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Air Quality Issues and Animal Agriculture: A Primer

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Summary

From an environmental quality standpoint, much of the public and policy interest in animal agriculture has focused on impacts on water resources, because animal waste, if not properly managed, can harm water quality through surface runoff, direct discharges, spills, and leaching into soil and groundwater. A more recent issue is the contribution of air emissions from animal feeding operations (AFOs), enterprises where animals are raised in confinement. This report provides background on the latter issue.

AFOs can affect air quality through emissions of gases such as ammonia and hydrogen sulfide, particulate matter, volatile organic compounds, hazardous air pollutants, and odor. These pollutants and compounds have a number of environmental and human health effects.

Agricultural operations have been treated differently from other businesses under numerous federal and state laws. Some environmental laws specifically exempt agriculture from regulatory provisions, and some are designed so that farms are not subject to most, if not all, of the regulatory impact. The primary regulatory focus on environmental impacts has occurred under the Clean Water Act. In addition, AFOs that emit large quantities of air pollutants may be subject to Clean Air Act regulation. Some livestock operations also may be regulated under the release reporting requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Emergency Planning and Community Right-to-Know Act (EPCRA). Questions about the applicability of these laws to livestock and poultry operations have been controversial and have drawn congressional attention. Agriculture's role as both a source of and a "sink" for greenhouse gases also has been of interest in connection with addressing the global challenge of climate change.

How to evaluate and manage the health and environmental impacts of emissions from animal agriculture facilities has largely been left up to states. Several states have recognized a need to regulate air emissions from agricultural operations, but many states have not yet adopted or enacted programs affecting AFO emissions. State programs, under statutes and regulations, both implement and supplemental federal CAA requirements. States have used varied techniques to control air emissions from livestock facilities, including emission limits, use of best management practices, and imposition of other pre-operational and operational requirements.

Congress has shown interest in many of the issues discussed in this report and, more broadly, in the impact of federal regulation on the agriculture sector.

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Introduction

Animal agriculture is a $100 billion per year industry in the United States. Livestock and poultry are raised on an estimated 1.3 million farms throughout the nation. About 238,000 of these farms are considered animal feeding operations (AFO)—agriculture enterprises where animals are kept and raised in confinement. An estimated 95% of these are small businesses: most AFOs raise fewer than 300 animals. Very large AFOs, housing 300 or more animals such as cows (or equivalent numbers of other animal species), are defined as concentrated animal feeding operations, or CAFOs. For more than two decades, organizational changes within the industry to enhance economic efficiency have resulted in larger confined production facilities that often are geographically concentrated. Increased facility size, greater numbers of animals being raised at large feedlots, and regional concentration of livestock and poultry operations have, in turn, given rise to concerns over the management of animal wastes from these facilities and potential impacts on environmental quality.

From an environmental quality standpoint, much of the public and policy interest in animal agriculture has focused on impacts on water resources, because animal waste, if not properly managed, can adversely impact water quality through surface runoff and erosion, direct discharges to surface waters, spills and other dry-weather discharges, and leaching into soil and groundwater. However, animal feeding operations can also result in emissions to the air of particles and gases such as ammonia, hydrogen sulfide, and volatile organic chemicals (VOC). At issue today are questions about the contribution of AFOs to total air pollution and corresponding ecological and possible public health effects. Resolving those questions is hindered by a lack of adequate, accurate, scientifically credible data on air emissions from AFOs, data that are needed to gauge possible adverse impacts and subsequent implementation of control measures.

This report provides background on these issues.[1] It first reviews the types of air emissions from livestock and poultry operations and their human health and environmental impacts. It then discusses provisions of several federal laws concerned with environmental impacts, beginning with the Clean Water Act, because protecting water resources has been the primary regulatory focus regarding livestock and animal operations. The Environmental Protection Agency (EPA) has authority to address AFO air emissions under several laws—the Clean Air Act; the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, or Superfund); and the Emergency Planning and Community Right-to-Know Act (EPCRA)—which are discussed next. Questions about the applicability of these laws to livestock and poultry operations have been controversial in several arenas and have drawn congressional attention. Agricultural emissions of greenhouse gases that have been of interest in connection with proposals to address the global challenge of climate change are discussed. Studies by the National Research Council concerning air emissions are reviewed, as are relevant activities of the states and the U.S. Department of Agriculture. Finally, the report identifies a number of key research questions needed to characterize and evaluate animal agriculture emissions.

[1] This report focuses on the animal production segment of agriculture. Other types of production agriculture also can generate air emissions, such as land preparation and crop harvest activities, prescribed burning, and other farming practices, or emissions associated with storage and use of mobile source fuels and operation of farm vehicles, engines, and equipment. While some of these types of emissions may contribute to air quality problems, especially in agriculture-dominated regions, they are outside the scope of this report.

Air Emissions from Livestock and Poultry: Sources and Impacts

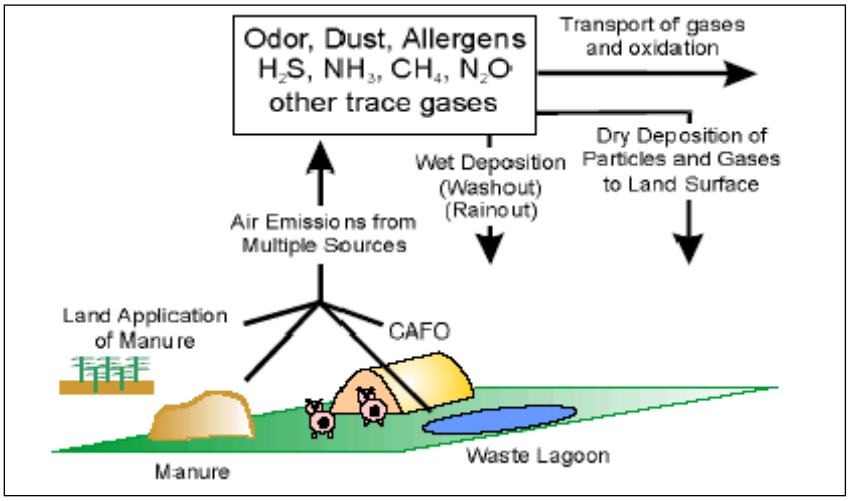
AFOs can affect air quality through emissions of gases (ammonia and hydrogen sulfide), particulate matter (PM), volatile organic compounds (VOC), hazardous air pollutants, microorganisms, and odor. AFOs also produce gases (carbon dioxide and methane) that are associated with climate change. The generation rates of odor, manure, gases, particulates, and other constituents vary with weather, time, animal species, type of housing, manure handling system, feed type, and management system (storage, handling, and stabilization).

Emission sources include barns, feedlot surfaces, manure storage and treatment units, silage piles, animal composting structures, and other smaller sources, but air emissions come mostly from the microbial breakdown of manure stored in pits or lagoons and spread on fields. Each emission source will have a different profile of substances emitted, with rates that fluctuate through the day and the year. The sources, fate, and transport of AFO emissions are illustrated in **Figure 1**.

Health and Environmental Impacts

Pollutants associated with AFOs have a number of environmental and human health impacts. Most of the concern with possible health effects focuses on ammonia, hydrogen sulfide, and particulate matter, while major ecological effects are associated with ammonia, particulates, methane, and oxides of nitrogen.[2]

Figure 1. Fate and Transport of Air Emissions Associated with Animal Feeding Operations



Source: The University of Iowa and The University of Iowa Study Group, *Iowa Concentrated Animal Feeding Operations Air Quality Study, Final Report*, 2002, p. 87.

The nitrogen in animal manure can be converted to **ammonia** (NH_3) by a combination of processes. Ammonia released from the surface of liquid manure storage structures rapidly adheres

[2] The following discussion is drawn primarily from National Research Council, *Air Emissions from Animal Feeding Operations, Current Knowledge, Future Needs*, 2003, pp. 65-71 (hereinafter cited as NRC 2003 AFO Report); and David R. Schmidt et al., National Center for Manure and Animal Waste Management, North Carolina State University, *Air Quality and Emissions from Livestock and Poultry Production/Waste Management Systems*, August 12, 2002.

to particles in the air, due to its cohesive properties, thus contributing to the formation of ambient particulate matter, specifically ammonium nitrate and ammonium sulfate. These particles form to a varying degree in the presence of ammonia and oxides of nitrogen or sulfur (see below). Once emitted, ammonia also is re-deposited back to earth in rainfall that can harm surface waters and aquatic life in lakes and streams. Ammonia aerosols in rainfall contribute to oxygen depletion of aquatic systems and excessive growth of algae, as well as acidification of the environment. It is estimated that emissions from animal waste account for about one-half of the total natural and anthropogenic ammonia emitted in the United States annually. Ammonia has a strong, sharp, characteristic odor that disperses rapidly in the air. Health effects at low concentrations include eye, nose, and throat irritation; exposure at very high short-term concentrations can be lethal.

Particles are highly complex in size, physical properties, and composition. For regulatory purposes, airborne particulate matter (PM) is commonly considered as coarse particles (those less than 10 microns in diameter, referred to as PM_{10}), or fine particles, those less than 2.5 microns in diameter (referred to as $PM_{2.5}$). PM_{10} and $PM_{2.5}$ can be directly emitted geologic material, including from unpaved roads and other dust. Agriculture is a major direct source of PM_{10}, from sources such as grain mills or storage facilities, feeding equipment, and particles generated in other mechanical processes. In contrast, $PM_{2.5}$ is a different class of particles, resulting more from evaporation and atmospheric chemical processes than from direct emissions. Fine particles are formed in the atmosphere through the chemical interaction of precursor emissions such as sulfur oxides, nitrogen oxides, and VOCs.

AFOs can contribute directly to particulate matter through several mechanisms, including animal activity, animal housing ventilation units, and particles of mineral and organic material from soil and manure that adhere to air molecules. As described above, particulate matter can contribute indirectly to fine particle formation by emissions of ammonia, nitrogen oxides, and hydrogen sulfide, which are converted to aerosols through reactions in the atmosphere. Particle formation is highly dependent on atmospheric temperature, humidity, concentrations of the precursor compounds, and other factors, so the particle formation is variable and difficult to predict. Particles of differing sizes have been linked to health effects. Larger particles tend to be deposited in the upper airways of the respiratory tract, whereas small particles have both health and environmental effects: they can be deposited in the smallest airways in the lungs and, while still airborne, also play an important role in formation of regional haze. Populations with long-term exposure to heavier loads of particles have higher rates of mortality from major cardiovascular diseases, as well as increased rates of morbidity. The primary environmental and ecological effects of particles are related to haze and decreased visibility, which is caused by the suspended aerosols that both absorb and scatter light.

Hydrogen sulfide (H_2S) is a colorless gas with a strong and generally objectionable rotten egg odor. It is produced in anaerobic (oxygen-deprived) environments from the microbial reduction of sulfate in water and the decomposition of sulfur-containing organic matter in manure. Acute human health effects include respiratory and cardiovascular irritation, as well as headaches. H_2S may have local effects of concern—especially odor—and may contribute to the atmospheric sulfur burden of regions with a high density of AFOs, but few other sources.

