6560-50-P

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Parts 60 and 63

[EPA-HQ-OAR-2021-0382; **FRL-7547-01-OAR]**

RIN 2060-AV37

Potential Future Regulation Addressing Pyrolysis and Gasification Units

AGENCY: Environmental Protection Agency (EPA).

ACTION: Advance notice of proposed rulemaking.

SUMMARY: The U.S. Environmental Protection Agency (EPA) is soliciting information and requesting comments to assist in the potential development of regulations for pyrolysis and gasification units that are used to convert solid or semi-solid feedstocks, including solid waste (*e.g.,* municipal solid waste, commercial and industrial waste, hospital/medical/infectious waste, sewage sludge, other solid waste), biomass, plastics, tires, and organic contaminants in soils and oily sludges to useful products such as energy, fuels and chemical commodities. Pyrolysis and gasification are often described as heat induced thermal decomposition processes. Through recent requests for applicability determinations, it appears that pyrolysis and gasification processes are more widely being used to convert waste into useful products or energy.

DATES: *Comments*. Comments must be received on or before **[INSERT DATE 60 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**.

ADDRESSES: You may send comments, identified by Docket ID No. EPA-HQ-OAR-2021-0382, by any of the following methods:

- *Federal eRulemaking Portal: https://www.regulations.gov/* (our preferred method). Follow the online instructions for submitting comments.
- *Email: a-and-r-docket@epa.gov*. Include Docket ID No. EPA-HQ-OAR-2021-0382 in the subject line of the message.
- *Fax:* (202) 566-9744. Attention Docket ID No. EPA-HQ-OAR-2021-0382.

- *Mail:* U.S. Environmental Protection Agency, EPA Docket Center, Docket ID No. EPA-HQ-OAR-2021-0382, Mail Code 28221T, 1200 Pennsylvania Avenue, NW, Washington, DC 20460.
- *Hand Delivery or Courier (by scheduled appointment only):* EPA Docket Center, WJC West Building, Room 3334, 1301 Constitution Avenue, NW, Washington, DC 20004. The Docket Center's hours of operation are 8:30 a.m. – 4:30 p.m., Monday – Friday (except Federal holidays).

Instructions: All submissions received must include the Docket ID No. EPA-HQ-OAR-2021-0382 for this rulemaking. Comments received may be posted without change to *https://www.regulations.gov/*, including any personal information provided. For detailed instructions on sending comments and additional information on the rulemaking process, see the **SUPPLEMENTARY INFORMATION** section of this document. Out of an abundance of caution for members of the public and EPA staff, the EPA Docket Center and Reading Room are closed to the public, with limited exceptions, to reduce the risk of transmitting COVID-19. The EPA's Docket Center staff will continue to provide remote customer service via email, phone, and webform. The Agency encourages the public to submit comments via *https://www.regulations.gov/* or email, as there may be a delay in processing mail and faxes. Hand deliveries and couriers may be received by scheduled appointment only. For further information on EPA Docket Center services and the current status, please visit us online at https://www.epa.gov/dockets.

FOR FURTHER INFORMATION CONTACT: For questions about this action, contact Nabanita Modak Fischer, Fuels and Incineration Group, Sector Policies and Programs Division (E143–05), Environmental Protection Agency, Research Triangle Park, North Carolina 27711; telephone number: (919) 541–5572; fax number: (919) 541–3470; email address: *modak.nabanita@epa.gov*.

SUPPLEMENTARY INFORMATION:

Docket. The EPA has a docket for this notice and the future listing action under Docket ID No. EPA-HQ-OAR-2021-0382. All documents in the docket are listed in Regulations.gov. Although listed, some information is not publicly available, *e.g.*, Confidential Business Information (CBI) or other information whose disclosure is restricted by statute. Certain other material, such as copyrighted material, is not placed on the Internet and will be publicly available only in hard copy. With the exception of such material, publicly available docket materials are available electronically in *Regulations.gov*.

Instructions. Direct your comments to Docket ID No. EPA-HQ-OAR-2021-0382. The EPA's policy is that all comments received will be included in the public docket without change and may be made available online at *https://www.regulations.gov/*, including any personal information provided, unless the comment includes information claimed to be CBI or other information whose disclosure is restricted by statute. Do not submit electronically any information that you consider to be CBI or other information whose disclosure is restricted by statute. This type of information should be submitted by mail as discussed below.

The EPA may publish any comment received to its public docket. Multimedia submissions (audio, video, *etc.*) must be accompanied by a written comment. The written comment is considered the official comment and should include discussion of all points you wish to make. The EPA will generally not consider comments or comment contents located outside of the primary submission (*i.e.*, on the Web, cloud, or other file sharing system). For additional submission methods, the full EPA public comment policy, information about CBI or multimedia submissions, and general guidance on making effective comments, please visit *https://www.epa.gov/dockets/commenting-epa-dockets*.

The *https://www.regulations.gov/* website allows you to submit your comment anonymously, which means the EPA will not know your identity or contact information unless you provide it in the body of your comment. If you send an email comment directly to the EPA without going through *https://www.regulations.gov/*, your email address will be automatically

captured and included as part of the comment that is placed in the public docket and made available on the Internet. If you submit an electronic comment, the EPA recommends that you include your name and other contact information in the body of your comment and with any digital storage media you submit. If the EPA cannot read your comment due to technical difficulties and cannot contact you for clarification, the EPA may not be able to consider your comment. Electronic files should not include special characters or any form of encryption and should be free of any defects or viruses. For additional information about the EPA's public docket, visit the EPA Docket Center homepage at *https://www.epa.gov/dockets*.

