CHAPTER 12:

Air Pollutant Emissions and Air Emissions Permitting for Biochar Production Systems

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Biochar production systems (BPS) need to comply with all applicable regulatory requirements, which depend on the size and location of the facility, characteristics of technical operation, feedstock composition, origin, and designation, site land use zoning, regulating jurisdiction, and nearby environmental conditions. Sites may require permits for air, storm water, waste discharge, solid waste, and conditional use as well as other environmental review. Stakeholders in the Western U.S. coastal states (California, Oregon, and Washington) have identified air emissions as a major barrier to more widespread adoption of biochar production. Thus, this section provides an overview of some of the common issues relating to biochar air pollutant emissions and air emissions permitting for BPS, relying on the regulatory experience of a range of experts.

States and tribal agencies have primacy for implementing the U.S. Clean Air Act, which provides a federal basis for air quality permitting.[1] In some states, local air agencies have been established over smaller areas. Different tribal, state, and local entities have different approaches to permitting biochar units because of variability in multiple and emerging technologies, local differences in air quality issues, differences in state regulations, and other factors.

EMISSIONS FROM BIOCHAR PRODUCTION SYSTEMS

Air pollutant emissions from biochar production units vary widely depending on biomass feedstock composition and BPS design, operation, and use of add-on control devices. However, generally speaking, the following potential air pollutants should be considered:

Criteria Air Pollutants

Criteria air pollutants are air pollutants for which the U.S. Environmental Protection Agency (EPA) has established National Ambient Air Quality Standards (NAAQS) and include particulate matter (PM), ozone, (O_3), nitrogen dioxide (NO_2), carbon monoxide (CO), sulfur dioxide (SO_2), and lead (Pb). Volatile organic compounds (VOCs), carbon containing compounds involved in ozone formation, are also regulated. Biomass feedstocks typically have very low sulfur and Pb levels, so SO_2 and Pb emissions tend to be less of a concern, but other criteria pollutants can be produced during biomass processing. Emissions of some criteria pollutants can be reduced with process controls or add-on technologies.

The EPA has established NAAQS for $PM_{2.5}$, fine particulate matter with an aerodynamic diameter less than 2.5 micrometers, and PM_{10}, particulate matter with an aerodynamic diameter less than 10 micrometers. $PM_{2.5}$ settles in the deep and sensitive parts of the lungs and aggravates respiratory illnesses including emphysema, asthma, and bronchitis. Particulate matter, especially $PM_{2.5}$ in the form of smoke, soot, and ash, results from inefficient combustion of BPS pyrolysis or gasification off-gases and the inorganic, non-combustible constituents of the biomass feedstock. PM emissions are controlled by ensuring complete combustion of the off-gasses (often called "syngas" or "producer gas"), and through the use of add-on controls such as cyclones, baghouse filters, electrostatic precipitators, or wet scrubbers that remove entrained particulate matter from the exhaust gases.

Tropospheric (ground level) ozone is not emitted directly into the air, but is created by chemical reactions between VOC and NOx in the presence of

1 *The EPA is responsible for air emissions permitting on tribal land for tribes that have not developed federally recognized permitting programs. To date, although some tribes have local environmental requirements, few tribes have approved permitting programs.*

sunlight. Tropospheric ozone, appearing as smog or haze, is a strong irritant that damages the respiratory system. Some VOCs are also regarded as toxic air pollutants by the U.S. EPA because of known health impacts. VOCs are emitted during the pyrolysis and gasification processes, and can be controlled by ensuring complete combustion. Nitrogen oxides (NOx), including NO_2, are emitted from high temperature reactions between nitrogen contained in the biomass fuel (fuel NOx) or in the combustion air (thermal NOx) with oxygen in the air. NOx emissions can be controlled through the use of fuel and air mixing, and add-on controls involving catalytic and non-catalytic reduction reactions.

