site. Last of the measurements, the chemical properties of waste materials and estimates of emissions after applying literature EFs are given. The modelling results follow, including the evaluation of emission estimates (Scenario 1, 2 & 3) with ALPHA concentration measurements.

3.1. Continuous measurements

During the first continuous measurement period the AiRRmonia analyser was placed at Location 1, 100 m NE of the AD plant and in-line with the prevailing SW wind direction (Fig. 5). Ammonia concentrations fluctuated with changes in wind direction, with the highest concentrations measured during SW wind directions when the AiRRmonia was downwind of the AD plant (Figs. 4 and 6). The mean measured air NH_3 concentration at this location from 28/05 to 26/06 was 4 $\mu g\ m^{-3}$. Filtering the AiRRmonia data measurements to periods where the AiRRmonia sensor was directly downwind of the central area of the AD plant (WD 210–235°, WS > 1 $m\ s^{-1}$) gave an average concentration C of 6.5 $\mu g\ m^{-3}$. The background concentration (C_b), approximated by filtering measurements to periods where the AiRRmonia sensor was upwind of the AD plant (310–180°), was 1.8 $\mu g\ m^{-3}$ (Table 2).

During the second period of AiRRmonia continuous air NH_3 concentration measurement, the instrument was placed to the north of the waste reception building at ALPHA site 7, 20 m from the entrance to the digestate store. The NH_3 concentration time series during this period (27/07–16/07) is characterised by a relatively low baseline (<10 $\mu g\ m^{-3}$) with high-concentration events occurring every 2–6 days, where air concentration would rise up to 300 $\mu g\ m^{-3}$ and return back to baseline level within a few hours (Fig. 7). Emissions from the digestate store are expected to be episodic as high concentrations accumulate inside and are released as the store is opened and the digestate is extracted. This occurred roughly three times per week (but exact days/times were not recorded by the plant operators), which is consistent with the number of emission events that occurred over the monitoring period. Therefore the digestate store door is a dominating source of emissions at this location which should be individually defined for dispersion modelling.

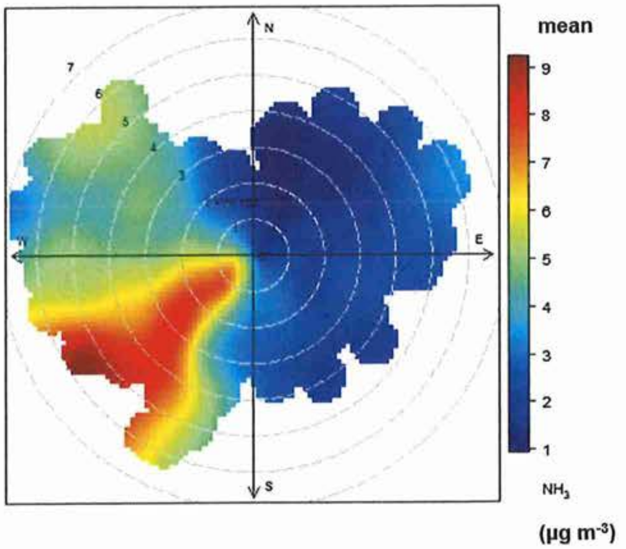

Fig. 4. Polarplot of AiRRmonia concentration measurements with wind speed and direction for AiRRmonia Period 1, (28th May–26th June). Averaging period is 10 min. Wind speed and direction data supplied by www.cumbernauld-weather.co.uk, plotted using the OpenAir package (Carslaw and Ropkins, 2012).

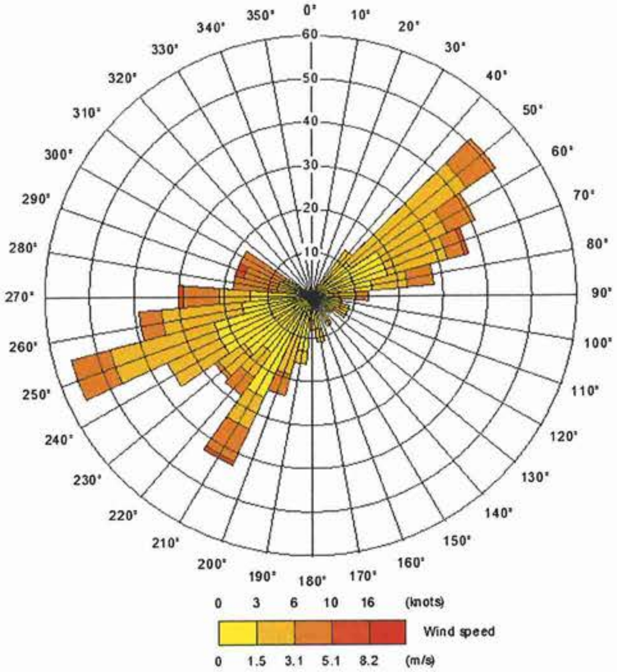

Fig. 5. Windrose of meteorological data from the 28th May to the 26th June. Averaging period is 1 h. Plotted using the ADMS met. data processor.

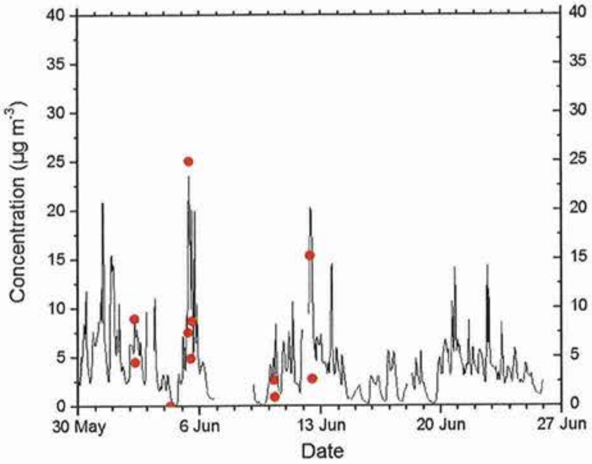

Fig. 6. Time series of AiRRmonia continuous air NH_3 measurements (black line) and bLS emissions estimates (red points), AiRRmonia Period 1, location 1 (28th May–26th June). Daily averaged wind direction arrows are annotated above (direction wind is coming from). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

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Table 2
Average downwind and background NH_3 concentration measurements, AiRRmonia Period 1 (28th May–26th June), and average WindTrax emission rate calculations.

	AiRRmonia averaged concentration per wind sector ($\mu g\ NH_3\ m^{-3}$)			Average emission rate ($mg\ NH_3\ s^{-1}$)[a]		
	All wind sectors	210–235°	310–180°	Background concentration: 0.43 $\mu g\ m^{-3}$	Background concentration: 1.8 $\mu g\ m^{-3}$	Background concentration: 3.17 $\mu g\ m^{-3}$
Average	4	6.5	1.8	8.4	7.4	6.3
Standard deviation	3.1	4.9	1.4	7.2	7	7.2

[a] Averaged bLS estimate calculated from continuous AiRRmonia measurements, filtered to the downwind (210–235°) wind sector and meteorological criteria. Averaged emissions are calculated for the mean background concentration (310–180° wind sector) and to one standard deviation above and below the mean.

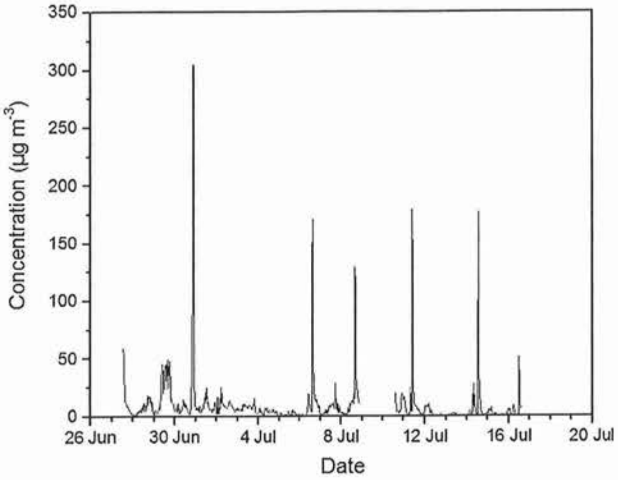

Fig. 7. Timeseries of AiRRmonia-measured NH_3 concentrations at Location 2, outside of digestate store.

3.2. Passive measurements

Of the 20 sampling locations across the site, the highest weekly mean concentrations (6–20 $\mu g\ m^{-3}$) occurred near the central WRB at the AD plant, showing strong temporal variation between measurements (Supplementary material). The WRB is a compartmentalised space containing the digestate storage, waste reception and waste pre-processing areas. A strong decrease in concentration occurred with increasing distance from the plant, with background concentrations (1.5 $\mu g\ m^{-3}$) found nearby (200 m), depending on the prevailing wind direction and the presence of hedge effects.

3.3. Theoretical emissions estimates

In reviewing the chemical analysis of the solid fraction digestate, there is a substantially higher Total Kjeldahl Nitrogen (TKN) and NH_4-N content than the literature values given, therefore more NH_3 should be available to volatilise thermodynamically (provided substrate pH is similar) (Table 3). Digestate store emission rates for air exchange rates of 0.5, 1 and 1.5 $m^3\ h^{-1}\ m^{-2}$ were calculated using Eq. (9), which compares well to the literature values given. The temperature within the digestate store displayed strong diurnal variations, with temperatures ranging from 10 to 25 °C night-day. The average air temperature (16.4 °C) was assumed to be equal to the average surface temperature of the digestate.

Emissions of NH_3 from the SBR, SWBT, the waste reception area, pre-processing area and biofilter stack are derived from emission measurements in the literature (Cumby et al., 2005; Borka et al., 2000; Willers et al., 1996; Leytem et al., 2010). These EFs are applied to the AD plant and presented in Table 4, using the available Deerdykes operational specifications, chemical measurements, and Gas-Micro-5 room air concentration measurements.

3.4. Inverse and forward dispersion modelling

3.4.1. bLS estimate of emissions

The WindTrax model treated the emissions from the AD plant as three homogeneous area sources that are marked by the boundaries of the WRB, SWBT & SBR (1000, 700 & 150 m^2 respectively, Fig. 2), which were identified as likely to be the main source areas. After filtering to the meteorological criteria set out in Section 2.4.1 only 11/690 hourly measurements are suitable for estimating emissions by the bLS method. From the remaining emission estimates, an important feature is the apparent temporal variation in strength of emissions, with a range of 0–25 $mg\ s^{-1}$ (Fig. 6).

Table 3
Intercomparison of the chemical composition and estimated emission rates of the Deerdykes digestate with different digestates reported in the literature. Deerdykes emission rates are calculated using the Borka et al. (2000) model.