The EPA has temporarily suspended its Docket Center and Reading Room for public visitors, with limited exceptions, to reduce the risk of transmitting COVID-19. The Docket Center staff will continue to provide remote customer service via email, phone, and webform. The Agency encourages the public to submit comments via *https://www.regulations.gov/* as there may be a delay in processing mail and faxes. Hand deliveries or couriers will be received by scheduled appointment only. For further information and updates on EPA Docket Center services, please visit us online at *https://www.epa.gov/dockets*.

The EPA continues to carefully and continuously monitor information from the Centers for Disease Control and Prevention, local area health departments, and our Federal partners so that the Agency can respond rapidly as conditions change regarding COVID-19.

Submitting CBI. Do not submit information containing CBI to the EPA through *https://www.regulations.gov/* or email. Clearly mark the part or all of the information that you claim to be CBI. For CBI information on any digital storage media that you mail to the EPA, mark the outside of the digital storage media as CBI and then identify electronically within the digital storage media the specific information that is claimed as CBI. In addition to one complete version of the comments that includes information claimed as CBI, you must submit a copy of the comments that does not contain the information claimed as CBI directly to the public docket through the procedures outlined in *Instructions* above. If you submit any digital storage media

that does not contain CBI, mark the outside of the digital storage media clearly that it does not contain CBI. Information not marked as CBI will be included in the public docket and the EPA's electronic public docket without prior notice. Information marked as CBI will not be disclosed except in accordance with procedures set forth in 40 Code of Federal Regulations (CFR) part 2. Send or deliver information identified as CBI only to the following address: OAQPS Document Control Officer (C404-02), OAQPS, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711, Attention Docket ID No. EPA-HQ-OAR-2021-0382. Note that written comments containing CBI and submitted by mail may be delayed and no hand deliveries will be accepted.

Preamble acronyms and abbreviations. The EPA uses multiple acronyms and terms in this preamble. While this list may not be exhaustive, to ease the reading of this preamble and for reference purposes, the EPA defines the following terms and acronyms here:

ANPRM	advance notice of proposed rulemaking
CAA	Clean Air Act
CBI	Confidential Business Information
CFR	Code of Federal Regulations
CISWI	commercial and industrial solid waste incineration
°C	degrees Celsius
EG	Emission Guidelines
EPA	U.S. Environmental Protection Agency
FR	*Federal Register*
HAP	hazardous air pollutant
HMIWI	hospital, medical, and infectious waste incinerator
MACT	maximum achievable control technology
MSW	municipal solid waste
MWC	municipal waste combustor
NAICS	North American Industry Classification System
NSPS	New Source Performance Standards
OAQPS	Office of Air Quality Planning and Standards
OMB	Office of Management and Budget
OSWI	other solid waste incineration
PAH	polycyclic aromatic hydrocarbon
SSI	sewage sludge incineration

Organization of this document.

The information in this preamble is organized as follows:

I. General Information

A. What is the purpose of this ANPRM?

The Agency is seeking comments and data to assist in the consideration of potential changes to existing regulations under Clean Air Act (CAA) section 129 or the development of regulations pertaining to pyrolysis and gasification units that are used to convert solid and semi-solid feedstocks, including solid waste (*e.g.,* municipal solid waste (MSW), commercial and industrial waste, hospital/medical/infectious waste, sewage sludge, other solid waste), biomass, plastics,[1] tires, and organic contaminants in soils and oily sludges to useful products such as energy, fuels and chemical commodities.[2] As a result of recent market trends, especially with respect to plastics recycling, the EPA has received several inquiries about regulations under CAA section 129 for solid waste incineration units and the applicability of such regulations to pyrolysis and gasification units for a variety of process and feedstock types. Based on these requests and the differences in language pertaining to pyrolysis among the CAA section 129

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[1] Pyrolysis and gasification units may be used to process plastics, whether "virgin" or recyclable or recycled. Note that under CAA section 129(g)(5), for example, "municipal waste" may consist of various materials, including "plastics," and the definition does not distinguish between non-recycled or recycled plastics. Some states or municipalities may not regard plastics in the recycling stream as waste, but for our purposes, here, the Agency is interested in information and comments relating to pyrolysis and gasification units that may use plastics as feedstock, whether or not the plastics are recycled or recyclable.

[2] The EPA has observed that not all pyrolysis or gasification processes produce a seemingly useful product or energy used for purposes other than drying incoming materials for destruction. These processes usually combust the resultant syngas or gaseous products from pyrolysis. The Agency is collecting information and comments on the full spectrum of gasification and pyrolysis units, regardless of the outputs.