Methane and **nitrous oxide** are greenhouse gases that are known to contribute to global warming. An estimated one-half of global methane comes from manmade sources, of which agriculture is the largest source, with livestock production being a major component within the sector. EPA estimates that more than 30% of the nation's methane emissions come from livestock. Agricultural methane is produced by ruminant animals, but also is emitted during microbial degradation of organic matter under anaerobic conditions. Nitrous oxide forms via the microbial processes of nitrification and denitrification. In the United States, manure management accounts

for about 5% of nitrous oxide emissions and 7.5% of methane emissions. (See "Agricultural Emissions of Greenhouse Gases," below, for discussion.)

Many of the complaints about AFOs are generated by **odor**. Odor from AFOs is not caused by a single substance, but is rather the result of a large number of contributing compounds, including ammonia, VOCs, and hydrogen sulfide. As classes of compounds, odor and VOCs can be considered together. VOCs (also referred to as reactive organic compounds, or ROG) vaporize easily at room temperature and include a large number of constituents, such as volatile fatty acids, sulfides, amines, alcohols, hydrocarbons, and halocarbons. In terms of their health and environmental effects, some VOCs may irritate the skin, eyes, nose, and throat. They also can be precursors to the formation of $PM_{2.5}$ and ozone (smog).

Adverse effects of ozone include lung damage and exacerbated respiratory disease, as well as diminished visibility. Ozone in the troposphere, the lowest layer of the atmosphere which is closest to the Earth, has both natural and anthropogenic sources. It can damage forests, crops, and manmade materials, and harm respiratory tissue through inhalation. Ozone that occurs naturally at ground-level is generally at low concentrations that are not believed to threaten human health or the environment. Ozone that is a byproduct of human activity is formed through the interaction of sunlight with VOCs, nitrogen oxides, and other substances and adds to the total atmospheric burden of the pollutant.

Other types of emissions associated with agricultural operations include biologically active agents (bacteria, mold spores, allergens, and toxins).

Effects of these pollutants occur on a variety of scales, as shown in **Table 1.**

Table 1. Potential Importance of AFO Emissions at Different Spatial Scales

Emissions	Global, national, and regional	Local (property line or nearest dwelling)	Primary effects of concern
NH_3 (ammonia)	Major	Minor	Atmospheric deposition, haze
N_2O (nitrous oxide)	Significant	Insignificant	Global climate change
NO_x (the sum of nitric oxide and nitrogen dioxide)	Significant	Minor	Haze, atmospheric deposition, smog
CH_4 (methane)	Significant	Insignificant	Global climate change
VOCs (volatile organic compounds)	Insignificant	Minor	Quality of human life
H_2S (hydrogen sulfide)	Insignificant	Significant	Quality of human life
PM_{10} (coarse particulate matter)	Insignificant	Significant	Haze
$PM_{2.5}$ (fine particulate matter)	Insignificant	Significant	Health, haze
Odor	Insignificant	Major	Quality of human life

Source: National Research Council, *Air Emissions from Animal Feeding Operations, Current Knowledge, Future Needs*, 2003, Table ES-1, p. 5. Rank order from high to low importance is major, significant, minor, and insignificant. Emissions from non-AFO sources may have different rankings. For example, VOCs and NO_x play important roles in the formation of tropospheric ozone, however, the role of AFOs is likely to be insignificant compared to emissions from other sources.

Control Strategies

Manure management varies widely across animal species, region, and farm type, depending on climate, soil productivity, farm size, and other factors. Systems and strategies now in wide use by farmers are those that have proved the most cost-effective and reliable at achieving their design objectives. Land application has been and remains the predominant method for disposing of manure and recycling its nutrient and organic content. For the most part, design objectives for managing manure do not include minimization of emissions of ammonia, methane, or other gaseous compounds, but rather focus on odor and dust control, avoidance of direct discharge to surface water, and land application at rates that are beneficial to growing crops.[3]

As noted above, emissions of odors, gases, and dust from livestock production facilities arise from buildings, manure storage, and land application. Eliminating emissions from one of these sources will likely not eliminate emissions entirely, as control technologies often address only one of the three sources. Many of the available technologies reduce emissions; none eliminates them.[4] Some technologies have been evaluated to the point of demonstrating efficacy, but most have not been evaluated systematically.

Emissions from buildings can be reduced by inhibiting contaminant generation, or by capturing and treating the air as it leaves the building (e.g., by using biofilters to treat ventilation air, or wet or dry scrubbing of air as it passes through evaporative pads before release). Frequent manure removal is one of the best ways of reducing contaminant generation within the building. Other methods that can be used inside buildings include using bedded solid manure (i.e., manure mixed with bedding that creates a solid stack of material), chemical additives on animal litter, and diet manipulation.

There are four general types of manure storage: deep pits, outdoor slurry storage, anaerobic lagoons, and solid stacks. Outdoor storage is the most apparent source of odors. Controls that have been shown to be effective when managed properly include various types of covers (permeable and impermeable, natural such as straw or cornstalks, and synthetic). Techniques to manipulate the manure to minimize emissions also exist but have certain limitations. For example, separating solids from liquid manure reduces the load on anaerobic lagoons, but also creates a second waste stream to manage which may be detrimental to overall air quality. Proper aeration will eliminate odors from outdoor storage, but it is expensive in a liquid system. Anaerobic digesters reduce odors, but they are also not economically feasible.[5]

Emission control during land application is best done by direct injection of liquid manure below the soil surface. Solid manure is generally less odorous than liquid, but because it cannot be injected, rapid incorporation into the soil by plowing or similar techniques is the best method to minimize odors.

While many treatment technologies are available that may be important in mitigating emissions, the effectiveness of most of them is not well quantified. Extensive research programs are underway in the United States and Europe, and many options of varying cost and effectiveness are being evaluated. Livestock emission mitigation research is being performed by the University of California at Davis, California State University Fresno, Purdue University, Texas A&M University, and others, and information on available control measures and strategies for

[3]NRC 2003 AFO Report, pp. 46-47.

[4] Iowa State University and The University of Iowa Study Group, *Iowa Concentrated Animal Feeding Operations Air Quality Study, Final Report*, February 2002, p. 203. (Hereinafter cited as *Iowa CAFO Air Quality Study*.)

[5] Ibid., p. 207.

agricultural sources of air pollution is being presented.[6] Experts believe that cost, increased management requirements, and a lack of economic or regulatory incentives to encourage or require their use are the primary reasons that more poultry and livestock producers have not adopted technologies to reduce emissions.[7]

Environmental Statutes and Regulation of Animal Feeding Operations

The animal sector of agriculture has undergone major changes in the last several decades, a fact that has drawn the attention of policymakers and the public. In the United States there are an estimated 238,000 animal feeding operations where livestock and poultry are confined, reared, and fed, according to the U.S. Department of Agriculture's 1997 Census of Agriculture.

Organizational changes within the industry to enhance economic efficiency have resulted in larger confined production facilities that often are geographically concentrated.[8] The driving forces behind structural change in livestock and poultry production are no different than those that affect many other industries: technological innovation and economies of scale. From 1982 to 1997, the total number of U.S. operations with confined livestock fell by 27%. At the same time, the number of animals raised at large feedlots (generally confining 300 animals or more) increased by 88%, and the number of large feedlots increased by more than 50%.[9] The traditional image of small farms, located in isolated, rural locales, has given way to very large farming operations, some on the scale of industrial activities. Increased facility size and regional concentration of livestock and poultry operations have, in turn, given rise to concerns over the management of animal wastes from these facilities and potential impacts on environmental quality.

Agricultural operations often have been treated differently from other types of businesses under numerous federal and state laws. In the area of environmental policy, one observer noted that agriculture is "virtually unregulated by the expansive body of environmental law that has developed in the United States in the past 30 years."[10] Some laws specifically exempt agriculture from regulatory provisions, and others are structured in such a way that farms are not subject to most, if not all, of the regulatory impact. The Clean Water Act (CWA), for example, expressly exempts most agricultural operations from the law's requirements, while under the Clean Air Act (CAA), most agricultural sources are not subject to that law's regulatory programs because the majority of them do not meet the CAA's minimum emission quantity thresholds. Moreover, in implementing environmental laws, federal and state regulators have traditionally focused more effort on controlling the largest and most visible sources of pollution to the water, air, and land—factories, waste treatment plants, motor vehicles—than on smaller and more dispersed sources such as farms.

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[6] For example, the California Air Pollution Control Officers Association maintains a website to assist agricultural operators, local air districts, and others with information on air pollution reduction techniques. See http://www.capcoa.org/ag-clearinghouse.

[7] *Iowa CAFO Air Quality Study*, p. 209.

[8] For additional information, see CRS Report RL33325, *Livestock Marketing and Competition Issues*, by Renée Johnson and Geoffrey S. Becker.

[9] U.S. Department of Agriculture, Natural Resources Conservation Service, *Manure Nutrients Relative to the Capacity of Cropland and Pastureland to Assimilate Nutrients: Spatial and Temporal Trends for the United States*, Publication no. nps00-0579, December 2000, p. 18. (Hereinafter cited as USDA 2000 Manure Nutrients report.)

[10] J. B. Ruhl, "Farms, Their Environmental Harms, and Environmental Law," *Ecology Law Quarterly*, vol. 27, no. 2 (2000), p. 265.

Nevertheless, certain large animal feeding operations are subject to environmental regulation. The primary regulatory focus on environmental impacts has been on protecting water resources and has occurred under the Clean Water Act. In addition, facilities that emit large quantities of air pollutants may be regulated under the Clean Air Act. Some livestock operations may also be subject to the release reporting requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (the Superfund law) and the Emergency Planning and Community Right-to-Know Act. The following sections describe relevant provisions of these laws.

Clean Water Act

The Clean Water Act (CWA, 33 U.S.C. §§1251-1387) provides one exception to policies that generally exempt agricultural activities—and specifically the livestock industry—from environmental rules. The law protects water quality by a combination of ambient water quality standards established by states, limits on effluent discharges, and permits.[11] The regulatory structure of the CWA distinguishes between point sources (e.g., manufacturing and other industrial facilities which are regulated by discharge permits) and nonpoint sources (pollution that occurs in conjunction with surface erosion of soil by water and surface runoff of rainfall or snowmelt from diffuse areas such as farm and ranch land). Most agricultural activities are considered to be nonpoint sources, since they do not discharge wastes from pipes, outfalls, or similar conveyances. Pollution from nonpoint sources is generally governed by state water quality planning provisions of the act.

However, the CWA defines large animal feeding operations that meet a specific regulatory threshold number of animals (termed concentrated animal feeding operations (or CAFO); they are a small percentage of all animal feeding operations) as point sources and treats CAFOs in a manner similar to other industrial sources of pollution. They are subject to the act's prohibition against discharging pollutants into waters of the United States without a permit. In 2003, EPA revised regulations that were first promulgated in the 1970s defining the term CAFO for purposes of permit requirements and specifying effluent limitations on pollutant discharges from regulated feedlots. The 2003 rules were challenged in federal court, and parts of the regulations were remanded to EPA for revision and clarification. As a result, EPA issued revised regulations in 2008.[12]

These regulations are intended to address the concern that animal waste, if not properly managed, can adversely impact the environment through several possible pathways, including surface runoff and erosion, direct discharges to surface waters, spills and other dry-weather discharges, leaching into soil and groundwater, and releases to air (including subsequent deposition back to land and surface waters). The primary pollutants associated with animal wastes are nutrients (particularly nitrogen and phosphorus), organic matter, solids, pathogens, and odorous/volatile compounds. Data collected for the EPA's 2004 National Water Quality Inventory identify agriculture as the leading contributor to water quality impairments in rivers and lakes and the third leading contributor to impaired lakes (after atmospheric deposition and "other"). Animal

[11] For additional information on the Clean Water Act, see CRS Report RL30798, *Environmental Laws: Summaries of Major Statutes Administered by the Environmental Protection Agency*, coordinated by David M. Bearden.