Parameter	Deerdykes (food waste)			Cumby et al. (2005) (livestock slurry)	Clemens et al. (2006) (cattle slurry, summer experiment, 140 days)					Whelan and Villa, (2010) (food waste)		
	Digestate			Digestate	Cattle slurry		Digestate			Digestate		
TKN (mg/l)	62,600			6583	2170		2280			–		
NH_4-N (mg/l)	25,000			5040	1190		1510			5775		
pH	8.0			8.2	7.4		7.8			8.3		
DM (g/kg)	120			–	32.9		22.9			37.2		
J_{NH3} ($g\ NH_3\ m^{-2}\ d^{-1}$)	Borka et al. (2000) model[b]			–	Uncovered	Covered	Uncovered	Straw cover	Covered	$\alpha = 0.1$	$\alpha = 1$	$\alpha = 10$
	$\alpha = 0.5$[a]	$\alpha = 1.0$	$\alpha = 1.5$		0.7	0.4	1.6	0.9	0.6	2.1	14	38.9
	1.2	1.5	1.7									
EF_{NH3} (kg N as NH_3, % TKN/year)	–			21.8	–		–			–		

The Total Kjeldahl Nitrogen (TKN), NH_4 concentration (NH_4-N), pH and dry matter content (DM) are presented. NH_3 emission rates are given as the equivalent flux rate (J_{NH3}) and the yearly emission factor (EF_{NH3}).

[a] α is the ventilation rate (air changes per hour).

[b] Deerdykes equivalent fluxes calculated from the empirical model of Borka et al. (2000), Eq. (9). Where: TS = 16.4, LD = 0.5, 1.0, 1.5, TAN = 20.5.

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Table 4
Initial (literature EF-based) and optimised (fitted to ambient concentration measurements) NH_3 emission rates calculated for individual sources within AD plant.

Source name	Type	Emission factor	Intensity	Scenario 2: initial area-integrated emission rate ($mg\ s^{-1}$)	Scenario 3: optimised emission rate ($mg\ s^{-1}$)	Reference
Digestate store	Point	$17.4\ \mu g\ m^{-2}\ s^{-1}$	$60\ m^b \times 5$	5.2	7.3	Borka et al. (2000)[a]
Biofilter	Point	$465\ \mu g\ s^{-1}$	1	0.5	0.5	Cumby et al. (2005)[b]
Waste reception area door	Point	$1020\ \mu g\ s^{-1}$	1	1	0.1	Cumby et al. (2005)[c]
Pre-processing area	Line	$41.5\ \mu g\ m^{-1}\ s^{-1}$	31 m	1.3	0.6	Cumby et al. (2005)[d]
Sequencing batch reactor	Point	$61.1\ \mu g\ m^{-2}\ s^{-1}$	$200\ m^b \times (10/24)$	5.1	5.1	Willers et al. (1996)[e]
Surface Water Balancing Tank	Area	$23.4\ \mu g\ m^{-2}\ s^{-1}$	$616\ m^b$	14.4	3.2	Leytem et al. (2010)[f]
Total emissions				27.5	16.8	

[a] Eq. (9): assumed ventilation rate is 1.0 air changes per hour. Surface roughness factor is estimated to be 5.

[b] Calculated from the mean of the NH_3 concentration measurements within the waste reception area, mechanical ventilation rate is $9000\ m^3\ h^{-1}$. Estimated combined room air concentration is $1.43\ mg\ s^{-1}$. Biofilter NH_3 scrubbing efficiency is taken to be 87% as measured in the experiments of Cumby et al. (2005).

[c] Based on the assumption that 50% of air exchange occurs through direct discharge (Cumby et al., 2005), and that the large door to the waste reception area on the west side of the building is the only outlet. Measured room air concentration is $0.75\ mg\ m^{-3}$.

[d] Assumed 25% direct discharge from the pre-processing area which features two small personnel doors on the north side of the building. Emissions assumed to occur evenly across this surface. Measured room air concentration: $2.25\ mg\ m^{-3}$.

[e] The emission factor of $220\ mg^{-1}\ m^{-2}\ h^{-1}$ for SBR aerobic treatment of veal slurry (Willers et al., 1996), which was found to be suitable after comparing to chemical analysis of Deerdykes SBR liquid. The authors reported that this was the average emission over the course of a daily 22 h aeration cycle.

[f] Flesch et al. (2009) and Leytem et al. (2010) published emission rates from dairy farm wastewater lagoons in the U.S., the lower estimate of the two ($2.02\ g\ m^{-2}\ d^{-1}$, Leytem et al., 2010) was selected for the SWBT at Deerdykes.

Therefore there were periods where the analyser was directly downwind from the AD plant yet the measured concentration showed no rise above background, which suggests that emissions occur in events, such as delivery and removal of waste materials at the site, or aerobic denitrification cycles starting within the SBR for effluent treatment.

The average emission rate was $7.4\ mg\ s^{-1}$ or $3.9\ \mu g\ m^{-2}\ s^{-1}$ (total source area $1875\ m^2$), (Table 2). Despite the apparent variation in emissions at the site, it is necessary to set the plant emission rate as a single average value to evaluate the bLS emissions estimate against the long-term passive sampler observations. The small number of emission estimates has a high standard deviation of $6.98\ mg\ s^{-1}$. This averaged figure therefore may not be representative of the true averaged emission rate with such a small sample. Further consideration must also be given to the background concentration, its variability and the sensitivity of emission estimates to different selections. The average background concentration (C_b), after filtering measurements to the 320–180° wind direction, was $1.8\ \mu g\ m^{-2}\ s^{-1}$. Emissions from the plant were also estimated using background concentrations set to one standard deviation above and below the average C_b, which gave a range of averaged emission estimates of $6.4–8.4\ mg\ s^{-1}$ (Table 2).

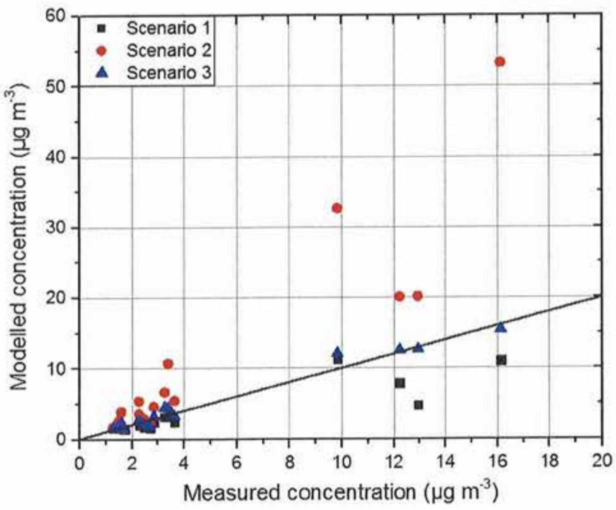

Fig. 8. Scatter plot of measured and ADMS-predicted NH_3 concentrations at ALPHA receptors, comparing model Scenarios 1, 2 & 3.

3.4.2. Evaluation of Scenario 1: bLS emissions estimates

The Scenario 1-simulated concentrations are generally lower than ALPHA measurements, with a regression of 0.68 (Fig. 8), indicating that this estimate is likely lower than the true averaged emission strength from the plant. There is a poorer fit near to the central area sources where concentrations are highest. WindTrax assumes that emissions are homogeneously distributed within the source area, which is not a realistic treatment and increases the degree of error in predicted concentrations around the central area. With increasing distance downwind, concentration predictions have a greater accuracy, in-line with a distance-related insensitivity to similar complications reported by Flesch et al. (2005, 2011).

3.4.3. ADMS modelling of NH_3 concentrations after differentiation of model into multiple sources: Scenario 2–3

Six discrete sources were input to the model to replace the homogenous area sources, with the aim to provide alternative estimates for total plant emissions, and to investigate emissions from individual sources and simulate NH_3 concentrations near the source area. Scenario 2 emission rates for each source were estimated by the theoretical methodology outlined in Section 2.4 (Table 4).

Overall, through optimisation the Scenario 3 total emissions from the plant were reduced to $16.8\ mg\ s^{-1}$, from the (theory-based) Scenario 2 estimate of $27.5\ mg\ s^{-1}$. Scenario 2-predicted concentrations at the passive receptors were higher by a factor of ~2.4 on average than the ammonia measured with ALPHA samplers (Fig. 8). In particular, the ADMS concentrations around the SWBT were much higher than the ALPHA measurements, with concentrations at site 5, 6 and 19 all exceeding measured concentrations by factors of ~3.2. The SWBT emission rate in the model leads to an overestimation of concentrations therefore the model was optimised using a factor to fit to observations. It was found that an optimisation factor of 0.22 best replicated the average concentration around the SWBT. Further optimisation factors were applied to the digestate store (1.4), the waste reception area door (0.06), and the pre-processing area line source (0.5) to fit the predicted concentrations against the ALPHA measurements.

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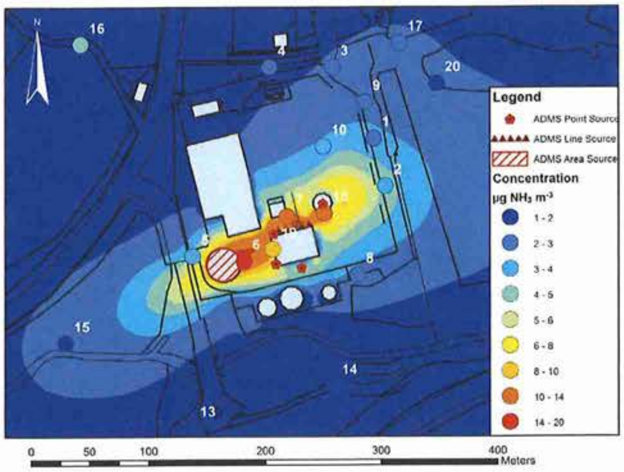

Fig. 9. Contour map of Scenario 3 predicted concentrations. This model shows an excellent fit to the ALPHA measurements and provides the best estimate of the magnitude and distribution of NH_3 emissions at Deerdykes. ALPHA measurements are set above the contour predictions, labelled by sample number on the same colourscale for evaluation. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Optimisation factors were derived after an empirical iterative-fit manner, yet there was consideration given to the conceptual model for NH_3 emissions from the site, and qualitative expectations of the degree of error associated with the initial emissions assessments. The optimised emission rates are given in Table 4. The predicted concentrations of the optimised model (Scenario 3) are shown in Figs. 8 and 9, where a near-perfect linear regression can be seen between measured and predicted concentrations.

4. Discussion

4.1. Assessment of modelling approach and comparison against measurements

The aim of this study was to estimate the NH_3 emissions from the Deerdykes AD plant. No direct measurements of emissions were made; rather the source strength was inferred through coupling of atmospheric measurements to forward and inverse dispersion modelling, and the estimation of emissions independently of atmospheric measurements through applying literature EFs and models to site parameters.