rules,[3] the Agency believes that there is considerable confusion in the regulated community regarding the applicability of CAA section 129 to pyrolysis and gasification units. On August 31, 2020, the EPA proposed various revisions to section 129 regulations for "other solid waste incineration units" (OSWI), including a proposal to revise the definition of "municipal waste combustion (MWC) unit" to remove the reference to "pyrolysis/combustion units" (85 FR 54178). In the proposal, the EPA indicated that pyrolysis units do not involve the combustion of solid waste but may combust uncontained gases and that the OSWI rule should not apply to such units (85 FR at 54187). The EPA received significant comments on the proposal regarding the removal of the reference to "pyrolysis/combustion units." In light of these comments and what appear to be on-going questions about the regulation of pyrolysis and gasification units, the EPA has determined that issuance of this ANPRM is an efficient mean for gaining a comprehensive understanding of these units to aid in potential development of future regulations or changes to existing CAA section 129 regulations pertaining to pyrolysis and gasification units. An ANPRM provides an opportunity for the EPA to gather information on the design, types, and sizes of pyrolysis and gasification units, as well as to identify other issues for consideration, including appropriate categorization of pyrolysis and gasification units. The EPA expects that this notice will allow a large and diverse group of stakeholders, including potentially impacted facilities, small businesses, and state, local, and tribal governments, to participate in the data and information gathering process. Based on data and information received through this ANPRM and other forms of information collection requests, the Agency will evaluate how best to address the pyrolysis and gasification units.

[3] CAA section 129 requires development of maximum achievable control technology (MACT) standards for several categories of waste incineration sources for nine pollutants. The MACT regulations for sources that are not waste incineration sources are developed under the authority and requirements of section 112 of the CAA.

B. Does this action apply to me?

Entities that may be interested in this ANPRM or potentially may be affected by the EPA's evaluation of the information and comments received include, especially, owners and operators of pyrolysis and gasification units that are used to convert solid or semi-solid feedstocks, including solid waste (*e.g.,* municipal solid waste, commercial and industrial waste, hospital/medical/infectious waste, sewage sludge, other solid waste), biomass, plastics, tires, and organic contaminants in soils and oily sludges to useful products such as energy, fuels, and chemical commodities. The categories and entities may include, but are not limited to, municipal waste combustor (MWC) units as defined in 40 CFR 60.32b, 40 CFR 60.51a, 40 CFR 60.51b, 40 CFR 60.1465, and 40 CFR 60.1940, commercial and industrial solid waste incineration (CISWI) units as defined in and 40 CFR 60.2265 and 40 CFR 60.2875, OSWI units as defined in 40 CFR 60.2977 and 40 CFR 60.3078; units excluded from the hospital, medical, and infectious waste incinerator (HMIWI) standards pursuant to 40 CFR 60.32e(f) and 40 CFR 60.50c(f); non-combustion units, such as thermal desorption units that process solid waste under pyrolytic conditions to recover oil or other marketable products; and other solid or semi-solid material thermal processing units that are currently undefined under CAA regulations. Table 1 of this preamble lists the entities that are regulated by the current MWC, CISWI, OSWI, sewage sludge incineration (SSI), and HMIWI standards that the EPA believes may be operating or could potentially own or operate a pyrolysis or gasification unit.

Table 1. SOURCE CATEGORIES INTERESTED IN THIS ACTION

Source Category	NAICS Code[1]	Examples of Potentially Regulated Entities
Any state, local, or tribal government or commercial owner/operators using a MWC unit.	562213, 92411	Solid waste combustion units disposing of municipal solid waste (MSW).
Any federal government agency using a pyrolysis or gasification unit.	928, 7121	Department of Defense (labs, military bases, munition facilities) and National Parks.
Any educational institution using a pyrolysis or gasification unit.	6111, 6112, 6113	Primary and secondary schools, universities,

		colleges, and community colleges.
Any industrial or commercial facility using a pyrolysis or gasification unit.	114, 211, 212, 221, 321, 322, 325, 326, 327, 337, 486	Oil and gas exploration operations; mining; pipeline operators; utility providers; manufacturers of wood products; manufacturers of pulp, paper, and paperboard; manufacturers of furniture and related products; manufacturers of chemicals and allied products, manufacturers of plastics and rubber products; manufacturers of cement; nonmetallic mineral product manufacturing; fishing operations.
Industry	622110, 622310, 562213, 611310	Private hospitals, other health care facilities, commercial research laboratories, commercial waste disposal companies, private universities.
Federal Government	622110, 541710, 928110	Federal hospitals, other health care facilities, public health service, armed services.
State/local/tribal Government	622110, 562213, 611310	State/local hospitals, other health care facilities, state/local waste disposal services, state universities.

[1] North American Industry Classification System.

This table is not intended to be exhaustive but rather provides a guide for readers regarding entities likely to be interested in this ANPRM and the EPA's evaluation of information or comments received in response. If you have any questions regarding whether the EPA is seeking input regarding a particular pyrolysis or gasification unit, contact the person listed in the preceding **FOR FURTHER INFORMATION CONTACT** section.

C. Where can I get a copy of this document and other related information?

In addition to being available in the docket, an electronic copy of this notice is available on the Internet. Following signature by the EPA Administrator, the EPA will post a copy of this

notice at *https://www.epa.gov/stationary-sources-air-pollution/clean-air-act-guidelines-and-standards-waste-management.* Following publication in the *Federal Register*, the EPA will post the *Federal Register* version of this document and key technical documents at this same website.

