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Regulatory Impact Analysis for Revisions to the Effluent Limitations Guidelines and Standards for the Meat and Poultry Products Point Source Category

United States
Environmental Protection
Agency

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U.S. Environmental Protection Agency
Office of Water (4303T)
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Table of Contents

List of Tables

List of Figures

Abbreviations

BAT	Best available technology economically achievable
BCA	Benefit and Cost Analysis
BCT	Best conventional pollutant control technology
BEA	U.S. Bureau of Economic Analysis
BLS	U.S. Bureau of Labor Statistics
BPT	Best practicable control technology currently available
CFR	Code of Federal Regulations
CPT	Cost pass-through
CTR	Cost-to-revenue
CWA	Clean Water Act
D&B	Dun and Bradstreet
DCF	Discounted cash flow
EA	Environmental Assessment
ELGs	Effluent limitations guidelines and standards
EO	Executive Order
EPA	U.S. Environmental Protection Agency
FCF	Free cash flow
FIML	Full information maximum likelihood
FRED	Federal Reserve Economic Data
FSIS	Food Safety and Inspection Service
FTE	Full time equivalent
GDP	Gross domestic product
GIPSA	Grain Inspection, Packers and Stockyards Administration
HHI	Herfindahl-Hirschman Index
ICIS-NPDES	Integrated Compliance Information System National Pollutant Discharge Elimination System
IRFA	Initial regulatory flexibility analysis
IRS	Internal Revenue Service
JW	Jaro-Winkler
LMIC	Livestock Marketing Information Center
MACRS	Modified Accelerated Cost Recovery System
MPP	Meat and poultry products
NAICS	North American Industry Classification System
NARA	North American Renderers Association
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPRM	Notice of proposed rulemaking
NSPS	New Source Performance Standards
NTTAA	National Technology Transfer and Advancement Act
OIRA	Office of Information and Regulatory Affairs
O&M	Operation and maintenance
OMB	Office of Management and Budget

POTW	Publicly owned treatment works
PRA	Paperwork Reduction Act
PSES	Pretreatment Standards for Existing Sources
PSNS	Pretreatment Standards for New Sources
QA	Quality assurance
QC	Quality control
RIA	Regulatory Impact Analysis
RFA	Regulatory Flexibility Act
ROW	Rest of world
SBA	Small Business Administration
SBAR	Small business advocacy review
SBC	Survey of Current Businesses
SBREFA	Small Business Regulatory Enforcement Fairness Act
SEC	U.S. Securities and Exchange Commission
SISNOSE	Significant impact on a substantial number of small entities
TDD	Technical Development Document
UMRA	Unfunded Mandates Reform Act
UNFAO	United Nations Food and Agriculture Organization
USDA	United States Department of Agriculture
WACC	Weighted average cost of capital

Executive Summary

EPA is proposing a regulation that revises the technology-based effluent limitations guidelines and standards (ELGs) for the meat and poultry products (MPP) point source category, 40 CFR part 432. The proposed rule revises or establishes effluent limitations for the MPP industry based on Best Practicable Control Technology Currently Available (BPT), Best Conventional Pollutant Control Technology (BCT), Best Available Technology Economically Achievable (BAT), and Pretreatment Standards for Existing Sources (PSES). Depending on the regulatory option, the proposed rule sets new limits for nitrogen, phosphorus, conventional pollutants, and/or chlorides.

This action is a significant regulatory action that was submitted to the Office of Management and Budget (OMB) for interagency review. This Regulatory Impact Analysis (RIA) presents an assessment of the compliance costs and impacts associated with this proposal and presents analyses to meet various statutory and Executive Order requirements. The accompanying *Benefit and Cost Analysis for Revisions to the Effluent Limitations Guidelines and Standards for the Meat and Poultry Products Point Source Category* (BCA) document presents social costs and benefits of the action, consistent with Executive Orders 12866,13563, and 14094.

Regulatory Options

For this proposed rule, EPA evaluated three regulatory options, with and without chlorides, as summarized in Table ES-1-1 and further described in the notice of proposed rulemaking (NPRM) for the action. EPA proposes to establish BAT effluent limitations based on the technologies described in Option 1.

Table ES-1-1: Regulatory Options Analyzed for the Proposed Rule

Discharge type	Process type	Technology Basis for BAT/BCT/PSES Regulatory Options[a]							
		Option 1		Option 2		Option 3		Chlorides	
		Production[b]	Technology	Production[b]	Technology	Production[b]	Technology	Production[b]	Technology
Direct	Meat first	> 50 M	Direct 2	> 50 M	Direct 2	> 10 M > 20 M	Direct 1 Direct 2	> 5 M	Chlorides 2
	Meat further	> 50 M	Direct 2	> 50 M	Direct 2	> 10 M > 20 M	Direct 1 Direct 2	> 5 M	Chlorides 2
	Poultry first	> 100 M	Direct 2	> 100 M	Direct 2	> 10 M > 20 M	Direct 1 Direct 2	> 5 M	Chlorides 2
	Poultry further	> 7 M	Direct 2	> 7 M	Direct 2	> 10 M > 20 M	Direct 1 Direct 2	> 5 M	Chlorides 2
	Render	> 10 M	Direct 2	> 10 M	Direct 2	> 10 M > 20 M	Direct 1 Direct 2	> 5 M	Chlorides 2
Indirect	Meat first	> 50 M	Indirect 1	> 50 M > 200 M	Indirect 1 Indirect 2	> 5 M > 30 M	Indirect 1 Indirect 2	> 5 M	Chlorides 2
	Meat further	> 50 M	Indirect 1	> 50 M	Indirect 1	> 5 M > 30 M	Indirect 1 Indirect 2	> 5 M	Chlorides 2
	Poultry first	> 100 M	Indirect 1	> 100 M > 200 M	Indirect 1 Indirect 2	> 5 M > 30 M	Indirect 1 Indirect 2	> 5 M	Chlorides 2
	Poultry further	> 7 M	Indirect 1	> 7 M	Indirect 1	> 5 M > 30 M	Indirect 1 Indirect 2	> 5 M	Chlorides 2
	Render	> 10 M	Indirect 1	> 10 M > 350 M	Indirect 1 Indirect 2	> 5 M > 30 M	Indirect 1 Indirect 2	> 5 M	Chlorides 2

a. See TDD for a description of these technologies ((U.S. Environmental Protection Agency, 2023c).

b. Production reported in millions (M) of pounds per year.

Source: U.S. EPA Analysis, 2023

Annualized Private Compliance Costs

EPA estimates that the regulatory options result in incremental costs to owners and operators of MPP facilities when compared to the baseline (Table ES-1-2). On an after-tax basis, the proposed rule (Option 1) has estimated incremental annualized compliance costs of $210 million.

Table ES-1-2: Estimated Total Annualized After-Tax Compliance Costs (in millions, 2022$)

Regulatory Option	Direct	Indirect	Total
Option 1	$196.4	$13.9	$210.3
Option 2	$196.4	$394.0	$590.4
Option 3	$202.6	$793.0	$995.6
Option 1 with chlorides	$253.6	$100.5	$354.1
Option 2 with chlorides	$253.6	$480.6	$734.2
Option 3 with chlorides	$259.8	$879.6	$1,139.4

Source: U.S. EPA Analysis, 2023.

Impacts on the MPP Market and Potential Cost Pass-Through

EPA examined the effects of the proposed revisions to the MPP ELGs on the national markets for beef, pork, chicken, and turkey. Based on a linear supply and demand model, EPA estimated the change in market price, U.S. demand and supply, and foreign demand and sales. EPA estimated that the proposed rule may result in a small increase in price and small decrease in supply and demand. EPA then assessed the potential cost pass-through and reduction of facility and firm impacts resulting from this price increase. The market impact analysis and cost pass-through analysis are described in Chapter 6 and Chapter 8, respectively.

Potential Impacts on Employment

EPA estimated the potential impacts of this proposed rulemaking on employment, measured in terms of changes in full-time equivalent (FTE) labor inputs. EPA estimated short-run employment impacts from post-compliance closures and long-run employment impacts associated with the operation of new treatment technology and new market equilibrium. In the short run, the Agency estimates negative employment impacts associated with each regulatory option. In the long run, EPA estimates positive employment impacts associated with each regulatory option. This analysis is detailed in Chapter 7.

Potential Impacts on Small Entities

In accordance with the Regulatory Flexibility Act (RFA) requirements, EPA assessed whether the regulatory options would have "a significant impact on a substantial number of small entities" (SISNOSE). The analysis is detailed in Chapter 9.

Under the proposed rule (Option 1), EPA estimates that one small entity owning MPP facilities would incur costs exceeding one percent of revenue. On the basis of percentage, this entity represents less than one percent of small entities. The analysis shows no small entities incurring costs greater than three percent of revenue. Overall, this screening-level analysis suggests that the analyzed regulatory options are unlikely to have a significant economic impact on a substantial number of small entities.

Unfunded Mandate Reform Act

Under Title II of the Unfunded Mandates Reform Act (UMRA) of 1995 section 202, EPA generally must prepare a written statement, including a cost-benefit analysis, for proposed and final rules with "Federal mandates" that might result in expenditures by State, local, and Tribal governments, in the aggregate, or by the private sector, of $100 million (adjusted annually for inflation) or more in any one year (*i.e.,* about $184 million in 2022 dollars). EPA estimates that the private sector would incur expenditures of greater than $184 million, in the aggregate, in any one year. EPA estimates the total annualized pre-tax compliance costs for private entities to range from $232 million under Option 1 to $1,234 million under Option 3 with chlorides.

Other Administrative Requirements

EPA conducted analyses to address other administrative requirements. Key findings, which are discussed further in Chapter 11, include:

- **Executive Order 12866: Regulatory Planning and Review and Executive Order 14094: Modernizing Regulatory Review**: Pursuant to the terms of Executive Orders 12866 and 14094, this action is a significant regulatory action. As such, the action is subject to review by the OMB. Any changes made in response to OMB suggestions or recommendations will be documented in the docket for this action. EPA prepared an analysis of the estimated benefits and costs associated with this action; this analysis is detailed in the BCA (U.S. Environmental Protection Agency, 2023a).

- **Executive Order 12898: Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, Executive Order 14008: Tackling the Climate Crisis at Home and Abroad, and Executive Order 14096: Revitalizing our Nation's Commitment to Environmental Justice for All:** EPA examined whether the benefits from this proposed rule may be differentially distributed among population subgroups in the affected areas. This analysis is detailed in the accompanying *Environmental Assessment for Revisions to the Effluent Limitations Guidelines and Standards for the Meat and Poultry Products Point Source Category* (EA) (U.S. Environmental Protection Agency, 2023b). The analysis showed that communities in close proximity to MPP facilities have greater proportions of low-income individuals and individuals identifying as Asian, Black, and/or Hispanic than the national average and could be at risk of pollutant exposure. EPA also assessed communities served by public water systems downstream of MPP direct dischargers and tribal lands in proximity to MPP facilities. This analysis is detailed in the EA (U.S. EPA, 2023b).

1 Introduction

1.1 Background

EPA is proposing a regulation that revises the technology-based effluent limitations guidelines and standards (ELGs) for the meat and poultry products (MPP) point source category, 40 CFR part 432. The effluent guidelines applicable to direct discharging MPP facilities were last revised in 2004, and do not reflect best available treatment technologies for nutrients, as required by CWA section 304(b). For indirect dischargers, there are currently no nationally applicable pretreatment standards, although CWA 307(b) requires such standards where, as here, there is passthrough and interference with POTW operations.

In addition, Executive Order 12866, directs agencies to identify the market failure they attend to address when issuing a rulemaking. A market failure is the inefficient distribution of goods and services in the free market, which may occur for a variety of reasons, such as externalities, market power, or asymmetric information. An externality occurs when the societal costs or benefits of a good or service are not captured in the market price of that good or service. This proposed rule would address the negative externality of water pollution generated by direct discharges of MPP plants. The current market prices of MPP production, do not reflect full societal costs, of meat production. As there is no market for direct discharges, prices do not capture the costs to the communities who may be impacted by this pollution, and may encourage MPP companies to produce more products and more water pollution than if pollution's costs to society were reflected in those prices.

MPP plants with indirect discharges impose costs on water systems for those pollutants removed by the POTWs. Where POTWs pass the treatment costs to indirect discharges through fees, the cost of pollution control can be included in the price of meat. However, because not all POTWs fully pass on these treatment costs to MPP plants, more pollution may occur than if pollution costs were fully borne by MPP plants. Furthermore, POTWs typically do not remove all pollutants received from indirect dischargers. Those pollutants in the MPP effluent not removed by the POTWs constitute a negative externality to the public that the agency seeks to address with the proposed rule.

The proposed rule revises or establishes effluent limitations for the MPP industry based on Best Practicable Control Technology Currently Available (BPT), Best Conventional Pollutant Control Technology (BCT), Best Available Technology Economically Achievable (BAT), and Pretreatment Standards for Existing Sources (PSES). Depending on the regulatory option, the proposed rule sets new limits for nitrogen, phosphorus, conventional pollutants, and/or chlorides.

This document describes the Agency's analysis of the costs and economic impacts of the three regulatory options that were evaluated by EPA. This document also provides information pertinent to meeting several legislative and administrative requirements.

This document complements and builds on information presented separately in other reports, including:

- *Technical Development Document for Proposed Effluent Limitations Guidelines and Standards for the Meat and Poultry Products Point Source Category* (TDD) (U.S. Environmental Protection Agency, 2023c). The TDD summarizes the technical and engineering analyses supporting the

proposed rule, including cost methodologies, pollutant removal estimates, non-water quality environmental impacts, and calculation of the proposed effluent limitations.

- *Benefit and Cost Analysis for Revisions to the Effluent Limitations Guidelines and Standards for the Meat and Poultry Products Point Source Category* (BCA) (U.S. Environmental Protection Agency, 2023a). The BCA summarizes the societal benefits and costs estimated to result from implementation of the proposed regulatory options.

- *Environmental Assessment for Revisions to the Effluent Limitations Guidelines and Standards for the Meat and Poultry Products Point Source Category* (EA) (U.S. Environmental Protection Agency, 2023b). The EA summarizes the environmental and human health improvements that are estimated to result from implementation of the proposed regulatory options. The EA also describes the environmental justice analysis conducted.

The proposed revisions to the ELGs for the MPP point source category are based on data generated or obtained in accordance with EPA's Quality Policy and Information Quality Guidelines. EPA's quality assurance (QA) and quality control (QC) activities for this rulemaking include the development, approval, and implementation of Quality Assurance Project Plans for the use of environmental data generated or collected from all sampling and analyses, existing databases and literature searches, and for the development of any models which used environmental data. Unless otherwise stated within this document, the data used and associated data analyses were evaluated as described in these quality assurance documents to ensure they are of known and documented quality, meet EPA's requirements for objectivity, integrity, and utility, and are appropriate for the intended use.

1.2 Overview of the Costs and Economic Impacts Analysis

This section describes the key components of the analysis framework.

1.2.1 Main Regulatory Options Presented in the Proposed Rule

For this proposed rule, EPA evaluated three regulatory options: Options 1-3, as shown in Table 1-1, plus each of these same options with chlorides, as shown in Table 1-1.

- Option 1
- Option 2
- Option 3
- Option 1 with chlorides
- Option 2 with chlorides
- Option 3 with chlorides

EPA proposes to establish BAT/PSES effluent limitations based on the technologies described in Option 1.

Table 1-1: Regulatory Options Analyzed for the Proposed Rule

Discharge type	Process type	Technology Basis for BAT/BCT/PSES Regulatory Options[a]							
		Option 1		Option 2		Option 3		Chlorides	
		Production[b]	Technology	Production[b]	Technology	Production[b]	Technology	Production[b]	Technology
Direct	Meat first	> 50 M	Direct 2	> 50 M	Direct 2	> 10 M > 20 M	Direct 1 Direct 2	> 5 M	Chlorides 2
	Meat further	> 50 M	Direct 2	> 50 M	Direct 2	> 10 M > 20 M	Direct 1 Direct 2	> 5 M	Chlorides 2
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	Poultry further	> 7 M	Direct 2	> 7 M	Direct 2	> 10 M > 20 M	Direct 1 Direct 2	> 5 M	Chlorides 2
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	Poultry further	> 7 M	Indirect 1	> 7 M	Indirect 1	> 5 M > 30 M	Indirect 1 Indirect 2	> 5 M	Chlorides 2
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a. See TDD for a description of these technologies (U.S. Environmental Protection Agency, 2023c).

b. Production reported in millions (M) of pounds per year.

Source: U.S. EPA Analysis, 2023

1.2.2 Baseline

The baseline for the analyses supporting this proposed rule reflects the 2004 rule requirements. The Agency estimated and presents in this report the incremental compliance costs that facilities could incur under each of the three regulatory options presented in Table 1-1, with and without chlorides, relative to this baseline.

As described in the preamble for this proposed rule, EPA relied on the following main sources of information to define the baseline universe of facilities potentially subject to this proposed rule:

- U.S. Department of Agriculture (USDA) Food Safety and Inspection Service (FSIS) data on federally inspected meat and poultry facilities.
- North American Renderers Association (NARA) information on the rendering industry.
- EPA's Integrated Compliance Information System National Pollutant Discharge Elimination System (ICIS-NPDES) database.
- EPA's MPP survey of facilities engaged in meat and poultry slaughtering and processing, and rendering, activities. EPA developed two survey questionnaires to collect site-specific technical and economic information: a Census Questionnaire and a Detailed Questionnaire. The Census Questionnaire was administered as a census of the industry to confirm the list of facilities that fall within the MPP industry. A statistically representative subset of MPP facilities were asked to answer a more extensive set of questions in the Detailed Questionnaire, including additional questions on processing operations, wastewater generation, and financial information.

1.2.3 Cost and Economic Analysis Requirements under the Clean Water Act

EPA's effluent limitations guidelines and standards for the meat and poultry processing industry are promulgated under the authority of the Clean Water Act (CWA) Sections 301, 304, 306, 307, 308, 402, and 501 (33 U.S.C. 1311, 1314, 1316, 1317, 1318, 1342, and 1361). In establishing national effluent guidelines and pretreatment standards for pollutants, EPA considers the availability and economic achievability of control and treatment technologies, as well as specified statutory factors including "costs." 33 U.S.C. 1311(b)(2)(A), 1314(b)(2)(B).

EPA analyzed economic achievability. The cost and economic impact analysis for this rulemaking also focuses on understanding the magnitude and distribution of compliance costs across the industry, and the broader market impacts. This report also documents analyses required under other legislative (*e.g.*, Regulatory Flexibility Act, Unfunded Mandates Reform Act) and administrative requirements (*e.g.*, Executive Order 12866: Regulatory Planning and Review, as supplemented by Executive Order 14094: Modernizing Regulatory Review).

1.2.4 Analyses of the Regulatory Options and Report Organization

This document discusses the following analyses EPA performed in support of the regulatory options as compared to the baseline:

- **Overview of the MPP industry** (Chapter 2), which presents an overview of the MPP industry, including recent trends in the number of facilities and firms; data on MPP facilities and their

discharge and processing type; and a description of trends in production, prices, industry concentration, and international trade.

