

MEMORANDUM

TO: Docket for rulemaking, “National Emission Standards for Hazardous Air Pollutants: Crude Oil and Natural Gas Production Facilities and Natural Gas Transmission and Storage Facilities. Technology Review and Reconsideration” (EPA-HQ-OAR-2025-1348)

DATE: April 16, 2026

SUBJECT: Economic Impact Analysis for National Emission Standards for Hazardous Air Pollutants: Crude Oil and Natural Gas Production Facilities and Natural Gas Transmission and Storage Facilities. Technology Review and Reconsideration

1. Introduction

The U.S. Environmental Protection Agency (EPA) is proposing amendments to the National Emissions Standards for Hazardous Air Pollutants (NESHAP) from Crude Oil and Natural Gas Production Facilities and from Natural Gas Transmission and Storage Facilities, which are regulated under 40 CFR part 63, subparts HH and HHH, respectively. Under the statutory authority granted to the Agency by the Clean Air Act (CAA) section 112, the EPA set maximum achievable control technology (MACT) standards for both the Crude Oil and Natural Gas Production and Natural Gas Transmission and Storage major source categories in 1999 and conducted the residual risk and technology review in 2012.¹

Subpart HH covers activities in the following segments of the oil and natural gas sector: oil and natural gas production, gathering and boosting, and natural gas processing. Oil and natural gas production includes wells and all related processes used in the extraction, production, recovery, lifting, stabilization, separation or treating of oil and/or natural gas (including condensate). Gathering and boosting consists of low pressure, small diameter, gathering pipelines and related components that collect and transport the oil, gas and other materials and wastes from the wells to the refineries or natural gas processing plants. Natural gas processing operations separate and recover natural gas liquids (NGL) or other nonmethane gases and liquids from a stream of produced natural gas. Oil refineries are covered by another subpart (40 CFR 63, subpart CC).

Subpart HHH covers activities in the natural gas transmission and storage segment. Once pipeline quality natural gas leaves the processing segment, it enters the transmission segment. To ensure that the natural gas flowing through any pipeline remains pressurized, compression of the gas is required periodically along the pipeline. This is accomplished by compressor stations usually placed between 40- and 100-mile intervals along the pipeline. In addition to the pipelines and compressor stations, the natural gas transmission segment includes underground storage facilities. Underground natural gas storage includes subsurface storage, which typically consists of depleted gas or oil reservoirs and salt dome caverns used for storing natural gas. For more

¹ See Section II.A of the Preamble for more details on the statutory authority and standard setting process under CAA section 112.

detailed information on operations in the oil and natural gas sector, see Section II.B of the Preamble to this action.

Air emissions can occur from a variety of processes and points throughout the oil and natural gas sector. Primarily, these emissions are organic compounds such as methane (CH₄), ethane, Volatile Organic Compounds (VOC) and organic hazardous air pollutants (HAP). The most common organic HAP are n-hexane and BTEX (benzene, toluene, ethylbenzene and xylenes) compounds. In some cases, hydrogen sulfide (H₂S) and sulfur dioxide (SO₂) are emitted from natural gas production and processing operations.

Within the CAA section 112 framework, sources of HAP emissions are either major sources or area sources, and CAA section 112 establishes different requirements for major source standards and area source standards. Major sources are defined as any stationary source or group of stationary sources located within a contiguous area and under common control that emits or has the potential to emit 10 tons per year (tpy) or more of any single HAP or 25 tpy or more of any combination of HAP. All other sources are area sources, including “synthetic minor” sources that have potential to emit above the major source thresholds but have taken emission limitations as part of their permitting processes.

In most instances, including natural gas processing and transmission and storage operations, emissions are aggregated across emission points to determine if facilities qualify as major sources. In the case of oil and gas production, however, CAA section 112(n)(4)(A) does not allow for such aggregation of emissions from wells and their associated equipment. When the major source NESHAP subpart HH was promulgated in 1999, the EPA defined associated equipment to exclude glycol dehydrators and storage vessels with potential for flash emissions (PFE), though the latter was amended in 2012 to include all storage vessels. As a result, under current regulations, emissions from all storage vessels and glycol dehydrators at a production field facility are to be aggregated to determine major source status. For the purposes of this document, the term “facility” is equivalent to “major source” or “area source” for the processing, transmission, and storage segments, and are typically natural gas processing plants or compressor stations. For the production segment, facility is meant to represent all the major and area sources at a particular site, e.g., a well site, gathering and boosting station, or centralized production facility. The equipment at sites from which emissions originate are referred to as “emission points.”

In this action, the EPA is proposing revisions to the major source definition for production facilities within subpart HH, new standards for previously unregulated HAP (methanol) from small dehydrators, and other technical changes. The EPA is further proposing two alternative approaches to emission points not currently regulated in these NESHAP. Under the first approach, the EPA is proposing that the Agency does not have an obligation to regulate previously unregulated emission points of already regulated HAP at this time and to defer action on that basis. Under the second (alternative) approach, the EPA is proposing new control standards for previously unregulated emission points. Currently, subpart HH contains major source standards for HAP emissions from glycol dehydration process vents, storage vessels, and natural gas processing plant equipment leaks and area source standards for glycol dehydrators,

while subpart HHH contains major source standards for glycol dehydration process vents. The alternative proposal subpart HH standards for previously unregulated sources apply to acid gas removal units (AGRU), storage vessels without PFE, and truck loading racks. The alternative proposal subpart HHH standards for previously unregulated sources apply to all storage vessels, truck loading racks, process controllers, and pumps. The proposed amendments are summarized in Table 1, along with references to the applicable sections in the Preamble.

Of the proposed amendments, the EPA only quantifies the impacts of the alternative proposal standards for previously unregulated sources, as well as the additional recordkeeping and reporting burden, due to the availability of data and the expected scale of the potential impacts; the alternative proposal standards for those sources are discussed in detail in the next section. For the remaining entries in Table 1, the impacts are assessed qualitatively; as such, the first proposed option does not have any quantified impacts. The change to the major source definition is potentially deregulatory, as it would cause sources in the production segment for which their HAP emissions from glycol dehydrators and storage vessels combined (but not individually) exceeded the major source threshold to no longer be subject to the major source requirements for those emission points. The EPA currently lacks the data to estimate to how many sources that situation would apply; however, we present a screening-level bounding analysis in Section 7 and are taking comment on the potential impacts (see Section V, item 17 in the Preamble). The regulation of methanol emissions from small dehydrators in subpart HH is not expected to have significant impacts as those units are already subject to standards for other HAP that likely controls methanol emissions to below the proposed standard.² Finally, the changes to the small dehydrator emission limitation equation could have small deregulatory impacts as they should ease the demonstration and verification of compliance.

² The current standards apply to all HAP listed in Table 1 in both NESHAP subparts HH and HHH. One aspect of the proposal is to present BTEX as a surrogate for all regulated HAP other than methanol. See Section III.B.3 of the Preamble for a detailed discussion.

Table 1 Summary of Proposed Amendments

Action	Applicable subparts	Summary	Preamble Section(s)	Quantified impacts?
Major source definition (both proposed options)	HH	HAP emissions from glycol dehydrators and storage vessels at production facilities will no longer be aggregated to determine major source status for those sources.	III.B.1	No
Regulation of methanol (both proposed options)	HH	Methanol emissions from small dehydrators must be controlled to 95%.	III.B.2 and III.B.3	No
Regulation of previously unregulated sources (alternative proposal only)	HH, HHH	Subpart HH standards apply to AGRU, storage vessels without PFE, and truck loading racks. Subpart HHH standards apply to storage vessels, truck loading racks, process controllers, and pumps.	III.B.4	Yes
Changes to small dehydrator emission limitation equation (both proposed options)	HH, HHH	Improvements in the emission limit equations that prevent calculation of implausible limits for small input values.	III.B.5	No
Recordkeeping and reporting requirements (alternative proposal only)	HH, HHH	A small amount of additional recordkeeping and reporting burden is expected under the alternative proposal option: \$20 per facility per year on average for subpart HH facilities and \$320 per facility per year on average for subpart HHH facilities.	VI.C	Yes

Below, we present an analysis of the potential economic impacts of regulating previously unregulated emissions sources. The baseline includes data-driven assumptions about control measures already employed for the previously unregulated emission points, as well as assumptions about future compliance with the “Standards of Performance for New, Reconstructed, and Modified Sources and Emissions Guidelines for Existing Sources: Oil and Natural Gas Sector Climate Review” (subparts OOOOb and OOOOc), which was published in March 2024,³ as amended by the “Extension of Deadlines in Standards of Performance for New, Reconstructed, and Modified Sources and Emissions Guidelines for Existing Sources: Oil and Natural Gas Sector Climate Review Final Rule,” which was published in July 2025.⁴

³ 89 FR 16820; see <https://www.federalregister.gov/documents/2024/03/08/2024-00366/standards-of-performance-for-new-reconstructed-and-modified-sources-and-emissions-guidelines-for>.

⁴ 90 FR 35966; see <https://www.federalregister.gov/documents/2025/07/31/2025-14531/extension-of-deadlines-in-standards-of-performance-for-new-reconstructed-and-modified-sources-and>. Another rulemaking that amends the March 2024 Final Rule, “Reconsideration of Standards of Performance for New, Reconstructed, and Modified Sources and Emissions Guidelines for Existing Sources: Oil and Natural Gas Sector Climate Review,” was signed on April 6, 2026 but did not affect the construction of the baseline scenario for this analysis; the preamble for that rulemaking can be found at: https://www.epa.gov/system/files/documents/2026-04/san-12031_final-rule_nsps-eg-ooobcrecon1_preamble.pdf.

Our analysis reflects estimated impacts for two scenarios for the previously unregulated emission points. The first scenario reflects the alternative proposal standards set under CAA section 112 authority based on the state of the industry at the time of the original MACT promulgation in 1999 (“Alternative Proposal” scenario). The second scenario reflects hypothetical (*i.e.*, not proposed) standards that reflect a more stringent set of control requirements than the alternative proposal standards (“More Stringent” scenario). The More Stringent scenario is intended to provide additional information to the public regarding this proposal and the choices facing the Agency.