Carbon monoxide (CO) is a relatively unreactive compound, but the gas is poisonous to humans and other air-breathing creatures that need oxygen. It also indirectly contributes to the buildup of some greenhouse gases in the troposphere. CO is generated during the pyrolysis and gasification process and from the incomplete combustion of biomass syngas. It is controlled through ensuring complete combustion.

Emissions of criteria pollutants vary widely between systems, and datasets are not extensive. However, it is clear that biochar production units can have considerably lower emissions of PM, CO, VOC, and NOx than open pile burning or burning during wildland fires (Clerico & Villegas 2017; Cornelissen et al. 2016; EMC 2017; Miller & Lemieux 2007; Springsteen et al. 2015; Springsteen et al. 2011). Table 12.1 compares criteria air pollutant emissions from open pile burning with a number of different biomass conversion technologies.

Toxic Air Pollutants

Toxic air pollutants, also called hazardous air pollutants (HAP), are pollutants that cause or may cause cancer, reproductive effects, birth defects or other serious health effects, or adverse environmental and ecological effects. Section 112 of the Clean Air Act identifies 187 hazardous air pollutants. Individual state regulations can identify more. Emissions of toxic air pollutants can vary significantly depending on biomass constituents and conversion unit design and operation – but could potentially include metals, volatile and semi -volatile organics (including polycyclic aromatic hydrocarbons, aldehydes, polychlorinated dioxins and furans, and chlorinated biphenyls), acids (including hydrogen chloride (HCl)), and other compounds, such as ammonia (NH_3) and chlorine (Cl_2). Existing datasets measuring toxic air pollutants are even more limited than those measuring criteria air pollutants.

Metals (such as lead, cadmium, arsenic, chromium, and mercury) emissions are not typically of concern because biomass feedstocks tend to contain very low levels of these constituents. However, they may be of concern for feedstocks that are co-mingled with urban waste. The lower operating temperatures of BPS (compared with combustors and incinerators) and gentle mixing in the primary charring reactor tend to lead to binding of any metals in the biochar product, and reduce metals in the exhaust gas emissions. Add-on control devices including filters, scrubbers, and electrostatic precipitators for fine particulate matter that may be required on larger biochar production units will also provide an additional reduction of non-volatile metals.

Table 12.1. *Comparison of criteria emissions from biomass management options.*

	lb/ton wet biomass (actual)			
Management Alternative	**NOx**	**PM**	**VOC**	**CO**
Open pile burn[1,2]	3.5	8.0	6.0	75.0
Circulating fluidized bed boiler[2]	1.0	0.1	0.0	0.0
Air curtain burner[3]	1.0	1.3	0.9	2.6
Biochar Now[4]	1.0	0.1	0.1	0.1
Kon tiki kiln[5]	0.2	3.0	1.5	13.0

1 *Springsteen, B, T Christofk, R York, T Mason, D Baker, et al., Forest biomass diversion in the Sierra Nevada: Energy, economics and emissions, California Agriculture Journal, Vol 69, No 3, pp 142-149, July-September 2015.*

2 *Springsteen, B, T Christofk, T Mason, C Clavin, B Storey, Emission reductions from woody biomass waste for energy as an alternative to open burning, Journal of the Air and Waste Management Association, Vol 61, pp 63-68, January 2011.*

3 *Clerico, B, E Villegas, San Joaquin Valley Air Pollution Control District, Memo to A Marjollet, Air Curtain Emissions Factors Determination, dated April 4, 2017.*

4 *Emissions Measurement Company, Emissions Testing Report for Biochar Now, LLC, Construction Permit 15WE1395, Biochar Kilns (AIRS 001), Weld County, Colorado, Test Dates: September 6-8, 2017, Project Code BN17-0090. Data courtesy of James Gaspard.*

5 *Cornelissen, G, NR Pandit, P Taylor et al., Emissions and Char Quality of Flame-Curtain "Kon Tiki" Kilns for Farmer-Scale Charcoal/Biochar Production, PLOS ONE 11(5), May 18, 2016.*