- **Compliance cost assessment** (Chapter 3), which describes the cost components and calculates industry-wide social costs by regulatory option.
- **Cost and economic impact screening analyses** (Chapter 4), which presents industry-wide after-tax compliance costs by regulatory option and evaluates the impacts of compliance on MPP facilities and their owning entities on an after-tax cost-to-revenue basis.
- **Facility closure analysis** (Chapter 5), which evaluates the potential for the proposed regulatory options to result in the closure of MPP facilities, based on a discounted cash flow (DCF) analysis.
- **Market impact analysis** (Chapter 6), which evaluates the effects of the proposed regulatory options on the national markets for beef, pork, chicken, and turkey.
- **Employment impact analysis** (Chapter 7), which evaluates the short- and long-term employment effects of the proposed regulatory options.
- **Cost Pass-Through Analysis** (Chapter 8), which assesses costs and impacts assuming a non-zero cost-pass scenario.
- **Initial Regulatory Flexibility Act (RFA) analysis** (Chapter 9) which assesses the impact of the rule on small entities on the basis of a revenue test, *i.e.*, cost-to-revenue comparison.
- **Analyses to address other legislative and administrative requirements** (Chapters 10 and 11), such as UMRA and Executive Orders 12866 and 14094.

Chapter 12 provides detailed information on sources cited in the text, and Appendix A: Proposed Rule Costs at 7 Percent Discount Rate presents industry-wide compliance costs by regulatory option using an alternative discount rate.

2 Overview of the MPP Industry

This section provides a general description of the MPP industry. Section 2.1 provides a snapshot of the meat and poultry products industry based on *Statistics of U.S. Business* datasets from the last 10 years; Section 2.2 describes EPA's MPP survey and the respondents; Section 2.3 provides recent trends in production, wholesale prices, and international trade in the MPP industry; Section 2.4 describes recent trends in concentration in the MPP industry; Section 2.5 discusses the presence of economies of scale within the MPP industry; and Section 2.6 provides an overview of the product mixes in the MPP industry.

2.1 Industry Sectors

The MPP point source category includes facilities "engaged in the slaughtering, dressing and packing of meat and poultry products for human consumption and/or animal food and feeds. Meat and poultry products for human consumption include meat and poultry from cattle, hogs, sheep, chickens, turkeys, ducks and other fowl as well as sausages, luncheon meats and cured, smoked or canned or other prepared meat and poultry products from purchased carcasses and other materials. Meat and poultry products for animal food and feeds include animal oils, meat meal and facilities that render grease and tallow from animal fat, bones and meat scraps" (See 40 CFR 432.1). These facilities can be categorized as one of five process types:

- "Meat first" refers to facilities that slaughter animals, excluding poultry.
- "Meat further" refers to facilities that further process animal products, excluding poultry.[1]
- "Poultry first" refers to facilities that slaughter poultry.
- "Poultry further" refers to facilities that further process poultry.
- "Render" refers to facilities that render meat and poultry materials.

MPP facilities generally fall under four North American Industry Classification System (NAICS) codes:

- Animal (except Poultry) Slaughtering (NAICS 311611),
- Meat Processed from Carcasses (NAICS 311612),
- Rendering and Meat Byproduct Processing (NAICS 311613), and
- Poultry Processing (NAICS 311615).

NAICS 311611 consists of establishments primarily engaged in slaughtering animals (except poultry and small game). Establishments that slaughter and prepare meats are included in this industry. NAICS 311612 comprises establishments primarily engaged in processing or preserving meat and meat byproducts (except poultry and small game) from purchased meats. This industry includes establishments primarily engaged in assembly cutting and packing of meats (i.e., boxed meats) from purchased meats.

[1] A facility that both slaughters animals and further processes animal products, excluding poultry, is categorized as "meat first."

NAICS 311613 comprises establishments primarily engaged in rendering animal fat, bones, and meat scraps. NAICS 311615 comprises establishments primarily engaged in (1) slaughtering poultry and small game and/or (2) preparing processed poultry and small game meat and meat byproducts.

Table 2-1 presents the number of firms in each NAICS sector from 2010 to 2020. Between 2010 and 2020, the number of firms engaged in Animal Slaughtering, Rendering and Meat Byproduct Processing, and Poultry Processing decreased, while the number of firms engaged in Meat Processed from Carcasses had a slight increase. The number of firms engaged in Animal Slaughtering and Rendering and Meat Byproduct Processing experienced the largest decreases, at 15.7 and 29.5 percent respectively. During this same period, the number of firms engaged in Meat Processing from Carcasses and Poultry Processing remained relatively unchanged.

Table 2-1: Number of Firms in the MPP Industry Sector, by Year and Segment

	Animal (except Poultry) Slaughtering (NAICS 311611)		Meat Processed from Carcasses (NAICS 311612)		Rendering and Meat Byproduct Processing (NAICS 311613)		Poultry Processing (NAICS 311615)	
Year	Number	% Change	Number	% Change	Number	% Change	Number	% Change
2010	1,431		1,195		122		320	
2011	1,402	-2.0%	1,208	1.1%	119	-2.5%	372	16.3%
2012	1,427	1.8%	1,202	-0.5%	114	-4.2%	307	-17.5%
2013	1,367	-4.2%	1,206	0.3%	110	-3.5%	313	2.0%
2014	1,414	3.4%	1,241	2.9%	116	5.5%	323	3.2%
2015	1,385	-2.1%	1,212	-2.3%	113	-2.6%	320	-0.9%
2016	1,344	-3.0%	1,245	2.7%	110	-2.7%	317	-0.9%
2017	1,343	-0.1%	1,196	-3.9%	99	-10.0%	310	-2.2%
2018	1,274	-5.1%	1,222	2.2%	93	-6.1%	302	-2.6%
2019	1,233	-3.2%	1,273	4.2%	89	-4.3%	307	1.7%
2020	1,207	-2.1%	1,242	-2.4%	86	-3.4%	300	-2.3%
2010-2020 Comparison								
Total Percent Change		-15.7%		3.9%		-29.5%		-6.3%
Average Annual Growth Rate		-1.7%		0.4%		-3.4%		-0.6%

Sources: U.S. Census Bureau, 2023

Table 2-2 presents the number of establishments[2] in each meat product category from 2010 to 2020. Between 2010 and 2020, the number of establishments engaged in Animal Slaughtering, Rendering and Meat Byproduct Processing, and Poultry Processing decreased, while the number of establishments

[2] An establishment is a single physical location at which business is conducted or services or industrial operations are performed.

engaged in Meat Processed from Carcasses increased. These trends are consistent with trends in the number of firms. During this period, in the Rendering and Meat Byproduct Processing Industry sector, the number of firms decreased at a much higher rate (29.5 percent) than the number of establishments (7 percent), a sign of consolidation.

Table 2-2: Number of Establishments in the MPP Industry Sector, by Year and Segment

Year	Animal (except Poultry) Slaughtering (NAICS 311611)		Meat Processed from Carcasses (NAICS 311612)		Rendering and Meat Byproduct Processing (NAICS 311613)		Poultry Processing (NAICS 311615)	
	Number	% Change	Number	% Change	Number	% Change	Number	% Change
2010	1,519		1,323		228		532	
2011	1,494	-1.6%	1,345	1.7%	220	-3.5%	583	9.6%
2012	1,513	1.3%	1,349	0.3%	214	-2.7%	517	-11.3%
2013	1,458	-3.6%	1,348	-0.1%	210	-1.9%	524	1.4%
2014	1,506	3.3%	1,384	2.7%	213	1.4%	532	1.5%
2015	1,474	-2.1%	1,360	-1.7%	222	4.2%	537	0.9%
2016	1,427	-3.2%	1,407	3.5%	220	-0.9%	532	-0.9%
2017	1,431	0.3%	1,358	-3.5%	203	-7.7%	532	0.0%
2018	1,357	-5.2%	1,391	2.4%	208	2.5%	524	-1.5%
2019	1,324	-2.4%	1,441	3.6%	212	-1.9%	524	0.0%
2020	1,290	-2.6%	1,423	-1.2%	212	0.0%	517	-1.3%
2010-2020 Comparison								
Total Percent Change		-15.1%		7.6%		-7.0%		-2.8%
Average Annual Growth Rate		-1.6%		0.7%		-0.7%		-0.3%

Sources: U.S. Census Bureau, 2023

Table 2-3 presents the number of employees in each meat product category from 2010 to 2020. Between 2010 and 2020, the number of employees engaged in Meat Processed from Carcasses, Rendering and Meat Byproduct Processing, and Poultry Processing increase by 17.3, 8.4, and 11.6 percent, while the number of employees engaged in Animal Slaughtering had increased by only 4 percent.

Table 2-3: Number of Employees in the MPP Industry Sector, by Year and Segment

Year	Animal (except Poultry) Slaughtering (NAICS 311611)		Meat Processed from Carcasses (NAICS 311612)		Rendering and Meat Byproduct Processing (NAICS 311613)		Poultry Processing (NAICS 311615)	
	Number	% Change	Number	% Change	Number	% Change	Number	% Change
2010	156,191		103,358		9,506		224,261	

Table 2-3: Number of Employees in the MPP Industry Sector, by Year and Segment

Year	Animal (except Poultry) Slaughtering (NAICS 311611)		Meat Processed from Carcasses (NAICS 311612)		Rendering and Meat Byproduct Processing (NAICS 311613)		Poultry Processing (NAICS 311615)	
	Number	% Change	Number	% Change	Number	% Change	Number	% Change
2011	156,041	-0.1%	101,442	-1.9%	8,699	-8.5%	222,666	-0.7%
2012	154,061	-1.3%	103,526	2.1%	8,370	-3.8%	220,521	-1.0%
2013	155,982	1.2%	97,759	-5.6%	8,496	1.5%	216,295	-1.9%
2014	145,515	-6.7%	98,091	0.3%	8,020	-5.6%	216,598	0.1%
2015	152,594	4.9%	98,150	0.1%	8,868	10.6%	226,273	4.5%
2016	147,390	-3.4%	109,084	11.1%	8,916	0.5%	231,457	2.3%
2017	154,895	5.1%	110,978	1.7%	8,874	-0.5%	240,416	3.9%
2018	159,349	2.9%	113,443	2.2%	8,818	-0.6%	246,713	2.6%
2019	166,495	4.5%	113,508	0.1%	9,262	5.0%	243,310	-1.4%
2020	162,393	-2.5%	121,195	6.8%	10,300	11.2%	250,183	2.8%
2010-2020 Comparison								
Total Percent Change		4.0%		17.3%		8.4%		11.6%
Average Annual Growth Rate		0.4%		1.6%		0.8%		1.1%

Sources: U.S. Census Bureau, 2023

2.2 Questionnaire and Subcategorization

As described in Section 1.2.2, EPA relied on several data sources, including EPA's MPP survey, to determine the universe of facilities in the MPP industry. Table 2-4 presents the number of facilities in each by process and discharge type, based on EPA's analysis of these data sources. There are an estimated 5,055 facilities in total in the MPP industry: 3,879 (77 percent) are MPP dischargers that discharge their wastewater directly to waters of the United States (direct dischargers) or send their wastewater to a publicly owned treatment works (POTW) (indirect dischargers), and 1,176 (23 percent) are zero dischargers, which do not discharge any wastewater to the environment.

Table 2-4: Number of Facilities in MPP Industry by Process and Discharge Type				
	Number of Facilities			
Process	Direct Dischargers	Indirect Dischargers	Zero Dischargers	Total
Meat First	47	509	270	826
Meat Further	29	2,741	690	3,460
Poultry First	70	168	52	290
Poultry Further	6	169	119	294
Render	19	121	45	185
Total	171	3,708	1,176	5,055
Source: U.S. EPA analysis, 2023.				

2.3 Trends in Production, Prices, and International Trade

In this section, EPA summarizes the recent trends in production, prices, imports, and exports in each U.S. MPP industry.

2.3.1 Production and Wholesale Prices

Table 2-5 presents U.S. domestic production and wholesale prices in the beef, pork, chicken, and turkey markets from 2010 to 2022. Between 2010 and 2022, production in beef, pork, and chicken steadily increased. Production in turkey remained relatively stable during this period. The wholesale price for beef spiked in 2014 and then again in 2021 but otherwise remained relatively stable. Wholesale prices for pork and chicken remained relatively stable between 2010 to 2020 and began to steadily increase after that period. The wholesale price for turkey remained relatively stable from 2010 to 2022.

Table 2-5: U.S. Domestic Production and Wholesale Prices from 2010 to 2022								
	Production (Million Pounds)				Average Wholesale Prices ($2022 per Million Pounds)			
Year	Beef	Pork	Chicken	Turkey	Beef[a]	Pork[b]	Chicken[c]	Turkey[d]
2010	26,304	22,437	36,910	5,644	$2,084,871	$1,172,215	NA	$1,170,854
2011	26,195	22,758	37,202	5,791	$2,389,579	$1,300,410	NA	$1,290,089
2012	25,913	23,253	37,039	5,967	$2,520,289	$1,104,564	NA	$1,177,918
2013	25,720	23,187	37,830	5,806	$2,457,841	$1,220,612	$1,246,533	$1,138,067
2014	24,252	22,843	38,565	5,756	$3,027,217	$1,495,682	$1,287,319	$1,261,527
2015	23,690	24,499	40,048	5,627	$2,948,197	$1,017,626	$1,100,050	$1,187,941
2016	25,221	24,941	40,696	5,981	$2,451,825	$1,008,078	$1,014,677	$1,080,553
2017	26,187	25,584	41,662	5,981	$2,498,066	$1,088,442	$1,104,901	$982,839
2018	26,872	26,315	42,601	5,878	$2,395,040	$945,428	$1,127,633	$869,146
2019	27,155	27,638	43,905	5,818	$2,505,031	$969,401	$1,003,366	$950,014
2020	27,174	28,303	44,583	5,743	$2,579,422	$897,110	$818,519	$1,039,960
2021	27,948	27,675	44,899	5,558	$2,854,281	$1,170,023	$1,082,680	$1,271,256
2022	28,290	26,994	46,206	5,222	$2,632,438	$1,113,816	$1,405,267	$1,496,779
Total Percentage Change[e]	7.55%	20.31%	25.19%	-7.48%	26.26%	-4.98%	12.73%	27.84%

Table 2-5: U.S. Domestic Production and Wholesale Prices from 2010 to 2022

Year	Production (Million Pounds)				Average Wholesale Prices ($2022 per Million Pounds)			
	Beef	Pork	Chicken	Turkey	Beef[a]	Pork[b]	Chicken[c]	Turkey[d]

a. Average of monthly prices of: choice 1-3, 600-900 lbs; select 1-3, 600-900 lbs; and boneless, 90 percent, fresh (excluding imported boneless , 90 percent, fresh).

b. Average of monthly prices of: Pork cutout composite; loins, 14-19 lbs, BI 1/4", trimmed; bellies, 10-12 lbs, skin on, trimmed; hams, 20-23 lbs, BI, trimmed; trimmings, 72 percent, fresh.

c. Average of monthly prices of: national composite. Data on wholesale prices were not available for 2010 to 2012.

d. Average of monthly prices of: Hens, 8-16 lbs; toms, 16-24 lbs; breast, 4-8 lbs; drumsticks; wings, full cut.

e. The total percentage change for the wholesale price of chicken is calculated as the 10-year percentage change between 2013 to 2022 due to data limitations.

Source: Knight et al., 2023; Haley, 2020; Haley et al., 2016; Haley et al., 2015a; Economic Research Service, 2023a

2.3.2 International Trade

Table 2-6 presents U.S. imports and exports for beef, pork, chicken, and turkey from 2010 to 2022. Imports and exports for beef increased relatively steadily between 2010 and 2022 with a temporary peak in imports and dip in exports in 2015. Pork exports steadily increased between 2010 to 2020 with a slight peak in 2020 and a steady decline between 2020 and 2022. Pork imports remained relatively stable between 2010 to 2022. During this period, imports and exports of chicken remained relatively stable with a slight dip in exports in 2015. Turkey imports during this period remained relatively stable and turkey exports peaked in 2012 until a dip in 2015. Turkey exports then steadily increased until 2019 until they began to steadily decline into 2022.

Table 2-6: U.S. Imports and Exports by Meat Product from 2010 to 2022 (Million Pounds)								
	Imports				Exports			
Year	Beef[a]	Pork	Chicken	Turkey	Beef[a]	Pork	Chicken	Turkey
2010	2,298	859	107	25	2,300	4,223	6,762	581
2011	2,057	803	107	21	2,785	5,196	6,978	703
2012	2,220	802	111	22	2,452	5,379	7,274	797
2013	2,250	880	122	20	2,588	4,986	7,345	741
2014	2,947	1,011	117	27	2,574	5,092	7,297	775
2015	3,368	1,116	131	45	2,267	5,010	6,321	529
2016	3,012	1,091	131	50	2,557	5,239	6,645	569
2017	2,993	1,116	126	25	2,859	5,632	6,786	622
2018	2,998	1,042	139	19	3,160	5,877	7,069	611
2019	3,058	945	131	12	3,026	6,321	7,103	639
2020	3,339	904	145	21	2,951	7,279	7,368	571
2021	3,346	1,180	155	22	3,431	7,026	7,355	548
2022	3,391	1,344	176	85	3,536	6,338	7,278	407
Total Percentage Change	47.6%	56.4%	65.4%	238.7%	53.8%	50.1%	7.6%	-29.9%

a. The import and export values for beef also include veal.

Source: Economic Research Service, 2023b

2.4 Trends in Industry Concentration

In this section, EPA summarizes the available information on consolidation and concentration within the national MPP industry.

As presented in Table 2-7, according to Economic Census data, the number of firms in each of the MPP industries listed above increased between 2012 and 2017, with the exception of NAICS 311611 which experienced a moderate decline in the number of firms. Additionally, the percentage of sales or revenue attributable to the largest firms in NAICS 311611, 311612, and 311615 were relatively unchanged between 2012 and 2017. In NAICS 311613, there was a 10.3 percent increase in sales or revenue attributable to the four largest firms, pointing to increased concentration in the rendering and meat byproduct processing industry.

Another indication of concentration in these industries is the Herfindahl-Hirschman index (HHI), which is a measure of the size of firms in an industry in relation to the size of the industry. HHI values under 1,500 point to a competitive market, values between 1,500 and 2,000 point to a moderately concentrated market, and values above 2,500 point to a highly concentrated market. The HHI value for NAICS 311611 increased from 1,085 to 1,175, indicating this industry remained competitive between 2012 and 2017. The HHI value for NAICS 311612 increased from 332 to 355, while the HHI value for NAICS 311615 decreased from 600 to 565, suggesting that these industries also remained competitive. The HHI value for NAICS 311613 increased substantially, from 673 in 2012 to 1,109 in 2017, indicating that while this industry became significantly more concentrated over time, it still remained competitive.

Table 2-7: 2012 and 2017 MPP Industry Economic Census						
	Number of Firms		Sales, value of shipments, or revenue of largest firms as percent of total sales, value of shipments, or revenue (%)		Herfindahl-Hirschman index	
Industry	2012	2017	2012	2017	2012	2017
Animal (except Poultry) Slaughtering (311611)	1,420	1,297	100.0	100.0	-	-
4 largest firms	4	4	60.7	63.4	-	-
8 largest firms	8	8	75.8	76.8	-	-
20 largest firms	20	20	86.4	87.1	-	-
50 largest firms	50	50	92.8	93.3	1,085	1,175
Meat Processed from Carcasses (311612)	1,204	1,241	100.0	100.0	-	-
4 largest firms	4	4	32.8	33.0	-	-
8 largest firms	8	8	42.3	41.6	-	-
20 largest firms	20	20	55.4	56.0	-	-
50 largest firms	50	50	71.2	71.5	332	355
Rendering and Meat Byproduct Processing (311613)	115	100	100.0	100.0	-	-
4 largest firms	4	4	44.5	54.8	-	-
8 largest firms	8	8	62.7	71.2	-	-
20 largest firms	20	20	83.4	89.1	-	-
50 largest firms	50	50	96.3	98.6	673	1,109
Poultry Processing (311615)	319	308	100.0	100.0	-	-
4 largest firms	4	4	39.8	39.4	-	-
8 largest firms	8	8	54.1	54.3	-	-
20 largest firms	20	20	77.4	76.6	-	-
50 largest firms	50	50	92.4	92.7	600	565
Source: U.S. Census Bureau, 2017b						

According to a 2000 USDA study (MacDonald et al., 2000), based on U.S. Census data, the four-firm concentration ratio[3] for the cattle slaughter industry rose from 25 percent in 1977 to 71 percent in 1992. During this same period, the four-firm concentration ratio for the hog industry increased from 31 to 43 percent, 22 to 41 percent for the chicken industry, and 41 to 45 percent for the turkey industry. The authors of this report find similar results for the same period using Grain Inspection, Packers and Stockyards Administration (GIPSA) data. Moreover, in 2021, Deese et al. (2021a) report that the top four processors of beef, poultry, and pork account for 82, 54, and 66 percent of these markets, respectively.