[12] For additional information, see CRS Report RL33656, *Animal Waste and Water Quality: EPA's Response to the Waterkeeper Alliance Court Decision on Regulation of CAFOs*, by Claudia Copeland.

feeding operations are only a subset of the agriculture category, but states identified animal feeding operations and grazing as significant contributors to water quality impairment.[13]

The CWA CAFO rule applies to approximately 15,300 of the largest animal feeding operations that confine cattle, dairy cows, swine, sheep, chickens, laying hens, and turkeys, or less than 10% of all animal confinement facilities in the United States. The rule details requirements for permits, annual reports, and development of plans for handling manure and wastewater. The rule contains a performance standard which prohibits discharges from regulated CAFOs except in the event of wastewater or manure overflows or runoff from an exceptional 25-year, 24-hour rainfall event. Parts of the rule are intended to control land application of animal manure and wastewater.

Scientists recognize that actions taken to mitigate harmful water quality impacts of managing animal waste can have implications for air quality, in complex ways that are not perfectly understood. Environmental policies do not always account for interactions between media. For example, to meet water quality goals, lagoons are commonly used to store and treat manure waste from swine and other operations. These storage systems volatilize nitrogen, thereby reducing its concentration in lagoon effluent. But the volatilized nitrogen compounds escape into the air, creating odors, contributing to fine particulates (haze), and potentially hastening global climate change.[14]

Clean Air Act

The Clean Air Act (CAA, 42 U.S.C. §§7401-7671q) provides a complex and comprehensive framework for regulating stationary and mobile sources of air pollution.[15] The law emphasizes controlling "major sources" that emit more than threshold quantities of regulated pollutants. Air emissions from farms typically do not exceed the specified thresholds, thus they generally escape most CAA regulatory programs. However, livestock producers and other agricultural sources are not exempt from the statute, and for any whose emissions meet statutory or regulatory definitions of "major," provisions of the act could apply.

Under the CAA framework, EPA designates criteria air pollutants that may reasonably be anticipated to endanger public health or welfare, and then establishes nationally uniform ambient air quality standards for those pollutants (NAAQS).[16] EPA has identified six criteria pollutants, two of which (particulate matter and nitrogen dioxide) are directly associated with AFO emissions. In addition, AFOs and other sources emit a number of substances (VOCs and nitrogen oxide compounds) which are precursors of ozone, another criteria pollutant. The CAA also regulates hazardous air pollutants (HAP). HAPs are identified in a statutory list that can be modified by EPA regulation; EPA currently regulates 188 HAPs, including volatile organic compounds (VOC) which are emitted by livestock facilities. Methanol, also known as methyl alcohol, is a listed HAP that is emitted from cows' enteric emissions, freshly excreted manure, and decomposing feed stored at dairies. Precursors of ozone (reactive VOCs) and $PM_{2.5}$ (ammonia), both emitted by livestock facilities, are regulated air pollutants, even though they are not listed as criteria pollutants or HAPs. (See **Table 2**.)

[13] U.S. Environmental Protection Agency, *National Water Quality Inventory, 2004 Report*, January 2009, EPA-841-R-08-001, 1 vol.

[14] Marcel Aillery, Noel Gollehon, Robert Johansson, Jonathan Kaplan, Nigel Key, Marc Ribaudo, *Managing Manure to Improve Air and Water Quality*, U.S. Department of Agriculture, Economic Research Report 9, September 2005.

[15] For additional information on the Clean Air Act, see CRS Report RL30853, *Clean Air Act: A Summary of the Act and Its Major Requirements*, by James E. McCarthy and Claudia Copeland.

[16] Under the act, EPA establishes primary ambient air quality standards at a level sufficient to protect the public health. EPA also is authorized to establish secondary ambient air quality standards designed to protect the public welfare.

The CAA threshold determination of whether a source—including a livestock or poultry operation—is subject to the requirements of the act depends on whether it is defined as "major." That definition differs based on the region in which the source is located and whether that region is attaining and maintaining national ambient air standards. The act classifies nonattainment areas based on the extent to which the NAAQS is exceeded, and it specifically creates five classes of ozone nonattainment (from least to most polluted: marginal, moderate, serious, severe, and extreme). More stringent control requirements are imposed in areas with worse pollution. Generally, a major source is a stationary source that emits, or has potential to emit, 100 tons per year or more of any pollutant. However, regulated sources of HAPs that emit more than 10 tons per year of an individual hazardous pollutant (or 25 tons per year of all HAPs combined), or sources in the most serious nonattainment areas that emit as little as 10 tons per year of VOCs or NO_x, are defined as major sources and would be subject to these CAA requirements.

Table 2. CAA Classification of Substances in AFO Emissions

Substance	Criteria pollutant	Hazardous air pollutant	Regulated air pollutant
Ammonia[a]			X
Nitrogen oxides	X		X
VOCs[b]		X	X
Hydrogen sulfide[c]			X
PM_{10}[d]	X		X
$PM_{2.5}$	X		X
Odor[e]			X

Source: National Research Council, Air Emissions From Animal Feeding Operations, Current Knowledge, Future Needs, 2003, table 1-1, p. 16.

a. Ammonia is not a criteria pollutant but is a precursor for secondary $PM_{2.5}$, which is a criteria pollutant.

b. Some but not all VOCs are listed as hazardous air pollutants. VOCs contribute to the formation of ozone, a criteria pollutant.

c. Hydrogen sulfide is not listed as a criteria pollutant or a hazardous air pollutant. However, it is a regulated pollutant because it is listed as having a New Source Performance Standard which EPA establishes for facilities that contribute significantly to air pollution.

d. Prior to 1987, particulate matter (PM) was a criteria pollutant and regulated as total suspended particulate (TSP). Currently, the PM fractions listed as criteria pollutants are PM_{10} and $PM_{2.5}$.

e. Odor is a regulated pollutant in some states.

States play an important role in carrying out CAA provisions and assuring that state air quality meets federal air quality standards. The State Implementation Plan (SIP), prepared by the state (or local) air pollution control agency, translates national ambient standards into emission limitations and other control measures that govern individual sources of air pollution; the SIP is enforceable as both state and federal law. The CAA details the basic content of SIPs: enforceable emission limitations, other control measures, monitoring requirements, and schedules for compliance.

The provisions of the SIP govern individual facilities through two types of state permitting programs. First, the preconstruction permit, or New Source Review permit, applies to major new sources or major modifications of an existing source, and it describes proposed air pollution abatement systems, allowable emission rates, and other requirements. Second, pursuant to CAA Title V, most major stationary sources are required to obtain operating permits that specify each source's emission limitations and standards, compliance schedule, reporting requirements, and other conditions. Major sources that emit HAPs also must control those emissions to a level no

less than the maximum achievable control technology (MACT), as determined by EPA or state permitting authorities.

A state's SIP provisions must be at least as stringent as federal requirements, but beyond the core CAA framework, states have latitude in adopting requirements to achieve national ambient air quality standards. States, for example, may regulate additional categories of sources or may define major sources more stringently than do federal programs.

Most agricultural operations are believed to be minor sources of air pollution, and few have been required to comply with the act's permit requirements. Some environmental advocates have argued that many large livestock facilities emit more than 100 tons per year of regulated pollutants (especially ammonia) and should be regulated as major sources under federal law. However, federal and state officials generally have placed a low priority on regulating agricultural sources, and, further, a lack of adequate air quality monitoring data hampers the ability of regulators to answer key questions. Agricultural air pollution has become more of an issue in some parts of the country as EPA implements the NAAQS for particulates[17] and as nonattainment areas look to reduce pollutants from more sources as they strive to come into attainment. As discussed previously, emissions of ammonia and several other AFO pollutants are precursors that transform in the atmosphere to form secondary particulate matter. Aside from ammonia, other agriculture pollutants include dust that contributes to PM_{10}, diesel emissions from farm equipment, and emissions from specialized activities such as crop burning.[18]

Enforcement of environmental laws requires accurate measurement of emissions to determine whether regulated pollutants are emitted in quantities that exceed specified thresholds. In 2005, EPA announced a plan called the Air Compliance Agreement intended to produce air quality monitoring data on animal agriculture emissions from a small number of farms, while at the same time protecting all participants (including farms where no monitoring takes place) through a "safe harbor" from liability under certain provisions of federal environmental laws. Some industry sectors involved in negotiating this agreement, notably pork and egg producers, strongly supported it, but other industry groups that were not involved in the discussions had concerns and reservations. State and local air quality officials and environmental groups opposed the agreement. The emissions monitoring study was conducted from 2007 to 2009. EPA released reports on the individual monitored sites in January 2011 and has been working since then to develop emissions-estimating methodologies.[19]

In calculating emissions to determine major sources, fugitive emissions are not counted; however, they do count for purposes of demonstrating attainment with NAAQS. Fugitive emissions are defined in regulation as "those emissions which could not reasonably pass through a stack, chimney, vent or other functionally equivalent opening" (40 C.F.R. §51.165[a][1][ix]). EPA has issued a number of interpretive memoranda and guidance documents discussing how fugitive emissions should be accounted for in evaluating such industries as landfills, printing, and paint manufacturing. No such guidance with respect to animal confinement systems has been issued, but some groups, who believe that agricultural air pollution should be more vigorously controlled, have in the past expressed concern that EPA might make a determination that emissions from

[17] For additional information, see CRS Report RL33254, *Air Quality: EPA's 2006 Changes to the Particulate Matter (PM) Standards*, by Robert Esworthy and James E. McCarthy.

[18] For additional information, see CRS Report 97-670, *Agriculture and EPA's New Air Quality Standards for Ozone and Particulates*, by James E. McCarthy and Jeffrey A. Zinn.

[19] Issues related to the Air Compliance Agreement are discussed in CRS Report RL32947, *Air Quality Issues and Animal Agriculture: EPA's Air Compliance Agreement*, by Claudia Copeland.

waste lagoons and barns are fugitive, thus excluding those types of AFO emissions from applicable CAA requirements. In a letter to EPA, state and local air program administrators said that such a policy, if pursued, would create inequities in CAA application between similar operations in some sectors but not others.