The quantitative analysis includes estimates of compliance costs; HAP, VOC, and methane emissions reductions; and the distribution of cost-to-sales ratios for small businesses. We also include qualitative discussion of the health and environmental impacts of HAP and VOC emissions. As discussed in more detail below, we include estimates of the impacts with and without baseline control assumptions.

Over a 2028–2038 analysis horizon, we estimate that the proposed Alternative Proposal standards will result in net present values (NPVs) of \$910,000 in compliance costs to industry, assuming a 3% social discount rate, and \$680,000 assuming a 7% discount rate. We estimate the hypothetical More Stringent standards, assuming the same analysis horizon, would result in NPVs of \$35 million (3% discount rate) and \$28 million (7% discount rate) in compliance costs.

2. Data and Methodology

In this section, we describe our data sources and methodology used to construct the baseline control scenario and the cost and performance of control measures to estimate economic impacts of regulating previously unregulated emissions points. We leverage data from two different sources: (1) EPA’s Enforcement and Compliance History Online (ECHO) database, which provides the count of regulated sources; and (2) operator responses to an Information Collection Request (ICR) issued in February 2023 pursuant to CAA section 114, which includes information on emission points, existing controls and work practices, and HAP and VOC emissions and was conducted to fill data gaps to facilitate this proposed rule. We use an engineering analysis in which we apply the facility-level characteristics from the survey data to the facility counts data to estimate baseline emissions and compliance costs.

Count of Regulated Facilities from EPA’s Enforcement and Compliance History Online database

A summary of the facility universe used for the analysis by subpart and CAA source type is provided in Table 2. The facility list was generated from queries to EPA’s ECHO database;⁵ the searches were conducted to screen for active facilities reporting under subpart HH or subpart HHH in the CAA program. For production facilities, the major source counts are based on the current definition that this action proposes to change. As the table illustrates, there are far more

⁵ See <https://echo.epa.gov/facilities/facility-search>. This provides our best estimate of the universe of facilities subject to the relevant subparts.

subpart HH facilities than subpart HHH facilities and, proportionately, many more of the subpart HHH facilities are classified as major sources.

Table 2 Estimated Facility Counts by Subpart and Segment

Subpart	Segment	Section 112 Source Classification		Total
		# of Area Sources	# of Major Sources	
HH	Production	2,541	449	2,990
HH	Processing	73	199	272
HHH	Transmission	29	65	94
Total		2,643	713	3,356

Note: Based on queries to EPA’s ECHO database.

Within subpart HH, it is important to distinguish between sources in the production (including gathering and boosting operations) and processing segments, since the major source definition differs. We accomplished this by using the facility names in the ECHO database, categorizing facilities whose names include certain common strings such as “NGPP” (natural gas processing plant) or “NGL” (natural gas liquids) as processing facilities. In addition, we categorize facilities that are assigned a Standard Industrial Classification (SIC) code of 1321 (Natural Gas Liquids) in the ECHO database as processing facilities. The remaining subpart HH facilities are categorized as production facilities. The exercise reveals that a far greater proportion of processing facilities are categorized as major sources compared to the proportion of production facilities.

Survey of facility characteristics from an Information Collection Request

The ECHO queries provide an estimate of the current number of active sources subject to each subpart, but not the emission points at each facility. To generate estimates for the distribution of emission points across facilities (as well as baseline emissions control and work practice rates and average emissions factors), we leveraged data from the ICR; the ICR effort is described in detail in Section II.C of the Preamble. The ICR responses corresponded to 204 production facilities (2 self-identified as major sources) and 25 processing facilities (6 major) for subpart HH,^{6,7} and 58 facilities (40 major) for subpart HHH. The limited data on major sources in the production segment limits our ability to assess the potential impacts of the change to the major source definition.

Since the ICR response rate of subpart HH major source facilities was so limited, we attempted to supplement our data on major sources by using ICR responses from synthetic minor sources as proxies for additional major sources. As mentioned previously, synthetic minor sources are facilities that have the potential to emit above the major source threshold but have limited their emissions as part of the permitting process. The ICR responses do not include a field that specifically identifies synthetic minors, so we use the self-reported potential emissions estimates to construct a field that indicates if sources are above the major source threshold. For production facilities, this involved aggregating potential HAP emissions estimates from dehydrators and storage vessels at each facility, yielding 51 synthetic minor sources. For processing facilities,

⁶ This does not include two facilities that did not self-identify as major or area sources and were subsequently dropped from the analysis.

⁷ One facility was reported as a centralized production facility but included “Gas Plant” in the facility name, so it was recategorized for our analysis as a processing facility.

potential HAP emissions estimates for all emissions points for which data was collected (AGRUs, storage vessels, loading operations, compressors, and dehydrators) were aggregated, yielding 11 synthetic minor sources. Along with the self-identified major sources, these potential synthetic minor sources were used to characterize average or “representative” major source facilities.

A summary of the equipment distribution, baseline control, and uncontrolled emissions is provided in Table 3; these assumptions are primarily driven by analysis of the ICR responses. The “facility proportion” column provides the fraction of major or synthetic minor facilities in the ICR responses that reported having that emission point.⁸ For each emission point, the average counts per facility are conditional on having at least one unit of each source. “Control proportion” refers to the proportion of units routing to emissions control devices, such as flares or vapor recovery units (VRUs). The “work practice proportion” refers to the proportion of units leveraging operational techniques to reduce emissions. The “uncontrolled HAP/VOC emissions per-facility” reflect emissions potentials prior to the application of any existing control or work practices. These were based on a combination of average facility-level, ICR-reported emissions, internal ICR-estimated average weight ratios (in instances where only VOC and not HAP emissions were reported), and assumed emission factors and weight ratios from other sources as described in the Technical Support Document (TSD) and associated workbooks for this action. The details of the calculations can be found in the files accompanying the economic analysis in the docket.

There are a few instances in which our assumptions deviate from either explicit analysis of the ICR or the analysis presented in the Preamble. Most notably, we assume baseline work practice adoption rates of 100% for storage vessels and vessel loading operations. The ICR did not ask about work practices for storage vessels,⁹ while the baseline proportions for vessel loading were 58% in processing and 0% in transmission and storage. Analysis of the value of product recovery versus the cost of the work practice brought into question the accuracy with which this field was populated in the responses, and so we impose a 100% adoption rate as the baseline assumption in our central analysis, while taking comment on the reasonableness of that assumption in the preamble; see below for a discussion of how we calculate the value of product recovery.¹⁰ In addition, our emissions factors deviate in some instances from those presented in the preamble, most notably in the case of AGRUs, where we assume, e.g., 515 tpy of uncontrolled HAP emissions per facility in this analysis versus 234 tpy in the preamble. This is because we calculate the average emissions factor for the EIA using all major sources discussed in the

⁸ For production facilities, emissions sources were only counted if they exceeded the major source thresholds on their own since emissions are not aggregated across the facility to determine major source threshold; e.g., only 4% of major/synthetic minor production facilities in the ICR included a storage vessel without potential for flash emissions with emissions for any individual HAP greater than 10 tpy or total HAP emissions greater than 25 tpy.

⁹ The ICR asked about control methods for these emission points but did not explicitly focus on work practice standards.

¹⁰ For processing plants, our analysis using the values in the ICR data suggested annual product recovery values that exceeded the initial capital and annual costs of the work practice and were 25–30 times greater than the annual costs. The same was not true for transmission and storage compressor stations, but since those facilities tend to be larger and operated by bigger companies, we assumed they were likely using more advanced operational practices.

preamble, including one particularly large emitting source that was omitted from the preamble analysis, as well as the smaller synthetic minor sources, which are also not included in the preamble analysis. The net effect is that the EIA assumption is around twice as large. In our view, either assumption is valid, but we choose to include all the data points in this analysis to maintain consistency with how emissions factors are estimated for the other emissions sources. Regardless of the assumption, all facilities are assumed to be controlled in the baseline, so our central analysis estimates no emissions changes associated with AGRUs.

Table 3 Equipment Distribution, Baseline Control, and Uncontrolled Emissions Assumptions for Previously Unregulated Emission Points at Major and Synthetic Minor Sources

Subpart	Segment	Emission Point	Metric				Uncontrolled HAP Emissions Per Facility (TPY) ^b	Uncontrolled VOC Emissions Per Facility (TPY) ^b	Uncontrolled Methane Emissions Per Facility (TPY) ^b
			Facility Prop.	Avg. Count Per Facility	Control Prop.	Work Practice Prop. ^a			
HH	Production	Storage vessels without PFE	4%	1.0	100%	100%	49	1,300	4,800
	Processing	AGRU	94%	1.7	100%	0%	520	1,100	4,000
		Storage vessels without PFE	100%	3.8	39%	100%	2.0	17	62
HHH	Transmission	Vessel loading	94%	1.6	46%	100%	3.9	22	80
		Storage vessels	88%	4.3	0%	100%	0.079	2.7	96
		Vessel loading	23%	1.0	0%	100%	0.00062	0.021	0.75
		Process controllers	100%	50	40%	0%	0.025	0.84	30
		Pumps	100%	1.0	94%	0%	0.0037	0.13	4.5

Note: Values have been calculated and rounded to two significant digits.

^a Work practice proportions are based on engineering and economic judgment. The ICR did not ask about work practices at storage vessels, while the reported work practice proportions in the ICR for vessel loading were 58% for processing and 0% for transmission. Analysis of the value of product recovery versus the cost of the work practice brought into question the accuracy with which this field was populated in the responses, and so we impose a 100% baseline assumption in our central analysis, while taking comment on the reasonableness of that assumption in the Preamble.

^b Emissions levels prior to application of any work practice or use of emissions control devices.

Table 4 Facility and Emission Point Counts After Applying ICR-Derived Distributions to Facility Counts

Subpart	Segment	Emission Point	Metric			Uncontrolled HAP Emissions (TPY)	Uncontrolled VOC Emissions (TPY)	Uncontrolled Methane Emissions (TPY)
			Facility Count	Emission Point Count				
HH	Production	Storage vessels without PFE	17	17	830	23,000	81,000	
	Processing	AGRU	190	320	97,000	210,000	750,000	
		Storage vessels without PFE	200	750	400	3,400	12,000	
		Vessel loading	190	300	720	4,100	15,000	
HHH	Transmission	Storage vessels	57	250	4.5	150	5,500	
		Vessel loading	15	15	0.0090	0.30	11	
		Process controllers	65	3,300	1.6	55	2,000	
		Pumps	65	65	0.24	8.1	290	

Note: Values have been calculated and rounded to two significant digits.