Additionally, according to a USDA study from 2018 (MacDonald et al., 2018), the median sales per company for broilers, fed cattle, hogs and pigs, and turkeys increased by 123, 119, 3,233, and 33 percent between 1987 to 2012, respectively. These increases in sales midpoints indicate a shift of production of these commodities towards larger farms with more revenue. The median inventory per company for beef cows over this period increased marginally from 86 to 110 cows (24 percent). These trends in consolidation slowed between 2007 and 2012. Deese et al. (2021b) report that the four largest meat-

[3] The four-firm concentration ratio measures the combined share of the market for the four largest firms in that market.

processing companies operating in the United States increased gross profits by 120 percent and net income by 500 percent since 2019.

Table 2-8 presents the average number of establishments per firm in each meat product category from 2010 to 2020. Between 2010 and 2020, the average number of establishments per firm engaged in Animal Slaughtering, Meat Processed from Carcasses, and Poultry Processing remained relatively unchanged, with an average annual growth rate of 0.1%, 0.3%, and 0.4%, respectively. However, the average number of establishments per firm engaged in Rendering and Meat Byproduct Processing saw a substantial increase of 31.9% from 2010 to 2020, and an average annual growth rate of 2.8%.

An increase in the average number of establishments per firm is a sign of consolidation, resulting in larger firms operating a greater number of unified establishments. On the other hand, a lower average indicates a less consolidated market, with greater dispersion or fragmentation of firm owned establishments . The high average annual growth rate of the average number of establishments per firm engaged in Rendering and Meat Byproduct Processing is a sign of consolidation, either by way of acquisitions or mergers with other businesses. Furthermore, a more consolidated industry sector has the potential to allow firms to more easily benefit from economies of scale.

Table 2-8: Average Number of Establishments per Firm in the MPP Industry Sector, by Year and Segment

	Animal (except Poultry) Slaughtering (NAICS 311611)		Meat Processed from Carcasses (NAICS 311612)		Rendering and Meat Byproduct Processing (NAICS 311613)		Poultry Processing (NAICS 311615)	
Year	Number	% Change	Number	% Change	Number	% Change	Number	% Change
2010	1.06		1.11		1.87		1.66	
2011	1.07	0.4%	1.11	0.6%	1.85	-1.1%	1.57	-5.7%
2012	1.06	-0.5%	1.12	0.8%	1.88	1.5%	1.68	7.5%
2013	1.07	0.6%	1.12	-0.4%	1.91	1.7%	1.67	-0.6%
2014	1.07	-0.1%	1.12	-0.2%	1.84	-3.8%	1.65	-1.6%
2015	1.06	-0.1%	1.12	0.6%	1.96	7.0%	1.68	1.9%
2016	1.06	-0.2%	1.13	0.7%	2.00	1.8%	1.68	0.0%
2017	1.07	0.4%	1.14	0.5%	2.05	2.5%	1.72	2.3%
2018	1.07	0.0%	1.14	0.3%	2.24	9.1%	1.74	1.1%
2019	1.07	0.8%	1.13	-0.6%	2.38	6.5%	1.71	-1.6%
2020	1.07	-0.5%	1.15	1.2%	2.47	3.5%	1.72	1.0%
2010-2020 Comparison								
Total Percent Change		0.7%		3.5%		31.9%		3.7%
Average Annual Growth Rate		0.1%		0.3%		2.8%		0.4%

Sources: U.S. Census Bureau, 2023

2.5 Economies of Scale

Recent trends in MPP industry consolidation and concentration may be partially attributable to economies of scale within the industry (MacDonald et al., 2000). Ollinger et al. (2005) find evidence of large economies of scale within the poultry industry in the United States. The authors find that the production costs for the largest poultry processing plants was 8 percent lower than plants half the size and 20 percent lower than plants one eighth the size between 1967 to 1992. MacDonald and Ollinger (2000) find evidence of moderate economies of scale in the U.S. hog industry. The authors find that the largest hog processing plants could sell products at a cost 2 to 3 percent lower than plants half the size and 10 percent lower than plants one tenth the size between 1963 and 1992.

2.6 Product Mixes

In this section we summarize the recent trends in product mixes in the MPP industry. Table 2-9 presents product mix (commodity production as a percentage of the total industry production) from 2010 to 2022. Overall, in 2022, beef, lamb and mutton, and pork made up about 26, 0.12, and 25 percent of the total meat produced in the United States, respectively. Additionally, chicken and turkey made up about 43 and 5 percent of total meat production in 2022, respectively. Between 2010 and 2022, the industry shares of beef, lamb and mutton, and turkey decreased. During this same period, the industry shares of pork and chicken increased.

Table 2-9: Annual Production Levels by Meat Category from 2010 to 2022

Year	Annual Industry Shares of Production (Million Pounds)				
	Beef	Lamb and Mutton	Pork	Chicken	Turkey
2010	28.76%	0.18%	24.53%	40.36%	6.17%
2011	28.44%	0.16%	24.71%	40.40%	6.29%
2012	28.07%	0.17%	25.19%	40.12%	6.46%
2013	27.75%	0.17%	25.01%	40.81%	6.26%
2014	26.48%	0.17%	24.95%	42.11%	6.29%
2015	25.20%	0.16%	26.06%	42.60%	5.99%
2016	26.00%	0.15%	25.72%	41.96%	6.17%
2017	26.30%	0.15%	25.70%	41.85%	6.01%
2018	26.39%	0.15%	25.84%	41.84%	5.77%
2019	25.94%	0.14%	26.41%	41.95%	5.56%
2020	25.65%	0.13%	26.72%	42.08%	5.42%
2021	26.31%	0.13%	26.05%	42.27%	5.23%
2022	26.48%	0.12%	25.27%	43.25%	4.89%
Δ 2010 - 2022	**-2.28%**	**-0.06%**	**0.73%**	**2.89%**	**-1.28%**
Annual Average	**26.75%**	**0.15%**	**25.55%**	**41.66%**	**5.88%**

Source: Knight et al., 2023; Haley, 2020; Haley et al., 2016; Haley et al., 2015b

According to MacDonald et al. (2018), the number of farms specializing in livestock production has increased in tandem with observed trends in consolidation. The percent of livestock produced by farms with no crop production increased by 22 percent between 1996 and 2015. Since the 1970s, cattle slaughter plants have transitioned away from just selling carcasses to further processors and towards slaughtering

and processing carcasses to make boxed (cut-up) and ground beef products. MacDonald et al. (2000) find that, based on industry averages, boxed beef accounted for 9.3 percent of total shipments in 1963 and grew to 56.2 percent in 1992. This trend was largely driven by large firms who saw their share of boxed beef shipments rise from 8.1 percent to 71.6 percent.

During the same period, MacDonald et al. (2000) found that hog slaughter plants have also moved away from vertically integrated operations where they were slaughtering carcasses, cutting them up and then producing final products such as bacon, sausages, or ham, and towards specializing in just producing cut-up carcasses and selling them to brand-name retailers for further processing. Based on industry averages, cut-up carcasses accounted for 27.5 percent of total shipments at hog slaughter plants in 1963 and grew to 52.4 percent in 1992. Moreover, the share of bacon, ham, and other cured pork products produced at non-slaughter plants as a share of total shipments in the market grew from 42.8 percent in 1982 to 63.1 percent in 1992. The share of sausage and similar products produced at non-slaughter plants a share of total shipments in the market grew from 55.9 percent in 1982 to 77 percent in 1992. MacDonald et al. (2000) further explain that slaughter plants can produce boxed beef and cut-up pork at a lower cost per pound and avoid the higher transportation costs of shipping whole and half carcasses. Because of this, meat processors, wholesalers, and retailers commonly purchase boxed beef and cut-up pork from slaughter plants.

2.7 Summary

Over the past two decades, the U.S. MPP industry has undergone significant consolidation, resulting in fewer, but larger dominant plants. This consolidation has led to increased concentration, raising concerns about competition and market power. The shift toward larger plants has been driven by technological scale economies and changes in labor relations, providing cost advantages and economies of scale, enabling them to outcompete smaller facilities (MacDonald et al. (2018). Moreover, data pertaining to the industry's Herfindahl-Hirschman index (see Table 2-7), average number of establishments per firm (Table 2-8), and establishment entry and exit rates (see Figure 6-1) suggest a trend towards consolidation.

Despite the current state of the industry, there is no consensus on whether the trend towards further consolidation and specialization will continue, or if the observed changes have reached a plateau. With global meat consumption anticipated to increase by 14% by 2030, compared to the base period average of 2018-2020 (OECD/FAO, 2021), there is a possibility of further consolidation and specialization in the U.S. to meet global demand. However, new governmental actions, such as the Meat and Poultry Supply Chain Action Plan, that aim to combat market dominance, could lead to a decline in consolidation in the industry (USDA, 2022). Additionally, advancements in the meat-replacement and alternative products industry, which have become significantly cheaper and have a lower climate impact than traditional meat production, have the potential to disrupt the current market composition of the U.S. MPP industry (Brennan et al., 2021; Newton et al., 2021). As a result, the future of the U.S. MPP industry remains uncertain, as multiple factors have the potential to reshape the industry from its current state.

3 Compliance Costs

In developing the proposed rule, EPA assessed the costs and economic impacts for three regulatory options summarized in Table 1-1, with and without chlorides. The options are labeled Option 1 through Option 3, in order of the stringency of the effluent limits relative to the baseline, and Option 1 with chlorides through Option 3 with chlorides. The key input for the compliance cost analysis is the estimated costs to MPP facilities (and their owners) for implementing control technologies upon which the proposed BAT and BPT limitations and pretreatment standards are based.[4] This chapter summarizes EPA estimates of the incremental compliance costs attributable to the regulatory options.[5] EPA determined that state and federal governments do not own regulated entities and thus would not incur material incremental costs, but control authorities would incur some additional reporting and recordkeeping costs.

The TDD describes the control technologies and their respective wastewater treatment performance in greater detail (U.S. Environmental Protection Agency, 2023c). The TDD also describes how EPA estimated facility-specific capital and operation and maintenance (O&M) costs. The cost analysis uses the 2004 rule as the baseline and incorporates treatment technology that facilities have in place at the time of this proposed action.

3.1 Analysis Approach and Inputs

EPA estimated costs to MPP facilities for meeting the limitations of the regulatory options. There are three principal steps to compliance cost development, the last of which is the focus of the discussion below:

1. Determining the set of facilities potentially implementing compliance technologies for each regulatory option. See TDD for details.
2. Developing facility-level costs for each technology option. See TDD for details.
3. Estimating *total* industry costs for all facilities in the MPP universe for each of the regulatory options.

EPA reports costs in 2022 dollars and discounts future costs to 2025, the anticipated rule promulgation year.

3.1.1.1 Facility-Specific Costs Approach

As detailed in the TDD, EPA developed costs for MPP facilities to implement treatment technologies to control the pollutants addressed by the regulatory options.

EPA assessed the operations and treatment system components currently in place at a given facility, and identified equipment and process changes that the facility would likely make to meet each of the

[4] Dischargers are not required to use the technologies specified as the basis for the rule. They are free to identify other perhaps less expensive technologies as long as they meet the BAT limitations and pretreatment standards in the rule.

[5] The analysis of the regulatory options presented in this RIA apply only to existing sources. Impact analyses for BAT and BPT limits are not reported separately. New sources would also be subject to New Source Performance Standards (NSPS) equivalent to BAT and Pretreatment Standards for New Sources (PSNS) equivalent to PSES.

regulatory options presented in Table 1-1. Facilities that do not discharge wastewater (1,176 facilities that are zero dischargers) or that employ technologies which would already meet the given limitations or standards do not incur incremental costs under the regulatory options. Facilities that fall below the applicable production threshold under each regulatory option also do not incur incremental costs.

3.1.1.2 Facility-Level Costs

EPA estimated compliance costs for all existing MPP facilities that generate wastestreams covered by the regulatory options, estimated to be a total of 3,879 facilities with direct or indirect discharges. Of these facilities, only a subset would incur non-zero costs under any of the regulatory options analyzed based on existing control technologies and production thresholds defined in the regulatory options: 845 facilities under options 1 and 2, 1,620 facilities under option 3, 946 facilities under options 1 and 2 with chlorides, and 1,621 facilities under option 3 with chlorides. The TDD provides additional details on this analysis.

The major components of technology costs are:

- *Capital costs*, which include the cost of compliance technology equipment, installation, construction, and other upfront, non-annually recurring outlays associated with compliance with the regulatory options. As explained in the TDD, compliance technologies are assumed to have a useful life of either 20 years or 40 years. EPA assumes that facilities incur full capital costs in the first installation year and 70 percent of capital costs 20 years later, the year in which 70 percent of capital equipment must be replaced at the end of its useful life of 20 years.
- *Annual O&M costs*, which include the labor costs for operating and inspecting the compliance technology equipment, as well as the cost of materials and electricity to run the treatment units. Facilities incur these costs each year.

3.1.1.3 Total Compliance Costs

EPA used the following methodology and assumptions to aggregate compliance cost components, described in the preceding sections, and develop total facility compliance costs for the three regulatory options, with and without chlorides:

- EPA estimated compliance costs (including zero costs, where applicable) for each of the 3,879 MPP facilities that generate wastewater discharges (see TDD for details). All other facilities covered by the MPP point source category do not generate wastestreams covered by the regulatory options and therefore incur zero costs.
- EPA discounted all future cost values to 2025. For the social costs presented in this section, EPA used a discount rate of 3 percent. To assess impacts on firms, as discussed in the remainder of this

RIA document, EPA used the industry's estimated private cost of capital.[6] EPA also discounted costs at 7 percent.[7]

- EPA annualized 70 percent of one-time capital costs over 20 years, and 30 percent of one-time capital costs over 40 years, to reflect the useful life of different components of the treatment technologies.
- EPA added annualized capital and annual O&M costs to derive total annualized compliance costs.

For the assessment of compliance costs to MPP facilities as an estimate of total social cost, EPA considered costs on a pre-tax basis. Pre-tax costs provide insight on the total expenditures as initially incurred by the facilities.

3.1.1.4 Estimated Social Cost of Compliance

EPA calculated the expected costs to society incurred because of compliance with each regulatory option. These costs incorporate a compliance schedule that varies by discharge type and assumes the time profiles of technology implementation and administrative costs. EPA incorporated a compliance schedule assuming:

- Direct dischargers will come into compliance over five years, with 20 percent incurring capital costs to install treatment technology in each of the first five years of the analysis period. Direct dischargers will also start to incur annual O&M costs on this schedule. As described above, 70 percent of capital must be re-installed after 20 years. As a result, 20 percent of direct dischargers will incur 70 percent of capital costs in each of years 21-25.
- All indirect dischargers will come into compliance, and install treatment technology, in the third year of the analysis period and replace 70 percent of capital costs in year 24, after the 20-year useful life. Indirect dischargers will start to incur annual O&M costs in year 3.

Social costs also include the administrative costs of compliance, including:

- A one-time burden for facilities to read and comprehend the rule, estimated to be 8 hours per facility.
- A one-time burden for Control Authorities and the Agency to review the ELGs and establish monitoring requirements, and an annual burden to review pollutant data submitted by MPP

[6] EPA estimated the industry's private cost of capital as the weighted average cost of capital (WACC) based on the median values reported in the MPP detailed questionnaire for debt-to-equity ratio, interest rate of debt, and equity rate of return, as well as the federal corporate income tax rate and national average state corporate income tax rate. See Section 5.2.3 for more information on the WACC calculation.

[7] The rate of 7 percent is an estimate of the private opportunity cost of capital. For the social cost analysis presented in Chapter 7 of the BCA, EPA uses a3 percent discount rate. This discount rate reflects society's valuation of differences in the timing of consumption; the 7 percent discount rate is an estimate of the private opportunity cost of capital to society. In Circular A-4, the Office of Management and Budget (OMB) recommends that 3 percent be used when a regulation affects private consumption, and 7 percent in evaluating a regulation that will mainly displace or alter the use of capital in the private sector (U.S. OMB, 2003; updated 2009). The same discount rates are used for both benefits and costs in the BCA. Costs at a 7 percent discount rate are presented in Appendix A.

dischargers. These burdens are incurred in accordance with dischargers' compliance schedule, as described above.

After creating a compliance schedule for technology implementation, EPA summed the costs each discharger is expected to incur in each year and aggregated these costs to estimate the total social costs for each year of the analysis. Specifically, EPA assumed that capital costs for technology equipment, installation, and other upfront, non-annually recurring expenditures associated with compliance with the regulatory options are incurred in the compliance year for each facility. Annual fixed and variable O&M (e.g., operating labor, maintenance labor and materials, electricity required to operate treatment technologies) are incurred each year beginning the year the technology is installed.

EPA then calculated the present value of these costs as of the anticipated rule promulgation year by discounting the cost in each year back to 2025 using a 3 percent discount rate, assuming that costs accrue at the end of each year in the analysis period. EPA also calculated the annualized value, using a 3 percent discount rate over a 40-year period.

3.2 Key Findings for Regulatory Options

Table 3-1 presents annualized incremental costs for each regulatory option, discounted at 3 percent, relative to the baseline. These costs represent the basis of the social cost analysis described above. EPA is considering pretreatment standards with conditional limits for nutrient removal which would provide flexibility for POTWs to waive nutrient limits for MPP industrial users. This could potentially result in lower cost to MPP facilities, however EPA cannot predict who would use this flexibility, and therefore cannot estimate those cost savings. EPA is requesting comment on conditional limits for MPP indirect dischargers. Specifically, EPA is requesting data that may help analyze these impacts in the future as well as the incremental impacts on cost savings and benefits.

Table 3-1: Estimated Total Social Costs by Regulatory Option and Discharge Type, 3 percent discount rate (in millions, 2022$, at 2025)

Regulatory Option	Direct	Indirect	Total
Option 1	$216.5	$15.3	$231.9
Option 2	$216.5	$426.3	$642.8
Option 3	$223.7	$853.6	$1,077.3
Option 1 with chlorides	$279.6	$109.9	$389.6
Option 2 with chlorides	$279.6	$520.9	$800.5
Option 3 with chlorides	$286.8	$948.2	$1,235.0

Source: U.S. EPA Analysis, 2023.

Table 3-2 provides a more detailed breakdown of the social cost calculations. The table presents, for each regulatory option, the assumed time profiles of technology implementation costs incurred relative to the baseline. The annualized costs, discounted 3 percent, can be found at the bottom of the table. Costs are highest in 2049 and 2028, when indirect facilities are assumed to incur capital costs. Control Authorities and the Agency also incur 60 percent of annual costs for direct dischargers and 100 percent of annual costs for indirect dischargers in 2049.