Volatile and semi-volatile organics are a potential concern. The syngas generated during biochar production can contain high levels of volatile and semi-volatile organics resulting from the conditions used to produce biochar. For environmental and safety reasons, this syngas must be treated or processed prior to release. Efficiency (and economics) of the biochar production process may also benefit as heat can be recovered during syngas combustion. Most commonly, the syngas is burned (fully oxidized) in add-on flare or afterburners, staged combustion design internal to the reactor, or heat recovery in an engine or boiler. With proper design and operation to ensure sufficient oxygen and time at elevated temperatures, organic emissions will be very low, comparable or lower than biomass combustion units, incinerators, or oil or gas combustion.

Biomass feedstocks typically have very low chlorine levels. Any chlorine in the biomass feedstock will be predominately emitted in the form of HCl in the oxidized exhaust gas, or Cl_2 where the syngas is not fully oxidized.

Greenhouse Gases

BPS emit greenhouse gases (GHGs), including carbon dioxide (CO_2) methane (CH_4), and $PM_{2.5}$[2]. Carbon in biomass is "biogenic", and part of the active natural carbon cycle. Because the CO_2 released during biochar production has been recently captured from the atmosphere and stored in plant tissues through photosynthesis, biomass is generally considered carbon-neutral by state and federal agencies. However, other emissions are of concern—the full GHG impact depends not only on the BPS, but on emissions associated with the complete lifecycle of production and application. This includes biomass sourcing, transport and processing, the amount of carbon captured in biochar, transport and application of biochar, as well as fossil fuel offsets resulting from energy produced and captured during biochar production, and the alternative fate of the biomass without the BPS. The climate impact of biochar is discussed more fully in Chapter 1.

PERMITTING COMPLEXITY AND COST FOR BIOCHAR PRODUCTION SYSTEMS COMPARED TO OPEN BURNING

Those who are exploring the use of BPS to replace open burns in forestry and agriculture will generally find that despite the air quality benefit, the applicable regulatory process is substantially more complex, costly, and time consuming than the permitting process for open burns. For example, in the Northwest, the Department of Natural Resources (Washington) or the Department of Forestry (Oregon) provide regulatory oversight for pile or understory burning in forestry contexts. The primary aim of this oversight is to avoid violating the NAAQS. In practice, the amount of burning allowed is based on the weather forecast and the distance upwind from communities, with a focus on keeping smoke and $PM_{2.5}$ away from communities and not worsening haze in areas that are protected by the Class I Regional Haze Rule.

In contrast, those seeking to operate BPS will need to obtain an air emissions permit from the appropriate state, local, or tribal authority, and the process is likely to require addressing both toxic air pollutants and criteria pollutants. The permit for a BPS is valid for the lifetime of the operation—whereas a prescribed burn permit is issued and approved for a limited one-time burn. Thus, the BPS permitting process is likely to be substantially more time consuming and expensive compared with open pile burning.

OVERVIEW OF PERMIT TYPES FOR BIOCHAR PRODUCTION SYSTEMS

Many, if not most, BPS will fail to qualify for an exemption from air quality permitting and thus will require a permit from the appropriate agency. BPS that have the capacity to discharge emissions exceeding a specified threshold may be subject to Title V or New Source Review/Prevention of Significant Deterioration (NSR/PSD) permitting requirements. Most sites will go through some type of review to determine whether or not these permits apply, and to review, approve, and issue the required permit.

2 *Black carbon, a component of particulate matter (PM), is considered an important climate pollutant that can cause local warming and increased melting when deposited globally on ice and snow.*

New Source Review / Prevention of Significant Deterioration

The NSR/PSD regulations apply to new "stationary sources" and "modifications" of existing sources. NSR applies in nonattainment areas[3] and PSD applies in attainment areas. A "major stationary source" is any source type belonging to a list of 28 source categories which emits or has the potential to emit 100 tons per year or more of any pollutant subject to regulation under the federal Clean Air Act, or any other source which emits (or has the potential to emit) such pollutants in amounts equal to or greater than 250 tons per year (see 40 CFR 52.21(b)(1)(i)).