The Deerdykes AD plant was not ideally suited as a source area for the bLS technique due to the spatial complexity of various sources. The distance between potential sources was greater than the distance from the nearest source to the concentration receptor homogenous area source, which should not be the case to ensure accurate estimates with the bLS method (Flesch et al., 2005). Furthermore, the AiRRmonia concentration sensor was suitably downwind and under the right stability conditions during only 11/690 hourly measurement intervals. The predicted Scenario 1 emission estimate therefore may not be expected to be fully representative of the entire measurement period, and was less than half (7.4 mg s^{-1}) of the best-performing Scenario 3 estimate (16.1 mg s^{-1}). Some concentration predictions were inaccurate close to the source area, and all were generally lower than ALPHA measurements. The prediction of variable emissions between 0 and 25 mg s^{-1} may describe the periodical nature of emissions from the AD plant, a theory which is supported by large peaks in continuous AiRRmonia concentration measurements made outside of the digestate store (Fig. 7).

According to the Chang and Hanna (2004) evaluation criteria (Table 5), a perfect model would have MG, VG, R^2 and FAC2 = 1.0; and FB and NMSE = 0.0. Scenario 2 showed considerable bias to overestimate the observed concentrations and as a result the fractional bias (FB) and geometric mean bias (MG) criteria were failed (Table 5), mostly due to the SWBT emission factor being too high. Scenario 3 produced emissions estimates after an iterative-fit-optimisation to the observed concentration field which very closely reproduced the measured concentrations at the individual ALPHA receptors across the model domain. The initial condition of the iterative process was not arbitrary as estimates were produced after analysis of site parameters and reviewing information within the literature, whilst the optimisation process remained sympathetic to this understanding of emissions from the site and the uncertainties therein. The optimised emission factors tuned to the observed concentrations are far from being independent of measurements, therefore performance criteria approaching ideal values would have be to be expected. An independent evaluation was carried out by taking the Scenario 3 optimised emission rates and comparing the predicted and measured concentrations for an earlier (ALPHA Period 1, 15 May–27 May 2014) period with a very different prevailing wind direction. The Scenario 3 emissions estimates were therefore validated with strong performance in all evaluation criteria (Table 5). Scenario 3 also describes the spatial distribution and relative weight of individual sources developed by this methodology, giving a more detailed understanding of the nature of NH_3 emissions at the plant. The Scenario 1 bLS-calculated source strength is within the acceptability range for all of the performance measures; however Scenario 3 with six individual sources and a higher total estimate performs much better and is therefore expected to represent the true area-integrated emission rate for this period.

4.2. Key sources of emissions identified at the site

The largest source of NH_3 at the plant was found to be the digestate store (7.3 mg s^{-1}, 44% of total emissions). Continuous AiRRmonia measurements taken over a period of three weeks from 20 m outside of the digestate store revealed that concentrations were dominated by high-magnitude events during which the air concentration would rise up to 300 μg m^{-3} and return back to a low

Table 5
Model evaluation criteria intercomparing the performance of Scenario 1, 2 & 3. Values in bold indicate 'acceptable' model performance according to Chang and Hanna (2004).

Performance measure	Normalised mean square error (NMSE)	Geometric variance (VG)	Fractional bias (FB)	Geometric mean bias (MG)	FAC2 (%)
Chang and Hanna (2004) acceptability criteria	<1.5	<4	<0.3	0.7 < MG < 1.3	>50
Scenario 1	**0.02**	**1.3**	**0.25**	**1.29**	**95**
Scenario 2	**0.24**	**1.01**	−0.74	0.46	**80**
Scenario 3	**0.02**	**1.18**	**−0.06**	**0.95**	**100**
Scenario 3 independent Period 1	**0.03**	**1.01**	**−0.16**	**0.85**	**100**

FAC2: fraction of model predictions within a factor of two of observations.
ALPHA receptors 12 and 16 are excluded due to the influence of an adjacent dairy farm on measured concentrations.

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baseline (<10 μg m^{-3}) within a few hours (Fig. 7). This is consistent with the conceptual model of intense emission events occurring as the digestate store is opened, inducing ventilation and release of the NH_3 within the room air of the digestate store, measurements of which were as high as 60 ppm (42 mg m^{-3}). The Deerdykes digestate was found to be very rich in TKN and NH_4-N, with a high pH, contributing to high emissions estimated by the empirical model of Borka et al. (2000) (Eq. (9)). Estimated fugitive emissions from the waste reception and pre-processing area were low, comprising around 4% of emissions from the plant. Indoor measured concentrations from the waste reception area at the AD seemed to be around 26 times lower than similar measurements taken from an agricultural AD (Cumby et al., 2005), potentially highlighting differences in the degree of NH_3 volatilisation from solid food wastes compared to livestock manure digestion substrates. The SBR was the second greatest source of NH_3 at the plant (5.1 mg s^{-1}, 30% of total emissions), a source which required no correction to fit to observed NH_3 concentrations from the initial emission factor (220 mg m^{-2} h^{-1}) adopted from the findings of Willers et al. (1996).

If minimising NH_3 emissions from the plant were required, it would be an effective course of action for plant operators to concentrate on emissions from the digestate storage area. Very low emissions were occurring at the entrance to the waste reception area, this indoor space is maintained at a negative pressure and connected to the mechanical ventilation and biofilter system, the entrance is also opened and closed rapidly to minimise emissions during deliveries. Connecting the digestate storage compartment to the mechanical ventilation and biofilter system and would reduce the NH_3 concentration within the room air and emissions, assuming the 87% NH_3 scrubbing efficiency measured by Cumby et al. (2005). Taking steps to minimise the ventilation rate and exposure to the atmosphere would contribute to further reductions, such as covering the digestate, using the biofilter ventilation system to keep a negative pressure, or streamlining the extraction process to reduce the duration of the entrance being opened.

Applying the emission factor of Willers et al. (1996) to the Deerdykes SBR produced an emission rate that was the second highest on the site (30% of total emissions). However, the feasibility of minimising emissions from the SBR is likely to be much reduced relative to the digestate store, as emissions from the surface of the tank would need to be contained without interfering with the aerobic treatment process, and the 5 m tall SBR tank is a greater distance from the biofilter system. Emissions from the SWBT (19% of emissions) arise after spillages of organic waste materials delivered and processed at the site are channelled into the tank via a drainage network. Therefore an effective strategy to minimise emissions from this source would be to apply further measures to minimise the occurrences of spillages on site.

4.3. Uncertainty in emission estimates

The averaged coefficient of variation (CV) between ALPHA triplicates for measurement periods 2–5 ranged from 1.9 to 10.9%, with the average being 4.5% (Supplementary material). As the downwind air concentration of a pollutant can be assumed to be directly proportional to the source strength (building effects may be exempt from this), a maximum error of 10.9% may be applied to emission rates that have been deduced by fitting predicted concentrations to those observed at the ALPHA sites. This is quite small relative to the rule-of-thumb of 'plus or minus a factor of two' that has often been adopted to describe the quality of predictions from atmospheric dispersion models (Fox, 1984; Chang and Hanna, 2004). Taking Scenario 3 emission rates and the maximum error observed in the ALPHA measurements, an emission rate for all sources at Deerdykes AD plant = 16.8 ± 1.8 mg s^{-1}. The emission rates for the Scenario 1 (bLS) and Scenario 2 (initial) estimates were 7.4 ± 0.8 mg s^{-1} and 27.5 ± 3 mg s^{-1} respectively.

There is however, potential error associated with the ADMS model, which hence impacts upon the assumption that the downwind concentrations will be directly proportional to the source strength. For example, ADMS has been shown to underestimate predicted concentrations relative to measurements in certain case studies (Hanna et al., 2001; Baumann-Stanzer et al., 2008; Theobald et al., 2012). Therefore if ADMS is underestimating concentrations around the AD plant, a greater emission rate will be needed to fit predicted concentrations to the ALPHA measurements. Further, perhaps the defined dry deposition velocity is of 0.02 ms^{-1} is unsuitable, or simply the single universal deposition velocity is unsufficient for the complexity of the area, and a more advanced canopy resistance model with multiple cover types is required. It is possible to set up a model with inaccurate emission rates and yet still arrive at perfect concentration predictions if overcompensating parameters and variables are not correctly representative. An important parameter with a high uncertainty is L, which is not derived from site sonic anemometer measurements as would ideally be the case but has been output from the ADMS meteorological pre-processor using time of day/year, latitude and cloud cover as the proxy for surface heating.

With six discrete sources grouped in a small area, determining individual emission rates by optimising to fit measurements is challenging, as there may be multiple source strength configurations to arrive at the 'correct' predictions. However at Deerdykes buildings and structures add complexity which can isolate certain sources, and the ADMS complex terrain module has the capability to provide accurate predictions where there are building effects (Hill et al., 2001). Non-Gaussian simulated concentration profiles in the wake of the AD plant are visible in Fig. 9. Without direct emission measurements for verification, the applicability of emission factors reported in the literature (Table 4) and close fit between predicted and observed concentrations at passive sampler receptors suggest that emission estimates are robust, reducing the associated uncertainties in qualitative terms.

4.4. Suitability of emission factors for upscaling

The measurement period at Deerdykes was relatively short, representative of summer conditions. The volatilisation of NH_3 is exponentially related to temperature (Sommer et al., 1991), where emissions can be expected to be higher during summer than the rest of the year. Further measurements would be necessary to determine the seasonal variability in emissions.

The storage and treatment of solid and liquid effluents (digestate store and SBR) were identified as the greatest sources of NH_3 at the AD plant, contributing 74% of total emissions. The optimised emission factor of Scenario 3 (0.0018% Total FW input volatilised as NH_3) is likely to be representative of AD plants where the digestate is separated into liquid and solid effluents, the liquid effluents being aerobically treated on-site while solids are stored for a short period of time in a warehouse-type storage unit with no emission control. Ultimately the management of digestate is an economic choice that is up to the operator, ranging from treating as a waste product to marketing as a high-value horticultural soil fertiliser. The UK market for digestate is immature and distribution is largely driven by local circumstances, where spreading of unseparated digestate to agricultural land is the most common end-use (WRAP/EA, 2009). Therefore this emission factor is not likely to be representative of the majority of AD plants. However, the estimated emissions from substrate storage and processing at the plant may well be representative of other community ADs that process source-segregated municipal and industrial wastes. Future investigations into NH_3 emissions from AD plants may benefit from focusing on the storage of digestate, preferably taking measurements at sites with isolated digestate storage and treatment facilities. Isolated sources with low topographical complexity create favourable conditions to take advantage of the efficiencies of the bLS method, to give valuable emission estimates and contribute to a representative EF for this emerging source of NH_3 emissions.