Table 3-2: Time Profile of Costs to Society (in millions, 2022$)						
Year	**Option 1**	**Option 2**	**Option 3**	**Option 1 with chlorides**	**Option 2 with chlorides**	**Option 3 with chlorides**
2025	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
2026	$191.9	$191.9	$198.1	$251.1	$251.1	$257.3
2027	$229.7	$229.7	$237.2	$300.2	$300.2	$307.7
2028	$353.1	$2,403.8	$4,942.3	$880.4	$2,931.1	$5,469.5
2029	$321.7	$682.8	$1,043.3	$499.6	$860.7	$1,221.2
2030	$361.3	$722.4	$1,084.2	$550.4	$911.5	$1,273.4
2031	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2032	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2033	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2034	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2035	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2036	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2037	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2038	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2039	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2040	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2041	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2042	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2043	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2044	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2045	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2046	$316.1	$677.2	$1,037.6	$490.9	$852.0	$1,212.3
2047	$316.1	$677.2	$1,037.6	$490.9	$852.0	$1,212.3
2048	$316.1	$677.2	$1,037.6	$490.9	$852.0	$1,212.3
2049	$365.6	$1,909.4	$3,795.0	$792.8	$2,336.6	$4,222.2
2050	$316.1	$677.2	$1,037.6	$490.9	$852.0	$1,212.3
2051	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2052	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2053	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2054	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2055	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2056	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2057	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2058	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2059	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2060	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2061	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2062	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2063	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2064	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2065	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
PV, 3%	**$5,359.4**	**$14,858.2**	**$24,900.8**	**$9,004.5**	**$18,503.3**	**$28,545.9**
Annualized costs, 3%	**$231.9**	**$642.8**	**$1,077.3**	**$389.6**	**$800.5**	**$1,235.0**

Source: U.S. EPA Analysis, 2023.

3.3 Key Uncertainties and Limitations

Despite EPA's use of best available data, including information provided to EPA in the MPP survey, this analysis has uncertainties:

- The MPP survey did not have a 100 percent response rate. In the absence of accurate data for a given facility, EPA made assumptions about facility production which affect the applicability of each regulatory option based on the production thresholds presented in Table 1-1, as well as the estimated quantity of wastewater produced and thus treatment costs for meeting the limits under applicable regulatory options. To the extent that actual production at facilities differs from EPA's estimated production, the number of affected facilities and total costs of the proposed regulatory options may be over- or understated.

- EPA assumed that 70 percent of capital costs are for technology components that have a useful life of 20 years, and 30 percent of capital costs are for technology components that have a useful life of 40 years. This is an assumption based on averaging over compliance technologies, technology components, and facilities, and may not reflect the exact equipment installed at each facility.

4 Cost and Economic Impact Screening Analyses

4.1 Analysis Overview

EPA assessed the costs and economic impacts of the regulatory options using a screening-level assessment reflecting current operating characteristics of MPP facilities and with assignment of estimated compliance costs to those facilities. This screening-level assessment, which is documented in this chapter, includes two specific analyses:

- A cost-to-revenue (CTR) screening analysis to assess the impact of compliance outlays on individual MPP facilities (Section 4.3)
- A CTR screening analysis to assess the impact of compliance outlays on domestic parent-entities owning MPP facilities (Section 4.4)

4.2 Total After-Tax Private Costs

After-tax costs are a more appropriate measure of compliance impact on privately owned for-profit facilities than pre-tax costs. Thus, EPA uses after-tax compliance costs for the impact screening analyses presented in this chapter, as well as all impact analyses following this chapter. EPA calculated the after-tax compliance costs by applying combined federal and state tax rates to the pre-tax cost values. For this adjustment, EPA used state corporate tax rates for 2023 (Tax Foundation, 2023) combined with a 21 percent federal corporate tax rate from the Department of the Treasury, Internal Revenue Service (U.S. Department of the Treasury Internal Revenue Service, 2023). For this analysis, EPA used a discount rate of 7.6 percent, equal to the industry's estimated private cost of capital.[6]

Table 4-1 presents total annualized after-tax compliance costs by regulatory option and discharge type.[8]

Table 4-1: Estimated Total Annualized After-Tax Compliance Costs (in millions, 2022$)

Regulatory Option	Direct	Indirect	Total
Option 1	$196.4	$13.9	$210.3
Option 2	$196.4	$394.0	$590.4
Option 3	$202.6	$793.0	$995.6
Option 1 with chlorides	$253.6	$100.5	$354.1
Option 2 with chlorides	$253.6	$480.6	$734.2
Option 3 with chlorides	$259.8	$879.6	$1,139.4

Source: U.S. EPA Analysis, 2023.

4.3 Cost-to-Revenue Analysis: Facility-Level Screening Analysis

The CTR measure compares the cost of implementing and operating compliance technologies with the facility's operating revenue to provide a screening-level assessment of the impact of the regulatory options. In assessing the cost impact of the regulatory options on MPP facilities in this screening-level analysis, the Agency assumed that the facilities would not be able to pass compliance costs either downstream to meat and poultry product consumers in the form of increased prices for end-products or

[8] Total costs include a one-time burden of 8 hours per facility for MPP dischargers to read and understand the rule. EPA did not include these costs in its assessment of impacts (Sections 4.3-4.4, Chapters 5-9) as this burden is *de minimis* and is not expected to affect the results.

upstream to farmers in the form of reduced prices for inputs. This is a worst-case scenario of regulatory impacts to MPP facilities.

4.3.1 Analysis Approach and Data Inputs

EPA divided annualized after-tax compliance costs by revenue at the facility level.[9] As described below, EPA used a combination of MPP survey data, facility-level revenue estimates, and Dun & Bradstreet (D&B) Hoover's revenue estimates. EPA assesses facilities incurring costs below one percent of revenue as unlikely to face material economic impacts, facilities with costs of at least one percent but less than three percent of revenue as having a higher chance of facing material economic impacts, and facilities incurring costs of at least three percent of revenue as having a still higher probability of material economic impacts.

4.3.1.1 MPP Survey Revenue

For facilities that responded to the MPP detailed questionnaire and provided financial data that EPA deemed reliable, EPA used reported 2021 facility revenue, adjusted to 2022 dollars using the GDP deflator (U.S. Bureau of Economic Analysis, 2023), for the facility CTR analysis. EPA reviewed financial responses to the MPP detailed questionnaire to assess the validity of the information provided by comparing responses across years, across facilities owned by the same parent company, to firm-level values, or to reported production. Where possible, EPA cleaned and manually adjusted data that had apparent issues, such as values reported in the wrong units. In some cases, EPA was able to identify values that were misreported (e.g., several facilities owned by the same parent company reported the same facility-level revenue) but was unable to make appropriate corrections; EPA did not use these data. In these cases, EPA relied on Hoover's or estimated revenue.

4.3.1.2 Dun & Bradstreet Hoovers Revenue Data

EPA also collected revenue data from D&B Hoovers dataset for facilities under the 4-digit NAICs code: 3116 (animal slaughtering and processing). EPA conducted a matching process programmatically in R to match records in the D&B Hoovers data ("Hoovers facilities") to MPP facilities using an approximate string matching method based on the Jaro-Winkler (JW) string metric (NIST, 2022). To complete this matching process, EPA relied on information about MPP facilities, as well as information reported in Hoovers records, on the address, city, state, county, and zip code of facilities. If this process returned no results, EPA also matched based on facility name, limiting matches to those in the same city and state.

Where possible, the Agency also identified the parent company of MPP facilities by identifying instances where a parent company name was present in the MPP facility name.[10] EPA conducted this process using a list of parent companies based on the top 100 meat and poultry processors in the United States by net sales in 2021 from the National Provisioner (The National Provisioner, n.d.) and the 100 Hoovers parent companies with the most company locations listed in the Hoover's dataset. Moreover, EPA conducted

[9] For private, tax-paying entities, *after-tax costs* are a more relevant measure of potential private cost burden than *pre-tax costs*.

[10] In most instances, EPA shortened the parent company name to the first one or two words in the name to facilitate more accurate matching.

this same process using brand names[11] from the top 15 firms with the most facilities in the MPP facility list.

After completing the full matching process, EPA conducted a manual review of all matches and kept only those matches determined to be correct.

4.3.1.3 Revenue Estimation Approach

If a facility did not report revenue in the MPP detailed questionnaire, and EPA was unable to identify a reliable Hoovers revenue estimate, EPA estimated facility-level revenue based on production and estimated unit sales ($/lb). EPA first calculated average unit sales by process type by dividing reported MPP sales by production for facilities that responded to the MPP detailed questionnaire, limited to those facilities that EPA deemed to have valid survey revenue and production.

EPA then multiplied these unit sale prices by the reported or estimated production,[12] based on the facility's process type. If a facility reported more than one process type, EPA multiplied the value of production for those process types by their respective average unit sale prices. EPA calculated the estimated revenue by facility as the sum of the total sales by process type at that facility.

4.3.2 Key Findings for Regulatory Options

Table 4-2 presents the facility CTR analysis results for each of the regulatory options. Under all regulatory options analyzed, most facilities would not experience compliance costs exceeding one or three percent of revenue. However, additional facilities would experience costs greater than one percent of revenue (and less than three percent of revenue) with regulatory Options 3 and 2 compared to Option 1 (with and without chloride costs).

Table 4-2: Facility-Level After-Tax Compliance Cost-to-Revenue Analysis Results by Discharge Type and Regulatory Option

Discharge Type	Total Number of Dischargers	Total Number of Facilities with Costs	Number of Facilities with a Ratio of				Percent of All Dischargers with a Ratio of			
			0%[a]	<1%	≥1 and <3%	≥3%	0%[a]	<1%	≥1 and <3%	≥3%
Option 1										
Direct	171	126	45	120	5	1	26%	70%	3%	0.6%
Indirect	3,708	719	2,989	718	0	1	81%	19%	0%	0.03%
Total	**3,879**	**845**	**3,034**	**838**	**5**	**2**	**78%**	**22%**	**0.1%**	**0.1%**
Option 2										
Direct	171	126	45	120	5	1	26%	70%	3%	0.6%
Indirect	3,708	719	2,989	708	7	4	81%	19%	0.2%	0.1%
Total	**3,879**	**845**	**3,034**	**828**	**12**	**5**	**78%**	**21%**	**0.3%**	**0.1%**

[11] EPA identified brand names by researching company websites and the USDA Meat, Poultry, and Egg Product Inspection Directory (https://www.fsis.usda.gov/inspection/establishments/meat-poultry-and-egg-product-inspection-directory).

[12] See the TDD for more information on EPA's methodology for estimating production in cases where reported production was unavailable or deemed inaccurate (U.S. Environmental Protection Agency, 2023c).

Table 4-2: Facility-Level After-Tax Compliance Cost-to-Revenue Analysis Results by Discharge Type and Regulatory Option

Discharge Type	Total Number of Dischargers	Total Number of Facilities with Costs	Number of Facilities with a Ratio of				Percent of All Dischargers with a Ratio of			
			0%[a]	<1%	≥1 and <3%	≥3%	0%[a]	<1%	≥1 and <3%	≥3%
Option 3										
Direct	171	135	36	128	4	3	21%	75%	2%	2%
Indirect	3,708	1,485	2,223	1,448	27	10	60%	39%	0.7%	0.3%
Total	**3,879**	**1,620**	**2,259**	**1,576**	**31**	**13**	**58%**	**41%**	**0.8%**	**0.3%**
Option 1 with chlorides										
Direct	171	129	42	120	6	3	25%	70%	4%	2%
Indirect	3,708	817	2,891	811	0	6	78%	22%	0%	0.2%
Total	**3,879**	**946**	**2,933**	**931**	**6**	**9**	**76%**	**24%**	**0.2%**	**0.2%**
Option 2 with chlorides										
Direct	171	129	42	120	6	3	25%	70%	4%	2%
Indirect	3,708	817	2,891	801	9	7	78%	22%	0.2%	0.2%
Total	**3,879**	**946**	**2,933**	**921**	**15**	**10**	**76%**	**24%**	**0.4%**	**0.3%**
Option 3 with chlorides										
Direct	171	136	35	126	6	4	20%	74%	4%	2%
Indirect	3,708	1,485	2,223	1,445	30	10	60%	39%	0.8%	0.3%
Total	**3,879**	1,**621**	**2,258**	**1,571**	**36**	**14**	**58%**	**41%**	**0.9%**	**0.4%**

a. These facilities already meet discharge requirements for the wastestreams controlled by a given regulatory option and therefore are not estimated to incur compliance costs.

Source: U.S. EPA analysis, 2023.

4.3.3 Uncertainties and Limitations

Despite EPA's use of the best available information and data, this analysis of facility-level impacts has uncertainties and limitations, including:

- EPA lacked revenue data for many facilities. Of the 3,879 MPP dischargers, 173 facilities reported revenue that EPA determined to be valid. EPA used estimated Hoover's revenue for an additional 626 facilities. EPA estimated revenue for the remaining 3,080 facilities. In addition, EPA relied on revenue from different data years – reported and estimated revenue reflect 2021 production and prices; D&B Hoovers revenue are from 2020. To the extent that temporary shocks to prices and production in 2020 resulting from the COVID-19 pandemic (Whitehead et al., 2022) affected 2020 revenue, as compared to 2021, comparing compliance costs based on 2021 production to 2020 revenue may over- or underestimate the impact of the regulatory options.

- As noted above, the zero-cost pass-through assumption represents a worst-case scenario from the perspective of the facility owner. To the extent that companies can pass some compliance costs on to consumers or farmers, this analysis overstates the potential impact of the regulatory options on MPP facilities.

- EPA utilized a 40-year analysis period, with MPP facilities incurring full capital costs in year one and 70 percent of capital costs in year 21. EPA reviewed technology components to calculate 70 percent, which is an average of the portion of capital that would need to be replaced after 20 years. In practice, facilities may have to replace more or less than this average, which may lead them to incur compliance costs that differ from EPA's estimates.

- MPP facilities may be able to offset the costs of compliance by offsetting other operating costs or generating additional revenue through the use or sale of treatment byproducts. This could include (1) the capture and use or sale of methane produced from the breakdown of organic matter in an anerobic lagoon or biological treatment system; (2) the sale of industrial sludge to farms for beneficial reuse as fertilizer or soil amendments; or (3) the additional rendering of oil and grease (O&G) removed by the dissolved air flotation (DAF) technology. The third would generate additional revenue for facilities with on-site rendering capacity while also reducing solids disposal costs. EPA is considering quantifying and monetizing these three categories of cost offsets for the final rule and requests comment on each.

4.4 Cost-to-Revenue Screening Analysis: Parent Entity-Level Analysis

EPA also assessed the economic impact of the regulatory options at the parent entity level. The CTR screening analysis at the entity level adds particular insight on the impact of compliance requirements on those entities that own multiple facilities. EPA conducted this screening analysis at the *highest* level of *domestic* ownership, referred to as the "domestic parent entity." The entity-level analysis maintains the worst-case analytical assumption of no pass-through of compliance costs, either downstream to meat and poultry product consumers in the form of increased prices for end-products or upstream to farmers in the form of reduced prices for inputs, used for the facility-level cost-to-revenue analysis in Section 4.3.

4.4.1 Analysis Approach and Data Inputs

To assess the entity-level economic/financial impact of compliance requirements, EPA summed facility-level annualized after-tax compliance costs calculated in Section 4.2 to the level of the MPP facility owning entity and compared these costs to parent entity revenue.

Similar to the facility-level analysis, EPA used cost-to-revenue ratios of one and three percent as markers of potential impact for this analysis. Also similar to the assumptions made for the facility-level analysis, for this entity-level analysis the Agency assumed that entities incurring costs below one percent of revenue are unlikely to face significant economic impacts, while entities with costs of at least one percent but less than three percent of revenue have a higher chance of facing significant economic impacts, and entities incurring costs of at least three percent of revenue have a still higher probability of significant economic impacts.

This entity-level cost-to-revenue analysis involved the following steps to obtain inputs needed to calculate the CTR: (1) determining the parent entity; (2) determining the parent entity revenue; (3) estimating compliance costs at the level of the parent entity. The sections below describe these steps.

Determining the Parent Entity

EPA identified parent entities and facilities owned by each parent entity using a combination of the census and detailed questionnaires, supplemental information provided by firms, D&B Hoovers data (as

described in Section 4.3.1.2), and manual review. EPA primarily identified parent entities based on responses to Question 2 in the census and detailed questionnaires, which asked respondents to indicate if a facility has a parent company and provide parent company information where relevant. To account for differences in reported parent entity names (e.g., "corp." versus "corporation"), EPA standardized parent names by removing punctuation and words like "company," "incorporated," "corporation," "inc," and "llc." EPA supplemented responses to this question with data from D&B Hoover's to ensure reported parent entity names are accurate and consistent across multiple facilities. EPA also conducted a manual review of MPP facilities, searching corporate websites, annual reports, U.S. Securities and Exchange Commission (SEC) filings, and conducting other general internet searches to improve identification of facilities' parent entities.

Determining Parent Entity Revenue

For each parent entity identified in the preceding step, EPA determined revenue values based on information reported in the detailed questionnaire, the D&B Hoovers database, and from corporate or financial websites, if those values were available. If parent entity revenue was unavailable from these sources, EPA estimated revenue as the sum of facility revenue across all facilities owned by that parent entity. EPA adjusted entity revenue values to 2022 dollars using the GDP deflator (U.S. Bureau of Economic Analysis, 2023).

Estimating Compliance Costs at the Level of the Parent Entity

EPA identified each MPP facility's parent entity, and in cases where no parent entity was identified, EPA assumed the facility is a single-facility entity. EPA summed facility-level compliance costs for each facility owned by a parent entity under each regulatory option to calculate parent entity level compliance costs.

4.4.2 Key Findings for Regulatory Options

Table 4-3 presents the results from the entity-level impact for each regulatory option. The table shows the number of entities that incur costs in four ranges: no cost, non-zero costs less than one percent of an entity's revenue, at least one percent but less than three percent of revenue, and at least three percent of revenue.

Overall, this screening-level analysis shows that under regulatory options 1 and 2, with and without chlorides, most entities are likely to incur zero costs and almost all are likely to incur costs less than one percent of revenue. Under Option 3 and Option 3 with chlorides, fewer entities are likely to incur zero costs and more entities are likely to incur costs greater than three percent of revenue.

Table 4-3: Entity-Level Cost-to-Revenue Analysis Results

Regulatory Option	Total Number of Entities	Number of Entities with a Ratio of				Percent of Entities with a Ratio of [b]			
		0%[a]	>0 and <1%	≥1 and <3%	≥3%	0%[a]	>0 and <1%	≥1 and <3%	≥3%
Option 1	3,114	2,717	394	3	0	87%	13%	0.1%	0.0%
Option 2	3,114	2,717	393	3	1	87%	13%	0.1%	0.0%
Option 3	3,114	2,118	978	14	4	68%	31%	0%	0%
Option 1 with chlorides	3,114	2,659	451	3	1	85%	14%	0.1%	0.0%

Table 4-3: Entity-Level Cost-to-Revenue Analysis Results

Regulatory Option	Total Number of Entities	Number of Entities with a Ratio of				Percent of Entities with a Ratio of [b]			
		0%[a]	>0 and <1%	≥1 and <3%	≥3%	0%[a]	>0 and <1%	≥1 and <3%	≥3%
Option 2 with chlorides	3,114	2,659	451	3	1	85%	14%	0.1%	0.0%
Option 3 with chlorides	3,114	2,118	978	14	4	68%	31%	0%	0%

a. These entities own only facilities that already meet discharge requirements for the wastestreams addressed by a given regulatory option and are therefore not estimated to incur any compliance technology costs.

b. Percentages may not add up to 100 percent due to rounding.

Source: U.S. EPA Analysis, 2023.