The PSD permitting process involves rigorous reviews of control technology and air quality impacts. However, unless a BPS is embedded within a major stationary source, it is unlikely to trigger PSD.

Title V

If a facility is designated as a major source, as defined in 40 CFR 70.2, it will need a federally enforceable Title V permit. A major source has actual or potential emissions at or above the major source threshold for any air pollutant subject to regulation. The major source threshold for any air pollutant is 100 tons per year. Lower thresholds apply in non-attainment areas (but only for the pollutants that are in non-attainment). Major source thresholds for hazardous air pollutants (HAP) are 10 tons per year for a single HAP or 25 tons per year for any combination of HAP.[4]

However, regardless of the level of potential emissions, biochar production facilities that are defined as incinerators are subject to one of the federal incinerator rules and will therefore require Title V permitting. For distinct units at commercial or industrial facilities, the Commercial and Industrial Solid Waste Incineration Units (CISWI) rule normally applies. For units that combust waste collected from the public or from multiple facilities, the small municipal solid waste incinerator rule or the Other Solid Waste Incinerators (OSWI) rule may apply. Incinerators are subject to strict emissions limits, as well as requirements for source testing, development of operating and monitoring parameters, and extensive reporting.[5]

Further guidance about whether a pyrolysis unit is an incinerator is available in 40 CFR 241, which identifies the requirements and procedures for the identification of solid wastes used as fuels or ingredients in combustion units under Section 1004 of the Resource Conservation and Recovery Act and Section 129 of the Clean Air Act. By law, units are incinerators if they combust any solid waste.[6] According to 40 CFR 241, clean cellulosic biomass, including materials such as virgin wood and agricultural residues, are not considered to be solid waste. Gases are not normally considered solid waste unless they are contained (such as gases in a discarded propane canister). When the biomass feedstock to a BPS stays under the control of the facility being permitted, then the facility can self-certify whether or not the secondary material is a fuel or a waste, after considering the definitions and procedures in 40 CFR 241.

Air curtain incinerators (ACI) represent a special category of BPS, as they are defined within section 129 of the Clean Air Act as incinerators. They will, therefore, be subject to one of the federal incinerator standards (with a limited set of requirements) and will be required to obtain Title V permits.[7] Oregon is trying to reduce this burden by creating a Title V general permit, which would allow owners and operations to obtain permits more easily and at a lower cost.[8] In August 2020, the EPA proposed a rule change to exempt ACI from Title V permitting where they process virgin forest materials.

NSR Permit

The Clean Air Act and its implementing regulations require each state to prepare a plan to ensure that the construction or modification of sources of air pollution will not result in violations of restrictions on air pollution or attainment or maintenance of the NAAQS.[9] On tribal lands, the EPA has established minor source permitting requirements in the *Federal*

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3 *A nonattainment area is an area where concentrations of a criteria air pollutant exceed the NAAQS. The boundaries of non-attainment areas are proposed by the state and approved the EPA.*

4 *In this case, the list of HAP is limited to those air toxics identified in section 112 of the Clean Air Act.*

5 *See 40 CFR part 60, subparts AAAA and BBBB for requirement that may apply to small municipal solid waste incinerators, subparts CCCC and DDDD of CISWI units, and subparts EEEE and FFFF for OSWI units.*

6 *Natural Resources Defense Council et al. vs. EPA, Case No. 04-1385 (D.C. Circuit, June 8, 2007)*

7 *Because this requirement is in the Clean Air Act, changing it would require an act of Congress.*

8 *General Title V permits are allowed under 40 CFR 70.6(d).*

9 *See Clean Air Act sections 110(a) and 110(j). Also, 40 CFR part 51, subpart I.*