II. Background

A. What are pyrolysis and gasification units?

The CAA does not define pyrolysis or gasification. The EPA has treated pyrolysis and gasification differently under some CAA section 129 rules. These rules apply to various categories of solid waste incineration units (see discussion in section II.B of this preamble). Different types of pyrolysis and gasification units may be operating and used for different purposes or under different circumstances in the United States today. Pyrolysis units have been used for decades in the production of olefins such as ethylene and propylene, and similarly, gasification units have been used for many years in the production of fuel gas from coal. However, over the past few years, there has been an increase in interest using pyrolysis or gasification units to convert different solid materials, such as agricultural wastes and plastics, into gaseous or liquid fuels or substances or materials to be used in the manufacture of products. Pyrolysis and gasification processes have been touted as potential methods to generate a "circular economy"[4] around plastics use, where a post-consumer plastic product can be recycled to produce a plastic of equal or similar quality again instead of being disposed of or "downcycled" to lesser quality products.[5] Pyrolysis and gasification technologies have been used to convert solid and semi-solid materials, including solid waste (*e.g.,* municipal solid waste, commercial and industrial waste, hospital/medical/infectious waste, sewage sludge, other solid waste), biomass, plastics, tires, and organic contaminants in soils and oily sludges to useful

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[4] Circular economy is an emerging term based on, in part, the concept of eliminating waste and the continual use of resources. In this notice, this term applies to recycling post-consumer plastic materials into the basic chemical building blocks for producing another plastic item of similar or the same quality and value.

[5] Downcycling is defined as recycling something in such a way that the resulting product is of a lower value than the original item (Merriam-Webster).

products such as energy, fuels and chemical commodities. Pyrolysis and gasification may have also been used simply to dispose of or reduce or decompose solid wastes. The products of pyrolysis or gasification vary based on whether the reaction is pyrolysis or gasification, the feedstock used, and the operating conditions of the reaction. In varying quantities and compositions, the products of pyrolysis and gasification are a mixture of: syngas (primarily in gasification, which produces a gaseous mixture of carbon monoxide and hydrogen, with smaller quantities of methane, carbon dioxide, water, and other low-molecular-weight volatile organics); liquids (typically oils or waxes of various kinds); char (a solid residue also sometimes called biochar or coke containing fixed carbon and ash); and any metals or minerals that might have been components of the feedstock. In general, these products are used to create other products or are burned to generate energy (*e.g.*, syngas can be converted into heat, power, fuels, or chemical products, or used in fuel cells). In the United States, with a few exceptions, facilities currently using these pyrolysis and gasification technologies for these purposes are most often operating in a demonstration mode and do not have waste contracts and/or energy or product contracts in place that would indicate a full-scale commercial operation. Because most facilities are currently only demonstration or pilot-scale plants, they are likely operating in batch-test rather than in a continuous-mode that would be typical of commercial plants.

1. Pyrolysis units

Pyrolysis is a process where materials are thermally decomposed or rearranged under process conditions where extremely little to no oxygen is present. Pyrolysis, which is also known as devolatilization, is an endothermic process[6] that produces 75-90 percent volatile materials in the form of gaseous and liquid hydrocarbons.[7] Remaining non-volatile materials with high

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[6] Endothermic is a process where heat is absorbed by a chemical reaction, thus resulting in decreased temperature.

[7] *Benchmarking Biomass Gasification Technologies for Fuels, Chemicals and Hydrogen Production*, Prepared for U.S. Department of Energy, National Energy for Technology Laboratory, by Jared P. Ciferno and John J, Marano, 2002

carbon content form a product called char.[8] Pyrolysis relies on intensive heat energy and does not require the presence of oxygen. Pyrolysis units may be used to "crack" or chemically decompose organic materials. Pyrolysis technology vendors use different variations of, and names for, pyrolysis units, including:[9] (1) Thermal pyrolysis/cracking where feedstock is heated at high temperatures (350–900 degrees Celsius (°C)) in the absence of a catalyst; (2) catalytic pyrolysis/cracking where the feedstock is processed using a catalyst; and (3) hydrocracking (sometimes referred to as "hydrogenation") where the feedstock is reacted with hydrogen and a catalyst under moderate temperatures and pressures (e.g., 150–400 °C and 30–100 bar hydrogen). Regardless of the process category, through application of heat, pyrolysis disintegrates the long hydrocarbon bonds of the incoming feed materials and may generate tars, oils, particulate matter, reduced sulfur and nitrogen compounds, and hazardous air pollutants (HAPs) including polycyclic aromatic hydrocarbons (PAHs).

2. Gasification units

Gasification is a process of converting feed materials (primarily carbonaceous) into syngas (carbon monoxide and hydrogen) and carbon dioxide. The materials are gasified when they react with controlled amounts of oxygen or steam at high temperatures (greater than 700 ºC). Oxygen (as air, concentrated oxygen, or steam) is added in small amounts to maintain a reducing (i.e., oxidation or combustion-preventing) atmosphere, where the quantity of oxygen available is less than the stoichiometric ratio (*i.e.*, amount needed for complete combustion of the feed material). The process of gasification has endothermic and exothermic[10] phases, but overall is an exothermic process and requires an external heat source, such as syngas combustion, char combustion, or steam. Gasifiers have a wide variety of types and designs, but there are four

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[8] *Ibid.*

[9] *State of Practice for Emerging Waste Conversion Technologies*. Prepared for U.S. Environmental Protection Agency, Office of Research and Development. EPA 600/R-12/705. October 2012. *https://cfpub.epa.gov/si/si_public_record_report.cfm?Lab=NRMRL&dirEntryId=305250.*

[10] Exothermic is a process where heat is produced by a chemical reaction, thus resulting in elevated temperature.