By applying the information in the facility proportion, average unit counts per facility, and uncontrolled HAP and VOC emissions per facility from Table 3 to the facility counts from Table 2, we can estimate the number of facilities with each emission point, the total number of units of each emissions source, and the total emissions from each emissions source before the application of any work practice or emissions control. Those estimates are presented in Table 4.

The control measures (including work practices) to reduce emissions, including cost and control efficiency assumptions, assessed in this analysis are summarized in Table 5.¹¹ Multiple measures are assessed for AGRUs, storage vessels, and vessel loading operations, with the latter two sources having a work practice standard option (submerged/bottom fill) as well as a flaring option. As the table illustrates, the work practice standards are assumed to be much less costly, but also much less efficient, than the 95% control option, which in turn is much less costly than the 98% control option.

Table 5 Summary of Control Measure Assumptions

Subpart	Emission Point	Measure	Metric			
			Cost Unit	Control Efficiency	Capital Cost (2024\$)	Annual Operating Cost (2024\$)
HH	AGRU	Flare—95% control	Facility	95%	140,000	23,000
		Flare—98% control	Facility	98%	570,000	40,000
Both	Storage vessels ^a	Submerged/bottom fill	Unit	58%	8,100	750
		Flare—95% control	Facility	95%	140,000	23,000
Both	Vessel loading	Submerged/bottom fill	Unit	59%	2,100	100
		Flare—95% control	Facility	95%	140,000	23,000
HHH	Controllers ^b	Compressed air system	Facility	100%	390,000	25,000
HHH	Pumps	Electrical pumps	Unit	100%	9,500	470

Note: Values have been calculated and rounded to two significant digits.

^a Control measures apply only to storage vessels without PFE for subpart HH major sources.

^b The 112(d)(6) standards for process controllers at subpart HHH major sources require bleed rates less than or equal to 6 standard cubic feet per hour (i.e., not high-bleed) unless an exception is required for functional needs. ICR responses indicated that fewer than 3% of process controllers are high-bleed, so we assume that the impacts of this requirement would be negligible.

Along with reducing emissions, some control measures enable the recovery of saleable products. In the case of compressed air systems and electrical pumps, the recovered product is natural gas. In the case of submerged/bottom fill, the recovered product is NGL. To calculate the value of natural gas product recovery, we translate the estimated reductions in methane emissions in short tons to estimated recovery of natural gas in cubic feet and then multiply by projected future natural gas prices. To calculate the value of NGL product recovery, we translate the estimated reductions in VOC emissions in short tons to estimated recovery of NGLs in barrels and then

¹¹ See *Background Technical Support Document for the National Emission Standards for Hazardous Air Pollutants: Crude Oil and Natural Gas Production Facilities and Natural Gas Transmission and Storage Facilities - Technology Review and Reconsideration. NESHAP Subparts HH and HHH. Proposed Rules.* in Docket ID No. EPA-HQ-OAR-2025-1348.

multiply by projected future oil prices and a conversion factor for the long-term ratio of NGL prices to West Texas Intermediate oil prices.¹²

Having characterized the anticipated universe of emission points affected by the proposed rule and the control measures that may already be in place at those sources, the final step is to define baseline and policy scenarios and the analysis horizon. A summary of the scenarios is provided in Table 6.

Baseline

As indicated in Table 6, we assume significant levels of baseline control based on analysis of the ICR data and other federal regulations. For example, the ICR data indicated that all AGRUs at major sources or above the major source threshold are already controlled. The presence of controls as reported in the ICR responses may be due to factors such as worker safety or local or state requirements. In addition, the EG OOOOc requirements for storage vessels, pneumatic controllers, and pumps are assumed to result in control levels greater than or equal to the options explored in the analysis for this action starting in 2029, consistent with the analysis of *Extension of Deadlines in Standards of Performance for New, Reconstructed, and Modified Sources and Emissions Guidelines for Existing Sources: Oil and Natural Gas Sector Climate Review Final Rule*, which included deadline extensions for state plan submissions for the EG OOOOc.¹³ As a bounding exercise, we also present estimates for scenarios without any baseline control.

Policy Scenarios

Our analysis considers two policy scenarios, one reflecting the alternative proposal and another reflecting a set of more stringent standards; the proposed option from the preamble is assumed to not result in quantified impacts. The Alternative Proposal standards are less stringent and would require 95% control at affected subpart HH AGRUs, a bottom loading/submerged fill work practice for storage vessels (without PFE for subpart HH) and vessel loading operations at major sources for both subparts, and zero emissions from pumps at subpart HHH major sources. The More Stringent standards are more stringent and would require 98% control at affected subpart HH AGRUs, 95% control for storage vessels (without PFE for subpart HH) and vessel loading operations at major sources for both subparts, and zero emissions from process controllers and pumps at subpart HHH major sources. The compliance deadlines required by the rule are 18 months after finalization for work practice standards and 36 months after finalization for 95% control, 98% control, and zero emissions standards. We assume the rule is finalized near the beginning of 2027,¹⁴ and so we assume compliance costs associated with the work practice standards start in 2028 and compliance costs for the other standards start in 2029.

¹² We assume an NGL density of 4.65 lbs per gallon based on a general range of densities for specific NGLs such as butane and propane (<https://www.epa.gov/sites/default/files/2020-11/documents/appa.pdf>), and a long-term ratio of benchmark NGL composite prices to WTI prices of 0.44 (<https://rbnenergy.com/daily-posts/analyst-insight/ngl-crude-ratio-weakens-remains-near-long-term-average>).

¹³ See <https://www.regulations.gov/document/EPA-HQ-OAR-2025-0162-0025>.

¹⁴ As of the date of the proposed action, there is a consent decree deadline for finalization of April 10, 2027.

Analysis horizon

The analysis horizon runs from the first year of impacts in 2028 through 2038. For the numerical standards (95% and 98% controls), this allows us to present ten years of economic impacts since we assume compliance costs begin in 2029 based on the compliance deadlines discussed in the previous subsection. Ten years is an acceptable analysis horizon since it represents a reasonable assumption about the equipment lifetime for the assumed compliance measures (flares, zero emitting pumps and controllers).

Table 6 Summary of Baseline and Policy Scenarios

Subpart	Emission Point	Scenario		
		Baseline	Alternative Proposal	More Stringent
HH	AGRU	All sources controlled to 98% based on ICR	Flare—95% control starting in 2029	Flare—98% control starting in 2029
HH	Storage vessels w/o PFE	All sources use submerged/bottom fill; 22% controlled to 95% based on ICR; all sources controlled to 95% starting in 2029 due to EG OOOOc	Submerged/bottom fill starting in 2028	Flare—95% control starting in 2029
HH	Vessel loading	75% of sources use submerged/bottom fill; 33% controlled to 95% based on ICR	Submerged/bottom fill starting in 2028	Flare—95% control starting in 2029
HHH	Storage vessels	All sources use submerged/bottom fill; all sources controlled to 95% starting in 2029 due to EG OOOOc	Submerged/bottom fill starting in 2028	Flare—95% control starting in 2029
HHH	Vessel loading	No control	Submerged/bottom fill starting in 2028	Flare—95% control starting in 2029
HHH	Controllers	No high-bleed controllers; 40% of sources already zero emissions via instrument air based on ICR; all sources converted to zero emissions via instrument air starting in 2029 due to EG OOOOc	Bleed rates less than or equal to 6 standard cubic feet per hour starting in 2028	Compressed air system—zero emissions starting in 2029
HHH	Pumps	94% of sources already zero emissions via electrical pumps based on ICR; all sources converted to zero emissions via electrical pumps starting in 2029 due to EG OOOOc	Electrical pumps—zero emissions starting in 2029	Electrical pumps—zero emissions starting in 2029

3. Compliance Cost and Product Recovery Impacts

Below we present compliance cost and product recovery estimates for the Alternative Proposal and More Stringent scenarios, both prior to and after applying social discount rates. Costs include both (unannualized) capital and annual costs in the year they are assumed to be incurred. Undiscounted estimates are provided for both subparts individually.

The estimated undiscounted compliance costs are summarized in Table 7 for subpart HH and Table 8 for subpart HHH. In each table, we provide results for both the Alternative Proposal scenario and the More Stringent scenario. In both cases, the compliance costs are calculated both with and without baseline control assumptions. For both subparts and scenarios, the estimates are significantly higher without the baseline controls, which illustrates the importance of those assumptions. Also, taken together, we estimate significantly larger impacts for subpart HH than for subpart HHH, mostly because we estimate that there are far more facilities subject to the former.

For both subparts, the estimated compliance cost trends over time reflect our assumptions about when facilities will incur compliance costs and what the levels of baseline control are, as discussed in 2. For both subparts, the costs estimated for the Alternative Proposal scenario with baseline control are due to recordkeeping and reporting requirements. Also for both subparts, the Alternative Proposal scenario without baseline control has additional cost impacts beyond the recordkeeping and reporting requirements starting in 2028 because it includes work practice standards with a shorter compliance deadline. For subpart HH, there are significant estimated capital costs in 2029 for the Alternative Proposal scenario without baseline control due to the requirements for AGRUs. The requirements for AGRUs also drive the larger estimates of capital costs in the More Stringent scenario in the absence of baseline control. For subpart HHH, most of the discrepancy in estimated costs between the scenarios with and without baseline control is due to the pumps (Alternative Proposal scenario) or process controller (More Stringent scenario) requirements. For both subparts, the capital cost estimates in 2029 for the More Stringent scenario with baseline control are due to achieving 95% control for vessel loading by installing flares.