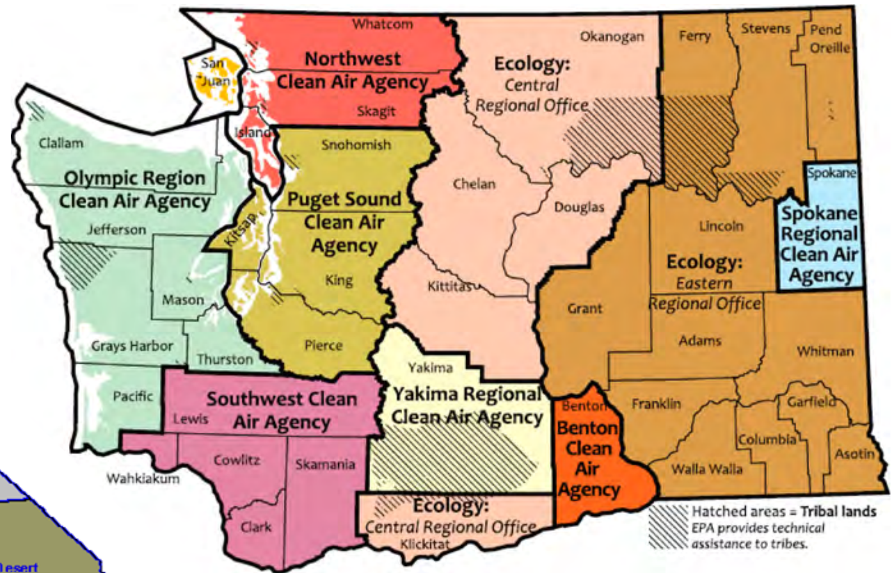

Figure 12.1. *(left) Map of California air districts.*
Figure 12.2. *(above) Map of Washington air districts.*

Minor New Source Review Program in Indian Country.[10] The threshold for permitting and the requirements of NSR vary significantly from permitting authority to permitting authority, even between different authorities within the same state.

In California, Oregon, and Washington, the review process for a BPS may include:

- A demonstration that the proposed equipment will comply with all applicable requirements, including federal standards (if any) and state prohibitory rules;
- A determination of the appropriate control technology;
- Quantification of emissions of all regulated air pollutants;
- A demonstration that additional emissions will not result in an exceedance of the NAAQS;
- A review of air toxics emissions and impacts (each state has its own health-based air toxics control program);
- In nonattainment areas (including in much of California) a requirement to offset new emissions;
- There may be an initial state-required siting review (such as CEQA in California or SEPA in Washington); and
- State-required GHG programs if applicable.

In some areas, including in California and Oregon, the NSR permitting process is divided into separate construction and operating permits. In other areas, such as Washington and tribal lands where the EPA issues the permits, there is a single permit that allows both construction and operation. However, it would be possible for state, local, and tribal agencies to issue a general NSR permit for classes of air pollution sources or implementing permit-by-rule, which allows equipment that meets certain criteria and complies with a set of standardized requirements to avoid permitting.[11]

To better understand local NSR permitting requirements, it is important to contact the permitting authority early in the process.

- In California, there are 35 local permitting authorities. See Figure 12.1 for more information.
- In Oregon, the Oregon Department of Environmental Quality issues permits except in Lane

10 See 40 CFR 49,151 through 49.165.

11 Tribal Minor New Source Review: https://www.epa.gov/tribal-air/tribal-minor-new-source-review

County, where permits are issued by the Lane Regional Air Protection Agency.

- In Washington, there are seven local permitting authorities. The Department of Ecology issues permits in many rural areas and under special circumstances. See Figure 12.2 for more information.
- EPA Region 9 issues air permits on tribal lands in Arizona, California, and Nevada.
- EPA Region 10 issues air permits on tribal lands in Alaska, Idaho, Oregon, and Washington.

To illustrate how the permitting process can play out at the local level, and the complexity that represents a barrier to BPS adoption, the sidebar ("A Case Study of the Permitting Process for a Biochar Production System in California" on page 163) provides more information relevant to permitting of BPS in California, which is among the more time-consuming processes in the western U.S.