major classifications: (1) Updraft fixed bed gasifier, (2) downdraft fixed bed gasifier, (3) bubbling fluidized bed gasifier, and (4) circulating fluidized bed gasifier.[11] In updraft gasifiers, which are the oldest designs, feed materials enter from the top of the gasifier and oxygen and/or steam are injected at the bottom; this is referred to as counterflow gasification. Updraft gasification can reach temperatures above 1200 ºC. Downdraft gasifiers generally are configured like updraft gasifiers, but rely on co-current flow, and feed materials and reactants (oxygen and steam) flow in the same direction within the reactor.[12] Like updraft gasification, downdraft gasification can reach high temperatures. Bubbling fluidized bed gasifiers mainly are used to convert materials to syngas. These units typically contain a bed made with inert particles of sand or alumina interspersed with several air or steam nozzles on the reactor floor. Oxygen and/or steam are injected through the nozzles into the bed and create bubbles as they move through the feed materials, leading to more uniform heat distribution throughout the reactor and a higher conversion rate from feed materials to syngas.[13] Circulating fluidized bed gasifiers are in many ways very similar to bubbling fluidized bed gasifiers but are capable of higher gas velocities and throughput by capturing and recirculating the bed medium. These gasifiers may lead to faster reaction and a higher conversion rate.

Syngas, the primary product of gasification, is a fuel and can be burned in boilers, gas engines, or turbines. It can also be used as a chemical feedstock to produce other, more complex chemicals or hydrocarbon fuels. Often, a gasification agent such as steam is added to enhance the fuel value of syngas because steam reacts with carbon monoxide to produce additional hydrogen. Hydrogen may be used as a feedstock or used in fuel cells or hydrogen turbines. Additionally, gasification facilities may use a process, knowns as the Fischer-Tropsch process, where syngas

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[11] *Benchmarking Biomass Gasification Technologies for Fuels, Chemicals and Hydrogen Production*, Prepared for US Department of Energy, National Energy for Technology Laboratory, by Jared P. Ciferno and John J, Marano, 2002.
[12] *Ibid.*
[13] *Ibid.*

converts, in the presence of metal catalysts at 150-300 ºC and high pressures, into liquid hydrocarbon fuel.

B. What is the regulatory background for pyrolysis and gasification units?

As noted previously, there is some difference in the treatment of pyrolysis units among the EPA's existing CAA section 129 rules. CAA section 129 relates to standards for various categories of solid waste incineration units. Some of the EPA's CAA section 129 rules do not mention pyrolysis or gasification at all, while others contain specific language applicable to certain types of units or processes. The rules for MWC, for example, generally define municipal waste combustion units (or municipal waste combustor units) to include "pyrolysis/combustion units" (see, *e.g.*, 40 CFR 60.51a; 40 CFR 60.1465) but exempt such units that are integrated parts of a "plastics/rubber recycling unit" under certain circumstances. (see, *e.g.*, 40 CFR 60.50a(k); 40 CFR 60.1020(h)). With some difference in language, these rules essentially define "pyrolysis/combustion units" as units that produce gases, liquids, or solids through the heating of MSW, and the gases, liquids, or solids produced are combusted and emissions vented to the atmosphere (see, *e.g.*, 40 CFR 60.51a and 60.1465).

The HMIWI rules, by contrast, define pyrolysis to mean the endothermic gasification of hospital waste and/or medical/infectious waste using external energy (see, *e.g.*, 40 CFR 60.51c) and provide that pyrolysis units are not subject to the HMIWI rules (see, *e.g.*, 40 CFR 60.50c(f)). The EPA discussed pyrolysis in a June 20, 1996, proposal relating to the HMIWI standards (61 FR 31736). In the September 15, 1997, final rule (62 FR 48348), the EPA deferred development of standards for pyrolysis units and determined that the HMIWI standards were not appropriate for pyrolysis units. In discussing pyrolysis, the EPA stated, "Pyrolysis technology is different from conventional incineration. Because air is generally not used in the pyrolysis treatment process, the volume of exhaust gas produced from pyrolysis treatment is likely to be far less than the volume of gas produced from the burning of waste in an HMIWI. Although conventional combustion does not occur during pyrolysis treatment, there are some emissions from the

pyrolysis process. (62 FR 48358).” The EPA also noted difficulties with attempting to modify the HMIWI regulations to apply to pyrolysis units; asserted that sufficient information was not available “to develop a separate and uniform regulation for pyrolysis;” and noted that “EPA may consider these devices in future regulatory development” Id. at 48359.

The Agency also notes that there is no definition of “pyrolysis/combustion units” in the NSPS and EG for CISWI units and SSI units, and no definition of gasification units in any of the NSPS and EG discussed in this section.

The current rules for OSWI units define “municipal waste combustion unit” to include “pyrolysis/combustion units” (without defining “pyrolysis/combustion” units (see, *e.g.*, 40 CFR 60.2977). On August 31, 2020, the EPA published a proposed rule in the *Federal Register* for the OSWI standards that, in part, proposed to remove “pyrolysis/combustion units” from the definition of “municipal waste combustion unit.” In that proposal preamble, the EPA stated that the term “pyrolysis/combustion units” is not defined in the current regulation and there is no similar specific reference to such units in the institutional waste incineration unit definition (85 FR 54178, 54187). The Agency also noted that the definition of “solid waste” in the OSWI rules included “contained gaseous material” (defined as gases that are in a container when that container is combusted) resulting from certain activities and asserted that the combustion of uncontained gases in pyrolysis/combustion units is inconsistent with such definition. *Id*. The EPA also added that “unlike combustion, the pyrolysis process is endothermic and does not require the addition of oxygen (*i.e.*, the partial pressure of oxygen during a pyrolysis process is maintained close to zero). Based on this understanding, the Agency recognizes that the pyrolysis process, by itself, is not combustion” *Id*. The EPA received adverse comment[14] on the proposed change to the definition of “municipal waste combustion unit” on the basis that pyrolysis should be considered solid waste combustion and regulated under the OSWI rule. In addition, the

[14] All comment letters associated with the August 31, 2020, proposal are contained in Docket ID No. EPA-HQ-OAR-2003-0156. For a complete history of the OSWI rule, refer to section I.B of the August 31, 2020, proposal preamble (85 FR 54178).