4.4.3 Uncertainties and Limitations

Despite EPA's use of the best available information and data, this analysis of entity-level impacts has uncertainties and limitations, including:

- EPA assumed that many facilities are single-facility entities when unable to find ownership information. As a result, EPA may be overestimating the number of entities in the MPP industry and potentially underestimating impacts to entities that own multiple facilities.
- EPA obtained revenue information from the census and detailed questionnaire responses, D&B Hoover's data, and estimates derived from production data. EPA reconciled variation in revenue information from each data source, but actual revenue may still differ.
- Revenue data reported in the questionnaires and estimated based on production are for 2021 and D&B Hoovers revenue data are for the year 2020. To the extent that actual 2024 entity revenue values are different, on a constant dollar basis, from those EPA utilized, the CTR measure for parent entities of facilities may be over- or underestimated.
- As is the case with the facility-level analysis discussed in Section 4.3, the zero-cost passthrough assumption represents a worst-case scenario from the perspective of the facility owner. To the extent that companies can pass some compliance costs downstream to consumers or upstream to farmers, this analysis may overstate the potential impact of the baseline and regulatory options on entities owning MPP facilities.

5 Facility Closure Analysis

5.1 Analysis Overview

EPA assessed the potential for MPP facilities to close as a result of compliance with proposed revisions to the MPP ELGs based on a discounted cash flow (DCF) under baseline and post-compliance conditions for each of the regulatory options. This analysis tests the effects of the costs of compliance on the financial performance and business value of the regulated facilities, based on changes in cash flow (and accounting for ongoing capital outlays, depreciation, and taxes). The discounted present value of cash flow provides a measure of business value. Reduction in business value, specifically when business value would become negative because of incremental compliance costs, is an indicator of potential adverse financial impact of the proposed rule's requirements. EPA performed this analysis in two steps:

- A baseline analysis to assess business condition and value before changes in regulatory requirements. The key purpose of this analysis is to identify entities that appear to have negative business value independent of increased regulatory costs.

- A post-compliance analysis to assess change in business value due to regulatory requirements. This analysis assesses the reduction in business value from compliance costs, focusing on whether some entities' business value is positive in the baseline but turns negative due to compliance requirements.

EPA performed this analysis for facilities that reported financial data in the MPP detailed questionnaire. EPA then extrapolated the results of this DCF analysis to the full universe of affected MPP facilities.

5.2 Analysis Inputs

5.2.1 Depreciation

EPA used the Modified Accelerated Cost Recovery System (MACRS) depreciation method. The Internal Revenue Service (IRS) bases the depreciable life of an asset on the useful life. The IRS classifies property with a 20-year useful life as 15-year property, and property with a 40-year useful life as 20-year property. Using the half-year convention, we depreciate capital equipment based on the depreciation schedule shown in Table 5-1, assuming 20-year capital is repurchased in year 21.

Table 5-1: Depreciation Schedule over Analysis Period

Year	Depreciation rate		Year	Depreciation rate	
	20-year capital	40-year capital		20-year capital	40-year capital
1	5.00%	3.75%	21	5.00%	2.23%
2	9.50%	7.22%	22	9.50%	0.00%
3	8.55%	6.67%	23	8.55%	0.00%
4	7.70%	6.18%	24	7.70%	0.00%
5	6.93%	5.71%	25	6.93%	0.00%
6	6.23%	5.28%	26	6.23%	0.00%
7	5.90%	4.89%	27	5.90%	0.00%
8	5.90%	4.52%	28	5.90%	0.00%
9	5.91%	4.46%	29	5.91%	0.00%

Table 5-1: Depreciation Schedule over Analysis Period

Year	Depreciation rate		Year	Depreciation rate	
	20-year capital	40-year capital		20-year capital	40-year capital
10	5.90%	4.46%	30	5.90%	0.00%
11	5.91%	4.46%	31	5.91%	0.00%
12	5.90%	4.46%	32	5.90%	0.00%
13	5.91%	4.46%	33	5.91%	0.00%
14	5.90%	4.46%	34	5.90%	0.00%
15	5.91%	4.46%	35	5.91%	0.00%
16	2.95%	4.46%	36	2.95%	0.00%
17	0.00%	4.46%	37	0.00%	0.00%
18	0.00%	4.46%	38	0.00%	0.00%
19	0.00%	4.46%	39	0.00%	0.00%
20	0.00%	4.46%	40	0.00%	0.00%

Rates for 20-year capital based on half-year convention for 15--year property. Rates for 40-year capital based on half-year convention for 20-year property.
Source: U.S. Department of the Treasury Internal Revenue Service, 2022

5.2.2 Combined Tax Rate

To calculate the reduction in income taxes (i.e., tax shield) resulting from a reduction in taxable income (due to increased capital, O&M, and interest expenses), EPA calculated the combined federal and state income tax rate (τ_c) based on the facility's location and its parent company's corporate structure:

$$\tau_c = \tau_f + \tau_s - (\tau_f \tau_s)$$

where τ_f is the federal tax rate and τ_s is the state tax rate.[13] C corporations pay federal and state taxes at the corporate level. S corporations and LLCs distribute earnings to partners, and these individuals pay the taxes. For the purposes of this analysis, EPA assumed a tax rate of zero for S corporations and LLCs. EPA assumed all other entities (limited partnerships, general partnerships, and sole proprietors) pay taxes at the individual rate.

5.2.3 Weighted Average Cost of Capital (WACC)

EPA used the weighted average cost of capital (WACC), or the average cost of capital the firm must pay to all its investors, both debt and equity holders, as the discount rate in the facility closure analysis. The WACC is calculated as:

$$WACC = Debt\% * DebtCost\% * (1 - \tau_c) + Equity\% * EquityCost\%$$

where $Debt\%$ and $Equity\%$ is the approximate mix of debt and equity the ultimate parent company, or the facility if it does not have an ultimate parent company, uses to finance capital improvements; $DebtCost\%$ is the interest rate on loans to finance capital improvements; and $EquityCost\%$ is the minimum rate of return on capital required to compensate equity owners for bearing risk. EPA obtained

[13] If a state does not have a flat income tax rate, for corporations or individuals, EPA uses the tax rate for the highest income bracket.

these four values from the MPP detailed questionnaire. If a respondent indicated these values are unknown, EPA used the median reported value across all detailed questionnaire responses.

5.3 Baseline Discounted Cash Flow

EPA calculated baseline present value of DCF as the present value over 40 years of free cash flow (FCF), defined as:

$$FCF = Net\ income + depreciation = EBIT - interest - taxes + depreciation$$

EPA added depreciation back to net income to account for the fact that it is a non-cash flow. This calculation is based on facility-level financial information provided in the detailed questionnaire for 2017, 2019, and 2021. After converting to 2022 dollars, EPA averaged across the three reported years and assumed this average value remains constant over the period of analysis. EPA then took the present value of the 40-year stream of FCF, with a discount rate equal to the WACC, to calculate the baseline present value of DCF (DCF_{BL}):

$$DCF_{BL} = \sum_{i=1}^{40} \frac{FCF_i}{(1 + WACC)^{i-1}}$$

EPA identified facilities with $DCF_{BL} < 0$ as baseline closures.

5.4 After-Tax Compliance Costs

5.4.1 Tax Shield

The depreciation rate represents the portion of capital equipment costs that can be written off each year to offset annual income for tax purposes. Depreciation, along with O&M and interest expenses, represent the reduction in taxable income in each year. To calculate the resulting reduction in income taxes (i.e., tax shield) paid, EPA calculated:

- **O&M tax shield** as the product of annual O&M expenses and the facility's combined tax rate. The tax shield in year *i* is therefore:

$$TaxShield_{OM,i} = OM_i * \tau_c$$

- **Interest tax shield** as the product of interest paid on the portion of capital costs financed through debt and the facility's combined tax rate. To estimate interest paid each year of the analysis period, EPA multiplied the compliance capital outlay by the fraction financed through debt ($Debt\%$) and assumed equal payments in all years, equal to the annualized value of the debt portion of the capital outlay ($Cap_{debt,annlzd}$), using a discount rate equal to $DebtCost\%$.[14] The interest portion of the annual payment is based on the outstanding debt and $DebtCost\%$. For example, EPA calculated the interest and principal paid in year 1 as:

[14] For simplification, EPA assumed a debt financing period equal to the useful life of the compliance technology (20 years or 40 years). EPA assumed the debt portion of the facility's compliance capital outlay, Cap_{debt}, would be financed over a period not exceeding the expected life of the compliance equipment.

$$Interest_1 = DebtCost\% * Cap * Debt\%$$

$$Principal_1 = Cap_{debt,annlzd} - Interest_1$$

The interest paid in year 2 is then based on the outstanding debt (initial debt less principal paid in year 1). Interest and principal payments in year 2 are therefore:

$$Interest_2 = \left((DebtCost\% * Cap * Debt\%) - Principal_1\right) * DebtCost\%$$

$$Principal_2 = Cap_{debt,annlzd} - Interest_2$$

The tax shield in year *i* is:

$$TaxShield_{int,i} = Interest_i * \tau_c$$

- **Depreciation tax shield** as the product of the depreciation rate (see Table 5-1), the total capital outlay, and the facility's combined tax rate. The tax shield in year *i* is:

$$TaxShield_{depr,i} = DeprRate_i * Cap * \tau_c$$

The potential tax shield is the sum of the tax shields from O&M, interest, and depreciation expenses:

$$TaxShield_i = TaxShield_{OM,i} + TaxShield_{int,i} + TaxShield_{depr,i}$$

5.4.2 After-Tax Compliance Costs

EPA calculated the after-tax compliance cost (*CmplC*) in year *i* as:

$$CmplC_i = OM_i + Cap_{equity,i} + Cap_{debt,annlzd} - TaxShield_i$$

where OM_i is equal to the annual O&M costs, $Cap_{equity,i}$ is the equity portion of capital outlay, $Cap_{debt,annlzd}$ is the annualized value of the debt portion of capital outlay, and $TaxShield_i$ is the minimum of the calculated tax shield (as described in Section 5.4.1) and the average taxes paid in 2017, 2019, and 2021.[15]

5.5 Post-Compliance Discounted Cash Flow

EPA predicted a potential facility closure resulting from compliance with the revised MPP ELGs (post-compliance closures) when the following two conditions were met:

$$(1)\ DCF_{BL} \geq 0$$

$$(2)\ DCF_{BL} - CmplC_{PV} < 0$$

The first condition is that the facility had a non-negative baseline discounted cash flow without the proposed rule and therefore was financially viable. The second condition is that the facility has a negative discounted cash flow with the proposed rule and is therefore no longer financially viable as a result of the proposed rule.

[15] Facilities cannot reduce their tax liabilities more than the baseline amount of taxes paid.

5.6 Extrapolation to Full Universe

EPA developed an approach to extrapolate the facility closure analysis, which was possible only for the subset of facilities with sufficient financial data, to the full universe of MPP facilities. The extrapolation approach relies on the relationship between facility CTR and assessed closures. EPA first developed a dataset based on facilities with detailed financial information: for each relevant technology combination (*e.g.*, for a direct discharger, the relevant technology combinations are Direct 1, Direct 2, Direct 1 with chlorides, and Direct 2 with chlorides), EPA calculated post-compliance DCF and facility CTR. Based on these results and the production characteristics of each facility, EPA calculated the percentage of facility closures by production size category, discharge type, processing type, and facility CTR (see Table 5-2; for example, meat first direct dischargers with production less than 20 million pounds per year were assessed as closures in 100 percent of instances when CTR was between 3 and 5 percent). Where data were unavailable, EPA made assumptions about the percentage of facilities that may close based on the results of the DCF analysis for similar production size, discharge type, processing type, and CTR categories (see indicated values in Table 5-2).

Table 5-2: Estimated Percent Closures by Production Size, Discharge Type, Processing Type, and CTR

Production size (lbs/yr)	Discharge type	Processing type	CTR <1%	CTR 1%-3%	CTR 3%-5%	CTR 5%-10%	CTR ≥10%
< 20 M	Direct	Meat first	0%[a]	0%[a]	100%	100%[a]	100%[a]
< 20 M	Direct	Meat further	0%	0%	0%	50%[a]	100%
< 20 M	Direct	Poultry first	0%	0%	50%[a]	75%[a]	100%[a]
< 20 M	Direct	Poultry further	0%[a]	0%	50%[a]	75%[a]	100%[a]
< 20 M	Direct	Render	0%[a]	0%[a]	50%[a]	75%[a]	100%[a]
>= 20 M, < 50 M	Direct	Meat first	0%[a]	0%[a]	50%[a]	75%[a]	100%[a]
>= 20 M, < 50 M	Direct	Meat further	0%[a]	0%[a]	50%[a]	75%[a]	100%[a]
>= 20 M, < 50 M	Direct	Poultry first	0%[a]	0%[a]	50%[a]	75%[a]	100%[a]
>= 20 M, < 50 M	Direct	Poultry further	0%[a]	0%[a]	50%[a]	75%[a]	100%[a]
>= 20 M, < 50 M	Direct	Render	0%[a]	0%[a]	50%[a]	75%[a]	100%[a]
> 50 M	Direct	Meat first	0%	0%[a]	50%[a]	75%[a]	100%[a]
> 50 M	Direct	Meat further	0%[a]	0%[a]	50%[a]	75%[a]	100%[a]
> 50 M	Direct	Poultry first	0%	0%	50%[a]	75%[a]	100%[a]
> 50 M	Direct	Poultry further	0%[a]	0%[a]	50%[a]	75%[a]	100%[a]
> 50 M	Direct	Render	0%	0%	50%[a]	75%[a]	100%[a]
< 20 M	Indirect	Meat first	0%	0%	0%	0%	81%
< 20 M	Indirect	Meat further	4%	0%	67%	60%	100%
< 20 M	Indirect	Poultry first	17%	25%	0%	30%[a]	90%[a]
< 20 M	Indirect	Poultry further	0%	14%	22%	30%[a]	90%[a]
< 20 M	Indirect	Render	5%[a]	10%[a]	22%[a]	30%[a]	90%[a]
>= 20 M, < 100 M	Indirect	Meat first	0%	0%	0%	0%	100%[a]

Table 5-2: Estimated Percent Closures by Production Size, Discharge Type, Processing Type, and CTR

Production size (lbs/yr)	Discharge type	Processing type	CTR <1%	CTR 1%-3%	CTR 3%-5%	CTR 5%-10%	CTR ≥10%
>= 20 M, < 100 M	Indirect	Meat further	0%	0%[a]	0%[a]	50%[a]	100%
>= 20 M, < 100 M	Indirect	Poultry first	0%	0%	0%	50%[a]	100%[a]
>= 20 M, < 100 M	Indirect	Poultry further	0%	0%[a]	0%[a]	50%[a]	100%[a]
>= 20 M, < 100 M	Indirect	Render	0%	0%	0%[a]	50%[a]	100%[a]
> 100 M	Indirect	Meat first	17%	51%[a]	51%[a]	76%[a]	100%[a]
> 100 M	Indirect	Meat further	0%	100%	100%[a]	100%[a]	100%[a]
> 100 M	Indirect	Poultry first	3%	20%	20%[a]	60%[a]	100%
> 100 M	Indirect	Poultry further	0%	51%[a]	51%[a]	76%[a]	100%[a]
> 100 M	Indirect	Render	0%	33%	33%[a]	67%[a]	100%[a]

a. EPA assumptions.
Source: U.S. EPA Analysis, 2023.

5.7 Results

EPA multiplied the number of facilities affected by each regulatory option that fall within each of the categories presented in Table 5-2 by the percentages in Table 5-2 to estimate the total number of potential facility closures. Table 5-3 presents the results of this analysis by regulatory option.

Table 5-3: Facility Closure Extrapolation Results

	Option 1	Option 2	Option 3	Option 1 with chlorides	Option 2 with chlorides	Option 3 with chlorides
Number of estimated facility closures	16	22	53	26	30	54
Number of facilities with costs	845	845	1,620	946	946	1,621
Number of dischargers	3,879	3,879	3,879	3,879	3,879	3,879
% of facilities with costs	1.9%	2.6%	3.3%	2.7%	3.2%	3.3%
% of all dischargers	0.4%	0.6%	1.4%	0.7%	0.8%	1.4%

Source: U.S. EPA Analysis, 2023.

5.8 Uncertainties and Limitations

The main sources of uncertainty for the facility closure analysis presented in this chapter are:

- EPA received limited financial data from responses to the MPP detailed questionnaire. As a result, not all categories of process type, discharge type, and production size are represented in the DCF closure analysis, and the facilities that are included may not be representative of the financial status of the entire MPP industry. The number of facility closures may by over- or underestimated.

- EPA assumed constant values over the analysis period. EPA does not have any data to determine if, or how, specific metrics may change for individual facilities. Changes in production or prices, for example, could affect facility revenue and therefore the facility's business value.
- There are limitations in how well the DCF analysis can predict facility closures. For example, EPA identified some facilities with $DCF_{BL} < 0$ as baseline closures, despite those facilities indicating they are currently operating. In addition, EPA received incomplete financial information about some facilities and thus made assumptions about certain metrics (e.g., WACC), potentially resulting in inaccurate results.

6 Market Impact Analysis

6.1 Analysis Overview

EPA examined the effects of the proposed revisions to the MPP ELGs on the national markets for beef, pork, chicken, and turkey. To do this, EPA constructed linear supply and demand equations for each meat product market based on the pre-regulatory market price and quantity (pre-regulatory equilibrium) and estimated how equilibrium quantity and price in each market will shift due to changes to the MPP ELGs (post-regulatory equilibrium).

Section 6.2 describes the methodology used to derive the model functions as well as the pre- and post-regulatory market equilibria. Section 6.3 presents the data sources used in the analysis including trade data, baseline price and quantity data, and elasticity estimates. Section 6.4 presents the results of the pre-regulatory equilibrium calculations, the method for determining average per-unit compliance costs for each meat product market, and the resulting estimated market-level impacts of the regulatory options. Section 6.5 presents the barrier-to-entry analysis of the proposed rule, and Section 6.6 presents uncertainties and limitations to the market impact analysis.

6.2 Analysis Methodology

In this section, EPA presents the methodology used to specify the domestic and trade demand and supply functions as well as calculate the pre- and post-regulatory equilibria. This methodology is based on the methodology previously used by U.S. EPA (2002).

6.2.1 Domestic and Trade Demand and Supply Functions

Linear domestic and trade demand and supply equations are expressed as:

$$Q_i^D = \alpha_{Di} + d_{ii}P_i + \sum_{i \neq j} d_{ij}P_j$$

$$Q_i^S = \alpha_{Si} + s_{ii}P_i$$

$$Q_i^X = \alpha_{Xi} + x_iP_i$$

$$Q_i^M = \alpha_{Mi} + m_iP_i$$

where U.S. demand for meat product i (Q_i^D) is a function of the U.S. price of meat product i (P_i), and the U.S. prices of other meat products j (P_j). The U.S. supply for meat product i (Q_i^S), the rest of the world (ROW) demand for U.S. meat product i (Q_i^X), and the U.S. demand for ROW meat product i (Q_i^M) are all modeled as functions of U.S. price for meat product i (P_i) only. The parameters d_{ii}, s_{ii}, x_i, m_i represent the slopes of their respective functions. The parameters α_{Di}, α_{Si}, α_{Xi}, α_{Mi} represent the intercepts of their respective functions.