Table 7 Undiscounted Annual Stream of Compliance Cost Estimates for Subpart HH, 2028–2038 (2024\$)

Year	Alternative Proposal		More Stringent	
	No baseline control	Baseline control	No baseline control	Baseline control
2028	7,500,000	70,000	70,000	70,000
2029	30,000,000	70,000	180,000,000	16,000,000
2030	5,000,000	70,000	17,000,000	2,400,000
2031	5,000,000	70,000	17,000,000	2,400,000
2032	5,000,000	70,000	17,000,000	2,400,000
2033	5,000,000	70,000	17,000,000	2,400,000
2034	5,000,000	70,000	17,000,000	2,400,000
2035	5,000,000	70,000	17,000,000	2,400,000
2036	5,000,000	70,000	17,000,000	2,400,000
2037	5,000,000	70,000	17,000,000	2,400,000
2038	5,000,000	70,000	17,000,000	2,400,000

Note: Values have been calculated and rounded to two significant digits.

Table 8 Undiscounted Annual Stream of Compliance Cost Estimates for Subpart HHH, 2028–2038 (2024\$)

Year	Alternative Proposal		More Stringent	
	No baseline control	Baseline control	No baseline control	Baseline control
2028	2,200,000	34,000	34,000	34,000
2029	870,000	34,000	39,000,000	2,400,000
2030	250,000	34,000	3,300,000	370,000
2031	250,000	34,000	3,300,000	370,000
2032	250,000	34,000	3,300,000	370,000
2033	250,000	34,000	3,300,000	370,000
2034	250,000	34,000	3,300,000	370,000
2035	250,000	34,000	3,300,000	370,000
2036	250,000	34,000	3,300,000	370,000
2037	250,000	34,000	3,300,000	370,000
2038	250,000	34,000	3,300,000	370,000

Note: Values have been calculated and rounded to two significant digits.

The estimated discounted compliance costs for both subparts combined are summarized in Table 9, along with PV and EAV estimates. Estimates are presented for both scenarios assuming baseline control for both 3 and 7 percent social discount rates. The estimated EAVs for the Alternative Proposal scenario are less than \$100,000 for both discount rates, while the estimated EAVs for the More Stringent scenario are just below \$4 million for both discount rates.

Table 9 Discounted Annual Stream of Compliance Cost Estimates, 2028–2038 (2024\$)

Year	Alternative Proposal		More Stringent	
	3% discounting	7% discounting	3% discounting	7% discounting
2028	95,000	85,000	95,000	85,000
2029	92,000	79,000	16,000,000	14,000,000
2030	90,000	74,000	2,400,000	2,000,000
2031	87,000	69,000	2,300,000	1,800,000
2032	85,000	65,000	2,200,000	1,700,000
2033	82,000	61,000	2,200,000	1,600,000
2034	80,000	57,000	2,100,000	1,500,000
2035	77,000	53,000	2,000,000	1,400,000
2036	75,000	49,000	2,000,000	1,300,000
2037	73,000	46,000	1,900,000	1,200,000
2038	71,000	43,000	1,900,000	1,100,000
PV	910,000	680,000	35,000,000	28,000,000
EAV	98,000	91,000	3,800,000	3,700,000

Note: Values have been calculated and rounded to two significant digits.

The undiscounted value of product recovery estimates resulting from the alternative proposal action are presented in Table 10 (subpart HH) and Table 11 (subpart HHH). For both subparts, there is no estimated product recovery in the scenarios with baseline control assumptions, as we assume that facilities are already recovering product with the baseline controls. For subpart HH, when assuming no baseline control, there is only product recovery of NGL at vessel loading operations for the Alternative Proposal scenario. For subpart HHH, when assuming no baseline

control, we only estimate product recovery of natural gas from zero emitting pumps and controllers for the Alternative Proposal scenario. For the More Stringent scenario, we also estimate product recovery of NGL at vessel loading operations.

Table 10 Undiscounted Annual Stream of Value of Product Recovery Estimates for Subpart HH, 2028–2038 (2024\$)

Year	Alternative Proposal		More Stringent	
	No baseline control	Baseline control	No baseline control	Baseline control
2028	6,100,000	-	-	-
2029	6,100,000	-	-	-
2030	6,200,000	-	-	-
2031	6,200,000	-	-	-
2032	6,100,000	-	-	-
2033	6,300,000	-	-	-
2034	6,300,000	-	-	-
2035	6,300,000	-	-	-
2036	6,300,000	-	-	-
2037	6,400,000	-	-	-
2038	6,400,000	-	-	-

Note: Values have been calculated and rounded to two significant digits.

Table 11 Undiscounted Annual Stream of Value of Product Recovery Estimates for Subpart HHH, 2028–2038 (2024\$)

Year	Alternative Proposal		More Stringent	
	No baseline control	Baseline control	No baseline control	Baseline control
2028	31,000	-	-	-
2029	76,000	-	350,000	-
2030	79,000	-	380,000	-
2031	82,000	-	390,000	-
2032	89,000	-	450,000	-
2033	96,000	-	500,000	-
2034	100,000	-	530,000	-
2035	100,000	-	540,000	-
2036	100,000	-	540,000	-
2037	100,000	-	530,000	-
2038	100,000	-	530,000	-

Note: Values have been calculated and rounded to two significant digits.

4. Emissions and Health Impacts

In this section we present estimated changes in annual emissions of HAP, VOC, and methane emissions over the analysis period from 2028 to 2038 for the Alternative Proposal and More Stringent scenarios. Estimated reductions in VOC emissions are expected to contribute to lower

ground-level ozone concentrations, thereby potentially reducing ozone-attributable health effects.¹⁵

a. Air Emissions

Neither the proposed nor the alternative proposal option is anticipated to impact emissions. For the More Stringent scenario, we estimate emissions reductions from a variety of processes and points throughout the oil and natural gas sector such as methane, ethane, VOC and organic HAP, including n-hexane, benzene, toluene, ethylbenzene, xylene, and methanol.¹⁶ Table 13 and Table 14 present summaries of the anticipated nationwide annual emission reductions in total HAP, VOC, and methane associated with the analysis scenarios.¹⁷

Table 13 Estimated Annual Stream of Emissions Reductions for Subpart HH, 2028–2038 (short tons)

Year	Alternative Proposal			More Stringent		
	<i>HAP</i>	<i>VOC</i>	<i>Methane</i>	<i>HAP</i>	<i>VOC</i>	<i>Methane</i>
2028	-	-	-	-	-	-
2029	-	-	-	150	880	3,200
2030	-	-	-	150	880	3,200
2031	-	-	-	150	880	3,200
2032	-	-	-	150	880	3,200
2033	-	-	-	150	880	3,200
2034	-	-	-	150	880	3,200
2035	-	-	-	150	880	3,200
2036	-	-	-	150	880	3,200
2037	-	-	-	150	880	3,200
2038	-	-	-	150	880	3,200
<i>Total</i>	-	-	-	1,500	8,800	32,000

Note: Values have been calculated and rounded to two significant digits.

¹⁵ See the discussion in Section 4.c. Human Health Effects from Exposure to VOCs and Related Pollutants, PM_{2.5}-Related Health Effects, which describes that, in addition to their role in the formation of ground-level ozone, VOC emissions may also undergo photochemical oxidation to form organic PM_{2.5}. However, formation of PM_{2.5} by photochemical oxidation of VOC is less well resolved than other sources of PM_{2.5}. The section concludes that is unlikely that changes to the VOC emissions projected to occur under this rule would have a large contribution to ambient PM_{2.5} concentrations. Therefore, reductions in VOC emissions due to this rule are expected to primarily impact ozone concentrations.

¹⁶ Control options that include flaring may result in additional nitrous oxide emissions; see, e.g., the EPA’s AP-42 Guidelines Section on Industrial Flares (https://www.epa.gov/sites/default/files/2020-10/documents/13.5_industrial_flares.pdf). However, for the proposed option with baseline control, we don’t estimate any additional flaring. For the alternative option and scenarios without baseline control, we would expect some increase in NO_x emissions associated with additional combustion of the gas stream.

¹⁷ Air quality modeling was not conducted for this rule. In the absence of air quality modeling, the EPA typically assumes a reduction in ozone equal to the quantity of annual VOC reduction weighted by the number of months in the April through September season during which conditions most strongly favor the formation of ground-level ozone (i.e., half of the total 12-month VOC reduction).

Table 14 Estimated Annual Stream of Emissions Reductions for Subpart HHH, 2028–2038 (short tons)

Year	Alternative Proposal			More Stringent		
	HAP	VOC	Methane	HAP	VOC	Methane
2028	-	-	-	-	-	-
2029	-	-	-	0.0035	0.12	4.3
2030	-	-	-	0.0035	0.12	4.3
2031	-	-	-	0.0035	0.12	4.3
2032	-	-	-	0.0035	0.12	4.3
2033	-	-	-	0.0035	0.12	4.3
2034	-	-	-	0.0035	0.12	4.3
2035	-	-	-	0.0035	0.12	4.3
2036	-	-	-	0.0035	0.12	4.3
2037	-	-	-	0.0035	0.12	4.3
2038	-	-	-	0.0035	0.12	4.3
<i>Total</i>	-	-	-	0.0350	1.20	43.0

Note: Values have been calculated and rounded to two significant digits.

b. Human Health Effects from Exposure to Hazardous Air Pollutants

Neither the proposed nor the alternative proposal option is expected to impact emissions of HAP. The main HAP emitted by facilities subject to subparts HH and HHH include n-hexane, benzene, toluene, ethylbenzene, xylene, and methanol. Due to methodology and data limitations, we did not attempt to quantify and monetize the health effects associated with increases in HAP for the More Stringent scenario. Quantifying and monetizing the economic value of reducing the risk of cancer effects due to HAP exposure is made difficult by the frequent lack of a central estimate of cancer risk as well as estimates of the value of an avoided case of cancer, fatal and non-fatal (LaPenta et al., 2024). Assessing population incidence of non-fatal health effects and risk from threshold carcinogens also poses unique challenges (National Research Council, 2009). We therefore provide a qualitative discussion of health effects associated with exposure to HAP affected by this rule.

Hexane (C₆H₁₄): Hexane is used to extract edible oils from seeds and vegetables, as a special-use solvent, as a cleaning agent, and for instrument calibration (ATSDR 2025). Acute (short-term) inhalation exposure in animals causes reduced motor function and adverse developmental and reproductive effects. In humans some associations with developmental effects such as low birth weight and developmental immunotoxicity have been reported. Chronic (long term) exposure to hexane in air can cause peripheral nerve damage in humans with tingling sensation and muscular weakness observed. In animal studies, neurotoxic effects as well as pulmonary and nasal lesions have been observed with chronic exposure (ATSDR 2025). The EPA has classified hexane as a Group D, not classifiable as to human carcinogenicity (U.S. EPA, 2005a).