> Since barns and lagoons are the dominant sources of emissions from the CAFO industry, such a policy would exempt most agricultural operations from many provisions of the Clean Air Act. The result would be an evisceration of states' and localities' ability to address air quality problems emanating from agricultural operations.[20]

Legal Challenges

Advocacy groups have pressed EPA on several occasions to address air pollutants emitted by livestock operations under provisions of the CAA. In 2009, the Humane Society and eight other organizations petitioned EPA under CAA Section 111(b) to list emissions from CAFOs, including hydrogen sulfide, ammonia, particulates, VOCs, and the greenhouse gases methane and NO_x, as air pollutants that endanger public health and welfare. Such a listing would trigger other provisions of the law, including a requirement for EPA to issue new source performance standards for CAFOs.[21] Listing ammonia and hydrogen sulfide as criteria pollutants would trigger a requirement to set NAAQS for those pollutants. Further, in 2011, a coalition of 20 groups led by the Environmental Integrity Project petitioned EPA under CAA Sections 108 and 109 to regulate ammonia as a criteria pollutant under the act.[22] EPA officials were said to be reviewing both petitions at the same time that the agency was gathering and evaluating CAFO emissions data through a national monitoring study as a prerequisite for future regulatory action (discussed above). EPA was expected to make joint decisions related to these petitions in order to avoid regulatory duplication. However, in January 2015, the coalition of environmental organizations filed two lawsuits seeking to force EPA to act on the two petitions. One suit sought to have the federal court require EPA to respond to the 2011 petition and to establish NAAQS for ammonia and hydrogen sulfide as criteria air pollutants; in December 2015, the court dismissed the lawsuit, after finding that the plaintiffs had failed to give EPA the required advance notice of the case.[23] The second suit, challenging EPA's delay in responding to the 2009 petition for rulemaking regarding regulation of CAFOs under the CAA's New Source Performance Standards provision, is still pending.[24]

In a separate but related lawsuit, several Iowa residents concerned about emissions from a hog feeding operation near an elementary school sought an order to require EPA to list AFOs as stationary sources to be regulated under the CAA and to list ammonia and hydrogen as criteria pollutants. In June 2014, a federal court dismissed the lawsuit.[25] The court found that EPA does not have a nondiscretionary duty to list a specific pollutant as a criteria pollutant until the agency

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[20] Lloyd L. Eagan (President of State and Territorial Air Pollution Program Administrators) and Ellen Garvey (President of Association of Local Air Pollution Control Officials), letter to Christine Todd Whitman (EPA Administrator), April 7, 2003, p. 2.

[21] The Humane Society petition is available at http://www.foe.org/sites/default/files/HSUS_et_al_v_EPA_CAFO_CAA_Petition.pdf. For information on the air emissions monitoring study, see CRS Report RL32947, *Air Quality Issues and Animal Agriculture: EPA's Air Compliance Agreement*, by Claudia Copeland.

[22] The petition is available at http://www.environmentalintegrity.org/documents/PetitiontoListAmmoniaasaCleanAirActCriteriaPollutant.pdf.

[23] Environmental Integrity Project, et al., v. U.S. EPA, D.D.C., No. 15-0139, Dec. 1, 2015.

[24] Humane Society v. McCarthy, D.D.C., No. 15-0141.

[25] Zook v. McCarthy, D.D.C., No. 13-1315, June 30, 2014.

makes a policy determination on whether the pollutant is expected to endanger public health or welfare, a finding that is up to the judgment of the EPA administrator. The Supreme Court denied a petition to review the lower court's ruling in November 2015.

A 2004 lawsuit brought in federal court by environmentalists argued that feedlots must be regulated under the CAA and must obtain a CAA "permit to construct" under provisions of the Idaho SIP. The company, intending to construct a large feedlot, had argued that the SIP did not require a permit for key pollutants from agricultural sources, including ammonia and hydrogen sulfide. In September 2004, the court ruled that the state's plan did not allow such exemptions, indicating that any agricultural facility in the state with sufficient emissions levels would have to obtain a permit. The case was settled early in 2005 when the parties to the lawsuit agreed to request that the Idaho Department of Environmental Quality conduct a rulemaking to establish a process for CAA permitting of dairies in the state.[26] Industry officials say the case had limited implications, because it refers specifically to the Idaho SIP, but environmentalists involved in the case believe it could have significance nationally because of the mutual agreement by the parties on emissions factors for ammonia that trigger CAA thresholds for dairies. In response to this case, in 2006 Idaho finalized a requirement that dairies and other CAFOs obtain air quality permits if they emit 100 tons or more of ammonia per year. The rule made Idaho the first state to regulate ammonia emissions from CAFOs.

CAA Regulation in California

Some of the interest in agriculture's impact on air quality derives from events in California and that state's progress in implementing the permit and SIP provisions of the Clean Air Act. The state's air pollution problems are diverse and, in some areas, severe. Throughout the state, emission controls have become increasingly more stringent on currently regulated sources of air pollution, such as factories and cars. State officials believe that, to meet state and federally mandated requirements to improve air quality, emissions from all air pollution sources must be reduced, whether they are large or small, industrial or agricultural.

Regarding agriculture, air quality improvement efforts have focused primarily on two regions which represent California's most challenging air quality problems for ozone and particulate matter pollution. The South Coast (Los Angeles) Air Basin and the San Joaquin Valley Air Basin are designated in extreme nonattainment for the federal eight-hour ozone standard. They are the only two U.S. areas designated in extreme nonattainment for this standard. In these two areas, all sources of air pollution produce air quality impacts and have some level of significance, and virtually all emission sources, even very small ones, are regulated. Both areas have large concentrations of confined animal feeding operations; agriculture is the San Joaquin Valley Basin's most important industry and a significant source of its air emissions. Thus, agricultural sources have been a particular focus of efforts to implement the federal and state laws in both regions.[27]

For more than 30 years, California law specifically exempted existing major livestock production or equipment used in crop growing from all environmental permitting requirements. In 2002, EPA temporarily withdrew federal approval of the state's clean air program for failure to impose air pollution controls on the state's agriculture industry. The state re-assumed responsibility after the legislature enacted a measure (California SB 700) in 2003 that removed the long-standing exemption for agriculture and set timelines for existing facilities to apply for clean air permits and install control technologies. SB 700 regulates crop growers, dairies, poultry farms, cattle ranches,

[26] Idaho Conservation League v. Adrian Boer, D.Id.,Civ. No. 1:04-cv-00250-BLW, February 1, 2005.

[27] Sixteen areas in California have been designated in nonattainment for the eight-hour federal ozone standard.

food-processing operations, and other agriculture-related businesses in the state. As of January 1, 2004, it made these sources subject to air quality permitting and specified emission mitigation requirements. Deadlines and requirements differ, depending on the size of facilities, level of emissions, and the attainment status of the region where the source is located.

The state and its local air quality management districts (in California, the state sets overall rules and policies, and 35 local agencies have primary day-to-day responsibility) are now implementing SB 700. Under SB 700, the district rules must require facilities to obtain permits and to reduce emissions to the extent feasible. For severe and extreme ozone nonattainment areas, the law requires best available retrofit control technology (BARCT). In moderate and serious areas, regulated facilities will need to use reasonably available control technology (RACT). In federal ozone attainment areas where air quality problems are less significant, districts must adopt a rule requiring existing large confined animal facilities to reduce air contaminants to the extent feasible unless the district makes a finding that such facilities will not contribute to a violation of any state or federal standard. Regulated facilities were required to prepare emission mitigation plans and comply with them by July 1, 2008.

In addition, the state board is working with local air districts, university researchers, and others to develop and evaluate research on emissions factors from livestock operations to be used by facilities that are required to obtain air permits. Affected industries are closely watching these research studies and the standards being adopted by local air districts.

While California SB 700 focuses on existing agricultural sources, by lifting the long-standing exemption for such operations from the state Health & Safety Code, new and modified agriculture sources in the state also became subject to permit and regulatory requirements of the California State Implementation Plan (SIP). New or modified sources located in nonattainment areas which may emit air pollution must obtain New Source Review permits that require installation of best available control technology (BACT) and require purchase of "offsets" or "emission reduction credits" from other sources in the same nonattainment area, in a relation determined by the severity of the air pollution problem. Local district rules implement these federal and state requirements.

Other States' Air Quality Regulatory Activities

In terms of geographic impact, every state has agricultural operations in which animals are raised in confinement, according to the U.S. Department of Agriculture. States with high livestock populations, and with significant numbers of large operations (i.e., with more than 300 animal units), include several West Coast, Southwest, and Northwest states (Washington, Oregon, California, and Arizona); the whole of the Midwest, from the Dakotas, Minnesota, and Wisconsin south through Texas; sweeping across the Southeast to the coastal states of Georgia, the Carolinas, Virginia, Maryland, and Pennsylvania; and north through New York and Vermont.[28]

The issue of evaluating and managing the health and environmental impacts of emissions from animal agriculture facilities has largely been left up to states. Air quality has not been the driving force behind state government action on AFOs, but has emerged out of long-standing concern to protect water resources. Several states have recognized a need to regulate air emissions from agricultural operations, but many states have not yet directly adopted or enacted programs affecting AFO emissions.

State programs, under statutes and regulations, both implement and supplement federal CAA requirements. That is, in some cases, state programs have been adopted to ensure state

[28] USDA 2000 Manure Nutrients report, pp. 28-29.

compliance with requirements of the federal law and to implement SIPs, such as facility permits that apply to construction and operation of livestock operations. In other cases, states have enacted more comprehensive laws and regulations calling for air emission testing and monitoring, manure management to abate pollutant emissions, inspections, and testing. Some states have regulatory programs or ambient air standards for odor and/or certain AFO pollutants, such as hydrogen sulfide, for which no NAAQS apply. In states with significant animal production, facility management statutes often govern construction and operation of AFOs, primarily for purposes of protecting water quality, with incidental provisions for air quality. For example, facility management statutes often contain setback requirements for confinement buildings and waste impoundments that may help to reduce air emissions by avoiding or minimizing odor nuisances.

States have used varied techniques to control air emissions from livestock facilities. State programs set emission limits, require use of best management practices, and impose other pre-operational and operational requirements. Hydrogen sulfide and odor emissions from AFOs have received significant attention, but there is little or no standardization of approach.[29] For example:

- Minnesota requires feedlots and manure storage areas to acquire construction and operating permits and also requires air emission plans for large livestock facilities. The state has adopted an ambient air quality standard for hydrogen sulfide which applies to emissions from AFOs as well as other sources.
- Iowa also has adopted a health effects-based ambient air quality standard for hydrogen sulfide that will be used in a three-year AFO field study to measure levels of hydrogen sulfide, ammonia, and odor to determine if material adverse health effects exist.
- Missouri regulations set odor emission limitations and require large AFOs to submit odor control plans. In addition, the state's CAA permit program includes operational requirements for AFOs to prevent air pollution. Missouri's CAA contains a hydrogen sulfide emission standard that does not refer to AFOs or other agricultural operations specifically, nor does it exempt AFOs. Missouri also has an ambient acceptable level (AAL) for ammonia.
- In Texas, a consolidated program governs water and air quality general permits. Its requirements control the emission of odors and other air contaminants from AFOs, although it does not have a specific air emission threshold for odors. Like Missouri, Texas has a hydrogen sulfide emission standard that makes no specific reference to, or exception for, animal agriculture.
- Illinois has implemented a facility statute that relies in part on setback distances to control odor emissions. Like Missouri, Illinois has established a numerical "objectionable odor nuisance" standard (that is, when odor is detectable in ambient air adjacent to residential or similar structures after dilution with a specific volume of odor-free air) and has enforced the limitation against AFOs.
- Colorado water quality rules help to control air emissions through provisions that govern the construction and operation of facilities that treat animal wastes. A separate regulation establishes an odor emissions standard for swine feeding operations and requires that anaerobic waste impoundments be covered.

[29] Jody M. Endres and Margaret Rosso Grossman, "Air Emissions from Animal Feeding Operations: Can State Rules Help?" *Pennsylvania State Environmental Law Review*, vol. 13, fall 2004, pp. 1-51.