THE ROLE OF EMISSIONS DATA IN PERMITTING

The level of emissions of both criteria pollutants and toxic air pollutants directs decisions throughout the permitting process, from whether and what type of permitting is needed, to identification of the most important criteria and toxic air pollutants that will be the permitting focus.

As previously discussed, one challenge to quantifying emissions of BPS is that emissions from biochar production units can be quite variable, depending on feedstock type, composition (including moisture content), and equipment parameters. This adds complexity to the task of developing a regulatory framework applicable to biochar—though in some cases, there are fairly straight-forward rules of thumb that can help reduce emissions (for example, processing dry feedstocks will generally reduce emissions compared to wet feedstocks).

A second challenge relates to the dearth of existing data measuring emissions of criteria pollutants and toxic air pollutants from BPS. In evaluating emissions rates for new sources, permitting agencies prefer source test performance data from similar units to the one being proposed. However, lacking this data, alternatives can be considered, such as the use of data from biomass or fossil fuel combustors, and/or engineering mass balance estimates based on feedstock composition. For criteria air pollutants, permits would most likely require source testing following installation of the BPS to demonstrate compliance with permit emission limits, and may require subsequent periodic source tests (for example, every 3 years).

When air agencies can rely on existing datasets to derive emissions factors that can be applied, this can speed the permitting process and greatly reduce costs. These costs are a concern for BPS at all scales, but can be a particular concern for smaller biochar production systems operating in resource-limited contexts. However, it can be difficult to utilize emissions factors for BPS, as existing emission data are limited for criteria pollutants for many (though not all) types of biochar production units; emission data are lacking for toxic air pollutants for all types.

Depending on the pollutants of interest, indirect sampling may be an option in some cases, and can reduce analytical complexity and cost compared to direct measurement. For metals (if suspect feedstocks such as urban waste are used) and for HCl, strategic feedstock sampling and analysis can be a very cost-effective alternative to stack sampling. For organics, an effective and commonly used alternative to speciated organics measurements is to use measurements of CO and total volatile organic compounds as surrogate indicators for complete combustion.

Given the lack of data, source testing may be required. While on the one hand, this process will generate data that may be helpful for others, it can be prohibitively expensive in some cases. However, in the absence of more specific data, permit writers tend to make conservative assumptions, which may overestimate the risk. This in turn results in more constrictive operational parameters, such as the minimum acceptable distance to a home, park, or other site of an individual who may be harmed by the pollution.

It is also likely that in a context in which there is limited-to-no existing data to help guide which toxics are of potential concern, variability in permitting approach from jurisdiction to jurisdiction will be particularly high. Depending on the specific biochar production process, toxic air pollutants which may potentially be of concern include acrolein, formaldehyde, acetaldehyde, benzene, trace metals, polycyclic aromatic hydrocarbons (PAH), dioxins, furans, and miscellaneous constituents including hydrogen chloride and ammonia. The list of potential concerns is currently large, so improvements in knowledge could also help narrow the focus to those most likely to be problematic.

If permitting is needed, emissions of one or a few potential criteria pollutants and one or a few potential toxic air pollutants generally drive the permitting process. The particular compound or compounds depend on the specific emission profile of the BPS, the air quality issues that are most important in the location(s) in which the BPS will operate, and the

A Case Study of the Permitting Process for a Biochar Production System in California

In California, an "Authority to Construct" (ATC) (or "Notice of Construction Permit") application must be submitted prior to facility construction. This application, prepared by the BPS developer, would contain a thorough description of the equipment, operation, and anticipated emissions. This application is submitted to the local regulatory agency responsible for air quality permitting. The application is then reviewed by the regulatory agency to ensure compliance with all applicable requirements, including New Source Review (NSR), prohibitory rules, and air toxics. These requirements, as discussed in more detail below, depend on the air quality attainment status of the siting location.