5. Conclusion

This study has demonstrated an economical methodology for the estimation of NH_3 emissions from a complex source. Three different modelling scenarios and approaches are evaluated for quantifying ammonia emissions without direct flux measurements: (1) top-down bLS method, (2) literature EF-based estimates of individual sources, (3) tuning of individual emission rates to observations of the surrounding concentrations. In this case site complexity likely caused significant error in estimating NH_3 emissions from the AD plant by the bLS method. Despite the complications, bLS simulations and continuous ambient concentration measurements describe a large degree of temporal variation in emissions due to daily operations on site. In differentiating the source area into six individual sources, the observed concentration field was very accurately reproduced by the ADMS model after optimising the theoretical emission estimates in an iterative-fit process. The total emission from the AD plant thus estimated by a tuned bottom-up approach was $16.8 \pm 1.8\ \mathrm{mg\ s^{-1}}$, which was significantly higher than top-down bLS estimate ($7.4 \pm 0.8\ \mathrm{mg\ s^{-1}}$). According to the tuned (Scenario 3) estimates the storage and treatment of solid and liquid fractions of the separated digestate comprised 74% of total emissions, while the emissions associated with substrates from the biofilter, waste reception area and pre-processing area contributed just 8%. The integrated approach involving the optimisation of emission factors and dispersion models to operation and measurement perspectives demonstrates a practical and useful approach to understanding emissions from facilities such as the AD plant, with potential application to other complex sources of gaseous emissions.

Acknowledgements

The authors would like to thank Scottish Water Horizons for permitting measurements to be taken at Deerdykes, and the site manager Colin Lindsay for facilitating our requirements on and off site. Thanks to Stefan Reis for providing the ADMS dispersion model and assisting with the project. This work was undertaken as a dissertation project for the degree of MSc Environmental Protection and Management at the University of Edinburgh, with the support of the School of Geosciences and SRUC.

Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.wasman.2016.06.002.

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Please cite this article in press as: Bell, M.W., et al. Ammonia emissions from an anaerobic digestion plant estimated using atmospheric measurements and dispersion modelling. Waste Management (2016), http://dx.doi.org/10.1016/j.wasman.2016.06.002

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Appendix F

EMEP/EEA Air Pollutant Emission Inventory Guidebook 2019

emep

European Environment Agency

Category		Title
NFR	5.B.2	Biological treatment of waste – anaerobic digestion at biogas facilities
SNAP	091006	Biogas production
ISIC		
Version	Guidebook 2019	

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Contents

1 Overview

This chapter covers the emissions from the biological treatment of waste by anaerobic digestion at biogas facilities. Feedstocks for anaerobic digestion can be any biodegradable organic material such as livestock manure and crops from agriculture, food waste from food processing industries, households and restaurants, and organic waste from municipalities. The 2014 nomenclature for reporting (NFR), used for the international reporting of emission inventory data, introduced the new source category '5.B.2 Biological treatment of waste — anaerobic digestion at biogas facilities'.

2 Description of sources

2.1 Process description

Anaerobic digestion is a natural process by which biomass is broken down by naturally occurring microorganisms in the absence of oxygen. These microorganisms digest the biomass and release a methane-rich gas (biogas) that, if collected in a biogas plant, can be used to generate renewable heat and power. The remaining material (digestate) is rich in nutrients, so it can be used as a fertiliser.

The digestion process depends on the biomass of microbes, the substrate composition, the temperature in the digester, the dry matter content of the feedstock, the residence time in the digester and the biogas technology. Depending on the digestion technique and in order to improve the digestion process, feedstock pre-treatment, heating of the digester and mixing of feedstock can be useful.

2.2 Techniques

Technologies developed to digest biomass fall into the following categories:

1. wet or low solid digestion: operated at a dry matter content of less than 10 % (but the feedstock can have much higher solid content, which would be diluted upon entry);
2. dry or high solid digestion: operated at between a 15 % and 35 % dry solid content;
3. two- or multi-stage digestion: the development of multi-stage processes aimed to improve different stages of the digestion process, thus providing flexibility and better process control for the different stages of the anaerobic biochemical reactions.

The general concept of a biogas facility comprises the following stages:

1. pre-storage of feedstock
2. anaerobic digestion in the digester
3. storage of the digestate.

In practice, not all feedstock is stored before anaerobic digestion, but may be fed directly into the digester. The digester can consist of more than one gas-tight vessel. The storage of the digestate can be in a gas-tight vessel, an open tank or another storage facility. The storage may be combined with, or preceded by, treatment of the digestate, e.g. the separation of the liquid and solid fractions before storage. The possible treatment of the liquid fraction in a wastewater treatment plant, the combustion of the solid fraction and the utilisation of digestate as organic fertiliser are beyond the scope of Chapter 5.B.2 (see section 2.3).

2.3 Emissions

The storage of feedstock and digestate in open tanks, as well as their mechanical treatment, may cause emissions of the nitrogen (N) gases ammonia (NH_3) and nitric oxide (NO), as well as N2O, CH4, odour and dust. Anaerobic digestion is carried out in gas-tight vessels, and fugitive air emissions are unlikely to occur except during transfer to and from the digester and storage of feedstocks and digestate. However, fugitive emissions of biogas are possible from emergency vent valves and from poorly sealed water traps.

The emissions generated by the combustion of the biogas are addressed separately in Chapter 1.A.1.

This chapter (Chapter 5.B.2) considers the potential for NH_3 emissions from the following sources of biogas facilities:

1. during storage of feedstock on the premises of the biogas facility (1);
2. during storage of the digestate.

Agricultural crops used for biogas production (energy crops) are commonly stored as silage. As the pH of silage is low for conservation purposes, NH_3 emissions resulting from the storage of energy crops before anaerobic digestion are negligible.

As the digester is completely enclosed, no NH_3 emissions should occur. In the operation of a biogas plant however, instances of excess pressure might occur. In these cases, pressure valves might release some biogas (approximately 1 % of gas produced). For greenhouse gas calculations, these losses are relevant, as about 60 % of the gas volume is methane. The concentration of NH_3 in biogas is far lower (0.1–1 %), depending on the substrates being fermented. For most digestion processes, the leakage losses will therefore be less than 0.05 % of the nitrogen (N) content of the resulting digestate. Therefore, this source is here considered negligible.

Emissions of NO, odour and dust from anaerobic digestion at biogas facilities are not considered because they are likely to be insignificant.

2.4 Controls

Information on ways to reduce NH_3 emissions during storage of livestock manures is provided in Chapter 3B (e.g. rigid covers can reduce NH_3 emissions from storage of livestock slurry by about 80 %). No data are available on controlling emissions of NH_3 from storage of food wastes, but these are likely to be very small. The process of anaerobic digestion leads to elevated pH values and total ammoniacal nitrogen (TAN) contents. Therefore, it is strongly recommended that digestate is held in a covered store. The same measures as for livestock manures can be applied for the reduction of NH_3 emissions.

Information on general abatement technologies for NH_3 emissions from storage processes is given in the United Nations Economic Commission for Europe (UNECE) Framework Advisory Code of Good Agricultural Practice for Reducing Ammonia Emissions

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(1) NH_3 emissions from feedstock storage prior to the pre-storage on the premises of the biogas facility (e.g. the on-farm storage of livestock manures) are not considered in this chapter in order to avoid possible double counting. The on-farm storage of livestock manures is dealt with in Chapter 3.B.

(https://www.unece.org/fileadmin/DAM/env/documents/2014/AIR/WGSR/eb.air.wg.5.2001.7.e.pdf) and the draft *Guidance document on preventing and abating ammonia emissions from agricultural sources* https://www.unece.org/fileadmin/DAM/env/documents/2014/AIR/WGSR/eb.air.wg.5.2001.7.e.pdf). This guidance document also gives information on the emission reduction potential of a variety of abatement technologies in terms of a percentage of unabated storage. If the proportion of digestate stored with certain technologies is known, the emission factor (EF) for this proportion can be reduced by this value.

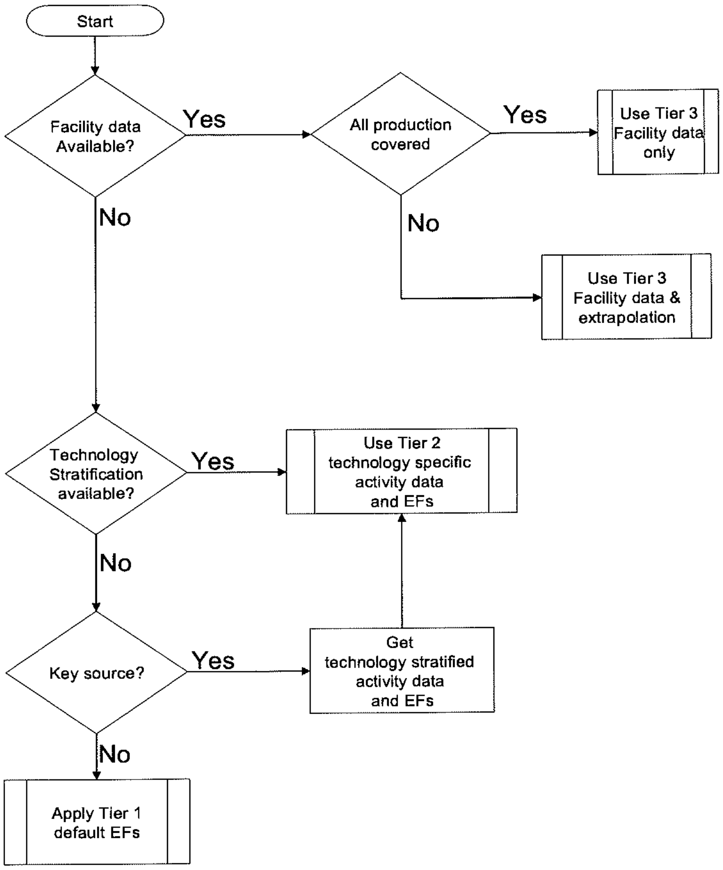
3 Methods

3.1 Choice of method

Figure 3.1 presents the procedure that should be used to select the methods for estimating emissions from this source category. The basic approach is outlined below.

- If detailed information is available, this should be used.
- If the source category is a key category, a Tier 2 or better method must be applied and detailed input data must be collected. The decision tree directs the user in such cases to the Tier 2 method, since it is expected that it will be easier to obtain the necessary input data for this approach than to collect the 'facility level' data needed for a Tier 3 estimate.
- The alternative to applying a Tier 3 method, that is, using a detailed process modelling at facility level, is included under 'facility data' in the decision tree.