Benzene (C₆H₆): Benzene is used as a constituent in motor fuels and is found in gasoline service station and motor vehicle exhaust emissions into air. Acute effects of benzene inhalation exposure in humans include neurological symptoms such as drowsiness, dizziness, headaches,

and unconsciousness. Exposure to benzene vapor can cause eye, skin, and upper respiratory tract irritation. Chronic exposure to benzene is associated with blood disorders, such as preleukemia and aplastic anemia (ATSDR 2024). The EPA has classified benzene as a known human carcinogen (causing leukemia) by all routes of exposure (U.S. EPA 2000).

Toluene (C₆H₅CH₃): Toluene is used as a gasoline additive, in benzene production, and as a solvent. The main source of atmospheric toluene is the production, transport, and use of gasoline. Commercial and consumer solvent use also contribute significantly to ambient levels. Inhalation of toluene most sensitively affects the central nervous system. Human studies show that acute (short-term) toluene inhalation causes reversible neurological effects, including fatigue, headache, decreased manual dexterity, and, at higher exposures, narcosis. Chronic (long-term) exposure can produce cognitive and neuromuscular performance decrements, hearing loss, and color vision deficits. Some evidence indicates that toluene exposure may also affect immune, kidney, liver, and reproductive function (ATSDR 2017). The EPA has concluded that there is inadequate information to assess the carcinogenic potential of toluene (U.S. EPA 2005b).

Ethylbenzene (C₈H₁₀): Ethylbenzene is a natural component of petroleum and is used in the production of styrene. It can be released into the atmosphere from fuel and solvent use, and through chemical manufacturing and production activities. Acute (short-term) inhalation of ethylbenzene in humans can cause irritation of the eyes, nose, and respiratory tract and reversible neurological effects such as dizziness. Chronic (long-term) inhalation can damage the inner ear and cause hearing loss in humans and animals (ATSDR 2010). Animal studies report additional effects on the blood, liver, and kidneys following chronic inhalation of ethylbenzene. Limited information is available on the carcinogenic effects of ethylbenzene in humans; however, a study by the National Toxicology Program (NTP) found that ethylbenzene inhalation increased incidence of kidney and testicular tumors in rats, and of lung and liver tumors in mice (ATSDR, 2010).

Xylene (C₈H₁₀): Xylenes (mixtures of ortho-, meta-, and para-xylene isomers) are released into the atmosphere as fugitive emissions from industrial sources, from auto exhaust, and through volatilization from their use as solvents. The individual isomers have similar physiochemical, toxicokinetic, and toxicological properties (ATSDR 2007). Acute (short-term) inhalation of mixed xylenes in humans can cause eye, nose, and throat irritation, as well as mild neurological effects such as headache, dizziness, nausea, and impaired balance (ATSDR 2007, U.S. EPA 2003). Data on chronic (long-term) xylene inhalation in humans is somewhat limited, but animal studies provide evidence of additional neurological effects including impaired motor coordination, cognitive deficits, and increased pain sensitivity (U.S. EPA 2003). The EPA has concluded that the data are inadequate for an assessment of human carcinogenic potential, and genotoxicity evaluations have consistently yielded negative results (U.S. EPA 2003).

Methanol (CH₃OH): Methanol has many commercial uses and is a basic building block for many chemicals. Exposure may occur from ambient air and during the use of solvents. Acute (short-term) exposure to high levels of methanol by inhalation or ingestion is known to cause adverse neurological and immunological effects, nasal irritation, blurred vision/blindness, coma, convulsions/tremors, nausea, headache, abdominal pain, diminished motor skills, acidosis, and

difficulty breathing in humans (U.S. EPA 2013). Chronic (long-term) exposure to methanol by inhalation or ingestion may result in adverse effects in the brain and liver at higher doses based on animal data. At lower doses, birth defects and developmental neurotoxicity has been observed with sufficient inhalation exposure across an array of animal studies. The EPA has not classified methanol with respect to carcinogenicity (U.S. EPA 2013).

c. Human Health Effects from Exposure to VOCs and Related Pollutants

This proposed rulemaking is not expected to impact emissions of VOCs. Direct exposure to VOCs may result in short- and long-term adverse health effects. Once emitted, VOCs may react in the atmosphere to produce ozone and PM_{2.5} and may also affect human health through these pathways. Specifically, during the summer season (April – September), VOC emissions undergo chemical reactions in the presence of sunlight resulting in ground-level ozone formation. Formation of PM_{2.5} by photochemical oxidation of VOC is less well resolved; therefore, this rule is projected to primarily affect ozone concentrations. The human health effects of changes in emissions of VOCs and of reductions in ozone concentrations were not quantified for this rule. A qualitative description of related human health effects is provided instead.

Historically, the EPA estimated the monetized benefits of avoided PM_{2.5}- and ozone-related impacts, which accounted for most, if not all, of the monetized benefits of many air regulations—even when the regulation was not regulating PM_{2.5} or ozone. The OMB, in its annual report of the Benefits and Costs of Federal Regulations, routinely provides estimates that the monetized benefits from reducing PM_{2.5} and/or ozone exceed hundreds of millions or even billions of dollars and result in most of the monetized benefits from Federal regulations.

In previous Regulatory Impact Analyses (RIAs), the Agency’s approach to estimating the impacts to human health of the changes in concentrations of ozone and PM_{2.5} relied substantially on information from the Integrated Science Assessments (ISAs) for ozone and particulate matter (e.g., U.S. EPA, 2020, U.S. EPA, 2019a). These documents synthesize the toxicological, clinical, and epidemiological evidence to determine whether PM and ozone are causally related to an array of adverse human health outcomes associated with either acute (i.e., hours or days-long) or chronic (i.e., years-long) exposure; for each outcome, the ISA reports this relationship to be causal, likely to be causal, suggestive of a causal relationship, inadequate to infer a causal relationship or not likely to be a causal relationship. The ISAs reflect the Agency most up-to-date evaluation of the strength and limitations of the available scientific evidence.

Historically, the Agency has estimated the incidence of air pollution effects for those health endpoints that the ISA classified as either causal or likely-to-be-causal and these endpoints are shown in Table 15. The table below omits welfare effects such as acidification and nutrient enrichment.

Table 15 Health Effects of Ambient Ozone and PM_{2.5}

Category	Effect	Causal/Likely-to-be-causal	More Information
Premature mortality from exposure to PM _{2.5}	Adult premature mortality based on cohort study estimates and expert elicitation estimates (age 65-99 or age 30-99)	✓	PM ISA
	Infant mortality (age <1)	✓	PM ISA
Nonfatal morbidity from exposure to PM _{2.5}	Heart attacks (age > 18)	✓	PM ISA
	Hospital admissions—cardiovascular (ages 65-99)	✓	PM ISA
	Emergency department visits— cardiovascular (age 0-99)	✓	PM ISA
	Hospital admissions—respiratory (ages 0-18 and 65-99)	✓	PM ISA
	Emergency room visits—respiratory (all ages)	✓	PM ISA
	Cardiac arrest (ages 0-99; excludes initial hospital and/or emergency department visits)	✓	PM ISA
	Stroke (ages 65-99)	✓	PM ISA
	Asthma onset (ages 0-17)	✓	PM ISA
	Asthma symptoms/exacerbation (6-17)	✓	PM ISA
	Lung cancer (ages 30-99)	✓	PM ISA
	Allergic rhinitis (hay fever) symptoms (ages 3-17)	✓	PM ISA
	Lost work days (age 18-65)	✓	PM ISA
	Minor restricted-activity days (age 18-65)	✓	PM ISA
	Hospital admissions—Alzheimer’s disease (ages 65-99)	✓	PM ISA
	Hospital admissions—Parkinson’s disease (ages 65-99)	✓	PM ISA
	Other cardiovascular effects	✓	PM ISA
	Other respiratory effects	✓	PM ISA
	Other nervous system effects	✓	PM ISA
	Cancer	✓	PM ISA
	Reproductive and developmental effects	—	PM ISA
Metabolic effects	—	PM ISA	
Mortality from exposure to ozone	Premature respiratory mortality based on short-term study estimates (0-99)	✓	Ozone ISA
	Premature respiratory mortality based on long-term study estimates (age 30–99)	✓	Ozone ISA
Nonfatal morbidity from exposure to ozone	Hospital admissions—respiratory (ages 0-99)	✓	Ozone ISA
	Emergency department visits—respiratory (ages 0-99)	✓	Ozone ISA
	Asthma onset (0-17)	✓	Ozone ISA
	Asthma symptoms/exacerbation (asthmatics age 2-17)	✓	Ozone ISA
	Allergic rhinitis (hay fever) symptoms (ages 3-17)	✓	Ozone ISA
	Minor restricted-activity days (age 18–65)	✓	Ozone ISA
	School absence days (age 5–17)	✓	Ozone ISA
Metabolic effects (e.g., diabetes)	✓	Ozone ISA	

For regulatory analyses, the Agency estimated changes in health effects in response to modeled air quality changes for each health endpoint identified as causal or likely-to-be-causal in Table 15. The environmental Benefits Mapping and Analysis Program—Community Edition (BenMAP-CE) software program was used to quantify counts of premature deaths and illnesses attributable to photochemical modeled changes in annual mean PM_{2.5} and summer season average ozone. This approach to estimating health impacts involved two major steps: (1) developing spatial fields of air quality across the U.S. for the baseline and regulatory scenarios using nationwide photochemical source apportionment modeling and related analyses; and (2) using these spatial fields in BenMAP-CE to quantify selected endpoints under each scenario and each year as compared to the baseline in that year while accounting for the changes in population size, income growth, and baseline incidence and prevalence rates.

Figure 1 summarizes the key data inputs and modeling steps for estimating the health impacts of a regulatory impact analysis using PM_{2.5} inputs as an example.