Best Available Control Technology

Under NSR, the use of Best Available Control Technology (BACT) may be required. Examples of BACT emissions thresholds in California Air Districts are shown in Table 12.5. The site-specific determination of BACT will be based on the most effective controls used (with lowest emissions levels achieved in practice) at similar existing facilities, or another control determined to be technologically feasible and cost effective. For larger BPS plants, this might require PM control with baghouse filters, electrostatic precipitators, or scrubbers, CO and reactive organic gas (ROG)[1] control through combustion air and fuel adjustments, and NOx control through selective non-catalytic reduction or selective catalytic reduction.

Offsets

For areas in non-attainment with ambient air quality standards, NSR may also require emissions "offsets". Much of the State of California is in non-attainment with ozone ambient air quality standards, thus offsets may be required for ROG and NOx in these locations. Offsets levels required are the difference between actual emissions after BACT and the specific offset threshold (shown in Table 12.5). Offsets are typically obtained through the purchase of Emission Reduction Credits (ERC). ERC represent previously reduced emissions, usually from other facilities, and must be shown to be in addition to any requirement under the law (surplus), documented through records (quantifiable), and have mechanisms to ensure reductions will continue in the future (enforceable and permanent). ERC must be obtained from sources within the same air basin as the biomass source, and can be required at a greater than 1-to-1 ratio, depending on the distance from the BPS and the site(s) where individuals may be impacted by emissions.

Health Risk Assessment

The regulatory agency will also likely require a health risk assessment (HRA) based on air toxics emissions. An HRA requires quantification of both the acute health risk from short-term exposure to high pollutant concentrations, and chronic non-cancer and cancer risk from long-term exposure for all air toxics that are emitted. This is performed using air dispersion modeling, requiring local meteorology data including wind speed and direction, and identification of local and sensitive receptors. Typical allowable additional risks are a cumulative cancer risk of less than ten in one-million, and a hazard index (for non-cancer constituents) of less than one.

Prohibitory Rules

There may also be prohibitory rules that apply to BPS, particularly limitations for boilers and internal combustion engines for CO, NOx, and/or PM. Typically, BACT and offset requirements are ultimately as or more stringent. BPS units also will need to meet general nuisance rules, which provide authority to the regulatory agency to control the discharge of any air contaminants that is determined to cause injury, detriment, endangerment, discomfort, annoyance, or which have a natural tendency to cause damage to business or property (California Health and Safety Code Section 41700; Placer County Air Pollution Control District Rule 205, Nuisance), and opacity limits,

Table 12.5. *Best Available Control Technology (BACT) and offset thresholds for selected local California Air Quality Agencies*

Local Air Quality Agency	BACT Threshold (lb/day)				Offset Threshold (tons/yr)			
	PM	NOx	CO	ROG	PM	NOx	CO	ROG
Feather River	80	10 / 25	500	10 /25		10 / 25		10 / 25
Butte Co.	80	25	500	25		25		25
El Dorado Co.	80	10	550	10	15	10	15	10
Placer Co.	80	10	550	10	15	10	99	10
Tehama Co.	80	25	500	25		25		25
Shasta Co.	80	25	500	25		25		25
N. Coast Unified	80	50	500	50		25		25

PM = particulate matter; NOx = nitrogen oxides; CO = carbon monoxide;
ROG = reactive organic gasses

1 *Reactive Organic Gases (ROG) is a term used by and defined by the California Air Resources Board. While it includes many of the compounds included on the list of Volatile Organic Compounds (VOC) as used by the U.S. Environmental Protection Agency (EPA), it also includes low-reactive organic compounds which have been exempted by the EPA.*

specific regulatory process in a given location. As one example, existing emissions data for a Biochar Now unit are shown in Table 12.2. If such a unit were to be installed in Placer County, California, comparison of the emissions values with the Best Available Control Technology (BACT) thresholds and the Emissions Reduction Credits (ERC) thresholds for this location (Table 12.3 and Table 12.4, respectively) indicates that NOx is the most important of the criteria pollutants for this situation, with BACT required for greater than ten units, and ERC purchase required if more than 50 units were operated in a single location.