- North Carolina, like Colorado, has focused its regulatory efforts on odor emissions from swine operations. All AFOs must use management practices that control odors, and some swine operations must submit odor management plans, although it does not require control technology (e.g., covers) unless best management practices fail. North Carolina does not have air emission standards for H2S, ammonia, or odor.

A separate survey done by the Nebraska Department of Environmental Quality found that more than half of the states have standards for hydrogen sulfide. States base standards on a variety of issues, including odor or nuisance, welfare effects, and health effects. Consequently, standards vary considerably from as low as 0.7 parts per billion (ppb) for a yearly average (New York) and 5 ppb averaged over 24 hours (Pennsylvania), to standards based on nuisance, such as Minnesota's 50 ppb not to be exceeded for one-half hour twice per year and measured at the AFO property line.[30]

CERCLA and EPCRA[31]

Both the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, or Superfund, 42 U.S.C. §§9601-9675) and the Emergency Planning and Community Right-to-Know Act (EPCRA, 42 U.S.C. §§11001-11050) have reporting requirements that are triggered when specified quantities of certain substances are released to the environment, including ambient air.[32] Both laws utilize information disclosure in order to increase the information available to the government and citizens about the sources and magnitude of chemical releases to the environment. At issue today is how the reporting requirements and other provisions of these laws apply to poultry and livestock operations.

CERCLA authorizes programs to remediate uncontrolled or abandoned hazardous waste sites and assigns liability for the associated costs of cleanup. Section 103(a) of CERCLA requires that the person in charge of a facility (as defined in Section 101[9]) that releases a "reportable quantity" of certain hazardous substances must provide notification of the release to the National Response Center.

EPCRA establishes requirements for emergency planning and notification to communities about storage and release of hazardous and toxic chemicals. Section 304(a)(1) of EPCRA requires the owner or operator of a facility (as defined in Section 329[4]) to report to state and local authorities any releases greater than the reportable quantity of substances deemed hazardous under Superfund or extremely hazardous under EPCRA. Under CERCLA, the term "release" (Section 101[22]) includes discharges of substances to water and land and emissions to the air from "spilling, leaking, pumping, pouring, emitting, emptying, discharging, injection, escaping, leaching, dumping, or disposing into the environment." Under EPCRA, the term "release" (Section 329[8]) includes emitting any hazardous chemical or extremely hazardous substance into the environment. CERCLA excludes the "normal application of fertilizer" from the definition of release (Section 101[22]), and EPCRA excludes from the definition of hazardous chemicals any substance "used in routine agricultural operations or is a fertilizer held for sale by a retailer to the ultimate customer" (Section 311[e][5]).

[30] Iowa CAFO Air Quality Study, p. 189.

[31] For additional information, see CRS Report RL33691, *Animal Waste and Hazardous Substances: Current Laws and Legislative Issues*, by Claudia Copeland.

[32] For general information on CERCLA and EPCRA, see CRS Report RL30798, *Environmental Laws: Summaries of Major Statutes Administered by the Environmental Protection Agency*, coordinated by David M. Bearden.

The CERCLA definition of "hazardous substance" (Section 101[14]) triggers reporting under both laws. Among the reportable substances released by livestock facilities are hydrogen sulfide and ammonia. The reportable quantity for both of these substances is 100 pounds per day, or 18.3 tons per year. Section 109 of CERCLA and Section 325 of EPCRA authorize EPA to assess civil penalties for failure to report releases of hazardous substances that equal or exceed their reportable quantities (up to $37,500 per day under CERCLA and $37,500 per violation under EPCRA). Requirements of both can be enforced by citizens under provisions of the laws, which allow "any person" to commence a civil action against either a person who violates a legal prohibition or requirement, or against EPA for failure to perform a nondiscretionary duty or specified actions (CERCLA Section 310, EPCRA Section 326).

In addition to these reporting requirements, CERCLA includes provisions authorizing federal cleanup of releases of hazardous substances, pollutants, or contaminants that may present an imminent and substantial danger to the public health or welfare (Section 104) and imposing strict liability for cleanup and damages to natural resources from releases of hazardous substances (Section 107). The applicability of these provisions to animal agricultural sources and activities has increasingly been receiving attention.

Enforcement against AFOs

EPA has enforced the CERCLA and EPCRA reporting requirements against AFO release of hazardous air pollutants in two cases. The first involved the nation's second-largest pork producer, Premium Standard Farms (PSF) and Continental Grain Company. In November 2001, EPA and the Department of Justice (DOJ) announced an agreement resolving numerous claims against PSF concerning principally the Clean Water Act, but also the Clean Air Act, CERCLA, and EPCRA. Among other actions under the settlement, PSF and Continental were to monitor air emissions for PM, VOCs, H2S, and ammonia, and if monitoring levels exceed CAA thresholds for any regulated pollutant, the companies would apply to the state of Missouri for any necessary CAA permits. The companies also agreed to fund a $300,000 supplemental environmental project (SEP) to reduce air emissions and odors from swine barns. In September 2006, DOJ announced settlement of claims against Seaboard Foods, a large pork producer with more than 200 farms in Oklahoma, Kansas, Texas, and Colorado, and PIC USA, the former owner and operator of several Oklahoma farms now operated by Seaboard. Like the earlier Premium Standard Farms case, the government had brought complaints for violations of several environmental laws, including failure to comply with the release reporting requirements of CERCLA and EPCRA.

The citizen suit provisions of both laws have been used to sue poultry producers and swine operations for violations of the laws. In two cases, environmental advocates claimed that AFO operators have failed to report ammonia emissions, putting them in violation of CERCLA and EPCRA. In both cases, federal courts have supported broad interpretation of key terms defining applicability of the laws' reporting requirements.[33]

CERCLA/EPCRA Reporting Exemption

In 2005, a group of poultry producers petitioned EPA for an exemption from EPCRA and CERCLA emergency release reporting requirements, arguing that releases from poultry growing

[33] Sierra Club v. Seaboard Farms Inc., 387 F.3d 1167 (10th Cir. 2004), and Sierra Club v. Tyson Foods, Inc., 299 F.Supp. 2d 693 (W.D. Ky. 2003).

operations pose little or no risk to public health, while reporting imposes an undue burden on the regulated community and government responders.[34]

EPA issued a proposal in response to the poultry industry petition in 2007. EPA proposed to exempt releases of hazardous substances to the air (typically during digestion or decomposition) from animal waste at farms from the notification requirements of CERCLA and EPCRA. EPA explained that the rule is justified because of the resource burden to industry of complying with reporting requirements, since the agency cannot foresee a situation where a response action would be taken as a result of notification of releases of hazardous substances from animal waste at farms.[35]

The proposal drew significant public comment and response. Environmental advocates and other interested entities opposed the exemption, saying that emissions from animal wastes are not trivial or benign. Critics noted that the EPA proposal would exempt releases of ammonia, as originally requested in the industry petition, plus hydrogen sulfide and all other hazardous chemicals, such as nitrous oxide and volatile organic compounds released from animal wastes. Some argued that an exemption is premature, since EPA is moving forward with research on emissions levels, which could be undermined by a regulatory exemption.[36] State air quality officials opposed a blanket regulatory or legislative exemption, and they recommended that if the agency considers any action, it should only be a narrow exemption, such as one based on a size threshold for farms.[37]

EPA finalized the CERCLA/EPCRA administrative reporting exemption in December 2008.[38] The final rule exempts hazardous substance releases that are emitted to the air from animal waste at farms from the notification requirement of CERCLA. It relieves all livestock operations, not just poultry farms, from CERCLA's requirement to report hazardous substances releases to the air to federal officials. In addition, the final rule provides a partial exemption for such releases from EPCRA's requirement to report releases to state and local emergency officials. Partially responding to some public comments, the final rule continues to apply EPCRA's reporting requirement to large CAFOs (those subject to Clean Water Act permitting, see page 8), but exempts smaller facilities. A number of groups criticized the final rule, which environmental advocates challenged in federal court. Industry groups, including the National Pork Producers Council, also challenged the rule. In June 2010, the federal government asked to remand the 2008 final rule for EPA to reconsider and possibly modify the rule, and the court approved the government's request for a remand. At that time, EPA indicated intent to propose a new or revised rule in 2012, but, as of June 2016, it has not done so. In the meantime, the 2008 exemption rule remains in effect. Legislation in the 112th Congress, discussed below, proposed to exclude

[34] In 1998, EPA granted an administrative exemption from release reporting requirements for certain radionuclide releases. EPA cited authority in CERCLA Sections 102(a), 103, and 115 for granting administrative reporting exemptions where "releases of hazardous substances that pose little or no risk or to which a Federal response is infeasible or inappropriate." See 63 *Federal Register* 13461 (March 19, 1998).

[35] Ibid., U.S. Environmental Protection Agency, "CERCLA/EPCRA Administration Reporting Exemption of Hazardous Substances from Animal Waste," 72 *Federal Register* 73700 (December 28, 2007), p. 73704.

[36] See CRS Report RL32947, *Air Quality Issues and Animal Agriculture: EPA's Air Compliance Agreement*, by Claudia Copeland.

[37] National Association of Clean Air Agencies, letter to the Honorable Barbara Boxer, chairman, Senate Environment and Public Works Committee, March 20, 2007.

[38] U.S. Environmental Protection Agency, "CERCLA/EPCRA Administrative Reporting Exemption for Air Releases," 73 *Federal Register* 76948-76960, December 18, 2008.

"manure" from the definition of hazardous substance under CERCLA and remove reporting liability under CERCLA and EPCRA.

In 2008, the Government Accountability Office (GAO) issued a report evaluating EPA's activities to regulate air emissions and water discharges from animal feeding operations. GAO found that EPA is unable to assess the extent to which pollution from feedlots may be impairing human health and the environment, because it lacks data on the amount of pollutants that CAFOs are releasing to the air and water. GAO recommended that EPA develop a comprehensive national inventory of CWA-permitted CAFOs and accelerate its efforts to develop protocols for measuring and quantifying air contaminants from animal feedlots. GAO noted that EPA has been criticized because its current air emissions monitoring activities are limited in scope and sample size and may not produce sufficient information to shape future regulation. Moreover, GAO questioned the basis for the CERCLA/EPCRA exemption that EPA proposed in 2007. "It is unclear how EPA made this determination when it has not yet completed its data collection effort and does not yet know the extent to which animal feeding operations are emitting these pollutants."[39]

Congressional Interest

Congressional interest in these issues has been apparent for some time. For example, in report language accompanying EPA's FY2006 appropriations, the House Appropriations Committee urged EPA to clarify the reporting requirements of the two laws.[40]

> The Committee continues to be concerned that unclear regulations, conflicting court decisions, and inadequate scientific information are creating confusion about the extent to which reporting requirements in [CERCLA] and [EPCRA] cover emissions from poultry, dairy, or livestock operations. Producers want to meet their environmental obligations but need clarification from the Environmental Protection Agency on whether these laws apply to their operations. The committee believes that an expeditious resolution of this matter is warranted.

Specific legislative proposals also have been discussed. In the 109th Congress, legislation was introduced in the House and Senate that would have amended CERCLA to clarify that manure is not a hazardous substance, pollutant, or contaminant under CERCLA and that the law's notification requirements would not apply to releases of manure. At a hearing held by a House Energy and Commerce subcommittee on animal agriculture and CERCLA, agriculture industry witnesses urged Congress to provide policy direction on the issue that has resulted from recent and potential litigation. Other witnesses testified that the reporting and notification requirements of CERCLA and EPCRA provide a safety net of information, and that other environmental laws, such as the Clean Air Act, cannot function in that manner.