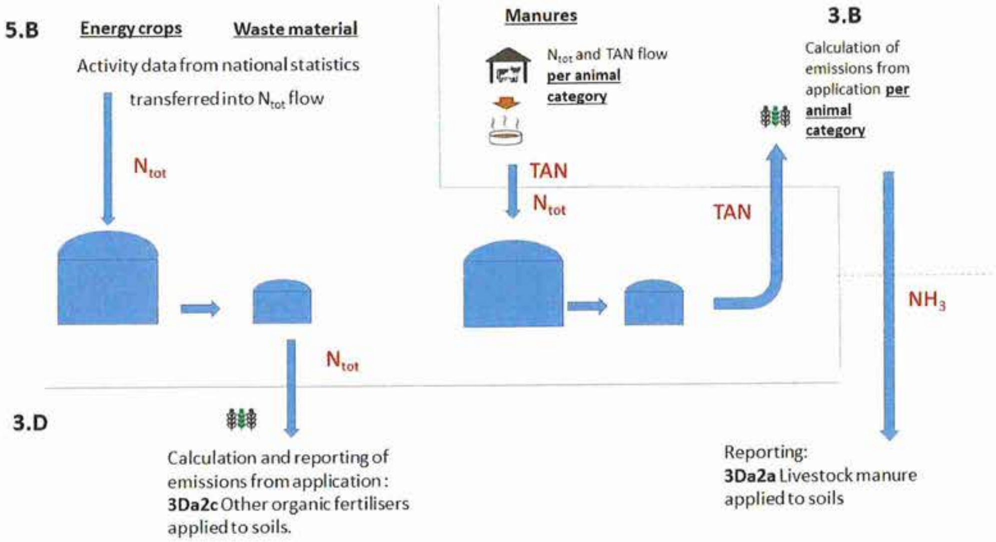
Figure 3.1 **Decision tree for source category 5.B.2 Biological treatment of waste — anaerobic digestion at biogas facilities**



3.2 Reporting emissions

As mentioned in chapter 3.B section 2.3, the Tier 2 method for calculating ammonia emissions from manure management follows a mass flow approach for total nitrogen (total-N) and total ammoniacal nitrogen (TAN). Therefore the emissions from application of digestates originating from livestock manure should be calculated in chapter 3.B, together with the emissions from application of untreated animal manures, and be reported under NFR code 3.D.a.2.a (Figure 3.2). Although being fully aware, that co-digestion of different feedstocks takes place, in 5.B.2, the digestion of manures should be calculated separately from the digestion of other organic wastes and of energy crops. The amount of total-N and TAN entering anaerobic digestion in manure must be consistent with formulae 22, 23, 28 and 29 in 3.B (chapter 3.4, Step 8). Emissions from spreading digestates resulting from digestion of manure are calculated in chapter 3B. Emissions from spreading digestates resulting from digestion of other organic wastes and energy crops are calculated in 3.D and reported under NFR code 3.D.a.2.c.

Figure 3.2 Reporting of emissions from anaerobic digestion at biogas facilities



If a Tier 1 approach is used, care should be taken not to double count emissions resulting from application of N excreted by livestock in 3.B According to Tier 1 in 3.B, emissions from manures are calculated based on animal places, including emissions from application. In this case, all N excreted by livestock is accounted for. Therefore no N from digested manures calculated in 5.B.2 should be considered for calculating emissions in 3.B if a Tier 1 approach is used in 3.B.

3.3 Tier 1 default approach

3.3.1 *Algorithm*

The Tier 1 approach estimates the total emission, E_{NH3} (in kg NH_3 per year), from:

$$E_{NH3} = AR_{feedstock} \times EF_{NH3\text{-}N,\,Tier\,1} \times 17/14 \qquad (1)$$

where $AR_{feedstock}$ is the total annual amount of N in feedstock, in kg a^{-1}; and $EF_{NH3\text{-}N,\,Tier\,1}$ is the Tier 1 NH_3-N EF related to N in feedstock, in kg NH_3-N per kg N. If no specific N amount is available from national data, $AR_{feedstock}$ is calculated by multiplying the total fresh weight of feedstock (tonnes a^{-1}) by the dry matter content of the feedstock (kg kg^{-1}) and the concentration of N in the feedstock dry matter (kg N per kg DM).

3.3.2 *Default emission factor*

The default EF (Table 3.1) is the total of the Tier 2 EFs provided in section 3.4.2. The range of uncertainty (95 % confidence interval) is estimated in accordance with section 3.4.2.

Table 3.1 Tier 1 EFs for source category 5.B.2 Biological treatment of waste — anaerobic digestion at biogas facilities

Tier 1 EFs					
	Code	Name			
NFR source category	5.B.2	Biological treatment of waste — anaerobic digestion at biogas facilities			
Fuel	NA				
SNAP (if applicable)	091006	Biogas production			
Technologies/practices					
Region or regional conditions	NA				
Abatement technologies	See section 2.4				
Not applicable	As, Cu, Ni, Se				
Not estimated	NO_x, CO, NMVOC, SO_2, TSP, PM_{10}, $PM_{2.5}$, BC, HCB, Pb, Cd, Hg, Cr, Zn, HCH, PCBs, PCDD/F, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene				
Pollutant	**Value**	**Unit**	**95 % confidence interval**		**Reference**
			Lower	**Upper**	
NH_3-N	0.0275	kg NH_3-N per kg N in feedstock	0.0163	0.0501	See text

Total nitrogen in digestate after storage is calculated using equation (2)

$$N_{tot,dig} = N_{tot,sub} - (E_{NH3} \times 14/17) \qquad (2)$$

With:

$N_{tot,dig}$: Total amount of N in digestate after storage in kg a^{-1}

$N_{tot,sub}$: Total amount of N in the feedstock entering 5.B.2 in kg a^{-1}

E_{NH3}: Ammonia emitted in kg a^{-1}, calculated in equation (1)

3.3.3 Activity data

The Tier 1 method requires the total annual amount of N in the feedstock entering the biogas plants to be known. In case if the data are not available they can be derived from the amount of fresh matter, based on data gathered by statistical surveys or derived from proxy data, e.g. livestock numbers and excretion rates, as well as information (e.g. expert judgement) on the percentage of manure being digested in biogas plants.

Table 3. provides default factors for the conversion of fresh matter units into N units.

3.4 Tier 2 technology-specific approach

3.4.1 Algorithm

The Tier 2 approach estimates the total emission, E_{NH3} (in kg NH_3 per year), from:

$$E_{\mathrm{NH3}} = AR_{\mathrm{feedstock}} \times \sum_{\mathrm{stages}} EF_{\mathrm{NH3\text{-}N,\,stage\ i}} \times 17/14 \tag{3}$$

where $AR_{feedstock}$ is the total annual amount of N in feedstock, in kg a^{-1}; and $EF_{NH3\text{-}N,\ stage\ i}$ is the NH_3-N EF for stage i (i is the pre-storage, digester, and storage of digestate) related to the **total N in feedstock** (kg NH_3-N per kg total N). If no specific N amount is available from national data, $AR_{feedstock}$ is calculated by multiplying the total fresh weight of feedstock (tonnes a^{-1}) by the dry matter content of the feedstock (kg kg^{-1}) and the concentration of N in the feedstock dry matter (kg N kg^{-1}).

As pointed out in section 2.3, NH_3 emissions from the digester or the system of digesters can be assumed to be negligible.

As mentioned in section 3.2, emissions from the field application of digestates resulting from biogas production should be calculated in chapter 3.B for digested manures and in 3.D.a.2.c for digested energy crops and organic waste. Therefore in 5.B.2, the N-flow should be calculated separately for manures on one hand and energy crops and wastes on the other hand. As emission factors in 3.B are based on TAN the TAN flow needs to be considered for manures. The emission factor in 3.D.a.2.c is based on total N, therefore no TAN flow needs to be considered for energy crops and waste.

For digested manures, the TAN and total-N in manure (TAN_{sub} and N_{tot} respectively, kg a^{-1}) are:

$$TAN_{sub} = m_{biogas\_slurry\_TAN} + m_{biogas\_solid\_TAN} \tag{4}$$

$$N_{sub} = m_{biogas\_slurry\_N} + m_{biogas\_solid\_N} \tag{5}$$

where $m_{biogas\_slurry\_TAN}$, $m_{biogas\_solid\_TAN}$, $m_{biogas\_slurry\_N}$ and $m_{biogas\_solid\_N}$ are obtained from equations 22, 23, 28 and 29 in chapter 3B.

The TAN in digestate that is returned to chapter 3B (for use in equation 35; m_{dig_TAN}) is calculated using equation 6:

$$m_{dig\_TAN} = TAN_{sub} + f_{min} \times (N_{tot} - TAN_{sub}) - (E_{NH3} \times 14/17) \tag{6}$$

where

m_{dig_TAN}: TAN in digestate after storage in kg a^{-1}

f_{min}: relative share of organic N entering the digester that is mineralized to TAN in the digester in kg kg^{-1}

E_{NH3}: NH3 emitted in kg a^{-1}, calculated from total N in equation (3)

The total-N in digestate that is returned to 3B (for use in equation 36; m_{dig_TAN}kg a^{-1}) is:

$$m_{dig\_N} = N_{tot\_dig} - (E_{NH3} \times 14/17) \tag{7}$$

If no national data are available for f_{min}, a value of 0.32 for the N-mineralization of organic N in manures digested in biogas plants is recommended as used in the German emission inventory (Haenel et al 2018).

As calculations in 3.B are differentiated for different animal categories, TAN flow for digestion should also be calculated separately for the respective animal categories.

For digested energy crops and waste, $N_{tot,dig}$ in digestate after storage is calculated using equation (2) replacing E_{NH3} from equation (1) by E_{NH3} from equation (3)

3.4.2 Tier 2 emission factors

The European Union (EU) reference document on best available techniques (BREF document) for 'Waste treatment industries' (EC, 2006) gives typical emission ranges for most pollutants, but there is no information for NH_3 emissions. This section presents the Tier 2 NH_3 EFs for anaerobic digestion at biogas facilities adopted from Cuhls et al. (2010). These EFs were derived from trials with municipal organic waste and green waste (gardening waste). For all stages, they were calculated by relating the stage-specific NH_3 emissions (if enclosed, before air scrubbing) to the total amount of fresh matter of the feedstock entering the biogas plants. However, because of the degradation of organic matter during the process, which might vary between the different feedstocks, fresh matter is an inappropriate entity for relating NH_3 emissions to. Hence, the EFs derived by Cuhls et al. (2010) were converted into units of kg NH_3-N per kg N in the feedstock. The input material for the German plants covered by the study of Cuhls et al (2010) are municipal organic wastes and green wastes (gardening wastes). These two substrates are used in approximately equal proportions for biogas production in Germany. Therefore, the arithmetic mean of the N content in fresh matter of municipal organic waste and green waste was used for the conversion. The data are provided in Table 3.4.