Agency received a comment that the OSWI category should also cover other combustion technologies not already regulated as municipal waste combustors, medical waste incinerators, or commercial and industrial solid waste incinerators under sections 111 and 129 of the CAA, such as pyrolysis and gasification technologies.

The EPA has not issued its final decision on the August 31, 2020, proposed rulemaking, but intends to do so after publication of this ANPRM.[15] As mentioned previously, the EPA will consider all information received through this ANPRM in determining if changes to the MWC, CISWI, OSWI, SSI, and HMIWI rules are appropriate, or whether development of other future regulations is necessary.

III. Small Business Considerations

The Small Business Regulatory Enforcement Fairness Act, signed into law on March 29, 1996, is an amendment to the Regulatory Flexibility Act of 1980 and adopts the Small Business Act's definition of "small entity" as defined in 5 U.S.C. section 601, 15 U.S.C. section 632, and Small Business Administration regulations.[16] This includes small businesses (typically 500 or 750 employees including all parent and subsidiary employees), small governmental jurisdictions (population of less than 50,000), and small organizations (*e.g.*, not-for-profit organizations) that are not dominant in their field. The definition of a "small business" is determined by a business's North American Industry Classification System (NAICS) code and annual receipts or number of employees. Table 2 presents the small business definition for source categories that are may be interested in this ANPRM.

Table 2. SMALL BUSINESS CLASSIFICATION FOR SOURCE CATEGORIES INTERESTED IN THIS ACTION

NAICS Codes[1,2]	NAICS Industry Description	Size Standards in millions of dollars	Size standards in number of employees
114	Fishing, Hunting and Trapping	6-22[3]	NA
211	Oil and Gas Extraction	NA	1,250

[15] The EPA currently is under a court order to sign a final OSWI rule by October 31, 2021. see *Sierra Club v. Wheeler, No. 1:16-cv-02461-TJK (D.D.C.).*

[16] *https://www.govinfo.gov/content/pkg/PLAW-104publ121/pdf/PLAW-104publ121.pdf.*

212	Mining except oil and gas	NA	250-1,500 [3]
221	Utilities	16.5-30[4]	250-1,000 [3]
321	Wood Product Manufacturing	NA	250-1,250 [3]
322	Paper Manufacturing	NA	500-1,250 [3]
325	Chemical Manufacturing	NA	500-1,250 [3]
326	Plastics and Rubber Products Manufacturing	NA	500-1,500 [3]
327	Nonmetallic Mineral Product Manufacturing	NA	500-1,500 [3]
337	Furniture and Related Product Manufacturing	NA	500-1,000 [3]
486	Pipeline Transportation	30-40.5 [5]	1,500[6]
541710	Research and Development	NA	NA
562213	Solid Waste Combustors and Incinerators	41.5	NA
6111	Elementary and Secondary Schools	12	NA
6112	Junior Colleges	22	NA
6113	Colleges, Universities, and Professional Schools	30	NA
622110	General Medical and Surgical Hospitals	41.5	NA
622310	Specialty Hospitals	41.5	NA
7121	Museums, Historical Sites and Similar Institutions	8-30 [3]	NA

[1] North American Industry Classification System.
[2] Small business size standards are not established for NAICS codes starting with 92 (Public administration). Establishments in the Public Administration Sector are Federal, state, and local government agencies that administer and oversee government programs and activities that are not performed by private establishments.
[3] Range represents the range of size standards for the more specific NAICS codes beyond the 3- or 4-digit codes shown, e.g., 221117 (for biomass electric power generation) small business size standard is 250 employees, while 221310 (for natural gas distribution) small business size standard is 1,000 employees.
[4] Size standard in millions of dollars applies only to NAICS codes 221310, 221320, and 221330.
[5] Size standard in millions of dollars applies only to NAICS codes 486210 and 486990.
[6] Size standard in number of employees applies to NAICS codes 486110 and 486910.

The EPA is requesting comment and information to help assess the potential impact of regulating pyrolysis and gasification units on small businesses. This includes requesting information on the number of small businesses potentially impacted by regulating pyrolysis or gasification units; the source categories that contain these entities; any unique or disproportionate burden that these small businesses may face; and any suggestions for addressing the specific impacts on these sources. The EPA is also requesting suggestions for additional outreach opportunities to ensure that small businesses are aware of the potential action and its potential impact on their operations.