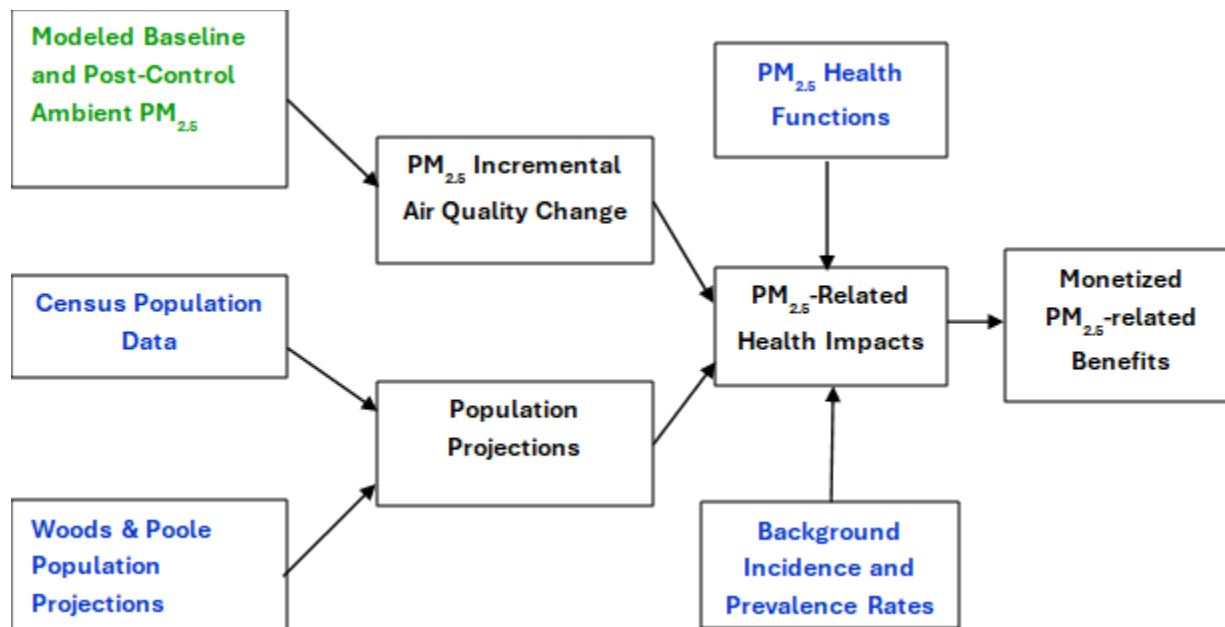


Figure 1 Data Inputs and Outputs for the BenMAP-CE Model Using PM_{2.5} as an Example

As the diagram above illustrates, the approach for estimating PM_{2.5} and O₃ benefits included health effect risk estimates from epidemiologic studies, population data, population growth estimates, economic data for monetizing risk reductions, and assumptions regarding the future state of the world (e.g., on-the-books regulations). Each of these inputs has unique uncertainties associated with it. When the uncertainties from each stage of the analysis are compounded, even small uncertainties can have large effects on the total quantified benefits. Where possible, the EPA in the past has attempted to quantitatively assess uncertainty in each input parameter. In some cases, quantitative analysis has not been possible due to lack of data, so the Agency instead characterized the sensitivity of the results to alternative plausible input parameters. And, for

some inputs into the benefits analysis, such as the air quality data, we lacked the data to perform either a quantitative uncertainty analysis or sensitivity analysis.

Throughout prior regulatory impact analyses, the EPA acknowledged these significant uncertainties around input parameters and employed various techniques for characterizing the resulting uncertainty in estimates of regulatory impacts. For example, the Agency has estimated the fraction of avoided health effects occurring at various concentration ranges, conducted sensitivity analyses, and employed alternate concentration-response assumptions to show how much estimates could vary depending on which assumptions and inputs were used in primary estimates vs. sensitivity estimates.

Chapter 6 of the EPA Health Benefits TSD, *Estimating PM_{2.5}- and Ozone-Attributable Health Benefits: 2024 Update*, details our approach to characterizing uncertainty associated with the estimation of PM_{2.5} and O₃ benefits in both quantitative and qualitative terms (U.S. EPA, 2024). Some of the key types of uncertainty highlighted in this chapter include:

- Statistical uncertainty around the risk estimate
- Uncertainty around low concentration exposures and the potential for thresholds
- Uncertainty in exposure estimates
- Co-pollutant confounding
- Confounding by other individual risk factors
- Effect modification
- Application of risk estimates to other locations and populations
- Uncertainties regarding at-risk populations
- Baseline incidence rate uncertainties
- Economic valuation estimate uncertainties (e.g. income elasticity of willingness to pay, statistical estimates of VSL, Alzheimer's and Parkinson's onset lifetime costs)
- Unquantified uncertainties (e.g. causality determination, estimating and assigning exposures in epidemiology studies, risk attributable to long-term and short-term exposures, shape of the concentration-response relationship)

Despite substantial investments by the EPA in approaches to characterizing uncertainties, the regulatory impact analyses have still tended to focus on point estimates for PM_{2.5} and ozone-related benefits. Frequently, the Agency has utilized more than one epidemiologic study to estimate mortality impacts because these estimates drive overall benefits for a given regulatory action due to the large monetary value assigned to such impacts. Risk estimates using the top epidemiologic studies sometimes differ by a factor of two or more. Presenting multiple estimates drawn directly from the primary literature is one way to convey the prevailing uncertainty. While this leads to an estimated range of benefits, it is not a range that reflects the true uncertainties in the underlying parameters supporting each study, either for mortality or for other effects. Because of the significant impacts of environmental regulations on the U.S. economy, it is essential that the Agency have confidence in the estimated benefits of an action, and their underlying uncertainties, prior to utilizing these estimates in a regulatory context.

A 2024 Scientific Advisory Board reviewed EPA's methods for estimating the health effects of PM_{2.5} and clearly and repeatedly recommended that EPA improve its approach to characterizing and presenting the uncertainty in estimating the health effects of PM_{2.5} (U.S. EPA-SAB, 2024). A Tier 1 SAB recommendation was that the EPA present a single probabilistic mortality estimate based on pooled risk estimates with associated uncertainty ranges rather than present multiple estimates of mortality outcomes from the epidemiologic studies. EPA was encouraged to explore meta-analysis methods or other forms of information synthesis, and support research and development of modified methods as needed.

The OMB "2017 Report to Congress on the Benefits and Costs of Federal Regulations" listed six key assumptions underpinning PM_{2.5} health effect estimation which introduce substantial uncertainties in the health effect estimates (OMB, 2017):

1. That inhalation of fine particles is causally associated with premature death at concentrations near those experienced by most Americans on a daily basis;
2. That the concentration-response function for fine particles and premature mortality is approximately linear, even for concentrations below the levels established by the NAAQS;
3. That all fine particles, regardless of their chemical composition, are equally potent in causing premature mortality;
4. That the forecasts for future emissions and associated air quality modeling accurately predict both the baseline (state of the world absent a rule) and the air quality impacts of the rule being analyzed;
5. That BPT approaches, when used to estimate benefits, are based on regional or national-level analysis that may not reflect local variability in population density, meteorology, exposure, baseline health incidence rates, or other local factors; and
6. That the estimated value of mortality risk reductions is an accurate reflection of what people would be willing to pay for incremental reductions in mortality risk from air pollution exposure, and that these values are constant across the life-cycle.

To the extent that any of these assumptions is incorrect, the benefit estimates will change, though the magnitude and direction of change are not known with certainty. The EPA is interested in improving understanding in each of these six areas. EPA understands that additional research is needed, and will begin to develop approaches that reduce these uncertainties. The EPA will seek peer review for new methods developed from this work consistent with the OMB's Peer Review Guidance (OMB, 2005).

In particular, the EPA is interested in reevaluating the validity of the approach for estimating the benefits of air quality improvements relative to the National Ambient Air Quality Standards (NAAQS) for PM_{2.5} and ozone. These standards, which have been set at a level which the Administrator judges to be requisite to protect public health or welfare with an adequate margin of safety, are widely understood to represent the divide between clean air and air with an unacceptable level of pollution. Even in instances where an assumption is found to be justified based on scientific evidence, the EPA is interested in reevaluating its approach to characterizing and communicating underlying uncertainty to the public.

In the past, the EPA has explored a variety of approaches to shed light on how the estimated benefits of an action relate to the level of the NAAQS. For example, in estimating PM benefits, the Agency has employed techniques such as cutpoint analyses and Lowest Measured Level analyses, noting that we are most confident in the magnitude of the risks we project at PM_{2.5} concentrations that coincide with the bulk of the observed PM_{2.5} concentrations in the epidemiological studies that are used to estimate the benefits (Regulatory Impact Analysis for the Repeal of the Clean Power Plan, and the Emission Guidelines for Greenhouse Gas Emissions from Existing Electric Utility Generating Units, Section 4.4.4, p. 4-26 (U.S. EPA, 2019b)). However, such approaches address only a few of the sources of uncertainty that influence PM-related air quality benefits.

The limitations of reduced-form approaches, such as the BPT approach are even more pronounced than photochemical modeling/BenMAP-CE approaches due to: 1) the compounding effects of emissions reductions typically occurring across many geographic areas simultaneously, with varying proximity to population centers; 2) differing atmospheric transformation pathways for nitrous oxides (NO_x), volatile organic compounds (VOCs), and secondary PM_{2.5}; and 3) region-specific photochemical and meteorological conditions. Using a national BPT estimate implicitly assumes uniform marginal health benefits for each ton of reduced emissions, an assumption not supported given heterogeneity in exposure patterns and atmospheric chemistry. As more areas achieve or maintain attainment with the NAAQS, the uncertainties associated with low-concentration health effects grow, and marginal benefits become more difficult to characterize with precision.

Therefore, it may be appropriate for the EPA to separate exposures and impacts above the level of the standard from those occurring at lower ambient concentrations. The EPA will investigate this prior to estimating these impacts in a regulatory analysis even for informational purposes.

Ozone-Related Health Effects: The Clean Air Act requires EPA to periodically review the science for six major air pollutants, including ozone. EPA's Center for Public Health and Environmental Assessment (formerly National Center for Environmental Assessment) develops Integrated Science Assessments (ISAs) that summarize the science related to the health and welfare effects of these pollutants.