NH_3 emissions from the digester can be considered negligible (see section 2.3), hence an EF of zero is suggested.

Cuhls et al. (2010) only provide emission factors for the storage of separated digestate (solid and liquid fractions). Therefore, this emission factor for storage was estimated by adding the emission factors for the storage of the two digestate fractions after separation. It applies to open storage only; if the digestate is stored in closed storage, the ammonia emission can be considered negligible. Countries are encouraged to use more specific national emission factors.

According to Heldstab et al. (2015), p. 284, the uncertainties (95 % confidence interval) of the EFs provided by Cuhls et al. (2010) are estimated to be a factor of 1.75.

Table 3.2 Tier 2 EFs for source category 5.B.2 Biological treatment of waste — anaerobic digestion at biogas facilities; pre-storage of feedstock

Tier 2 EFs		
	Code	Name
NFR source category	5.B.2	Biological treatment of waste — anaerobic digestion at biogas facilities
Fuel	NA	
SNAP (if applicable)	091006	Biogas production
Technologies/practices	Pre-storage	
Region or regional conditions	NA	
Abatement technologies	See section 2.4	
Not applicable	As, Cu, Ni, Se	

Not estimated	NO_x, CO, NMVOC, SO_2, TSP, PM_{10}, $PM_{2.5}$, BC, HCB, Pb, Cd, Hg, Cr, Zn, HCH, PCBs, PCDD/F, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene				
Pollutant	**Value**	**Unit**	**95 % confidence interval**		**Reference**
			Lower	**Upper**	
NH_3	0.0009	kg NH_3-N per kg N in feedstock	0.0005	0.0015	See text

Table 3.3 Tier 2 EFs for source category 5.B.2 Biological treatment of waste — anaerobic digestion at biogas facilities; storage of digestate (open storage)

Tier 2 EFs					
	Code	Name			
NFR source category	5.B.2	Biological treatment of waste — anaerobic digestion at biogas facilities			
Fuel	NA				
SNAP (if applicable)	091006	Biogas production			
Technologies/Practices	Storage of non-separated digestate				
Region or regional conditions	NA				
Abatement technologies	See section 2.4				
Not applicable	As, Cu, Ni, Se				
Not estimated	NO_x, CO, NMVOC, SO_2, TSP, PM_{10}, $PM_{2.5}$, BC, HCB, Pb, Cd, Hg, Cr, Zn, HCH, PCBs, PCDD/F, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene				
Pollutant	**Value**	**Unit**	**95 % confidence interval**		**Reference**
			Lower	**Upper**	
NH_3	0.0266	kg NH_3-N per kg N in feedstock	0.0152	0.0465	See text

3.4.3 *Activity data*

Surveys on the amounts of different types of feedstock are necessary to derive the necessary activity data on N entering anaerobic digestion. These cover all biodegradable organic materials including livestock manures, crops that are grown for energy production and other organic agricultural wastes, such as crop residues, that are used for anaerobic digestion at biogas facilities. According to the definition of the EFs (see section 3.4.2), the total N amounts of feedstock entering the biogas plants are required for calculating the emissions in the biogas process with the Tier 2 methodology.

The amounts of N and TAN in livestock manures to be digested should be derived from the corresponding N and TAN flows calculated in Chapter 3.B, section 3.4 (Step 8).

Table 3. gives the N contents of some possible feedstock types. These default values can be used to convert feedstock fresh matter into amounts of N. The figures in

Table 3. are based on German data, but are also in reasonable agreement with data from the United Kingdom (Webb, J., UK national atmospheric emission inventory team, personal communication, 2016). Countries are encouraged to use their own national data if available.

If dry matter contents differ substantially from those given in

Table 3., N contents can be corrected using the ratio of national to default dry matter contents. In particular, for municipal organic waste, green waste and food waste it is strongly recommended that national data are established, as N content can vary widely.

According to Heldstab et al. (2015), p. 284, the uncertainty of the activity data (95 % confidence interval) is estimated to range from –20 % to +20%.

Table 3.4 N content for various feedstock categories

Feedstock type	Dry matter content of fresh matter (kg kg^{-1})	N content of fresh matter (kg kg^{-1})
Municipal organic waste (a)	0.40	0.0068
Green waste (grass, etc.) (a)	Not available	0.0046
Food waste (food processing) 1)	Not available	0.0051
Cattle slurry (a)	0.10	0.0052
Pig slurry (a)	0.06	0.0048
Cattle solid manure (b)	0.25	0.0052
Pig solid manure (b)	0.25	0.0060
Poultry manure (b)	0.50	0.0175
Maize silage (a)	0.35	0.0046
Grass silage (a)	0.35	0.0094
Straw (a)	0.86	0.0051

Sources: (a)KTBL, (2013), (b) LfL (2013).

3.5 Tier 3 emission modelling and use of facility data

This guidebook does not provide a Tier 3 method because of the scarcity of sound methodologies with this approach. However, Wulf and Haenel (2014) proposed a method that could be considered by the countries to implement Tier 3 emission estimates for agricultural feedstock [2]. A comprehensive description of this German methodology is given by Haenel et al. (2018).

4 Data quality

4.1 Completeness

A complete inventory for biogas facilities should estimate NH_3, NO, total suspended particles (TSP), particulate matter (PM) and non-methane volatile organic compounds (NMVOCs). However, at present, NO, TSP, PM and NMVOC emissions from biogas facilities cannot be reported, as no methods exist to calculate these emissions.

It is essential to include the complete range of feedstocks in the emission calculations and to ensure that emissions from the utilisation of digestate are reported properly (e.g. utilisation as fertiliser in section 3.D and incineration in Chapter 1.A).

4.2 Avoiding double counting with other sectors

Care should be taken not to double count emissions from biogas facilities. NH_3 emissions resulting from the storage of agricultural feedstocks not located on the premises of biogas facilities have to be considered in Chapter 3.B (Manure management).

In addition, emissions produced from the burning of the biogas produced in engines, boilers and/or turbines have to be reported in the relevant chapter (Chapter 1.A, Combustion). Emissions following the application to land of digestate derived from livestock manure are calculated in 3B and reported in 3Da2a.

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[2] http://www.tfeip-secretariat.org/assets/Ag_Nature/2014/Biogasemission-inventoryTFEIP5.pptx

4.3 Verification

There are no direct methods to evaluate total inventory estimates of NH_3 emissions from the biological treatment of waste.

4.4 Developing a consistent time series and recalculation

There are no specific issues related to developing a consistent time series and recalculation.

4.5 Uncertainty assessment

General guidance on quantifying uncertainties in emission estimates is given in Part A, Chapter 5, 'Uncertainties', of the EMEP/EEA Guidebook (EMEP/EEA, 2016).

The uncertainties related to the EFs are addressed in section 3.4.2. It is good practice to consider that, from country to country, the composition of the treated waste may vary because of differences in waste definitions and fractionation. This could lead to country-specific EFs that are not comparable with those of other countries.

For more on the uncertainty of the activity data, see section 3.4.3.

4.6 Inventory quality assurance/quality control (QA/QC)

There are no specific issues related to inventory quality assurance/quality control (QA/QC).

4.7 Gridding

There are no specific issues related to gridding.

4.8 Reporting and documentation

Emissions calculated with Equations 1 or 2 are to be reported under NFR 5.B.2.

It should be noted that emissions from the application of digestate to land need to be reported under NFR 3.D.a.2.c.

Documentation, detailing when and where the biogas facility inventory was checked and by whom, is required.

5 References

Cuhls, C., Mähl B. and Clemens J., 2010, 'Emissionen aus Biogasanlagen und technische Maßnahmen zu ihrer Minderung', in: Thomé-Kozmiensky, K. J. and Beckmann, M (eds), *Erneuerbare Energien Band 4*, TK Verlag — Fachverlag für Kreislaufwirtschaft, Neuruppin, Germany, 147–160

EC, 2006, *Integrated pollution prevention and control: reference document on best available techniques for the waste treatments industries*, European Commission (http://www.prtr-es.es/data/images/BREF%20Tratamiento%20de%20Residuos-21891D712A33A259.pdf), September 2016.

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No 21/2016, European Environment Agency (http://www.eea.europa.eu/emep-eea-guidebook), accessed 30 September 2016.

Haenel, H.-D., Rösemann, C., Dämmgen, U., Döring, U., Wulf, S., Eurich-Menden, B., Freibauer, A., Döhler, H., Schreiner, C. and Osterburg B., 2018, *Calculations of gaseous and particulate emissions from German agriculture 1990–2016: Report on methods and data (RMD) Submission 2018*, Thünen Report 57, Thünen Institute, Braunschweig, Germany DOI:10.3220/REP1519913866000

Heldstab, J., Herren, M. and Walder, J., 2015, *Switzerland's Informative Inventory Report 2015 (IIR) — Submission of March 2015 to the United Nations ECE Secretariat*, Federal Office for the Environment (FOEN), Air Pollution Control and Chemicals Division, Bern, Switzerland.

KTBL, 2013, Internal substrate database. Association for technology and structures in agriculture (KTBL), Darmstadt, Germany. Database accessed 3 August 2016. Database is used for all KTBL publications.

LfL, 2013, Basic data for German agricultural consultancy. Bavarian State Research Center for Agriculture, Freising, Germany (http://www.lfl.bayern.de/mam/cms07/iab/dateien/basisdaten_2013_7.pdf) accessed 3 August 2016.

Wulf, S. and Haenel, H.-D., 2014, 'Implementation of biogas-production into the German agricultural emission inventory', the Task Force on Emission Inventories and Projections' Expert Panel on Agriculture and Nature, 13 May 2014, Ghent, Belgium.

6 Point of enquiry

Enquiries concerning this chapter should be directed to the relevant leader(s) of the Task Force on Emission Inventories and Projections' (TFEIP's) Expert Panel on combustion and industry. Please refer to the TFEIP website (www.tfeip-secretariat.org/) for the contact details of the current expert panel leaders.

Appendix G

Ohio EPA DAPC Air Toxics Policy

OPTION A

REVIEW OF NEW SOURCES OF AIR TOXIC EMISSIONS

Ohio Environmental Protection Agency
Division of Air Pollution Control
1800 WaterMark Drive
Columbus, Ohio 43215

REVIEW OF NEW SOURCES OF TOXIC EMISSIONS

Synopsis

The following is a summary of the Ohio Environmental Protection Agency (EPA) policy for the control of toxic air emissions.