IV. Request for Data and Comments

Given that the United States is in the early stages in development of pyrolysis and gasification technologies, the EPA is soliciting real-world cost, design, process, and

environmental information about these technologies, especially for those that have advanced beyond laboratory-scale or bench-scale research and development stages to operational pilot-scale plants or facilities that are already in commercial operation. The Agency identified several facilities that appear to be currently or should soon be operating in the United States that claim to use either the pyrolysis or gasification process to convert solid waste into char, syngas, and/or oil. Table 3 of this preamble lists the facility name, location, and a brief description of the feedstock and technology used at each of these facilities. This table may not be exhaustive, however, and is based on a search of the EPA's applicability determination index database,[17] a 2012 EPA report related to emerging waste conversion technologies,[18] internet searches, and various other information collected by the EPA.

Table 3. COMMERCIAL-SCALE OR PILOT-SCALE FACILITIES CURRENTLY OPERATING OR NEAR OPERATIONAL IN THE US THAT USE EITHER PYROLYSIS OR GASIFICATION UNITS TO PRODUCE CHAR, SYNGAS, AND/OR OIL

Facility Name	Location	Feedstock	Process Description
Del-Tin Fiber LLC/Callidus Closed Loop Gasification System (CLGS)	El Dorado, AR	Bark and sander dust	Gasification
Renew Phoenix	Phoenix, AZ	Mixed Plastics	Pyrolysis
Aries-Holloway Bioenergy Facility	Lost Hills, CA	Biomass	Gasification
Aemerge RedPak Services Southern California LLC	Hesperia, CA	Medical Waste	Gasification
Sierra Energy FastOx Gasification Biorefinery	Fort Hunter Liggett, Monterey County, CA	Biomass and Waste	Gasification
Synergy Solutions Crisp County	Cordele, GA	Biomass	Gasification
Nexus Fuels, LLC	Atlanta, GA	Mixed Plastics	Pyrolysis
Plastic Advanced Recycling Corporation (PARC)	Willowbrook, IL	Mixed Plastics	Pyrolysis

[17] See *https://cfpub.epa.gov/adi/.*
[18] See *"State of Practice for Emerging Waste Conversion Technologies"* dated October 2012, EPA 600/R-12/705 at: *https://cfpub.epa.gov/si/si_public_record_report.cfm?Lab=NRMRL&dirEntryId=305250.*

Tradebe	East Chicago, IL	Organics-laden Solid Waste	Thermal Desorption Unit/Pyrolysis
Brightmark/RES Polyflow	Ashley, IN	Mixed Plastics	Pyrolysis
Coaltec - River View Farms (RVF)	Orleans, IN	Manure	Gasification
Inez Power	Debord, KY	MSW	Gasification
Thermaldyne	Port Allen, LA	Organics-laden Solid Waste	Thermal Desorption Unit/Pyrolysis
Aries Taunton Biosolids Gasification Facility	Taunton, MA	Biosolids	Gasification
InEnTec Dow Corning Corporation Midland	Midland, MI	Chlorosilane Industrial Waste	Gasification
Ecoremedy - Hampton Alternative Energy Products	Triplett, MO	Manure	Gasification
Coaltec - Mead, NE	Mead, NE	Wet Distiller's Grain	Gasification
Aries Linden Biosolids Gasification Facility	Linden, NJ	Biosolids	Gasification
Aries Newark Bio-Fly-Ash Manufacturing Plant	Newark, NJ	Biosolids	Gasification
Monarch Waste Technologies	Santa Fe, NM	Hospital/Medical/Infectious Waste	Pyrolysis
Fulcrum Bioenergy - Sierra BioFuels Plant	Storey County, NV	Prepared MSW	Gasification
JBI/Plastic2Oil	Niagara Falls, NY	Mixed Plastics	Pyrolysis
Lockheed Martin/Concord Blue - RMS facility	Owego, NY	Biomass and MSW	Gasification
Alterra Energy (formerly Vadxx Energy)	Akron, OH	Mixed Plastics	Pyrolysis
Intrinergy Coshocton LLC	Coshocton, OH	Biomass	Gasification
Covanta Tulsa Cleergas Demonstration Plant	Tulsa, OK	MSW	Gasification
Agilyx	Tigard, OR	Mixed Plastics	Pyrolysis
InEnTec Columbia Ridge	Arlington, OR	MSW, Industrial Byproducts, Medical Waste	Gasification
Chemical Waste Management	Arlington, OR	Organics-laden Solid Waste	Thermal Desorption Unit/Pyrolysis
Continental Energy Associates	Hazleton, PA	Anthracite coal refuse (culm)	Gasification
Ecoremedy - Morrisville Municipal Authority	Morrisville, PA	Biosolids	Gasification

Ecoremedy - Flintrock Farms	Central PA	Chicken Litter	Gasification
Norbord South Carolina, Inc.	Kinards, SC	Wood	Gasification
Climax Global Energy	Allendale, SC	Mixed Plastics	Pyrolysis
Lebanon Gasification Initiative	Lebanon, TN	Waste wood, tires and biosolids	Gasification
Carbon Black Global LLC	Dunlop, TN	Wood	Gasification
TDX/US Ecology	Robstown, TX	Petroleum and Petrochemical Wastes	Thermal Desorption Unit/Pyrolysis
Clean Harbors	San Leon, TX	Organics-laden Solid Waste	Thermal Desorption Unit/Pyrolysis
Renewlogy Salt Lake City	Salt Lake City, UT	Mixed Plastics	Pyrolysis
Coaltec - Frye Poultry	Wardensville, WV	Chicken Litter	Gasification

The EPA is also aware of numerous additional pyrolysis or gasification units that are currently operating under development or testing phases in the United States. However, the Agency requests comment on whether Table 3 of this preamble accurately represents the full array of commercial-scale or pilot-scale facilities in the United States that are currently operating and claim to use either pyrolysis and gasification units to convert solid and semi-solid materials, such as waste, biomass, plastics, tires, and organic contaminants in soils and oily sludges, to useful products such as fuels and chemical commodities. The EPA also requests comment on whether the information provided in section II.A of this preamble appropriately captures the universe of pyrolysis and gasification units, and, if not, the Agency requests information on other types of pyrolysis and gasification units or other types of non-combustion units, such as thermal desorption units that process solid waste under pyrolytic conditions to recover oil or other marketable products, that may not be addressed in section II.A of this preamble or may be currently under development or testing phases in the United States.