The slopes of the demand functions for each meat product represent the own-price elasticity of demand (d_{ii}, s_{ii}, x_i, m_i) for each meat product, as well as the cross-price elasticities (d_{ij}) with relation to the other three meat products in the case of domestic demand. Calculating the slope of the demand functions in this way helps account for cross-market effects that may affect the post-regulatory equilibrium of each

meat market. For instance, an increase in the price of pork due to regulatory changes could increase demand in the beef market if beef is a substitute for pork. Functions of import supply and export demand are included in the model to account for international trade. For U.S. supply, export demand, and import supply functions, the slopes were calculated using the own-price elasticity of supply and the export and import elasticities calculated by EPA (Table 6-6). These elasticities were linearized by multiplying the elasticity by baseline quantity and price values. Elasticity is described as:

$$\varepsilon_{ij} = \frac{\delta Q_i^D}{\delta P_j}\frac{P_j}{Q_i^D}$$

The slope may be described as:

$$d_{ij} = \frac{\delta Q_i^D}{\delta P_j} = \frac{Q_i^D}{P_j}\varepsilon_{ij}$$

where ε_{ij} is the elasticity of demand for meat product i with respect to the price of meat product j. P_j and Q_i^D refer to the baseline price and quantity for meat product j and i, respectively.

The slopes of U.S. supply (s_{ii}), export demand (x_i), and import supply (m_i) are similarly defined as:

$$s_{ii} = \frac{\delta Q_i^S}{\delta P_i} = \frac{Q_i^S}{P_i}\gamma_{ii}$$

$$x_i = \frac{\delta Q_i^X}{\delta P_i} = \frac{Q_i^X}{P_i}\eta_{xi}$$

$$m_i = \frac{\delta Q_i^M}{\delta P_i} = \frac{Q_i^M}{P_i}\eta_{mi}$$

where $\gamma_{ii}, \eta_{xi}, \eta_{mi}$ are elasticities with respect to U.S. price.

6.2.2 Pre-Regulatory Equilibrium

To estimate market equilibrium for each meat market, the sum of domestic demand (Q_i^D) and export demand (Q_i^X) must equal the sum of domestic supply (Q_i^S) and import supply (Q_i^M):

$$Q_i^D + Q_i^X = Q_i^S + Q_i^M$$

This can also be expressed as:

$$Q_i^D + Q_i^X - Q_i^S - Q_i^M = 0$$

or:

$$\left(\alpha_{Di} + d_{ii}P_i + \sum_{i \neq j} d_{ij}P_j\right) + (\alpha_{Xi} + x_iP_i) - (\alpha_{Si} + s_{ii}P_i) - (\alpha_{Mi} + m_iP_i) = 0$$

This expression can be simplified as:

$$(\alpha_{Di} + \alpha_{Xi} - \alpha_{Si} - \alpha_{Mi}) + (d_{ii} + x_i - s_{ii} - m_i)P_i + \sum_{i \neq j} d_{ij}P_j = 0$$

$$\pi_i + \lambda_i P_i + \sum_{i \neq j} d_{ij}P_j = 0$$

$$\lambda_i P_i + \sum_{i \neq j} d_{ij}P_j = -\pi_i$$

Because each supply and demand function in the model is specified linearly, the model components are additive. Given this, EPA simultaneously solved for the pre-regulatory equilibrium. This is expressed in the matrix form:[16]

$$\begin{bmatrix} \lambda_B & d_{BP} & d_{BC} & d_{BT} \\ d_{PB} & \lambda_P & d_{PC} & d_{PT} \\ d_{CB} & d_{CP} & \lambda_C & d_{CT} \\ d_{TB} & d_{TP} & d_{TC} & \lambda_T \end{bmatrix} \begin{bmatrix} P_B \\ P_P \\ P_C \\ P_T \end{bmatrix} = \begin{bmatrix} -\pi_B \\ -\pi_P \\ -\pi_C \\ -\pi_T \end{bmatrix}$$

This matrix is expressed in vector notation as $A \times P = \Pi$, so the Agency solved for the intercept for each excess demand equation, $-\pi_i$ using the baseline prices (matrix *P*) and the price parameters (λ_i and d_{ij}) in matrix A.

6.2.3 Post-Regulatory Equilibrium

To estimate the impacts of the regulatory options, EPA respecified the domestic supply curve to incorporate the compliance costs incurred by processors in each meat product market. The Agency expects that the compliance costs incurred by processors will decrease the domestic supply of each meat product (a shift in the supply curve). The magnitude of the decrease in supply for each meat product will be based on the average compliance costs per unit of output incurred in each meat product market (see Section 6.4.1 on how EPA derived the average per-unit compliance costs by meat product). The decrease in supply in each meat product market due to compliance costs is expressed as a decrease in the intercept of the supply function ($\alpha_{Si} - s_{ii}\delta_i$) while the slope remains the same, defined as:

$$Q_i^S = \alpha_{Si} + s_{ii}(P_i - \delta_i)$$

where δ_i represents the average per-unit compliance costs for meat product i. Based on this new supply function, the post-regulatory excess demand function can be written as:

$$\lambda_i P_i + \sum_{i \neq j} d_{ij}P_j = -s_{ii}\delta_i - \pi_i$$

This is expressed in the matrix form:

[16] Within this matrix, subscript B refers to beef, P refers to pork, C refers to chicken, and T refers to turkey.

$$\begin{bmatrix} \lambda_B & d_{BP} & d_{BC} & d_{BT} \\ d_{PB} & \lambda_P & d_{PC} & d_{PT} \\ d_{CB} & d_{CP} & \lambda_C & d_{CT} \\ d_{TB} & d_{TP} & d_{TC} & \lambda_T \end{bmatrix} \begin{bmatrix} P'_B \\ P'_P \\ P'_C \\ P'_T \end{bmatrix} = \begin{bmatrix} s_{BB}\delta_B - \pi_B \\ s_{PP}\delta_P - \pi_P \\ s_{CC}\delta_C - \pi_C \\ s_{TT}\delta_T - \pi_T \end{bmatrix}$$

In this equation, the elements of matrix A (i.e., λ_i, d_{ij}) and the elements of the new vector Π* (i.e., s_{ii}, δ_i, π_i) are known. Matrix P can be solved for by multiplying the inverse of matrix A by the vector Π* to estimate the post-regulatory equilibrium prices for each meat product (i.e., $P_i' = A^{-1}\Pi^*$). The new equilibrium prices ($P_i{}'$) can then be substituted into each model equation to estimate post-regulatory U.S. demand ($Q_i^{D\prime}$), U.S. supply ($Q_i^{S\prime}$), export demand ($Q_i^{X\prime}$), and import supply ($Q_i^{M\prime}$):

$$\alpha_{Di} + d_{ii}P_i{}' + \sum_{i \neq j} d_{ij}P_j{}' = Q_i^{D\prime}$$

$$\alpha_{Si} + s_{ii}(P_i' - \delta_i) = Q_i^{S\prime}$$

$$\alpha_{Xi} + x_i P_i{}' = Q_i^{X\prime}$$

$$\alpha_{Mi} + m_i P_i{}' = Q_i^{M\prime}$$

6.3 Data

In this section, EPA presents data sources for baseline domestic quantities and price, imports, exports, and Armington trade elasticity[17] for the four meat categories of interest. EPA also presents the estimates of the elasticity of demand and elasticity of supply for each meat product used in the market impact analysis.

6.3.1 Trade Data and Baseline Quantity and Price Data

Table 6-1 presents the data sources the Agency used in the market impact analysis for the following model parameters, based on the analysis presented in U.S. EPA (2002): domestic price and quantity, U.S. imports and exports (total and as share of world production), and Armington trade elasticity. For each field, EPA also reports the data vintage. Table 6-2 presents the values of baseline price and quantities taken from the sources in Table 6-1. The value of the Armington trade elasticity used in this analysis is 4.36 (Ahmad & Riker, 2020).

Table 6-1: Data Sources by Data Requirement

Data Requirement	Data Source	Vintage
Baseline domestic quantity	USDA Livestock, Dairy, and Poultry Outlook	2022
Baseline domestic price	Wholesale prices from USDA Livestock and Meat Domestic Data	2022
U.S. import quantity	USDA Livestock and Meat International Trade Data	2022
U.S. export quantity	USDA Livestock and Meat International Trade Data	2022
Armington elasticity[a]	Ahmad and Riker (2020) - U.S. International Trade Commission working paper	2017

[17] The Armington elasticity measures the percentage change in market share of an imported good relative to a domestically produced good due to changes in the price of the domestic and imported good and is used to calculate import and export elasticities.

Table 6-1: Data Sources by Data Requirement		
Data Requirement	**Data Source**	**Vintage**
Share of U.S. exports as % of rest of world (ROW) production	UNFAO data	2021
Share of U.S. imports as % of U.S. quantity	UNFAO data	2021
a. The estimate of the Armington trade is estimated for the animal slaughtering and processing sector (NAICS code 3116). *Sources: Economic Research Service, 2023a, 2023b; Food and Agriculture Organization, 2022; Knight et al., 2023.*		

Table 6-2: Baseline Prices and Quantities by Meat Product				
		Baseline Quantities (Million Pounds)		
Meat Product	**Prices (2022$ per Million Pounds)[a]**	**Domestic Production**	**Foreign Imports**	**U.S. Exports**
Beef	$2,632,438	28,290	3,391	3,536
Pork	$1,113,816	26,994	1,344	6,338
Chicken	$1,405,267	46,206	176	7,278
Turkey	$1,496,779	5,222	85	407
a. See Table 2-5 for EPA's method for calculating baseline prices for each meat product market. *Source: Economic Research Service, 2023a, 2023b; Food and Agriculture Organization, 2022; Knight et al., 2023.*				

6.3.2 Elasticity Estimates

6.3.2.1 Elasticity of Demand Estimates

EPA reviewed the available literature to obtain estimates of own-price and cross-price elasticity of demand. Table 6-3 and Table 6-4 present the identified studies, along with the reported estimates of own-price and cross-prices elasticities. EPA used the estimates of own-price elasticity of demand from Yang et al. (2019) in the market impact analysis, as these estimates are based on more recent data. Okrent and Alston (2012) and Lee et al. (2020) also report estimates of cross-price elasticity of demand for each meat product of interest. EPA used the estimates for cross-price elasticity of demand from Lee et al. (2020). Though Okrent and Alston (2012) also report cross-price elasticity, the Agency omitted this study as the estimates from Lee et al. (2020) are based on more recent data and are reported to have a higher degree of statistical significance.

Table 6-3: Sources of Own-Price Elasticity of Demand

Source	Meat Product				Data Source[b]	Data Years
	Beef	Pork	Chicken[a]	Turkey[a]		
Okrent and Alston (2012)[c]	-0.70	-1.26	-0.81	-0.81	CES & CPI (U.S. BLS)	1998-2010
Lee et al. (2020)	-0.98	-0.98	-0.8	-0.80	CES & CPI (U.S. BLS)	1984-2012
Yang et al. (2019)[d]	-0.54	-0.69	-0.77	-0.77	CES & CPI (U.S. BLS)	2009-2016

a. Elasticity estimates for turkey and chicken are based on data for the total U.S. poultry market in each study.
b. CES = Consumer Expenditure Surveys, CPI = Consumer Price Index, U.S. BLS = U.S. Bureau of Labor Statistics.
c. This is a USDA study and is the most recent update of the estimates used in U.S. EPA (2002).
d. This study does not contain cross-price elasticity estimates for meat categories of interest.

Table 6-4: Estimates of Cross-Price Elasticities of Demand

Meat Product	Cross-Price Elasticity Estimates			
	Beef	Pork	Chicken	Turkey
Beef	-	0.11	-0.03	-0.03
Pork	0.14	-	-0.06	-0.06
Chicken	-0.04	-0.07	-	-0.80
Turkey	-0.04	-0.07	-0.80	-

Source: Lee et al. (2020)

6.3.2.2 Elasticity of Supply Estimates

EPA also reviewed available studies with estimates of long-run own-price elasticity of supply for each meat product.[18] Table 6-5 presents the range of values from the literature. Differences in elasticity estimates arise due to differences in the data years and methodologies used by the authors. To account for these differences, EPA calculated the average long-run elasticity of supply for each meat product using the elasticity estimates in Table 6-5 for use in the analysis.

Table 6-6 presents the average values of long-run elasticity of supply for each meat product. Marsh (1994) and Jeong (2019) note that their long-run elasticity of supply estimates for fed cattle are larger than previous studies. As a result, EPA excluded their estimates from the calculation of the average long-run elasticity of supply for beef in Table 6-6. Additionally, EPA assumed that the elasticities for fed cattle, wholesale fed cattle, and beef are similar. Thus, EPA included the elasticity values for these different products from Table 6-5 in the calculation of the average long-run elasticity of supply for beef.

[18] Long-run elasticity of supply is estimated to examine the impact that changes in price might have on long-run investment decisions (e.g., plant closure). Short-run elasticity of supply estimates are used to look at how capital expenditures may change in the short-run due to temporary shocks. EPA used long-run estimates of the elasticity of supply for each meat category to account for the long-run impacts the proposed changes to the MPP ELGs might have on firm-level investment decisions.

Table 6-5: Sources of Long-Run Own-Price Elasticity of Supply

Source	Meat Category	Product	Elasticity Estimate	Data Sources[a,b]	Data Years
McKendree et al. (2020)	Beef	Fed cattle	0.24	LMIC, NOAA, USDA, Author calculations, University of Michigan, U.S. BLS, Meat and Livestock Australia	1996 (Q1) - 2016 (Q3)
Jeong (2019)		Fed cattle	4.13	USDA, LMIC, FRED	1999-2018
Sarmiento et al. (2000)		Fed cattle	0.33	USDA	1978-1991
Marsh (1994)		Fed cattle	3.24	LMIC, USDA, SBC (U.S. BEA)	1978 - 1991
Marsh (1994) (Tvedt, et. al., 1991)		Beef	0.993	-	1960 - 1987
Marsh (1994) (Bedinger and Bobst, 1988)		Wholesale fed cattle	0.2	-	1965 - 1983
Holt et al. (1988)	Pork	Pork	0.628	-	1967 - 1985
Meilke et al. (1974)		Pork	0.43	-	-
			0.48	-	-
Epple et al. (2006)	Chicken	Broiler	0.6	USDA, U.S. BLS, U.S. BEA	1960-1999
Holt et al. (1990)		Broiler	0.39	FIML estimator	1969 - 1986
			0.587		
Chavas (1982)	Turkey	Turkey	0.222	-	-
Chavas et al. (1982)		Turkey	0.21	USDA	1965 - 1975
A. Soliman (1971)		Turkey	0.518	-	1946 - 1966

a. FIML = Full Information Maximum Likelihood, FRED = Federal Reserve Economic Data, LMIC = Livestock Marketing Information Center; NOAA = National Oceanic and Atmospheric Administration, SBC = Survey of Current Businesses, U.S. BEA = U.S. Bureau of Economic Analysis. U.S. BLS = U.S. Bureau of Labor Statistics, USDA = U.S. Department of Agriculture.

b. Information on data sources and data years are unavailable for some studies.

Table 6-6: Average Long-Run Elasticity of Supply Estimates by Meat Product

Meat Product	Average of Long-Run Elasticity of Supply Estimates
Beef[a]	0.44
Pork	0.51
Chicken	0.53
Turkey	0.32

a. Excludes the long-run elasticity of supply estimate calculated by Marsh (1994) and Jeong (2019).

Source: Averages of long-run elasticity of supply estimates by meat product based on sources in Table 6-5.

6.3.2.3 Import and Export Elasticity Estimates

The elasticity of U.S. demand for imports of ROW meat product i (η_{mi}) can be expressed as a function of U.S. elasticity of demand for meat product i (ε_{ii}), the ratio of ROW and U.S. market shares (θ_U^U and θ_R^U, respectively), and the Armington elasticity (ξ^U). This function is described as:

$$\eta_{mi} = \frac{\theta_R^U}{\theta_U^U}(\xi^U + \varepsilon_{ii})$$

EPA considered only two countries in the model, the United States and the ROW, and assumed that U.S. imports as a share of the U.S. market (θ_R^U) and U.S. production (less exports) as a share of the U.S. market (θ_U^U) represent the entire U.S. market for meat product i (i.e., $\theta_U^U = 1 - \theta_R^U$). The expected sign of η_{mi} is positive. EPA expects that an increase in the U.S. price of meat product i will increase the U.S. demand for ROW meat products.

The elasticity of ROW demand for U.S. meat product i (η_{xi}) with respect to U.S. price can be expressed as a function of ROW elasticity of demand for meat product i (ε_{ii}^R), the ratio of ROW and U.S market shares (θ_U^R and θ_R^R, respectively), and the ROW's elasticity of substitution between ROW and U.S. meat products (ξ^R). This function is described as:

$$\eta_{xi} = \left(\frac{\theta_U^R}{\theta_R^R}\right)\left(\xi^R + \varepsilon_{ii}^R\right) - \xi^R$$

The expected sign of η_{xi} is negative because the own-price elasticity of demand for each meat product used in this analysis is negative. Given the limitations of available data, the model relies on several assumptions to calculate export elasticity. The model assumes that U.S. exports as a share of ROW market (θ_U^R) and ROW production (less exports) as a share of ROW market (θ_R^R) represent the entire ROW market for meat product i (i.e., $\theta_R^R = 1 - \theta_R^U$). Additionally, the model assumes that the ROW elasticity of substitution for U.S. meat products is equal to the U.S. elasticity of substitution for meat products (i.e., $\xi^R = \xi^U$). The model also assumes that the ROW elasticity of demand for meat products is equal to the U.S. elasticity of demand for meat products (i.e., $\varepsilon_{ii}^R = \varepsilon_{ii}$).[19]

Table 6-7 presents the estimates for import elasticity (η_{mi}) and export elasticity (η_{xi}) calculated using the methodology described in this section.

Table 6-7: Estimated Armington Trade Elasticities with Respect to U.S. Price

	Elasticity of Meat Imports w.r.t. U.S. Price				Elasticity of Meat Exports w.r.t. U.S. Price			
Meat Product	**U.S. Elasticity of Demand**	**Armington Elasticity (ξ^U)[a]**	**U.S. Imports as % of U.S. Market**	**Import Elasticity (η_{mi})**	**U.S. Elasticity of Demand**	**Armington Elasticity (ξ^R)[a]**	**U.S. Exports as % of ROW Market**	**Export Elasticity (η_{xi})**
Beef	-0.54	4.36	0.01	0.04	-0.54	4.36	0.002	-4.35
Pork	-0.69	4.36	0.005	0.02	-0.69	4.36	0.01	-4.33
Chicken	-0.77	4.36	0.004	0.01	-0.77	4.36	0.03	-4.23
Turkey	-0.77	4.36	0.004	0.01	-0.77	4.36	0.06	-4.13

w.r.t. = with respect to.

a. The estimate of the Armington trade is estimated for the animal slaughtering and processing sector (NAICS code 3116).

[19] U.S. exports as a share of the ROW market is small for each meat product market (Table 6-7). Thus, the value of the ROW trade elasticity (export elasticity) approaches the ROW elasticity of substitution for U.S. meat products (i.e., $\eta_{xi} \to -\xi^R$). As a result, the assumption that ROW elasticity of demand is equal to U.S. elasticity of demand for meat product i (i.e., $\varepsilon_{ii}^R = \varepsilon_{ii}$) is not critical to the results of the analysis.

Table 6-7: Estimated Armington Trade Elasticities with Respect to U.S. Price								
	Elasticity of Meat Imports w.r.t. U.S. Price				Elasticity of Meat Exports w.r.t. U.S. Price			
Meat Product	U.S. Elasticity of Demand	Armington Elasticity (ξ^U)[a]	U.S. Imports as % of U.S. Market	Import Elasticity (η_{mi})	U.S. Elasticity of Demand	Armington Elasticity (ξ^R)[a]	U.S. Exports as % of ROW Market	Export Elasticity (η_{xi})
Source: Ahmad and Riker (2020); Food and Agriculture Organization, 2022; U.S. EPA analysis, 2023.								

6.4 Pre- and Post-Regulatory Equilibria

In this section, EPA describes the approach used to estimate the market impact model.