1. Determine if a threshold limit value (TLV) exists for the specific compound which is emitted form the source.

2. Divide the TLV by ten to adjust the standard from the working population to the general public (TLV/10).

3. Adjust the standard to account for the duration of the exposure (operating hours of the source) of "X" hours per day and "Y" days per week from 8 hours per day and 5 days per week. This formula is used to obtain the Maximum Acceptable Ground-Level Concentration (MAGLC).

$$\frac{TLV}{10} \times \frac{8}{X} \times \frac{5}{Y} = 4\,\frac{TLV}{XY} = MAGLC$$

4. The Director may, on a case-by-case basis, accept an alternate analysis from a new source applicant.

Introduction

The basis for the air program's activities have been based upon the ambient air quality standards for "criteria pollutants." These standards, designed to protect health and welfare, have been established by U.S. EPA for the following six (6) pollutants:

1. Total suspended particulates,
2. Sulfur dioxide,
3. Carbon monoxide,
4. Nitrogen dioxide,
5. Ozone, and
6. Lead (Pb).

Emission limitations for new and existing sources have been established under the federal National Emission Standards for Hazardous Air Pollutants (NESHAPs) for the following pollutants:

1. Vinyl chloride,
2. Asbestos,
3. Beryllium,
4. Mercury,
5. Benzene, and
6. Arsenic (proposed).

The federal New Source Performance Standards (NSPS) also address several additional pollutants which are:

1. Fluorides,
2. Sulfuric acid mist,
3. Hydrogen sulfides, and
4. Reduced sulfur compounds.

For new sources, the Permit to Install rules require the application of Best Available Technology, and emissions of non-specified contaminants can be controlled through this mechanism. However, this level of review may not be adequate for toxic emissions. U.S. EPA has been slow to promulgate NESHAPs for additional pollutants. In order to assist in the review of new sources of toxic contaminants, the following policy has been developed by the Air Quality Modeling and Planning Section of the Division of Air Pollution Control.

<u>Background and Rationale</u>

The American Conference of Governmental Industrial Hygienists (ACGIH) has been involved with the safety aspects of work places where individuals may be exposed to varying levels of toxic substances. The ACGIH publishes and continuously updates a list of "Threshold Limit Values" (TLVs) for many substances. These TLVs represent maximum concentrations under which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse effects. Most of the TLVs refer to time-weighted average concentrations for a normal work day, with certain excursions within limits permissible during that time period, as long as the weighted average is not exceeded. However, for certain substances, there are levels that should not be exceeded at any time.

As outlined below, there are certain limitations and dangers in the literal application of TLVs for air pollution control purposes.

1. Threshold Limit Values are based on the information gathered in industrial/commercial settings, through experience from medical research and practice, from experimental human and animal studies, and also from a combination of these sources. Only in a few instances have the values been established firmly on a basis of examinations of human subjects correlated with extensive environmental observations.

2. The TLVs were determined for a population of workers who are essentially healthy and who fall within a "working age group" of about 17 to 65 years.

3. Synergistic effects of mixtures of substances are not considered in the development of TLVs, although the TLVs for mixtures can be calculated via the appropriate formula.

4. Individuals vary in sensitivity of susceptibility to toxic substances.

5. Often a single value is given for substances which occur in different forms and may have different toxicities.

6. For most contaminants, a worker during a normal work schedule (8 hours per day, 5 days a week) receives 40 hours of exposure per week daily and weekend periods in which the body may rid itself of the accumulated substances before toxic levels are reached. For a person living continuously in an environment containing such substances, however, these recovery periods do not exist. Exposure to TLV levels may, therefore, subject the person to an unacceptably high risk of injury.

In setting ambient goals for toxic substances, two time periods must be considered.

1. Duration of Exposure - This is the amount of time a person spends in contact with a toxic substance. (In this application, it is assumed that a person may continuously be exposed to the specific contaminants during the operating hours of a source.)

2. Averaging Time - This time period is used to measure compliance with the standard.

For example, the OSHA TLVs have a maximum allowable duration of exposure of 8 hours/day and 40 hours/week, but an averaging time of 8 hours for determining compliance with the rules. Similarly, the ambient lead standard has a continuous duration of exposure, but a quarterly averaging time for determining compliance. Also, the ACGIH publishes acceptable ceiling concentration values within an 8-hour workday, and acceptable peak concentrations for a short period of time, in addition to the time-weighed 8-hour weekday.

Determination of Maximum Acceptable Ground-Level Concentration (MAGLC)

Taking into account the duration of exposure and averaging time, the following stepwise procedure should be used to determine the allowable ambient air concentration for a toxic substance:

1. Determine if a TLV exists for the specific compound which is emitted from the source.

2. Divide the TLV by ten (10) to adjust the standard from the working population to the general public (TLV/10).

3. Adjust the standard to account for the duration of the exposure (operating hours of the source) of "X" hours per day and "Y" days per week from 8 hours per day and 5 days per week.

$$\frac{TLV}{10} \times \frac{8}{X} \times \frac{5}{Y} = 4\ \frac{TLV}{XY}$$

4. The TLVs are based on an averaging time of 8 hours per day. The standard method of determining the ambient air quality effect of the source is through dispersion modeling. The most readily adaptable averaging time for dispersion models is generally one hour. The approvability of a source will be based on the predicted one-hour averaging time (under worst-case meteorology) in comparison to the MAGLC obtained from Step 3. If the impact of the source is greater than the MAGLC, additional measures by the source will be necessary before the Permit to Install can be issued. Because no adjustment is made to the formula in Step 3, an additional safety factor of approximately 30% is produced (see Appendix A for the derivation of the 30% safety factor).

$$MAGLC = 4\ \frac{TLV}{XY}$$

By using a factor of 10 in Step 2 and by decreasing the averaging time in Step 3, the TLV has been adjusted for the greater susceptibility of the general population in comparison to healthy workers.

The 8/X and the 5/Y multipliers in Step 3 are used to relate the exposure to longer than 40-hour time periods and ascertain that the individual's total exposure will be no greater than that allowed by the TLV.

For less than 40 hours per week of plant operation, the MAGLC formula will yield a value greater than the TLV/10. Although excursions of up to three times the TLV can be calculated in some cases, it does not appear reasonable to permit this situation for the general population. A condition on the formula is, therefore, necessary to limit the allowable concentration to TLV/10 for operating times less than 40 hours per week.

Thus, from the above analysis, the derivation of the maximum acceptable ground-level concentration (maximum one hour average) beyond the plant boundary of a continuous emitting source would be:

$$MAGLC = \frac{TLV}{10} \times \frac{8\ hours}{24\ hours} \times \frac{5\ days}{7\ days} = \frac{TLV}{42}$$

An example of this procedure is contained in Appendix B.

The application of the policy is for use as a guideline in the review of new source applications. There may be cases where the TLV values are inappropriate for this type of application. The Director may consider, on a case-by-case basis, other data in the determination of a Maximum Acceptable Ground-Level Concentration from a new source.

Comparisons of MAGLC to National Ambient Air Quality Standards Values

In order to determine the relative stringency of this procedure, a comparison was made using this method with the National Ambient Air Quality Standards (NAAQS) for sulfur dioxide and ozone, and with the NESHAP for beryllium:

A. Sulfur Dioxide

For a continuously emitting sulfur dioxide source, the acceptable one-hour ground-level concentration would be:

$$MAGLC = \frac{4\ TLV}{X\ Y} = \frac{(4)\ (5\ ppm)}{(24\ hr/day)(7\ days/week)} = 0.12\ ppm$$

Under the NAAQS, the three-hour standard is 0.5 ppm, not to be exceeded more than once per year.

B. Ozone

For an intermittent ozone source operating three hours per day, five days per week, the allowable impact would be:

$$MAGLC = \frac{TLV}{10} = \frac{0.1\ ppm}{10} = 0.01\ ppm$$

The NAAQS for ozone is 0.12 ppm one-hour average, not to be exceeded more than once per year over a three-year period.

APPENDIX A

The vertical (σ_z) and horizontal (σ_y) dispersion parameters utilized in most gaussian models were developed by Pasquill[1] and modified by Gifford[2]. Although the original experiments were based on a ten-minute sampling time, in practice, σ_y and σ_z values are considered to represent dispersion for a one-hour average. Due to wind direction fluctuations and variations in wind speed, it is necessary to adjust predictions which are greater than one-hour to account for these meteorological phenomena. To apply the predictions to longer than a one-hour period, the following equation is suggested by Turner[3]:

$$X_s = X_k \frac{(t_k)^p}{t_s}$$

Where

X_s is the concentration predicted over an averaging time t_s,
X_k is the concentration predicted over an averaging time t_k,and
^{p} is a constant and should be between 0.17 and 0.2

---

[1] F. Pasquill, "The estimation of the dispersion of windborne material," Meteorological Magazine, Vol. 90, 1961, pp. 33-49.

[2] F.A. Gifford, "Use of routine meteological observations for estimation atmospheric diffusion," Nuclear Safety, Vol. 2, 1961 p. 47.

[3] D.B. Turner, "Workbook of Atmospheric Dispersion Estimates," Office of Air Programs Publication, No. AP-26, U.S. EPA, Research Triangle Park, North Carolina, 1970.

As shown below, applying this equation to the case of estimating an eight-hour average concentration, the one-hour predicted concentration should be reduced by 32%.

$$X_s = \frac{(t_k)^p}{t_s}$$

$$\frac{X_s}{X_k} = \frac{(1)}{(8)}0.185$$

$$\frac{X_s}{X_k} = 0.680$$

By not allowing for this adjustment when reducing the averaging time from eight-hour to one-hour in step 4, an additional safety factor of 32% is realized.

APPENDIX B

A new hazardous waste incinerator is proposing to burn sludge containing cadmium. The incinerator is equipped with a wet scrubber which is designed to remove 98% of the cadmium in the waste gas stream and will emit 4.6 pound per hour of cadmium. The incinerator will operate 24 hours per day, 7 days per week.

The TLV for cadmium is 0.1 mg/m^3, and from Step 4, the maximum allowable ground-level concentration would be:

$$MAGLC = \frac{4\ TLV}{X\ Y} = \frac{(4)\ (0.05\ mg/m^3)}{(24\ hr/day)(7\ days/week)} = 1.19 \times 10^{-3}\ mg/m^3$$

$$= 1.19 \text{ x } 10^{-6}\ g/m^3$$

From the PTMAX model, the maximum one-hour impact from the source is predicted to be $6.24\text{x}10^{-6}$ at 0.5 m/sec wind speed and F stability.

Since the predicted concentration is greater than the MAGLC of $1.19\text{x}10^{-6}$ g/m^3, the source will be required to develop a plan to reduce the ambient impact of the cadmium emissions.