Similar legislation has been introduced, most recently in the 112th Congress, in bills that were intended to clarify that manure is not a "hazardous substance" or "pollutant or contaminant" under CERCLA and to remove emissions reporting liability under CERCLA and EPCRA. Supporters of these bills seek to block EPA from revising the 2008 exemption rule so as to require reporting of releases. (For additional discussion, see CRS Report RL33691, *Animal Waste and Hazardous Substances: Current Laws and Legislative Issues*, by Claudia Copeland.)

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[39] U.S. Government Accountability Office, "Concentrated Animal Feeding Operations, EPA Needs More Information and a Clearly Defined Strategy to Protect Air and Water Quality from Pollutants of Concern," September 2008, GAO-08-944, p. 7.

[40] U.S. Congress, House Committee on Appropriations, *Report accompanying H.R. 2361, Department of the Interior, Environment, and Related Agencies Appropriation Bill, 2006*, H.Rept. 109-80, 109th Cong., 1st sess., p. 87.

Some Members of Congress were critical of EPA's proposal to exempt routine animal waste air releases from CERCLA and EPCRA's reporting requirements (discussed above), questioning the potential for harmful environmental and enforcement impacts of the proposal.[41] At a 2008 hearing where GAO's report was discussed,[42] several House Energy and Commerce subcommittee members said that they are skeptical of the EPA's authority for a blanket exemption. Others suggested that an exemption for small farms, whose emissions are unlikely to cause environmental harm, would make sense. EPA and USDA witnesses supported the proposal, saying that the air release waiver would only affect reporting meant for emergency response situations, but would not affect requirements to report emissions of hazardous substances from other farm sources, or releases of hazardous substances from manure into soil, ground water, or surface water.

Agricultural Emissions of Greenhouse Gases

Agriculture is both a source of several greenhouse gases (GHGs) and a "sink" for absorbing carbon dioxide, the most common GHG, thereby partly offsetting emissions.[43] Agricultural activities contribute directly to emissions of GHGs through a variety of processes such as enteric fermentation in domestic livestock (i.e., digestion) and manure management systems and practices. Non-livestock source categories in agriculture also emit greenhouse gases, including rice cultivation, agricultural soil management, and field burning of agricultural residues

Overall, however, agriculture is a comparatively modest source of U.S. GHG emissions: it accounts for approximately 8.3% of U.S. emissions, according to EPA.[44] Further, while agriculture's emissions are a small percentage overall, the two principal greenhouse gases emitted by this sector, methane (CH_4) and nitrous oxide (N_2O), have greater potency, or ability to impact climate change by trapping heat in the atmosphere, relative to carbon dioxide (CO_2). Between 1990 and 2014, CH_4 emissions from all U.S. sources declined by 5.6%, and N_2O emissions decreased by 0.7%. During that same period, CH_4 emissions from U.S. agricultural activities increased by 10.1%, while N_2O emissions increased by 5.9%.[45]

As shown in **Table 3**, agricultural activities contributed 32.5% of all CH_4 emissions and 83.2% of all N_2O emissions in the United States in 2014. Livestock-related categories (enteric fermentation and manure management, primarily from dairy cattle and swine) were 30.9% of total U.S. CH_4 emissions, while various land management practices were the largest source of N_2O emissions, or 78.9% of total N_2O emissions.

The Obama Administration has taken a number of actions to develop national policies and strategies to address GHGs and climate change. The 111th Congress considered legislation in this area: comprehensive climate and energy legislation passed the House in 2009 and was reported by a Senate committee, but no comprehensive bill was enacted. Agriculture in general was a

[41] Letter from Reps. John Dingell, Albert Wynn, Hilda Solis to Stephen L. Johnson, EPA Administrator, March 18, 2008.

[42] See http://energycommerce.house.gov/cmte_mtgs/110-ehm-hrg.092408.CERCLA.shtml.

[43] For additional information, see CRS Report R41530, *Agriculture and Greenhouse Gases*, by Claudia Copeland, Megan Stubbs, and Kelsi Bracmort (archived).

[44] U.S. Environmental Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2014*, April 15, 2016, EPA 430-R-16-002, Table ES-4, http://www.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2016-Main-Text.pdf.

[45] Ibid. By comparison, methane emissions by the energy sector, which is the largest overall source of GHG emissions in the United States, decreased by 9.6% between 1990 and 2014. Ibid., Table 2-4.

major part of these discussions, but so far the agriculture sector has been largely excluded from regulatory and legislative proposals.

Table 3. Estimated Emissions of Methane and Nitrous Oxide: U.S. Agriculture (2014)

Million Metric Tons of CO_2 equivalent ($MMTCO_2e$)

	$MMTCO_2e$	**Percentage of Total**
Total anthropogenic GHG emissions, all sectors	6,870.5	100% of all GHG emissions
Total U.S. methane (CH_4) emissions, all sources	730.8	10.6% of all GHG emissions
Total agriculture CH_4 emissions, all categories	**237.7**	32.5% of all CH_4 emissions
Enteric Fermentation in Domestic Livestock	164.3	22.5% of all CH_4 emissions
Livestock Manure Management	61.2	8.4% of all CH_4 emissions
Rice Cultivation	11.9	1.6% of all CH_4 emissions
Field Burning of Agricultural Residues	0.3	0.04% of all CH_4 emissions
Total U.S. nitrous oxide (N_2O) emissions, all sources	403.5	5.9% of all GHG emissions
Total agriculture N_2O emissions, all categories	**336.0**	83.2% of all N_2O emissions
Agricultural Soil Management	318.4	78.9% of all N_2O emissions
Livestock Manure Management	17.5	4.3% of all N_2O emissions
Field Burning of Agricultural Residues	0.1	0.02% of all N_2O emissions

Source: U,S. Environmental Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2014*, April 15, 2016, EPA 430-R-16-002, Tables ES-2, 5-1; calculations by CRS.

Notes: Greenhouse gas emissions also may be measured in teragrams of CO_2 equivalent (Tg CO_2e). One teragram is equal to 1 million metric tons. The level of certainty for the emissions data varies by source category. Uncertainty rates are more pronounced for the methane and nitrous oxide agricultural source categories than others (e.g., transportation and electricity generation) due to limited site, crop, and manure management information.

EPA Activities

Two sets of actions by EPA concerning GHG emissions have drawn the attention of agricultural stakeholders.

Regulating GHGs under the Clean Air Act

The first action occurred in July 2008. The Bush Administration published an Advance Notice of Proposed Rulemaking (ANPR) in connection with its consideration of how it should comply with *Massachusetts v. EPA*, in which the Supreme Court held that the Clean Air Act authorizes EPA to regulate emissions from new motor vehicles on the basis of their climate change impacts. The Court held that the Administrator must determine whether or not emissions of greenhouse gases from new motor vehicles cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare (i.e., an endangerment finding), or whether the science is too uncertain to make a reasoned decision.[46] Responding to this ruling with the ANPR, EPA discussed a wide range of CAA authorities and programs that could potentially be used to address climate

[46] 549 U.S. 497 (2007). For information, see CRS Report RS22665, *The Supreme Court's First Climate Change Decision: Massachusetts v. EPA*, by Alexandra M. Wyatt.

change, including the permitting provisions of Title V of the act.[47] The ANPR did not propose or recommend the use of any particular CAA authority, or commit to specific next steps to address GHGs from any category of emission sources.

Agricultural sources were not specifically referenced in any of this ANPR discussion; nevertheless, agriculture stakeholders—especially many representing livestock operations—were highly critical of the potential economic impacts on their operations and the possibility that Title V permits might be required. In the months following the ANPR, EPA officials, including Administrator Lisa Jackson, said that the agency has no plans to tax livestock or pursue other "doomsday scenarios" for new regulations.[48] The public comment period on the ANPR ended in November 2008; no further action on it occurred.

However, in December 2009, the EPA Administrator signed two findings about greenhouse gases. First, the Administrator found that the current and projected concentrations of six GHGs in the atmosphere (including CH_4 and N_2O) threaten the public health and welfare of current and future generations. Second, the Administrator found that GHG emissions from motor vehicles contribute to the atmospheric concentrations of the six key greenhouse gases and hence to the threat of climate change.[49] The endangerment finding does not itself impose any CAA requirements on industry or other entities or trigger regulation under the entire act. However, the endangerment finding is a prerequisite to greenhouse gas emission standards for light-duty vehicles, which EPA issued jointly with the Department of Transportation in April 2010. When the light-duty vehicle rule took effect (January 2011), other CAA requirements were triggered. In particular, stationary sources that emit any of the six GHGs covered by the endangerment finding became subject to certain permitting requirements under the Title V operating permit and New Source Review (NSR) provisions in the law.[50]

Related to the CAA requirements that are triggered by the endangerment finding and light-duty vehicle rule, on May 13, 2010, EPA issued a rule specifying thresholds for GHG emissions that define when Title V and NSR permits would be required. In the absence of the rule, called the GHG Tailoring Rule, sources that emit as little as 100 tons per year of CO_2 equivalent of GHGs would be subject to permits. In order to limit the number of facilities that would be required to obtain permits, in the Tailoring Rule EPA established a threshold of 75,000 tons per year of CO_2 equivalent of GHG emissions. EPA estimated that the rule would cover 67% of the nation's largest stationary source GHG emitters, while shielding small businesses and agriculture operations from new permitting requirements.[51] Significantly, EPA believed that animal agriculture operations would not be subject to CAA permitting as a result of the Tailoring Rule, because of the high threshold in the rule and because the rule did not apply to so-called "fugitive emissions" from animal manure management systems.[52] In 2012, a federal court dismissed legal

[47] Title V requires major industrial sources of air pollutants to obtain permits which detail all of the federal emission control requirements that apply to the facility.

[48] EPA Administrator Lisa P. Jackson, "Address, 2009 USDA Agricultural Outlook Forum," Feb. 26, 2009, http://www.usda.gov/oce/forum/2009_Speeches/Speeches/Jackson.pdf.

[49] For additional information, see http://www.epa.gov/climatechange/endangerment.html.

[50] For additional information, see CRS Report R40984, *Legal Consequences of EPA's Endangerment Finding for New Motor Vehicle Greenhouse Gas Emissions*, by Robert Meltz (archived). New Source Review (NSR) is a CAA program designed to minimize emissions from new sources and existing sources making major modifications.

[51] See "Final GHG Tailoring Rule" at http://www.epa.gov/NSR/actions.html#may10.

[52] The Tailoring Rule does apply to GHG emissions from internal combustion diesel engine generators, including on farms. However, because of the 100,000 tpy threshold in the rule, EPA estimated that no farm stationary fuel combustion sources emit GHGs at levels that would be subject to the rule.

challenges to EPA's tailoring rule from industry groups and some states, reaffirming the rule in its entirety. The Supreme Court agreed to review the appellate ruling. The Court's opinion in the case, issued in June 2014, partially vacated the Tailoring Rule and put limits on sources that would be required to obtain CAA permits. The Court said that EPA may not treat greenhouse gases as an air pollutant for purposes of the act's permitting requirements, but that the agency can continue to require permits with GHG emission limits based on emissions of conventional pollutants.[53] The ruling did not alter applicability of such requirements to agricultural operations. The Court said that EPA should set a *de minimis* threshold for when GHGs trigger CAA regulatory review; in response, the agency has been developing a new threshold in a revised Tailoring Rule, which it expects to propose by August 2016.