6.4.1 Pre-Regulatory Equilibrium

Table 6-8 reports the pre-regulatory equilibrium prices and quantities for each meat product market and the calculated intercepts ($-\pi_i$) of each excess demand equation based on the methodology in Section 6.2.2.

Table 6-8: Estimated Pre-Regulatory Quantities and Prices						
		Quantities Demanded and Supplied (Million Pounds)				
Meat Product	Prices (2021$ per Million Pounds) (P_i)	Quantity Demanded Domestically (Q_i^D)	Quantity Supplied Domestically (Q_i^S)	Exports Demanded (Q_i^X)	Imports Supplied (Q_i^M)	Excess Demand Intercepts (Million Pounds) ($-\pi_i$)
Beef	$2,632,438	28,145	28,290	3,536	3,391	41,784
Pork	$1,113,816	22,000	26,994	6,338	1,344	53,508
Chicken	$1,405,267	39,105	46,206	7,278	176	117,186
Turkey	$1,496,779	4,900	5,222	407	85	11,505
Source: U.S. EPA analysis, 2023.						

6.4.2 Compliance Costs

EPA estimated average compliance costs per unit of output for each meat product market based on the steps taken by U.S. EPA (2002).[20] For each facility, EPA:

- Calculated the after-tax annualized compliance costs for each regulatory option (see sections 3.1.1.3 and 4.2).
- Calculated the percentage of the total quantity of production each meat product represents. EPA calculated the percentage of red meat production accounted for by beef and pork production and the percentage of poultry production accounted for by chicken and turkey production based on the domestic baseline values of production in 2021 from the USDA's Livestock, Dairy, and Poultry Outlook data (Knight et al., 2023). EPA also calculated the percentage of total meat production

[20] U.S. EPA (2002) state that the distinction between direct and indirect dischargers is not relevant when estimating per-unit market-level compliance costs.

each meat product (i.e., beef, pork, chicken, and turkey) represents to calculate the percentages of rendering and mixed production accounted for by each meat product.

- Calculated the quantity of production by facility accounted for by each meat product based on the calculated percentages above.
- Attributed annualized compliance costs to each meat product based on the percentage of meat production accounted for by each meat product. For instance, if beef production accounts for 50 percent of red meat production, then 50 percent of the annualized costs for that facility will be attributed to beef. Additionally, if beef rendering accounts for 25 percent of all rendering, then 25 percent of the annualized costs for renderers will be attributed to beef rendering.
- Divided the attributable annualized compliance costs for each meat product by the quantity of that meat product produced.

After completing these steps, EPA calculated average per-unit compliance costs of each meat product across all subcategories. To do this, EPA calculated the weighted average of the per-unit compliance costs of each meat product, weighted by the production of the relevant meat product. EPA also included zero dischargers in the calculation of average per-unit compliance costs to accurately convey the impacts of the proposed rule on each meat market. The estimates of average per-unit compliance costs are then used to estimate the post-regulatory equilibrium of the proposed rule (see Section 6.2.3 on the methodology EPA used to calculate the post-regulatory equilibrium).

6.4.3 Post-Regulatory Equilibrium

Table 6-9 presents the post-regulatory equilibrium prices and quantities for each meat product under each regulatory option. These results are based on the methodology described in Section 6.2.3.

Table 6-9: Estimated Post-Regulatory Quantities and Prices

Meat Product	Prices (2022$ per Million Pounds)	Quantities Demanded and Supplied (Million Pounds)			
		Quantity Demanded Domestically	Quantity Supplied Domestically	Exports Demanded	Imports Supplied
Option 1					
Beef	$2,632,624	28,144	28,288	3,535	3,391
Pork	$1,113,942	21,999	26,989	6,334	1,344
Chicken	$1,405,389	39,101	46,199	7,275	176
Turkey	$1,496,822	4,899	5,221	407	85
Option 2					
Beef	$2,633,012	28,142	28,284	3,533	3,391
Pork	$1,114,202	21,995	26,980	6,328	1,344
Chicken	$1,405,502	39,097	46,193	7,273	176
Turkey	$1,496,854	4,899	5,221	407	85
Option 3					
Beef	$2,633,237	28,141	28,282	3,532	3,391
Pork	$1,114,357	21,993	26,973	6,324	1,344

Table 6-9: Estimated Post-Regulatory Quantities and Prices					
		Quantities Demanded and Supplied (Million Pounds)			
Meat Product	Prices (2022$ per Million Pounds)	Quantity Demanded Domestically	Quantity Supplied Domestically	Exports Demanded	Imports Supplied
Chicken	$1,406,012	39,081	46,166	7,261	176
Turkey	$1,497,055	4,897	5,219	407	85
Option 1 with chlorides					
Beef	$2,632,738	28,143	28,287	3,535	3,391
Pork	$1,114,019	21,998	26,986	6,333	1,344
Chicken	$1,405,500	39,097	46,193	7,273	176
Turkey	$1,496,863	4,899	5,221	407	85
Option 2 with chlorides					
Beef	$2,633,126	28,142	28,283	3,532	3,391
Pork	$1,114,279	21,994	26,977	6,326	1,344
Chicken	$1,405,613	39,093	46,187	7,270	176
Turkey	$1,496,895	4,898	5,220	407	85
Option 3 with chlorides					
Beef	$2,633,350	28,141	28,280	3,531	3,391
Pork	$1,114,434	21,992	26,970	6,322	1,344
Chicken	$1,406,124	39,077	46,160	7,259	176
Turkey	$1,497,096	4,896	5,218	407	85
Source: U.S. EPA analysis, 2023.					

6.4.4 Market-Level Impacts

After estimating the pre- and post-regulatory equilibria for each meat product market, EPA estimated the following market-level impacts of proposed changes to the MPP ELGs on prices and quantities:

- Change in market price for each meat product ($P_i{}' - P_i$)
- Change in U.S. demand for each meat product ($Q_i^{D\prime} - Q_i^D$)
- Change in U.S. supply of each meat product ($Q_i^{S\prime} - Q_i^S$)
- Change in foreign demand for each U.S. meat product ($Q_i^{X\prime} - Q_i^X$)
- Change in foreign sales of each meat product to the United States ($Q_i^{M\prime} - Q_i^M$)

Table 6-10 and Table 6-11 present the price and quantity impacts of the proposed rule on each meat product market based on the methodology above, respectively.

Table 6-10: Post-Compliance Meat Market Prices Compared to Baseline Prices

Meat Product	Baseline Prices (2022$ per Million Pounds)	Percentage Change in Price[a]					
		Option 1	Option 2	Option 3	Option 1 with chlorides	Option 2 with chlorides	Option 3 with chlorides
Beef	$2,632,438	0.01%	0.02%	0.03%	0.01%	0.03%	0.03%
Pork	$1,113,816	0.01%	0.03%	0.05%	0.02%	0.04%	0.06%
Chicken	$1,405,267	0.01%	0.02%	0.05%	0.02%	0.02%	0.06%
Turkey	$1,496,779	<0.01%	0.01%	0.02%	0.01%	0.01%	0.02%

a. The change in price is calculated as the percentage change in terms of the baseline price. Generally this is described as: $(P_i' - P_i)/P_i)$.

Source: U.S. EPA analysis, 2023.

Table 6-11: Post-Compliance Meat Market Quantities Compared to Baseline Prices

Meat Product	Baseline Quantities (Million Pounds)	Percentage Change in Quantity[a]					
		Option 1	Option 2	Option 3	Option 1 with chlorides	Option 2 with chlorides	Option 3 with chlorides
Quantity Demanded Domestically							
Beef	28,145	>-0.01%	-0.01%	-0.01%	>-0.01%	-0.01%	-0.02%
Pork	22,000	-0.01%	-0.02%	-0.03%	-0.01%	-0.03%	-0.04%
Chicken	39,105	-0.01%	-0.02%	-0.06%	-0.02%	-0.03%	-0.07%
Turkey	4,900	-0.01%	-0.02%	-0.06%	-0.02%	-0.03%	-0.07%
Quantity Supplied Domestically							
Beef	28,290	-0.01%	-0.02%	-0.03%	-0.01%	-0.02%	-0.03%
Pork	26,994	-0.02%	-0.05%	-0.08%	-0.03%	-0.06%	-0.09%
Chicken	46,206	-0.01%	-0.03%	-0.09%	-0.03%	-0.04%	-0.10%
Turkey	5,222	-0.01%	-0.02%	-0.06%	-0.02%	-0.03%	-0.07%
Exports Demanded							
Beef	3,536	-0.03%	-0.09%	-0.13%	-0.05%	-0.11%	-0.15%
Pork	6,338	-0.05%	-0.15%	-0.21%	-0.08%	-0.18%	-0.24%
Chicken	7,278	-0.04%	-0.07%	-0.23%	-0.07%	-0.10%	-0.26%
Turkey	407	-0.01%	-0.02%	-0.08%	-0.02%	-0.03%	-0.09%
Imports Supplied							
Beef	3,391	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Pork	1,344	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Chicken	176	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Turkey	85	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%

a. The difference in post-regulatory quantity and baseline quantity are calculated as the percentage change in terms of the baseline quantity. Generally, this is described as: $(Q_i^{j\prime} - Q_i^j)/Q_i^j)$.

Source: U.S. EPA analysis, 2023.

For this market analysis, EPA focused on the cross-price elasticities between meat products produced by the regulated industry, rather than a broader set of substitutes. However, EPA acknowledges that some consumers would choose substitutes not included in these meat products. EPA requests comment on the potential consideration of additional substitution effects beyond the ones considered for this market analysis.

6.5 Barrier-to-Entry Analysis

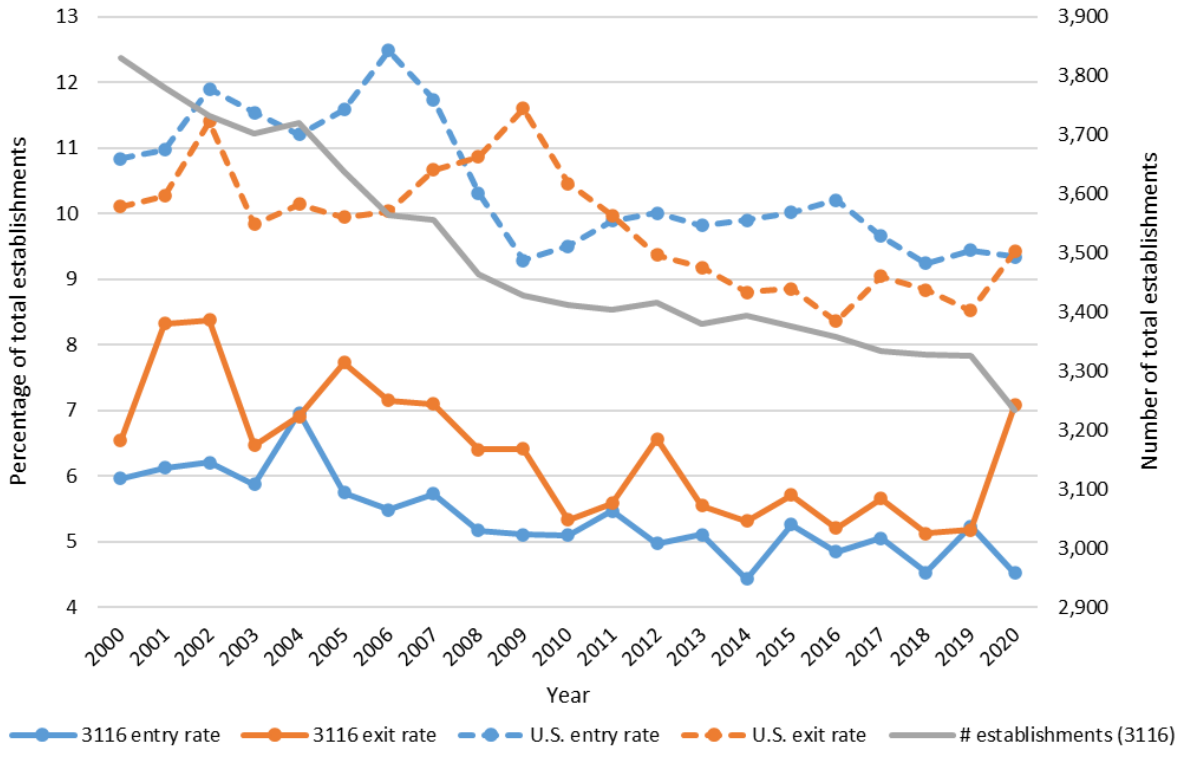
A barrier to entry is broadly understood as fixed costs that must be incurred by a new entrant, regardless of production or sales activities, into a market that incumbents typically do not have or have not had to incur. New entrants often face capital-intensive requirements to begin operations, which can discourage entry, particularly for firms with limited financial resources or access to funding. Moreover, economies of scale tend to favor established incumbents as efficiencies in production, distribution, and procurement allow existing firms to benefit from cost advantages that are not available to new entrants. This forces newcomers to compete on a cost basis with larger firms, potentially dissuading their entry into the market. Because barriers to entry protect incumbent firms and restrict competition in a market, they can contribute to the existence of monopolies and oligopolies or give incumbent firms large amounts of market power.

For example, a potential barrier to entry in the meat products market is the incremental capital costs that the proposed rule may impose on a new entrant. If the new entrant not only needs capital to build and equip a new facility and start operations, but also must invest significant capital in wastewater treatment equipment to meet the proposed effluent guidelines, then this additional financial burden could discourage the new entrant from entering the market. EPA examined the possibility that the proposed rule may create incremental barriers to entry in the meat products industry.

Figure 6-1 presents the average entry and exit rates for new establishments in both the meat products market and all-U.S. industries from 2000 to 2020, based on the U.S. Census Bureau's Business Dynamic Statistics (BDS) dataset. For the most part, since 2000, establishment exit rates have exceeded entry rates in the MPP industry. This finding is consistent with the data that shows the overall decline in the number of establishments in the MPP industry. Furthermore, the low entry rate, along with the declining number of total MPP-related establishments, may indicate that consolidation has been taking place in the industry. It is possible that large vertically integrated establishments are being retained, while smaller independent establishments constitute the large exit rates associated with the MPP industry.

Additionally, both the entry and exit rates are lower for the MPP industry than the overall U.S. average. This could indicate that the MPP industry is relatively stable, or less subject to changes in the form of new establishments entering or existing businesses exiting. Moreover, an entry rate that is lower than the exit rate and the U.S. average could be an indication that there are barriers to entry in the MPP industry. These findings are consistent with the discussion in Section 2.4: Trends in Industry Concentration.

Figure 6-1: Establishment Entry and Exit Rates for MPP and all U.S. Industries, from 2000-2020



Source: U.S. Census Bureau, 2020

To further analyze the impact of the proposed rule on incremental capital requirements for new entrants, EPA estimated the total assets owned by each in-scope facility. EPA took total assets (adjusted to 2022 dollars) from the U.S. Census Bureau's 2017 Economic Census (EC) dataset. EPA assigned average total assets by establishment from the EC 2017 dataset to each facility based on the facility's state and NAICS. If the facility's state information was unavailable, EPA assigned average total assets by establishment based on the facility's NAICS at the national level. If the facility's NAICS information was unavailable at the national level, or if a facility had associated capital costs but no NAICS, EPA assigned average total assets by establishment for the U.S. MPP industry (NAICS 3116). Using identical methodology, EPA calculated total baseline capital expenditures for every in-scope facility. EPA calculated capital costs based on the treatment technology costs for each facility, by option. EPA calculated both the ratio of incremental capital costs to total assets and baseline capital expenditures to total assets as measures of the potential for barriers to entry due to the proposed rule.

The incremental capital costs to total asset ratio indicates the proportion of a facility's total assets that are being used to cover capital costs associated with adhering to regulatory requirements. A larger ratio suggests that a substantial portion of the company's assets is allocated to financing obligations, encompassing costs related to regulatory compliance, such as compliance technology, installation, and construction. This signifies significant financial commitments required for adherence to regulatory standards, and a possible barrier-to-entry, as new entrants face challenges in covering compliance-associated expenses.

On the other hand, the total baseline capital expenditures to total asset ratio reflects the proportion of a company's total assets allocated to all baseline capital expenditures, irrespective of regulatory obligations. This ratio accounts for investments in operational assets, infrastructure, and equipment. Unlike the incremental capital costs to total asset ratio, this ratio includes investments that would occur in the absence of any regulation.

Table 6-12 presents the ratio of incremental capital costs to total assets and the ratio of total baseline capital expenditures to total assets by processing type and regulatory options. EPA weighted the capital costs, baseline capital expenditures, and asset values by production for facilities that are covered under each regulatory option and have associated treatment technology-based capital costs. For some processing types and regulatory options (e.g., meat first under Option 1), compliance capital costs are a significant portion of total assets and larger than baseline capital expenditures, indicating a potential barrier to entry. As expected, these ratios become larger with more stringent regulatory options. This is reflected in the observed changes in the capital costs to assets ratio and baseline capital expenditures to assets ratio, indicating that compliance-related capital costs may pose a more significant barrier to entry for new entrants then non-regulatory expenditure costs, under more stringent regulatory options.

Table 6-12: Capital Cost and Baseline Expenditure Ratios by Processing Type and Regulatory Option

Option 1					
Process Type	**Average Capital Costs ($1,000)**	**Average Total Baseline Capital Expenditures ($1,000)**	**Average Total Depreciable Assets ($1,000)**	**Capital Costs to Assets Ratio**	**Baseline Capital Expenditures to Assets Ratio**
Meat First	$9,968	$1,769	$21,133	0.472	0.084
Meat Further	$2,112	$2,293	$29,911	0.071	0.077
Poultry First	$8,147	$6,456	$53,463	0.152	0.121
Poultry Further	$2,843	$6,490	$50,997	0.056	0.127
Render	$3,894	$5,870	$49,693	0.078	0.118
Option 2					
Process Type	**Average Capital Costs ($1,000)**	**Average Total Baseline Capital Expenditures ($1,000)**	**Average Total Depreciable Assets ($1,000)**	**Capital Costs to Assets Ratio**	**Baseline Capital Expenditures to Assets Ratio**
Meat First	$13,454	$1,877	$24,386	0.552	0.077
Meat Further	$2,112	$2,293	$29,911	0.071	0.077
Poultry First	$12,649	$7,272	$56,398	0.224	0.129
Poultry Further	$2,843	$6,490	$50,997	0.056	0.127
Render	$6,339	$4,331	$46,462	0.136	0.093
Option 3					
Process Type	**Average Capital Costs ($1,000)**	**Average Total Baseline Capital Expenditures ($1,000)**	**Average Total Depreciable Assets ($1,000)**	**Capital Costs to Assets Ratio**	**Baseline Capital Expenditures to Assets Ratio**
Meat First	$13,160	$1,873	$24,095	0.546	0.078
Meat Further	$7,083	$2,758	$23,251	0.305	0.119

Table 6-12: Capital Cost and Baseline Expenditure Ratios by Processing Type and Regulatory Option					
Poultry First	$12,329	$7,239	$56,149	0.220	0.129
Poultry Further	$3,839	$5,008	$45,426	0.085	0.110
Render	$4,712	$3,406	$34,793	0.135	0.098
Option 1 + Chlorides					
Process Type	**Average Capital Costs ($1,000)**	**Average Total Baseline Capital Expenditures ($1,000)**	**Average Total Depreciable Assets ($1,000)**	**Capital Costs to Assets Ratio**	**Baseline Capital Expenditures to Assets Ratio**
Meat First	$10,601	$1,848	$26,230	0.404	0.070
Meat Further	$1,398	$2,373	$25,693	0.054	0.092
Poultry First	$8,041	$5,728	$60,266	0.133	0.095
Poultry Further	$1,605	$5,097	$43,999	0.036	0.116
Render	$3,894	$5,870	$49,693	0.078	0.118
Option 2 + Chlorides					
Process Type	**Average Capital Costs ($1,000)**	**Average Total Baseline Capital Expenditures ($1,000)**	**Average Total Depreciable Assets ($1,000)**	**Capital Costs to Assets Ratio**	**Baseline Capital Expenditures to Assets Ratio**
Meat First	$16,669	$1,866	$24,008	0.694	0.078
Meat Further	$1,398	$2,373	$25,693	0.054	0.092
Poultry First	$14,151	$7,159	$58,483	0.242	0.122
Poultry Further	$1,605	$5,097	$43,999	0.036	0.116
Render	$6,339	$4,331	$46,462	0.136	0.093
Option 3 + Chlorides					
Process Type	**Average Capital Costs ($1,000)**	**Average Total Baseline Capital Expenditures ($1,000)**	**Average Total Depreciable Assets ($1,000)**	**Capital Costs to Assets Ratio**	**Baseline Capital Expenditures to Assets Ratio**
Meat First	$16,338	$1,863	$23,772	0.687	0.078
Meat Further	$7,097	$2,742	$23,070	0.308	0.119
Poultry First	$13,840	$7,139	$58,225	0.238	0.123
Poultry Further	$4,027	$5,002	$45,261	0.089	0.111
Render	$4,712	$3,406	$34,793	0.135	0.098
Source: U.S. Census Bureau, 2017a, 2017b; U.S. EPA analysis, 2023.					