Exhibit 2

HAAK LAW LLC
Environmental, Health & Safety
Legal and Consulting Services

William H. Haak
whh@haaklawllc.com
Tel: 216.772.3532

- VIA ELECTRONIC MAIL ONLY –

April 13, 2022

Aaron Farmer, Assistant Section Chief
Jack McManus, Assistant Attorney General
Rebecca Kanz, Assistant Attorney General
Ohio Attorney General – Environmental Enforcement Section
30 East Broad Street – 25th Floor
Columbus, Ohio 43215

Re: *Bath Township, Greene County, Ohio and City of Fairborn, Ohio*
60 Day Notice of Intent to File a Citizen Suit Under 42 U.S. Code 7604

Dear Aaron, Jack, and Becca:

April and I are writing to formally request that we both be involved in any discussions and/or negotiations that the Ohio Attorney General's Office and Ohio EPA are having with Dovetail Energy, LLC and/or Renergy, Inc. in connection with resolution of the above-referenced matter.

While we wish to resolve this matter amicably on behalf of our respective clients through a judicially enforceable order, any resolution advanced by the State of Ohio without the direct, substantive involvement of both Bath Township and the City of Fairborn is wholly unacceptable. Under no circumstances would any such resolution be deemed to constitute diligent prosecution by the State of Ohio under 42 U.S. Code 7604(b)(1)(B).

We look forward to working with you.

Thank you.

Sincerely,

Will H. Haak

William H. Haak
Haak Law LLC
Cleveland, Ohio
Attorney for Bath Township

cc: April Bott Moore, Attorney for the City of Fairborn

Exhibit 3

DAVE YOST
OHIO ATTORNEY GENERAL

Environmental Enforcement
Office: (614) 466-2766
Fax: (614) 644-1926

April 14, 2022

Via email

William H. Haak
Haak Law LLC
whh@haaklawllc.com

April Bott
Taft Stettinius & Hollister LLP
65 East State Street
Suite 1000
Columbus, OH 43215-4213
ABott@taftlaw.com

Subject: Citizen Suit Notice Against Renergy, Inc. and Dovetail Energy LLC

Dear Bill and April:

We very much appreciated the opportunity to speak to you earlier this week. In that call you mentioned that your client's goal is compliance with Ohio's air laws as quickly as possible. You can be sure that we share this goal and are doing all we can to assure compliance as expeditiously as possible.

With respect to Bill's letter dated April 13, 2022, third parties do not negotiate or litigate statutory referrals from the Director of Environmental Protection. And specific to this case, we don't feel that direct involvement by your clients will be compatible with the goal assuring compliance with the law as quickly as possible. Current negotiations are proceeding expeditiously and the involvement of additional parties would slow the process.

We will share the final agreement with you if we are able to reach an agreement. And in the event that we are able to reach an agreement, that agreement will require the submission of a permit application for the digestate storage tank. The City of Fairborn and Bath Township will then have the opportunity to comment on the permit application under Ohio Adm.Code 3745-31-06.

Again, thank you for sharing you concerns directly with us.

Sincerely,

DAVE YOST
OHIO ATTORNEY GENERAL

/s/ Rebecca Kanz

Rebecca Kanz
Jack McManus
Assistant Attorneys General

c: Aaron Farmer, Assistant Section Chief, Environmental Enforcement Section

Exhibit 4

FILED

2022 APR 15 AM 9:26

AJ WILLIAMS
COMMON PLEAS COURT
GREENE COUNTY, OHIO

IN THE COURT OF COMMON PLEAS
GREENE COUNTY, OHIO

STATE OF OHIO, ***ex rel.*** **DAVID YOST,** **OHIO ATTORNEY GENERAL** Environmental Enforcement Section 30 East Broad Street, 25th Floor Columbus, Ohio 43215	:	CASE NO. 2022 CV 0201 JUDGE JUDGE TORNICHIO
Plaintiff,	:	**COMPLAINT FOR INJUNCTIVE RELIEF AND CIVIL PENALTIES**
v.	:	**DESIGNATION – OTHER CIVIL**
RENERGY INC. c/o Alexander Ringler Statutory Agent 461 SR 61 Marengo, Ohio 43334	:	
DOVETAIL ENERGY, LLC c/o CH&K Agent Service, Inc. Statutory Agent 1 South Main Street, Suite 1300 Dayton Ohio 45402	:	
Defendants.	:	

NATURE OF THE ACTION

Defendant Renergy Inc. and Defendant Dovetail Energy, LLC ("Defendants") operate an organic waste processing facility that employs a sealed anaerobic digestion tank to produce methane that is used to generate electricity. The plant's operations result in the production of a waste sludge, called digestate, that is stored initially in a concrete tank and ultimately land applied by area farms as fertilizer. The concrete tank is uncovered and has unpermitted emissions of ammonia (NH_3).

Plaintiff, the State of Ohio, on relation of its Attorney General, Dave Yost, at the written request of the Director of Environmental Protection ("Director"), brings this action to enforce Chapter 3704 of the Ohio Revised Code and the rules adopted thereunder. The Plaintiff alleges:

GENERAL ALLEGATIONS

Defendants

1. Defendant Renergy Inc. ("Renergy") is an Ohio corporation registered and licensed to do business in Ohio. It identified its statutory agent as Alexander Ringler, 461 Sr 61, Marengo, Ohio 43334.

2. Defendant Dovetail Energy, LLC ("Dovetail") is an Ohio limited liability company registered and licensed to do business in Ohio. It identified its statutory agent as CH&K Agent Service, Inc., 1 South Main Street, Suite 1300, Dayton, Ohio 45402.

3. Dovetail is the owner of the organic waste processing facility that is the subject of this action. That facility is located at 1146 Herr Road, Fairborn, Greene County, Ohio, and is referenced herein as the "Operation."

4. Dovetail is a subsidiary of Renergy, and Renergy and Dovetail manage and operate the Operation.

Factual Background

5. The Operation includes waste receiving pits, a sealed anaerobic digestion tank, and a concrete digestate storage tank, as well as ancillary equipment.

6. The Operation receives hog manure and other organic wastes in the waste receiving pits and mixes the wastes into a slurry.

7. The mixed slurry is then transferred to the adjacent anaerobic digestion tank for the production of methane that is burned onsite to generate electricity.

8. At the conclusion of the digestion process, the digestate is discharged from the anaerobic digestion tank to the digestate storage tank.

9. The digestate storage tank is open at the top and has no controls to prevent the emission of air pollutants.

10. The digestate is removed periodically from the digestate storage tank for land application as a source of nutrients to fertilize farm fields.

11. The Operation was constructed in 2013 and initially accepted only agricultural waste.

12. Sometime between 2013 and February of 2018, the company started introducing non-agricultural organic wastes into its process.

13. Although the company has obtained air pollutant permits for some aspects of its operations, the company failed to obtain the required permit for the digestate storage tank at the time it started introducing non-agricultural organic wastes into the process and thus became subject to regulation.

14. As explained herein, the digestate storage tank emits ammonia (NH3) at levels that subject the digestate storage tank to air pollutant permitting requirements as well as certain substantive requirements applicable to such sources.

Regulatory Status of the Digestate Storage Tank and the Operation

15. Ammonia is an "air contaminant," as that term is defined in R.C. 3704.01 and Ohio Adm.Code 3745-31-01, and is listed as a toxic air contaminant in Ohio Adm.Code 3745-114-01.

16. Defendants' digestate storage tank is a regulated "stationary source" of "air contaminants" under Ohio Adm.Code 3745-31-01 and has regulated "emission[s]," under R.C. 3704.01 and Ohio Adm.Code 3745-15-01.

17. Defendants' Operation is a regulated "facility," under R.C. 3704.01 and Ohio Adm.Code 3745-15-01 and 3745-31-01.

18. Defendants are each an "owner or operator" of the "facility" as those terms are defined in Ohio Adm.Code 3745-15-01 and/or 3745-31-01.

Jurisdiction and Venue

19. Defendants transacted business and/or contracted to supply services or goods in the State of Ohio.

20. Defendants are each a "person" as that term is defined in R.C. 1.59 and 3704.01.

21. This Court has jurisdiction over Defendants pursuant to R.C. 2307.382 and R.C. 3704.06.

22. Venue is proper in this Court pursuant to Civ. R. 3(C).

23. In accordance with Civ.R. 8(A), the State informs the Court that the amount sought is in excess of twenty-five thousand dollars ($25,000.00).

24. The allegations in the paragraphs above are incorporated into the following Count of this Complaint as if fully rewritten therein.

COUNT ONE
FAILURE TO OBTAIN A PERMIT

25. Under Ohio Adm.Code Chapter 3745-31-02, the owner or operator of an air contaminant source is required to apply for and obtain a permit unless the source is either specifically exempt under Ohio Adm.Code 3745-15-05, or Ohio Adm.Code 3745-31-03, or exempt under R.C. 3704.011 because the air contaminant source emits less than ten pounds per day.

26. The digestate storage tank does not qualify for any exemption identified in the preceding paragraph and is, therefore, subject to permitting requirements contained in Ohio Adm.Code 3745-31-02.

27. Pursuant to R.C. 3704.05, no person shall cause, permit, or allow emission of an air contaminant in violation of any rule adopted by the director of environmental protection unless the person is the holder of a variance or permit that includes a compliance schedule issued by the director of environmental protection.

28. Defendants do not have a variance or permit that includes a compliance schedule issued by the director of environmental protection and have therefore, beginning sometime before February 13, 2018 and continuing to the present, violated R.C. 3704.05 by failing to have a permit.

29. Pursuant to R.C. 3704.06, a person who violates R.C. 3704.05 shall pay a civil penalty of not more than twenty-five thousand dollars for each day of each violation.

PRAYER FOR RELIEF

WHEREFORE, Plaintiff respectfully requests this Court:

A. Permanently enjoin Defendants to comply with R.C. Chapter 3704, the rules adopted thereunder;

B. Order Defendant to apply for and obtain a permit from Ohio EPA to regulate emissions from the digestate storage tank and employ all necessary emissions controls;

C. Order Defendant, under R.C. 3704.06, to pay civil penalties for the violations in an amount up to twenty-five thousand dollars ($25,000.00) per day for each day of each violation, including each day of each violation occurring after the filing of this Complaint;

D. Order the Defendants to pay all costs and fees for this action, including any attorney fees assessed by the Office of the Ohio Attorney General and extraordinary enforcement costs incurred by the State of Ohio;

E. Retain jurisdiction of this suit for the purpose of making any order or decree which it may deem necessary at any time to carry out its judgment; and

F. Grant such other relief as may be just.

Respectfully submitted,

DAVID YOST
OHIO ATTORNEY GENERAL

Rebecca Kanz
REBECCA KANZ (100091)
JOHN K. MCMANUS (0037140)
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