Mandatory Reporting of Greenhouse Gases

A second EPA action that drew agriculture's attention was a 2009 EPA proposal to require reporting of greenhouse gas emissions by certain facilities that emit GHGs and by suppliers of fossil fuels and industrial GHGs. The proposal responded to a congressional directive in the FY2008 Consolidated Appropriations Act (P.L. 110-161) for EPA to develop a comprehensive national system for reporting emissions of CO_2 and other GHGs produced by major U.S. sources. Included in the categories of sources that would be subject to the rule are manure management systems that emit, in the aggregate, methane and nitrous oxide in amounts equivalent to 25,000 metric tons of CO_2 equivalent or more per year. Because of the proposed reporting threshold, EPA estimated that fewer than 50 beef cattle, dairy cattle, and swine operations would be subject to the rule; an unknown number of poultry operations also would be covered.[54]

A number of agriculture stakeholders criticized the proposal in public comments. Many noted that agriculture as a whole is responsible for only a small percentage of total GHGs and questioned why manure management systems in particular were included in the proposal, since they are responsible for approximately 1% of total U.S. GHGs (see **Table 3**). Other categories of agricultural sources, such as livestock enteric fermentation and soil management, emit larger amounts of CH_4 and N_2O. EPA explained that the proposal did not include reporting by the other agriculture categories because, for those sources, there are no direct GHG emission measurement methods available except for expensive and complex equipment. Using emissions estimates for such sources, instead of direct measurement, would have a high degree of uncertainty and likely would burden a large number of small emitters. Some who commented on the proposal said that similar concerns—about a lack of adequate accurate measurement methods and the costly burden of compliance with only very small benefits—apply equally to reporting by manure management systems.

The EPA Administrator signed the final reporting rule on September 22, 2009.[55] As in the proposal, the final rule applies to manure management facilities with the same reporting threshold of 25,000 metric tpy of CO_2 equivalent of GHGs, but not to other agricultural sources or agricultural land uses. In response to comments about the burden of the rule, EPA removed manure sampling requirements and instead will allow facilities to use default values for estimating emissions. EPA also made certain recalculations of affected facilities and estimated that about 100 livestock facilities will be subject to the reporting rule (73 beef feedlots, 27 dairies,

[53] Utility Air Regulatory Group v. EPA, No. 12-1146, 2014 Westlaw 2807314, 573 US ___ (U.S., June 23, 2014).

[54] U.S. Environmental Protection Agency, "Mandatory Reporting of Greenhouse Gases; Proposed Rule," 74 *Federal Register* 16562, April 9, 2009.

[55] U.S. Environmental Protection Agency, "Mandatory Reporting of Greenhouse Gases," 74 *Federal Register* 56260-56519, October 30, 2009.

and 8 swine operations). The final rule identifies population threshold levels below which facilities are not required to report emissions, such as fewer than 29,300 beef cattle and fewer than 3,200 dairy cattle. Facilities subject to the rule would report annually, beginning in 2011. However, as discussed next, in EPA's FY2010 appropriations (P.L. 111-88) and subsequent appropriations bills, Congress has included bill language barring EPA from using funds under that act to implement mandatory GHG reporting by manure management facilities.

Livestock Emissions and the 2015 Paris Agreement

In December 2015, 196 Parties to the U.N. Framework Convention on Climate Change (UNFCCC) adopted the Paris Agreement, a legally binding framework for an internationally coordinated effort to address climate change. It aims to hold the rise in global average temperature by 2100 to well below 2°C above pre-industrial levels. Researchers are assessing how much mitigation will be needed by various sectors worldwide to meet the global target, including how much mitigation is feasible.

Because livestock emissions are estimated to represent 14.5% of anthropogenic GHG emissions globally, it is generally acknowledged that the livestock sector plays an important role in climate change.[56] How much of a role the sector can play in attaining the global target of the Paris Agreement is unknown for now, especially in view of projections that worldwide livestock production will increase by about 70% between 2010 and 2050 to meet growing demand, especially in developing countries.[57]

Research has identified a range of GHG mitigation options for the livestock sector. A number of approaches are believed to be promising, but no single option has "hit the sweet spot" of reducing emissions dramatically while not harming animals or dampening production of farms and ranches. Adoption of more efficient technologies and practices is key to reducing emissions. Possible technologies and practices include the use of better quality feed and feed balancing to lower enteric and manure emissions. Manure management practices can assist in recovery and recycling of nutrients and energy. Technologies such as feeding additives, vaccines that reduce the microorganisms in cows that produce methane, and genetic selection methods are believed to have potential to reduce emissions but require further development.[58] Some believe that reducing the livestock sector's contribution to climate change, while also ensuring that nutritional security and health needs are supported, is an urgent global research and investment priority.[59]

Congressional Interest

The 111th Congress showed interest in several aspects of issues concerning agriculture and greenhouse gases, acting mainly to exempt or relieve agriculture from potential regulation of sources' GHG emissions.

First, legislation was introduced in response to EPA's 2008 ANPR, and to concerns that EPA might require CAA permits for greenhouse gas emissions from agriculture that some groups characterized as a "cow tax proposal." The legislation, S. 527 and H.R. 1426, would have

[56] P.J. Gerber, H. Steinfeld, and B. Henderson, et al., *Tackling Climate Change through Livestock—A Global Assessment of Emissions and Mitigation Opportunities*, Food and Agriculture Organization of the United Nations, Rome, 2013, p. xii.

[57] Ibid., p. 100.

[58] Ibid., pp. 45-53.

[59] Mario Herrero, Benjamin Henderson, and Petr Havlik, et al., "Greenhouse gas mitigation potential in the livestock sector," *Nature Climate Change*, DOI: 10.1038/nclimate2925, May 2016.

amended the Clean Air Act to mandate that no Title V permit be issued for controlling carbon dioxide, nitrogen oxide, water vapor, or methane emissions "resulting from biological processes associated with livestock production." No further action occurred on either bill. But, in the FY2010 appropriations bill for EPA (P.L. 111-88), Congress included a provision similar to the prohibitory language of S. 527 and H.R. 1426. As adopted, the measure prohibited EPA from using funds under the act to promulgate or implement any rule requiring the issuance of CAA Title V permits for GHG emissions associated with livestock production.

Second, also in final action on P.L. 111-88, Congress blocked EPA from using funds in the bill to implement any rule that would require mandatory reporting of GHG emissions from manure management operations. This bill language applies to manure management systems of all sizes, not just to those that emit more than 25,000 metric tons of CO_2-equivalent per year, as contained in EPA's mandatory reporting rule. As noted previously, EPA's rule excludes reporting by 99% of farms with manure management systems; P.L. 111-88 excluded the other 1% of operations.

Since FY2010, Congress has extended both of these prohibitions—barring EPA from developing a rule to require issuance of Title V permits for emissions associated with livestock production and barring implementation of a rule to mandate GHG emissions reporting from manure management systems—each year in the agency's appropriations bill, including for FY2016 (P.L. 114-113).

Climate Change Legislation

The 111th Congress debated comprehensive climate change bills and in that context considered whether or how to include regulation of agricultural and other sources of GHGs in the legislation. In 2009, the House passed the American Clean Energy and Security Act (H.R. 2454), legislation that would cover clean energy, energy efficiency, reducing global warming pollution, transitioning to a clean energy economy, and agriculture and forestry related offsets. The complex and controversial legislation reflected compromises on various issues, including a number of negotiated changes sought by agriculture interests.[60] A key feature of the House-passed bill was a cap-and-trade system designed to reduce GHG emissions from covered entities. As passed, the legislation excluded any agricultural enterprise or any small business that emits less than 25,000 metric tons of CO_2 equivalent of GHG emissions per year. Animal agriculture sources were excluded from the definition of "covered entities" in H.R. 2454, because of their *de minimis* impact on the climate, and thus, they would not be subject to the cap or other mandatory provisions of the bill.

The House-passed bill also would have created a carbon offset provision for certain agricultural and forestry activities. Offsets (emission reductions from non-covered sources) could be purchased by covered entities and used to meet their compliance obligations. Thus, the agricultural and forestry sectors could earn income for any emission reductions that they undertake, provided that the reductions are measurable and verifiable. The legislation also would have established the offset program under USDA (rather than EPA), a key difference sought by agriculture stakeholders.[61]

Comprehensive climate change legislation was reported from the Senate Environment and Public Works Committee in 2010 (S. 1733, the Clean Energy Jobs and American Power Act). Regarding

[60] "Climate Bill Slated for House Vote June 26; Waxman, Peterson Announce Deal on Offsets," *Daily Environment Report*, June 26, 2009, p. A-11.

[61] For additional information, see CRS Report R40994, *Agriculture and Forestry Provisions in Climate Legislation in the 111th Congress*, by Renée Johnson, and CRS Report RL34436, *The Role of Offsets in a Greenhouse Gas Emissions Cap-and-Trade Program: Potential Benefits and Concerns*, by Jonathan L. Ramseur.

agriculture, this bill was similar to H.R. 2454 in that it used the same emissions threshold (25,000 metric tons of CO_2 equivalent per year) applicable to the cap-and-trade and other mandatory provisions and would exclude animal agriculture from the definition of "covered entities." Like H.R. 2454, S. 1733 would have allowed for agriculture and forestry offsets as part of a cap-and-trade scheme. Also in the Senate, the Clean Energy Partnerships Act of 2009 (S. 2729) was introduced by Senator Stabenow shortly after the Senate Environment and Public Works Committee completed work on S. 1733. This bill (often referred to as the "Stabenow Amendment") would have expanded the agricultural and forestry carbon offset provisions in the comprehensive climate bills (e.g., S. 1733) and also would have allowed for certain other provisions benefitting U.S. farmers and landowners. No further action occurred, and Congress has not considered comprehensive climate change legislation since the 111th Congress.

National Research Council Reports on Air Emissions from AFOs

During the time that EPA was developing the revised Clean Water Act CAFO rules that it promulgated in 2003 (discussed above), the issue of air emissions from CAFOs received some attention. The Clean Water Act requires EPA to consider non-water quality environmental impacts, such as air emissions, when it sets effluent limitations and standards. EPA recognized that certain animal waste management practices can either increase or decrease emissions of ammonia and/or hydrogen sulfide and that some regulatory options intended to minimize water discharges (such as anaerobic lagoons and waste storage ponds) have the potential to result in higher air emissions than other options, due to volatilization of ammonia in the waste. Likewise, emissions of nitrous oxide are liberated from land application of animal waste on cropland when nitrogen applied to the soil undergoes nitrification and denitrification.[62] Some environmental groups had urged EPA to address or restrict feedlot air emissions as part of the water quality rule. In the proposed rule and the 2003 final revised rule, EPA generally evaluated air emissions impacts of the rule, but it said that insufficient data exist to fully analyze all possible compounds and the significance of air emissions from feedlot operations.