As more pilot and commercial-scale facilities that use pyrolysis or gasification technologies are built and begin to operate in the United States, there is a growing interest in the general need to determine whether these conversion technologies should be regulated under

CAA section 129 as part of a category (or subcategory) of solid waste incineration unit, or as a specific source category under other provisions of the CAA, including under CAA sections 111 or 112.[19] The Agency is seeking the following information for any pilot or commercial-scale US facility that claims to use a pyrolysis or gasification technology:

- Construction date;
- Startup date;
- Physical address (e.g., state and city);
- Brief description of the technology including the primary purpose of the technology (*e.g.*, to convert MSW into syngas) and how the products (thermal energy, tar, char) are utilized;
- Design type (*e.g.*, indirect heated gasifier or pyrolysis chamber in combination with a thermal oxidizer);
- Additional process equipment (*e.g.*, feed dryer);
- Description of process parameters for the pyrolysis or gasifier chamber which are monitored to ensure proper operation (such as temperature, residence time in reactor, etc.);
- Air pollution control devices or other abatement/upgrade systems and description of operating parameters which are monitored to ensure proper operation;
- Process flow diagram identifying all emission release points to the atmosphere for the facility with or without air pollution or abatement control;
- Air emissions data related to:
    - Emissions from the pyrolysis or gasification chamber(s);

[19] CAA section 111 generally relates to standards for source categories that cause or contribute to air pollution that may endanger public health or welfare and CAA 112 generally relates to standards for major and area sources of listed hazardous air pollutants.

- Emissions from downstream combustion devices (*e.g.*, thermal oxidizer) where gases produced by the pyrolysis or gasification unit are combusted;[20]

- All applicable state and local air regulations specific to the pyrolysis or gasification unit;
- Feedstock composition (*e.g.*, plastics, tires, MSW);
- Facility design capacity (*e.g.*, tons of feedstock per day);
- Mode of operation (*e.g.*, batch or continuous);
- Heat recovery, if any (*e.g.*, feed dryer);
- Operating hours per day and number of operating days per year;
- Nature of operation (*e.g.*, commercial or research and development);
- Plant energy conversion efficiency (*i.e.*, percentage of feedstock energy value that is transformed to and contained in the end product);
- Recovery of materials for recycling, if applicable;
- Beneficial offsets (compared to disposal of feedstock or avoided fossil-fuel or petrochemical use or emissions) for different end product alternatives;
- Distance to market for liquid or gaseous fuels;
- Market prices for energy products; and
- Market prices for recyclable and other byproduct streams.

The EPA reviewed air permits for six of the facilities identified in Table 3 of this preamble. Unfortunately, the air permit review did not result in obtaining the types of information that was requested in this ANPRM.

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[20] According to a 2019 report issued by the U.S. Department of Energy, a major challenge associated with gasification of the MSW is the prevalence of nitrogen and sulfur in the syngas that is produced. The presence of these substances requires cleanup and/or removal if the syngas is to be used in power generation units or catalytic processes to make fuels and co-products. See *"Waste-to-Energy from Municipal Solid Wastes,"* dated August 2019 at: *https://www.energy.gov/sites/prod/files/2019/08/f66/BETO--Waste-to-Energy-Report-August--2019.pdf.*

The EPA is in the process of preparing a detailed questionnaire to obtain the information described above as well as additional process and operating information. The EPA intends to distribute this questionnaire in the form of a CAA section 114 request to entities that will likely include a mixture of vendors of pyrolysis and gasification units, owners of demonstration or pilot-scale plants, and owners of commercial-scale facilities. The first draft of the questionnaire can be found in Docket ID No. EPA-HQ-OAR-2021-0382. The EPA is soliciting comments on additional information or revisions that need to be incorporated in the questionnaire.

V. Statutory and Executive Order Reviews

Under Executive Order 12866, titled *Regulatory Planning and Review* (58 FR 51735, October 4, 1993), this action is not a significant regulatory action and was therefore not submitted to the Office of Management and Budget (OMB) for review.

Because this action does not propose or impose any requirements and instead seeks comments and suggestions for the Agency to consider in possibly developing a subsequent proposed rule, the various statutes and Executive Orders that normally apply to rulemaking do not apply in this case. Applicable statutes and Executive Orders will be addressed once the Agency develops the proposed and final rulemakings.

List of Subjects

40 CFR Part 60

Environmental protection, Administrative practice and procedure, Air pollution control, Hazardous substances, Intergovernmental relations.

40 CFR Part 63

Environmental protection, Administrative practice and procedure, Air pollution control, Hazardous substances, Intergovernmental relations.

Michael S. Regan,
Administrator.
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