Following a comprehensive review of toxicological, clinical, and epidemiological evidence, the *Integrated Science Assessment for Ozone and Related Photochemical Oxidants* (Ozone ISA) (U.S. EPA, 2020) found both short-term (i.e., less than one month) and long-term (i.e., one month or longer) ozone exposure to be related to an array of adverse human health effects. For each effect, the Ozone ISA reports relationships to be causal, likely to be causal, suggestive of a causal relationship, inadequate to infer a causal relationship, or not likely to be a causal relationship. This assessment is based on the body of scientific evidence which can include observational human studies, experimental human exposure studies, animal model studies, and mechanistic studies.

The Ozone ISA found short-term exposure to ozone to be causally related to respiratory effects, including respiratory mortality, and likely to be causally related to metabolic effects. For short-

term exposure, evidence was suggestive of a causal relationship for cardiovascular and nervous system effects as well as total mortality. The Ozone ISA reported that long-term exposure to ozone is likely-to-be-causally related to respiratory effects, including respiratory mortality. Evidence on metabolic, cardiovascular, reproductive, and nervous system effects as well as total mortality was suggestive of a causal relationship with long-term ozone exposure.

When adequate data and resources are available, the EPA has generally quantified health effects which the Ozone ISA classified as causally related or likely-to-be-causally related to short- or long-term ozone exposure. Health effects classified as suggestive-of-causality or weaker have not historically been quantified. Historically quantified health effects include premature respiratory mortality, hospital admissions and emergency department visits, asthma onset and related symptoms (chest tightness, cough, shortness of breath, and wheeze), allergic rhinitis symptoms, as well as restricted activity days and school absences.

The EPA did not quantify or monetize the benefits or disbenefits associated with changes in the incidence of the listed health effects for this rule.

PM_{2.5}-Related Health Effects: Particulate matter is composed of some or all of the following components: nitrate (NO_3^-), sulfate (SO_4^{2-}), ammonium (NH_4^+), metals, minerals (dust), and organic and elemental carbon. Secondary, or non-directly emitted, PM_{2.5} forms through atmospheric photochemical oxidation reactions of both inorganic and organic gas-phase precursors. Anthropogenic NO_x and SO₂ are the predominant precursor gases in the formation of secondary PM_{2.5}, and the gas-to-particle equilibrium between ammonia (NH₃) and ammonium (NH_4^+) are relatively well understood. However, formation of secondary organic PM, often referred to as secondary organic aerosol, by photochemical oxidation of VOCs is less well resolved. Additionally, biogenic emissions of VOC are the predominant organic precursor at the national scale (71%), while only a fraction of secondarily formed organic aerosols is of anthropogenic origin. Given that only a portion of secondary PM_{2.5} is from anthropogenic VOC emissions, it is unlikely that changes to the VOC emissions projected to occur under this rule would have a large contribution to ambient PM_{2.5} concentrations. Consequently, we do not expect significant changes in the incidence of PM_{2.5}-related health effects from this rulemaking. For more information on PM_{2.5}-related health effects, see the *Integrated Science Assessment for Particulate Matter* and the *Supplement to the Integrated Science Assessment for Particulate Matter* (U.S. EPA, 2019a; U.S. EPA, 2022).

d. Welfare Effects

The Clean Air Act encourages consideration of the welfare effects of air pollutants, which it defines as including, but not limited to, effects on soils, water, crops, vegetation, manmade materials, animals, wildlife, weather, visibility, and climate, damage to and deterioration of property, and hazards to transportation, as well as effects on economic values and on personal comfort and well-being, whether caused by transformation, conversion, or combination with other pollutants (42 U.S.C. §7602(h)). In this section, we provide qualitative discussions of select welfare effects.

Ozone Vegetation and Ecosystem Effects: Exposure to ozone has been found to be associated with a wide array of vegetation and ecosystem effects in the published literature (U.S. EPA, 2020). Sensitivity to ozone is highly variable across species, with over 66 vegetation species identified as “ozone-sensitive,” many of which occur in state and national parks and forests. These effects include those that cause damage to, or impairment of, the intended use of the plant or ecosystem. Such effects are considered adverse to public welfare and can include reduced growth and/or biomass production in sensitive trees, reduced yield and quality of crops, visible foliar injury, changes to species composition, and changes in ecosystems and associated ecosystem services (U.S. EPA, 2020).

Ozone Animal Welfare Effects: While effects can be context- and species-specific, a large body of scientific evidence links ozone exposure to health effects in animals. When exploring environmental pathways through which environmental effects of ozone may impact animals, the Ozone ISA found a likely-to-be-causal relationship between ambient ozone concentrations and alterations of herbivore growth and reproduction (U.S. EPA, 2020, Girón-Calva et al. 2016, Habeck and Lindroth, 2013, Hong et al., 2016, Ueno et al., 2016). In addition, many animal toxicological studies served as evidence for determining the causality of relationships between human exposure to ozone and human health effects, including respiratory and metabolic effects. The Ozone ISA states, “A large body of experimental animal toxicological studies demonstrates (short- and long-term) ozone-induced changes in measures of lung function, inflammation, increased airway responsiveness, and impaired lung host defense” (U.S. EPA, 2020). Additionally, animal studies report relationships between short-term ozone exposure and metabolic effects in various stocks and strains of animals across multiple laboratories (U.S. EPA, 2020, Gordon et al., 2017, Miller et al., 2015, Ying et al., 2016,).

e. Effects from changes in methane emissions

There are significant uncertainties related to the monetization of greenhouse gases (GHGs) that include, but are not limited to: the magnitude of the change in climate due to a change in GHG emissions; the relationship between changes in the climate and the economy and therefore, the resulting economic impacts; future economic and population growth which are important for estimating vulnerability, willingness to pay to avoid impacts, and the ability to adapt to future changes; future technological advancements that would reduce vulnerability and impacts; the share of impacts from GHG emissions that affect citizens and residents of the United States; and the appropriate discount rates to use when discounting in an intergenerational context. Consistent with the memorandum titled “Guidance Implementing Section 6 of Executive Order 14154, Entitled ‘Unleashing American Energy’”, the EPA did not monetize impacts from changes in GHG emissions for this proposed action. Monetizing these impacts could potentially result in flawed decision-making due to overreliance on highly uncertain values.

5. Comparison of Benefits and Costs

In Table 16, we present a summary of the estimated benefits and costs of the proposed action. The top panel of the table provides the monetized estimates, which only apply to the alternative proposal option, and the bottom panel summarizes unquantified items, which apply to both the

proposed and alternative proposal options. The monetized impacts that we estimate consist of recordkeeping and reporting costs to industry; we do not estimate any quantified benefits resulting from the proposed action. The proposed change to the major source definition will potentially result in cost savings and increased emissions since it would unambiguously increase the emissions threshold for a facility to qualify as a major source, though we are unable to estimate the extent of those impacts at this point. Finally, we expect some small cost savings to result from adjusting the small dehydrator emission limitation equation to ease demonstration and verification of compliance with the standards for those sources.

Table 16: Summary of Benefits and Costs, 2028–2038 (thousand 2024 dollars)

	3% Discount Rate		7% Discount Rate	
	<i>PV</i>	<i>EAV</i>	<i>PV</i>	<i>EAV</i>
<i>Monetized benefits and costs (only applies to alternative proposal option)</i>				
<i>Benefits</i>	0	0	0	0
<i>Costs</i>	910	98	680	91
<i>Net Benefits</i>	-910	-98	-680	-91
<i>Unquantified benefits</i>				
	<ul style="list-style-type: none"> • Cost savings from changing the major source definition such that fewer facilities qualify as major sources. • Cost savings from easing the demonstration and verification of compliance through the changes to the small dehydrator emission limitation equation. 			
<i>Unquantified costs</i>				
	<ul style="list-style-type: none"> • Additional HAP, VOC, and CH₄ emissions from changing the major source definition such that fewer facilities qualify as major sources. 			

Note: Values have been calculated and rounded to two significant digits.

6. Economic Impact and Distributional Analysis

In this section, we describe the potential impacts of this action on the domestic market for natural gas as well as small businesses. The market impact analysis is qualitative. The small business analysis leads us to certify that the proposed action will not have a significant economic impact on a substantial number of small entities (SISNOSE) in accordance with the Regulatory Flexibility Act (RFA).¹⁸

a. Market Impacts

It is unlikely that either the proposed options or the More Stringent scenario would have appreciable impacts on the domestic market for natural gas based on the relatively small size of our cost estimates. For instance, Section 4.1 of the 2024 subparts OOOOb and OOOOc Final Rule RIA provided estimates of the impact of the regulation on domestic prices and production for crude oil and natural gas. The largest impacts were estimated to occur in and beyond the initial year of assumed compliance with the EG OOOOc (2028). For that initial year, the EPA estimated up to a 0.75% decrease in natural gas production, along with a 1.76% increase in natural gas prices. In that analysis, the EAV was \$1.5–3.2 billion (2019\$) for 3 and 7 percent

¹⁸ 5 U.S.C. §§601–612.

discount rates,¹⁹ which is orders of magnitude greater than the costs for any option considered in this analysis. Thus, we don't anticipate significant impacts on natural gas production or prices.

b. Small Business Analysis

In accordance with the RFA, we conducted a screening analysis to assess the potential impacts of the proposed action on small entities subject to the rule; there are no expected impacts for the proposed option. For the Alternative Proposal and More Stringent scenarios, the analysis consists of determining the extent to which facilities likely to be impacted are owned or operated by small businesses, the scope of the expected costs for those firms, and how those costs compare to estimates of the revenue for those firms. Below we describe the details of the methodology and provide a summary of the results.

The first step in our screening analysis was to map the major source entries in our subpart HH/HHH facility lists to owners/operators. The ECHO database does not include a specific operator field, though operator names are often present in the facility name field. Using the facility names, along with other information from the ECHO database such as the facility location, nearly every facility was mapped to an operator.²⁰ In turn, each operator was mapped to a Data Universal Numbering System (DUNS) number to facilitate matching with entries in Dun & Bradstreet's (D&B) business database.

The second step was to pull business data for the firms represented in the facility lists. When appropriate, operators were mapped to ultimate parent companies using the D&B database. For each ultimate parent company, we queried the D&B database to obtain company-level NAICS codes and estimates of employee counts and revenues.