Illustrating the importance of location and regulatory context, if such a unit were installed Skagit County, Washington, a permit would not be required based on the potential emissions profile shown in Table 12.2.

PORTABLE OR TEMPORARY BIOCHAR UNITS

Portable or temporary BPS represent a particularly difficult issue for most local air quality agencies. Mobile units are also often smaller scale operations for whom the permitting costs can be prohibitively complex, time consuming, and expensive. And in situations where mobile facilities are used primarily to produce biochar from residues in place of open burns, permitting can serve as an obstacle to improvements in air quality, counter to its original intent.

Table 12.2. *Emissions data for a Biochar Now unit (Gaspard, unpublished data).*

Pollutant	Actual Emissions (per kiln) lb/hr	Potential Emissions (per kiln)		Emission Factor lb/ton material
		lb/day	tons/year	
NOx	0.13	1.17	0.214	1.04
PM	0.016	0.14	0.026	0.13
VOC	0.01	0.09	0.016	0.08
CO	0.0072	0.06	0.012	0.06

Table 12.3. *Best Available Control Technology (BACT) thresholds for select Air Districts in California, in April 2020.*

Pollutant	BACT Threshold (lb/day)		
	Placer	San Joaquin	Shasta
NOx	10	2	25
PM	10	2	25
VOC	80	2	80
CO	550	2	500

Table 12.4. *Emissions Reduction Credit (ERC) thresholds for select Air Districts in California, in April 2020.*

Pollutant	ERC Threshold (tons/yr)		
	Placer	San Joaquin	Shasta
NOx	10	10	0
PM	10	10	0
VOC	15	15	0
CO	99	100	0

Continued from "A Case Study of the Permitting Process for a Biochar Production System in California" on page 163.

which limit opacity to no more than 3 minutes of opacity greater than 20% in any one hour (e.g., Placer County Air Pollution Control District Rule 201, Visible Emissions).

California Environmental Quality Act

An evaluation under the California Environmental Quality Act (CEQA) may be required if it is concluded that the biomass project has a significant impact on the environment. CEQA review involves an analysis of the environmental impacts of the project, the alternatives, and consideration that significant impacts are mitigated to the extent feasible. For a biomass conversion unit, alternatives to be analyzed may include different siting locations and different biomass disposal options such as open pile burn, on-site grinding, and/or air curtain destructors. The analysis must incorporate all significant effects of facility construction, indirect emissions from mobile source activity, and the cumulative impacts of other emission sources in the area.

Greenhouse Gas Emissions

The California Air Resources Board (CARB) requires the annual reporting of GHG from sources, including biomass, that emit GHG of greater than 25,000 metric tonnes annually. Under the CARB GHG cap-and-trade program, GHG from biomass combustion are considered carbon neutral, and will not require allowances. This is consistent with other regional programs, and international and federal guidance. A consideration of GHG impacts may also be required under CEQA review.

Permit to Operate

Following facility construction and startup operation, and a regulatory agency inspection, a full Permit to Operate (PTO) will be issued. The PTO is a legally binding document that includes enforceable conditions with which the biomass plant operator must comply. It contains a detailed list of requirements including those related to the facility operation (such as material throughput limits, pressure and temperatures, and conditions on the operation of the air pollution control devices), emissions limitations, monitoring and testing procedures, and recordkeeping and reporting. ■

Though there are some allowances for certain limited temporary operations, the existing regulatory structure tends to require that these units have permits. There are also concerns relating to the ability to know how often they will move, what areas they will operate in, and how regulators will be able to access them for inspections. Obtaining land use approval at multiple locations may also be an issue. Addressing these issues may require long-term policy work to develop regulatory structures that are appropriate to their scale and use, while also protecting air quality for the communities near their operation.

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