In part because of this lack of information, in 2001 EPA asked the National Research Council (NRC) of the National Academy of Sciences to evaluate the current scientific knowledge base and approaches for estimating air emissions from AFOs. EPA asked the NRC to identify critical short- and long-term research needs and provide recommendations on the most promising science-based approaches for estimating and measuring emissions. USDA joined EPA in the request for the study. At the time, EPA was under a court order to revise its water quality rules, and officials hoped that the NRC report would help assure that rules aimed at improving water quality would not have negative impacts on air emissions.

In an interim report released in 2002, the NRC responded to several of the EPA questions.[63] Nitrogen emissions from production areas are substantial, the committee found, and control strategies aimed at decreasing emissions should be designed and implemented now. It recommended developing improved approaches for estimating and measuring emissions of key air pollutants from AFOs and initiating long-term coordinated research by EPA and USDA with the goal of eliminating release of undesirable air emissions. The committee said that

[62] Nitrification and denitrification are biological processes that, respectively, oxidize ammonia to nitric acid, nitrous acid, or any nitrate or nitrite; and reduce nitrates or nitrites to nitrogen-containing gases.

[63] National Research Council, *The Scientific Basis for Estimating Air Emissions from Animal Feeding Operations, Interim Report* (Washington, DC: National Academies Press, 2002).

implementation of feasible management practices that are designed to decrease emissions, such as incorporating manure into soil, should not be delayed while research on mitigation technologies proceeds. This report focused particularly on the suitability of an approach for estimating air emissions from AFOs presented in a 2001 draft EPA report. In that report, EPA attempted to develop a set of model farms, based on manure management systems typically used by large AFOs, and identify emissions factors that could be associated with each element of the model farm. In the absence of actual data from extensive monitoring, EPA hoped that emission factors could be applied to model farms to estimate annual mass emissions.[64]

An emissions factor is a representative value that attempts to relate the quantity of a pollutant released to the atmosphere with an activity associated with the release of the pollutant. The emission factor approach is based on measuring emissions from a set of defined AFOs to obtain an average emission per unit (per animal unit, or per production unit process, such as manure storage piles and lagoons, stall areas, and feed storage areas), then multiplying the emission factor by the number of units and period of time (e.g., annually). The current method of estimating cow, chicken, swine, or any other livestock animal emissions is generally expressed in terms of emissions per head, per year. Using this method, facility emissions are directly proportional to the number of animals at the facility.

The NRC recognized that direct measurement of air emissions at all AFOS is not feasible. However, it found that the model farm construct described by EPA cannot be supported because of weaknesses in the data needed to implement it, which fail to consider variations in many factors (geography, climate, management approaches) that could affect annual amounts and temporal patterns of emissions from an individual AFO. Alternatively, the NRC recommended that EPA consider a more complex process-based approach to focus on activities that determine the movement of nutrients and other substances into, through, and out of each component of the farm enterprise.

The NRC expanded on these recommendations in its final report, issued in 2003.[65] Overall, it found that scientifically sound protocols for measuring air concentrations, emission rates, and fates are needed for the elements, compounds, and particulate matter associated with AFOs. Similarly, standardized methodology for odor measurement should be developed in the United States, the NRC said. The report noted that emission factor approaches should be broadened to integrate animal and crop production systems both on and off the AFO (i.e., imported feeds and exported manure) in order to represent the full environmental effects of animal production systems. Such a systems analysis should include impacts of best management practices (BMPs) aimed at mitigating AFO air emissions on other parts of the entire system.

The Role of USDA

The U.S. Department of Agriculture (USDA) manages a diverse range of programs involving food, forests, rural development, agricultural trade, and conservation of natural resources. Several USDA agencies have conservation responsibilities that may involve livestock and their environmental effects. For example, the Natural Resources Conservation Service (NRCS) provides technical assistance and information, as well as financial assistance, to landowners and agricultural producers to implement conservation systems and practices, such as developing Comprehensive Nutrient Management Plans to control AFO runoff.

[64] U.S. Environmental Protection Agency, *Emissions from Animal Feeding Operations (Draft)*, EPA Contract No. 68-D6-0011, Washington, DC, August 15, 2001, 414 pp.

[65] NRC 2003 AFO Report.

The Agricultural Research Service (ARS) is the in-house research agency of USDA and conducts a wide range of research activities. One of ARS's national programs addresses climate change, soils, and emissions. ARS has supported projects to assess emissions from beef cattle feedlots, dairy operations, and poultry operations; to evaluate swine wastewater treatment systems; and to improve soil and water management practices in cropping and livestock systems. ARS has participated in climate change research to develop technologies and systems for reducing atmospheric greenhouse gas concentrations emissions from agricultural sources. In 2015, ARS initiated plans for research on managing emissions from livestock, including projects concerning emissions processes, pathways, and cost-effective mitigation strategies.

A second USDA agency is the National Institute of Food and Agriculture (NIFA). NIFA uses extramural funding and works with government agencies and commodity and public organizations that conduct research and carry out extension and education programs to manage manure nutrients. Through its Agriculture and Food Research Initiative Air Quality program, NIFA supports research activities to develop emissions data and improve management, control, and transport of odor, gasses, and particulate matter. NIFA also provides outreach to producers on transfer of technology and best practices to reduce pollutants and greenhouse gases.

USDA cooperates with EPA when issues concern both agriculture and the environment. Notably, the two collaborated on a Unified National Strategy for Animal Feeding Operations, issued in 1999, intended to minimize public health and environmental impacts of runoff from AFOs. That strategy consisted of multiple elements and was based on a national performance expectation that all AFO owners and operators would develop and implement site-specific Comprehensive Nutrient Management Plans by 2009 to protect water quality and public health.

The importance of relationships between air quality and agriculture has received increased recognition at USDA in recent years. One direct result was enactment of a provision in the Federal Agriculture Improvement and Reform Act (P.L. 104-127), the 1996 farm bill, requiring USDA to create an Agricultural Air Quality Task Force. One finding in Section 391 of the statute stated that USDA should lead efforts to determine accurate measures of agriculture's role in air pollution and in the development of cost-effective approaches to reduce pollution. Several provisions of the 2002 farm bill (the Farm Security and Rural Investment Act, P.L. 107-171) specifically addressed air quality issues in the context of USDA conservation programs.

The Agricultural Air Quality Task Force is an advisor to the Secretary of Agriculture. Its chairman is the chief of the NRCS, and its members represent USDA, EPA, industry, and basic and applied science. It is charged with ensuring sound data quality and interpretation, so that policy recommendations made by federal or state agencies to address air pollution problems related to agriculture are based on accurate scientific findings, peer review, and economic feasibility.

Research Priorities

In debates over controversial and complex public policy questions, stakeholders who hold differing perspectives at times may find little common ground. Sometimes the only point of agreement is the need for more and better research to resolve key questions—and each side hopes that research findings will support its own perspectives on the issues at hand. With regard to questions about AFO emissions and the possible need to implement control strategies, there is little dispute about the need for more research. Research on a wide range of topics currently is being supported by federal agencies, a number of individual states, academic institutions, and industry, but there is no apparent coordination or unified strategy. The monitoring study that EPA initiated as part of the Air Compliance Agreement, discussed previously, was intended to answer some key questions. However, in view of criticism of the study, doubts exist about the study's

utility. Some critics of the Air Compliance Agreement fault EPA for planning only to measure emissions, but not also using the monitoring study as an opportunity to research mitigation techniques, as well as address health effects of air pollutants emitted by AFOs.

In its 2003 report, the National Research Council addressed these issues and recommended "substantial research efforts in both the short term and the long term." Research in the short term (four to five years), the NRC said, can significantly improve the capability of scientifically sound modeling approaches for measuring and estimating air emissions, especially for process-based modeling that the NRC recommends be developed by EPA and USDA. A long-term research program (20-30 years) that encompasses overall impacts of animal production on the environment can have substantial results in decreasing overall impacts on the environment, while sustaining production at a high level. For the long term, coordinated research is needed to determine which emissions are most harmful to the environment and human health and to develop technologies to decrease their releases into the environment.[66]

Priority research needs identified by the NRC, USDA's Agricultural Air Quality Task Force,[67] and others fall into two broad categories: fundamental research to estimate, measure, and characterize emissions; and technology research (including technology transfer).

- Foremost is the need to produce scientifically sound, standardized methodology as a basis for measuring and estimating gaseous and particulate emissions and odor, from AFOs on local, regional, and national scales. The science for estimating air emissions from individual AFOs should be strengthened, along with models to understand the totality of AFO processes, including dispersion, transformation, and deposition of emissions. This information is needed in order to assess relationships between emissions, potential health indicators, and candidate regulatory and management programs. The air emissions monitoring study undertaken as part of the Air Compliance Agreement was completed in 2011, and, based on that research, EPA has begun development of emissions estimating methodologies for animal sectors.
- A related concern is that much more needs to be understood about community-level impacts from exposure to AFO emissions. Occupational health studies have documented adverse health effects among AFO workers, such as acute and chronic respiratory diseases, but experts agree that occupational health risks cannot be extrapolated to community health risks. Peer reviewed studies of health impacts on residents in the vicinity of livestock operations are limited. These studies suggest that AFO air emissions may constitute a public health hazard, deserving of public health precautions as well as larger, well controlled, population-based studies to more fully ascertain adverse health outcomes and their impact on community health.[68]
- With regard to technology, there is a need to develop standardized measurement technologies for pollutants and odorous compounds emitted by AFOs and effective, practical, and economically feasible technologies to reduce and control odors and pollutants. Experts believe that there is a need to develop and evaluate innovative treatment processes for each of the major sources of AFO emissions, confinement buildings, manure storage areas, and land application. Research

[66] NRC 2003 AFO Report, pp. 11, 174-175.

[67] AAQTF CAFO White Paper, p. 5.

[68] *Iowa CAFO Air Quality Study*, p. 138.

further should include programs to provide for transfer of economically viable technologies to all producers.

In its 2003 report, the National Research Council observed that EPA and USDA have not devoted the necessary technical or financial resources to estimating air emissions and developing mitigation technologies, and it criticized both for failing to address this deficiency in defining high-priority research programs. The report said, "Each has pursued its regulatory and farm management programs under the assumption that the best currently available information can be used to implement its program goals." It concluded that a change in research priorities in both agencies is needed if air emissions are to be addressed with an adequate base of scientific information.[69] There appears to be wide agreement among stakeholder groups on the need for more research on a large number of related issues, but congressional interest in supporting or funding more federal participation in research activities is unclear.

Prior to the 112th Congress, congressional attention to the issues discussed in this report had been limited, with the result that developments had proceeded largely by administrative and some judicial actions, not through legislative policymaking. As described previously, one aspect that has attracted congressional interest is questions about the applicability of CERCLA and EPCRA to livestock and poultry operations. That interest was apparent in the context of appropriations bills and in legislation in the 112th Congress to amend CERCLA to clarify that manure is not a hazardous substance. Similar legislation has not been introduced subsequently.

More broadly, Congress has shown considerable interest in the impact of federal regulation, especially by EPA, on the agriculture sector.[70] The Senate and House Committees on Agriculture and other congressional committees have shown particular interest in EPA's actions and have conducted oversight hearings on regulatory impacts—costs and administrative burdens of compliance with environmental and other requirements—on agriculture.

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[69] NRC 2003 AFO Report, pp. 13, 153.

[70] For information, see CRS Report R41622, *Environmental Regulation and Agriculture*, coordinated by Megan Stubbs.

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