Most parent companies were able to be matched to a NAICS code that could be used for business size classification.²¹ Each ultimate parent company was classified as "small" or "not small" according to Small Business Administration (SBA) size standards. Table 17 lists the standards for the NAICS codes most closely associated with oil and natural gas production and downstream natural gas operations.

Table 17 SBA Size Standards by NAICS Code

NAICS Code	NAICS Industry Description	Size Standard	
		Millions of dollars	Number of employees
2111	Oil and Natural Gas Extraction		1,250
213111	Drilling Oil and Gas Wells		1,000
213112	Support Activities for Oil and Gas Operations	47.0	
221210	Natural Gas Distribution		1,150
486210	Pipeline Transportation of Natural Gas	41.5	

¹⁹ See Table 2-13.

²⁰ Fifteen facilities, as identified by unique Federal Registry Service identification numbers, could not be matched.

²¹ Twelve operators for whom DUNS numbers had been identified had dropped out of the D&B database by the time we performed our final queries, 15 mapped to NAICS code 999990 "Unclassified Establishments", and six mapped to NAICS codes in the 9211 series (government entities).

Table 18 summarizes the results of applying the SBA size standards to our parent company list, while Table 19 provides average revenue for the firms by size classification. Most companies are identified with a NAICS in the oil and natural gas production or downstream natural gas industries. For those companies, most of the ones coded for production (NAICS 2111 and 2131) are classified as small entities, compared to a little less than half of the ones coded for downstream operations. Of the companies that were coded to “Other” industries that were able to be classified, a little more than half were classified as small entities. As expected, across all NAICS, average revenues are significantly smaller for firms classified as small entities. The revenue distributions are significantly skewed towards higher values, as evidenced by the mean values being much larger than the median values, particularly for small entities.

Table 18 Counts and Estimated Percentages of Small Entities

NAICS Code	NAICS Industry Description	Metric			
		Number of Firms Identified	Estimated Number of Small Entities	Unknown Size	Percentage of Small Entities for Identified Firms
2111	Oil and Natural Gas Extraction	23	15	0	65%
2131	Oil and Natural Gas Support Activities	30	25	0	83%
2212, 4862	Natural Gas Transportation and Distribution	21	5	0	24%
	Other	53	19	4	39%
Total		127	64	4	52%

Table 19 Summary Statistics for Revenues of Potentially Affected Entities (2024\$)

Firm Size	Metric	
	Mean	Median
Small	370,000,000	6,000,000
Not Small	38,000,000,000	7,500,000,000

Note: Values have been calculated and rounded to two significant digits.

After classifying the ultimate parent companies, the final step in the analysis was to assign estimated compliance costs at the firm level for comparison to revenues. To get firm level costs, we estimated costs at the facility level and then summed those costs over facilities for each firm. The assignment of facility-level costs was complicated by not having facility-level information on the emission points addressed in this action for our universe of facilities. To address this data gap, we used a Monte Carlo simulation approach in which each facility received a set of equipment draws based on the facility proportions in Table 3, and then a corresponding set of control draws based on the control and work practice proportions in that table. According to those draws, facilities were then assigned model plant costs if they had regulated equipment that was not controlled or subject to work practice, depending on the regulatory option under consideration. To facilitate comparison with the annual revenue estimates from the D&B database, capital costs were annualized using 7 and 10 percent discount rates. To generate a distribution of results, we followed this procedure for 50 Monte Carlo simulations.

Within each simulation, for each firm, cost-to-sales ratios (CSRs) were calculated, and operators were binned based on the ratio; Table 20 summarizes the distribution of CSRs across all simulations by size category for both the proposed option and the alternative. For each option and CSR category, counts are on the top line and percentages of total entities for each size classification are below. For the proposed option, we estimate that, on average, 0.3 percent of small entities have CSRs greater than 1 percent (and none greater than 3 percent). Across all simulations, we estimate that in no case do more than one percent of small entities have CSRs greater than 1 percent. For the alternative option, we estimate that, on average, 6 percent of small entities have CSRs greater than 1 percent (and 3 percent have CSRs greater than 3 percent). Across all simulations, we estimate that in no case do more than 10 percent of small entities have CSRs greater than 1 percent, or 5 percent have CSRs greater than 3 percent. For both options and across all simulations we do not find CSRs greater than 1 percent for non-small entities.

Table 20 Summary Statistics Across Monte Carlo Simulations for Compliance Cost-to-Sales Ratios

Scenario	CSR Category	Small Entities			Not Small Entities		
		Median	Min	Max	Median	Min	Max
Alternative Proposal	Less than 1%	68 100%	68 100%	68 100%	59 100%	59 100%	59 100%
	Greater than 1%	- 0%	- 0%	- 0%	- 0%	- 0%	- 0%
	Greater than 3%	- 0%	- 0%	- 0%	- 0%	- 0%	- 0%
More Stringent	Less than 1%	65 96%	62 91%	67 99%	59 100%	59 100%	59 100%
	Greater than 1%	4 6%	2 3%	6 9%	- 0%	- 0%	- 0%
	Greater than 3%	1 1%	1 1%	1 1%	- 0%	- 0%	- 0%

7. Limitations and Uncertainties

Our analysis of this action is subject to several important limitations and key uncertainties, some of which we have previously alluded to. Below we provide a summary of those items.

- Major source definition change:** This analysis did not estimate the cost and emissions impacts associated with changing the major source definition such that emissions from glycol dehydrators and storage vessels are no longer aggregated in determining major source classification. Qualitatively, this change is likely to be deregulatory, but because we had so few major source observations from production facilities in the ICR responses, we lack the data required to estimate quantitative impacts. The Agency is taking comment on the scale of those impacts; see Section III.B.2 of the Preamble for more information.

However, our assessment of the emissions profiles of the production facilities in the ICR responses lends some limited insight into the scope and scale of the potential impacts of

the change to the major source definition when we consider potential synthetic minor sources. It is unclear to what extent synthetic minor sources would choose to remove emissions controls due to a change in the major source definition, or how similar the equipment, control, and emissions profiles of major sources are to the synthetic minors, but we can at least use the ICR response data to perform an initial screen. From the ICR responses, we estimate that 52 facilities have the potential to exceed the major source thresholds based on the current definition, with emissions from dehydrators and storage vessels combined. Of those facilities, we estimate that there are 47 facilities with storage vessels such that no storage vessel at the facility exceeds the major source threshold and that there are 7 facilities with dehydrators such that no dehydrator at the facility exceeds the major source threshold (6 facilities fall into both categories). Of those, 29 of the 47 facilities with storage vessels such that no storage vessel at the facility exceeds the major source threshold have at least one controlled tank with average facility-wide uncontrolled HAP emissions at controlled tanks of 8.5 tpy. Likewise, 6 of the 7 facilities with dehydrators such that no dehydrator at the facility exceeds the major source threshold have at least one controlled dehydrator with average facility-wide uncontrolled HAP emissions at controlled dehydrators of 33 tpy.

As a bounding exercise, we can apply the above analysis to the broader set of production facilities retrieved from the ECHO database. We estimate that there are 1,692 synthetic minor or major sources at production facilities in that database. If 56% of those facilities (consistent with the 29 of 52 facilities in the ICR data analysis described above) have controlled storage vessels that no longer need to be controlled under the new definition, and we assume those storage vessels account for uncontrolled emissions of 8.5 tpy on average per facility and control efficiency is 95%, then removing controls at every facility would increase HAP emissions by an estimated 7,700 tpy (120,000 tpy VOC and 450,000 tpy CH₄). The equivalent analysis for dehydrators yields an estimated HAP emissions increase of 6,100 tpy (26,000 tpy VOC and 94,000 tpy CH₄). Similarly, if we maintain the assumption that annual operating costs of control is \$22,840, then removing those controls would result in annual cost savings of \$22 million for storage vessels and \$4.5 million for dehydrators. Of course, this analysis may dramatically overstate the impacts of the proposed change to the major source definition as there may be other reasons why controls may be needed at synthetic minor or major production facilities, such as workplace safety and state and local regulations.

- **Extrapolation of ICR:** Because a census of facility-level equipment and emissions for subparts HH and HHH is not available, our estimates of nationwide impacts rely heavily on extrapolating summary statistics from the ICR to all facilities. For subpart HH, the ICR only yielded data from 8 self-identified major source facilities out of the 231 production and processing facilities for which information was collected. We attempted to supplement those samples by identifying potential synthetic minor sources but including those facilities in the estimates that could also raise concerns about representativeness. As a result, the estimates contained in Table 3 for equipment and

control proportions, average equipment counts, and average emissions factors are based on a small sample of possible data points and thus may not be representative of the broader population of emissions sources. This could cause our analysis, all else equal, to either over- or underestimate the impacts of the regulatory alternatives.

A couple more specific issues arise from the small sample size of the subpart HH portion of the ICR. First, because we have so few major source observations, we can't separately characterize different types of facilities within the subpart (e.g., production facilities versus gathering and boosting stations). To the extent there are meaningful differences on average in the equipment and emissions profiles of these types of facilities, our analysis will misrepresent the likely impacts on the universe of major source facilities in the subpart. Second, we assume independence in the distributions of emission points across facilities because we don't have enough observations to meaningfully characterize correlations in the joint distributions. To the extent that the presence of one emissions source (or level of emissions) at a facility is correlated (either positively or negatively) with the presence of another source, our analysis will misrepresent impacts.

- **Baseline scenario:** The primary estimates for this analysis assume a substantial amount of control in the baseline scenario, based on responses from the ICR, engineering and economic judgment, and assumptions about compliance with EG OOOOc. As noted above, we received limited data for subpart HH major sources, so our assumptions with respect to baseline control levels may not be representative of the overall population. As a result, we may be underestimating the impacts of this action.
- **Facility list and small business analysis:** The ECHO database is the best available source for building a comprehensive facility list for subparts HH and HHH. However, the database is updated intermittently and it's possible that more recent operating status or ownership changes may not be reflected. Additionally, we rely heavily on the facility names and internet search to assign ownership, as well as the facility names and listed SIC codes to determine facility types, both of which are imprecise approaches. Finally, the D&B business database may suffer from imperfect mapping of firm structure and uses modeled (rather than observed) estimates of employee counts and revenues.

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