6.6 Uncertainties and Limitations

The main sources of uncertainty for the market impact analysis presented in this chapter are:

- EPA relied on an average long-run elasticity of supply based on estimates from a range of years. Some of these studies are relatively old compared to the analysis period of this rule. Moreover, for the calculation of the average long-run elasticity of supply for beef, EPA excluded estimates from Marsh (1994) and Jeong (2019) because they are noted by the authors to be larger than other

estimates in the existing literature. Overall, the average long-run elasticity of supply estimates for each meat product may differ from the true elasticity of supply for each meat product in the market impact analysis.

- In calculating the weighted average compliance costs for each meat product market, the Agency relied on limited production data from the survey and relied on estimates of production for some facilities.
- EPA relied data on baseline trade, production, and wholesale prices from USDA and trade share data from UNFAO, consistent with U.S. EPA (2002). These data include estimates that may differ from the true baseline values of the U.S. MPP market.

7 Assessment of Impacts on Employment

7.1 Background and Context

In addition to addressing the costs and impacts of the regulatory options, EPA estimated the potential impacts of this rulemaking on employment, measured in terms of changes in full-time equivalent (FTE) labor inputs.[21] Evaluation of employment impacts is required by many environmental statutes, including the Clean Water Act (CWA section 507I, 33 U.S.C. § 1367I). EPA estimated short-run employment impacts from post-compliance closures (Section 7.2) and long-run employment impacts associated with the operation of new treatment technology (Section 7.3) and new market equilibrium (Section 7.4) under each regulatory option. Section 7.5 presents the total employment impacts of the proposed rule, and Section 7.6 presents the uncertainties and limitations of the Agency's assessment of the proposed rule's impact on employment.

7.2 Post-Compliance Closures

The Agency estimated the short-run impacts associated with post-compliance closures under each regulatory option. To do this, EPA calculated the labor productivity[22] at each facility using survey questionnaire data where available. The Agency then calculated the average labor productivity and average production by process type and production size. Table 7-1 presents estimates of the average production and labor productivity by process type and production size.

[21] One FTE equals 2,080 labor hours per year.

[22] Labor productivity at the facility-level is calculated as the production at the facility divided by the number of employees at the facility.

Table 7-1: Average Facility Labor Productivity and Production by Process Type and Production Size

Process Type	Production size[a]				
	< 20 M	>= 20 M, < 50 M	>= 20 M, < 100 M	>= 50 M	>= 100 M
Average labor productivity (pounds/employee)					
Meat first	165,615	458,738	693,387	913,945	922,391
Meat further	106,024	208,782	311,734	384,980	367,652
Poultry first	94,288	133,714	165,293	5,623,413	5,769,791
Poultry further	95,120	662,096	477,642	305,494	226,803
Rendering	197,624	954,156	1,016,609	4,168,573	4,599,020
Average production (pounds/facility/year)					
Meat first	2,084,258	32,033,800	47,601,846	1,205,942,164	1,513,620,792
Meat further	2,136,400	31,443,390	55,560,390	118,891,108	229,233,755
Poultry first	2,913,433	38,336,641	47,067,494	540,429,760	557,917,396
Poultry further	3,104,067	36,124,320	55,525,866	132,415,326	192,498,592
Rendering	4,893,616	32,616,921	62,091,549	259,546,986	276,284,524

a. EPA estimated closures for direct and indirect dischargers using different production size bins. As a result, there is overlap in the production sizes shown in this table. The Agency calculated output loss for direct and indirect dischargers based on the average production for the appropriate production size and process type.

Source: U.S. EPA Analysis, 2023.

EPA multiplied the number of closures (see Section 5.7 for more information of the number of facility closures under each regulatory option), by process type and production size, by the associated average production for those facilities to estimate the loss in output. The Agency then estimated the loss in employment by dividing losses in output by average labor productivity. Table 7-2 presents the employment impacts associated with facility closures by regulatory option and process type. Overall, the Agency estimates employment losses under each regulatory option. Without chlorides, Option 3 has the greatest short-run employment decrease, followed by Options 2 and 1. Employment decreases due to facility closures are considered short-run. Post-compliance facility closures may not directly translate to decreases in demand for meat products. As a result, losses in employment due to closures may be mitigated in the long run as supply adjusts to meet demand (see Section 7.4).

Table 7-2: Employment Changes Due to Facility Closures by Regulatory Option and Process Type (# FTE)

Process Type	Option 1	Option 2	Option 3	Option 1 with chlorides	Option 2 with chlorides	Option 3 with chlorides
Meat first	-16,410	-16,410	-16,422	-16,410	-16,410	-16,422
Meat further	0	0	-1,383	-397	-397	-1,383
Poultry first	-483	-966	-1,346	-803	-1,093	-1,442
Poultry further	0	0	-849	-881	-881	-849
Rendering	-25	-85	-205	-25	-85	-205
Total	**-16,917**	**-17,461**	**-20,205**	**-18,516**	**-18,866**	**-20,301**

Table 7-2: Employment Changes Due to Facility Closures by Regulatory Option and Process Type (# FTE)						
Process Type	Option 1	Option 2	Option 3	Option 1 with chlorides	Option 2 with chlorides	Option 3 with chlorides
Total employment change as % of U.S. employment[a]	**3.33%**	**3.43%**	**3.97%**	**3.64%**	**3.71%**	**3.99%**

a. Total employment for the total U.S. MPP sector (NAICS 3116) was 508,781 in 2017 (U.S. Census Bureau, 2017b)

Source: U.S. EPA analysis, 2023.

7.3 New Treatment Technology

In addition to estimating the short-run employment impacts associated with post compliance closures under each regulatory option, EPA estimated the long-run employment impacts associated with the operation of the new treatment technologies due to the proposed rule.

To do this, EPA calculated the additional labor hours required by MPP facilities that would install treatment technologies under each regulatory option (see TDD for details). Table 7-3 presents the estimated change in FTE by process type associated with the required labor to operate the new treatment technologies for each regulatory option.[23] Overall, EPA estimates that the operation of the new treatment technologies would increase labor inputs for all MPP process types, with a total increase ranging from 166 to 1,942 FTEs, depending on the regulatory option.

Table 7-3: Estimated FTE Requirements for Operation of Treatment Technology, by Process Type and Regulatory Option			
	Regulatory Option		
Process Type	Option 1	Option 2	Option 3
Meat first	37	221	355
Meat further	15	15	650
Poultry first	78	365	491
Poultry further	15	15	209
Rendering	21	52	237
Total	**166**	**669**	**1,942**

Source: U.S. EPA analysis, 2023.

7.4 New Market Equilibrium

In addition to estimating the long-run employment impacts associated with new treatment technology, EPA estimated the employment impacts associated with the long-run changes in domestic production due to the proposed rule (see Section 6 for more information on the market impact analysis of the proposed rule). As a result of the long-run decrease in domestic production, MPP processors will reduce the level of employment at facilities to adjust to new levels of production. EPA estimated this decrease in

[23] EPA has not estimated the labor hours required for operation of high chloride wastewater treatment systems.

employment based on the labor productivity and the reduction in the quantity produced in each meat product market.

To estimate labor productivity, EPA gathered information on the number of employees under each MPP NAICS sector (NAICS 311611, 311612, 311613, and 311615) from the 2017 Economic Census (U.S. Census Bureau, 2017b) and on domestic production by meat product market from USDA (Knight et al., 2023). Data on employment are available for meat first (NAICS 311611) and meat further (NAICS 311612) processors. However, information on employment for poultry first and further processers are only available for NAICS code 311615 (poultry processing). To estimate the number of employees at poultry first and further processing facilities separately, the Agency estimated the percentage of facilities in the total U.S. meat and poultry markets that are first and further processors. Table 7-4 presents the percentages of the meat and poultry industry made up of first and further processors. EPA multiplied the number of employees under NAICS sector 311615 by the percentages of first and further processors in the poultry industry.

Table 7-4: Percentages of Facilities Belonging to Each Meat Process

Process type	# facilities	% total facilities
Meat		
Meat first	826	19%
Meat further	3,460	81%
Total	**4,286**	**100%**
Poultry		
Poultry first	290	50%
Poultry further	294	50%
Total	**584**	**100%**

Source: U.S. EPA analysis, 2023.

Data on domestic production from USDA are available by meat product (i.e., beef, pork, chicken, and turkey). EPA added the total domestic production for beef and pork to estimate total U.S. meat production. Similarly, EPA added total domestic production for chicken and turkey to estimate total U.S. poultry production. Then, the Agency estimated the domestic production that belongs to each process type by multiplying the production for the total meat and poultry industries by the percentages of first and further processors in those industries, respectively. EPA then calculated the labor productivity by dividing production by the number of employees. Table 7-5 presents the Agency's estimates of labor productivity by process type.

Table 7-5: Labor Productivity by Process Type

Process type	NAICS code	NAICS description	Number of employees	Domestic production (pounds)	Labor productivity (pounds/employee)
Meat first	311611	Animal (except poultry) slaughtering	146,671	10,654,359,309	72,641
Meat further	311612	Meat processed from carcasses	112,939	44,629,640,691	395,166

Table 7-5: Labor Productivity by Process Type

Process type	NAICS code	NAICS description	Number of employees	Domestic production (pounds)	Labor productivity (pounds/employee)
Poultry first	311615	Poultry processing	119,211	25,537,876,712	214,224
Poultry further	311615	Poultry processing	120,856	25,890,123,288	214,224

Source: U.S. Census Bureau, 2017b; Knight et al., 2023; U.S. EPA analysis, 2023.

EPA converted the loss in production by meat product market, estimated in Section 6.4.4, to process type by following the same approach outlined above using the percentages of facilities belonging to each process type (Table 7-4). The Agency estimated loss in employment by dividing the loss in output by the labor productivity.

Table 7-6 presents baseline employment and estimated long-run changes in employment by process type and regulatory option.[24] Overall, EPA estimates each regulatory option will result in a decrease in FTE due to decreased domestic production. Option 1 has the lowest associated losses in employment and Option 3 has the largest, with or without chlorides.

Table 7-6: Change in FTE by Process Type and Regulatory Option

Process type	Baseline domestic employment	Option 1	Option 2	Option 3	Option 1 with chlorides	Option 2 with chlorides	Option 3 with chlorides
Meat first	146,671	-18	-54	-77	-29	-65	-88
Meat further	112,939	-14	-41	-60	-22	-50	-68
Poultry first	119,211	-17	-33	-100	-32	-48	-115
Poultry further	120,856	-17	-33	-102	-32	-48	-117
Total	**499,677**	**-65**	**-161**	**-339**	**-114**	**-211**	**-389**
Total employment change as % of U.S. employment[a]	**-**	**-0.01%**	**-0.03%**	**-0.07%**	**-0.02%**	**-0.04%**	**-0.08%**

a. Total employment for the total U.S. MPP sector (NAICS 3116) was 508,781 in 2017 (U.S. Census Bureau, 2017b).

Source: U.S. EPA analysis, 2023.

7.5 Estimated Impacts of the Proposed Rule

Table 7-7 presents the short- and long-run employment impacts associated with each regulatory option by process type. These employment impacts are also presented as a percentage of the total U.S. employment in the MPP industry (NAICS 3116). In the short run, the Agency estimates negative employment impacts associated with each regulatory option. In the long run, EPA estimates positive employment impacts associated with each regulatory option.

[24] EPA does not analyze renderers in the market impact analysis. As a result, EPA excludes them from this analysis of long-run employment impacts associated with changes in domestic production.

Table 7-7: Short-run and Long-run Employment Impacts Associated with the Proposed Rule						
Process Type	**Option 1**	**Option 2**	**Option 3**	**Option 1 with chlorides**	**Option 2 with chlorides**	**Option 3 with chlorides**
Short-run employment impacts						
Meat first	-16,410	-16,410	-16,422	-16,410	-16,410	-16,422
Meat further	0	0	-1,383	-397	-397	-1,383
Poultry first	-483	-966	-1,346	-803	-1,093	-1,442
Poultry further	0	0	-849	-881	-881	-849
Render	-25	-85	-205	-25	-85	-205
Total	**-16,917**	**-17,461**	**-20,205**	**-18,516**	**-18,866**	**-20,301**
Total employment change as % of U.S. employment[a]	**-3.3%**	**-3.4%**	**-4.0%**	**-3.6%**	**-3.7%**	**-4.0%**
Long-run employment impacts[b]						
Meat first	19	167	278	8	156	267
Meat further	1	-26	590	-7	-35	582
Poultry first	61	333	391	46	318	376
Poultry further	-2	-18	107	-17	-33	92
Render	21	52	237	21	52	237
Total	**101**	**508**	**1,603**	**52**	**458**	**1,553**
Total employment change as % of U.S. employment[a]	**0.02%**	**0.10%**	**0.32%**	**0.01%**	**0.09%**	**0.31%**

a. Total employment for the total U.S. MPP sector (NAICS 3116) was 508,781 in 2017 (U.S. Census Bureau, 2017b).

b. Long-run employment impacts are calculated as the sum of the employment changes related to new technology from Table 7-3 and new market equilibria from Table 7-6 by process type and regulatory option.

Source: U.S. EPA analysis, 2023.

7.6 Uncertainties and Limitations

The main sources of uncertainty for the employment analysis presented in this chapter are:

- EPA relied on information from the MPP detailed questionnaire to estimate labor productivity by process type for the analysis of short-run employment impacts related to facility closures. Due to the limited employment data available from the MPP detailed questionnaire, the results of the short-run employment impact analysis may over or underestimate the true labor productivity and short-run employment impacts of the proposed rule.

- EPA did not estimate the employment requirements associated with operation of high chloride wastewater treatment systems. EPA expects the long-run labor impacts associated with regulatory options with chlorides to be larger than for those without chlorides. As a result, EPA may underestimate the long-run employment impacts associated with new treatment technology.

- The Agency relied on the results of the market impact analysis (see Section 6.4.3) to estimate the long-run impacts of the proposed rule on employment. However, the market impact analysis does not explicitly examine rendering facilities. Because of this, the Agency does not analyze long-run

employment impacts related to new market equilibria under the regulatory options for rendering facilities.

8 Cost Pass-Through Analysis

8.1 Background and Context

Cost pass-through (CPT) refers to the process by which changes in operating costs incurred by a business or industry are transferred to other entities within the supply chain, such as suppliers or consumers. In this context, when businesses incur regulatory compliance costs, they may choose to pass on a portion or the entirety of these additional expenses to other entities in the supply chain. The transfer of costs could occur both upstream, affecting suppliers, and downstream, impacting consumers. This process has the potential to impact the net costs incurred by MPP facilities, wholesale and retail prices for meat products, and the prices paid to farmers for MPP inputs.

The analysis of impacts of the proposed rule presented in the main body of this RIA conservatively assumes zero CPT. With this sensitivity analysis, EPA estimated the facility impacts of the proposed rule using an assumption of nonzero CPT derived from the market impact analysis of the proposed rule.

Markets may have zero CPT if demand is perfectly elastic (demand is fixed at one price point) or if supply is perfectly inelastic (production does not change due to market price changes). The estimated demand and supply elasticities for the U.S. MPP markets taken from literature (see Section 6.3.2) demonstrate that the supply and demand for these markets are not perfectly inelastic and elastic, respectively.

As estimated in the market impact analysis of the proposed rule (Section 6), domestic MPP processors will reduce the quantity produced at their facilities in response to the compliance costs of the proposed rule. As a result, the Agency estimates that the equilibrium price for each meat product market will increase. The higher prices MPP facilities are estimated to receive will offset a portion of their compliance costs, resulting in lower net costs and smaller impacts. EPA assumes that MPP facilities will only offset a portion of compliance costs to consumers via higher prices in this quantitative analysis of CPT.

The Agency estimated CPT by regulatory option and meat product i using the pre- and post-regulatory price and average per-unit compliance costs from the market impact analysis as follows:

$$Cost\ pass\ through\ (CPT) = \frac{P_i' - P_i}{\delta_i}$$

This equation returns the percentage of compliance costs paid by consumers via higher prices in MPP market i. Conversely, the percentage of compliance costs incurred by MPP processors is defined as:

$$\%\ compliance\ costs\ incurred\ by\ MPP\ processors = 1 - CPT$$

For instance, if CPT is 40 percent in meat market i, consumers pay $0.40 and processors pay $0.60 of every $1 of per unit compliance costs. EPA estimated CPT under each option for each meat and poultry product market (i.e., the beef, pork, chicken, and turkey markets). EPA then calculated the average CPT for the total meat and poultry markets weighted by the domestic production of each meat and poultry product in those markets, respectively. Table 8-1 presents the weighted average percentages of compliance costs incurred by facilities (1-CPT) by total meat and poultry market. EPA used these

weighted average percentages to conduct this sensitivity analysis. To do this, EPA estimated CPT by facility as an average, weighted by the facility's relative production of meat and poultry. EPA then calculated the percentage of compliance costs incurred by each facility based on this weighted average of CPT at the facility.

Table 8-1: Weighted Average Percentage of Compliance Costs Incurred by Facilities (1-CPT) by Meat Product

Market	Option 1	Option 2	Option 3	Option 1 with chlorides	Option 2 with chlorides	Option 3 with chlorides
Meat	73.67%	73.35%	74.01%	73.82%	73.47%	74.02%
Poultry	80.16%	80.61%	79.93%	80.04%	80.38%	79.93%

Source: U.S. EPA Analysis, 2023.

8.2 Total Compliance Costs

EPA estimated total compliance costs assuming nonzero CPT based on facility-specific compliance costs and CPT estimates described in Section 8.1. Table 8-2 presents estimates of the total annualized pre-tax compliance costs by regulatory option with CPT at a 3 percent discount rate. As stated in Section 3.1.1.4, these costs represent the social costs associated with the proposed rule assuming nonzero CPT. The total compliance costs associated with the preferred option (Option 1) are about 22% smaller assuming nonzero CPT compared to the compliance costs assuming zero CPT, under both discount rates (Table 3-1).

Table 8-2: Estimated Total Annualized Pre-Tax Compliance Costs with CPT, 3 percent discount rate (in millions, 2022$, at 2025)

Regulatory Option	Direct	Indirect	Total
Option 1	$170.7	$11.8	$182.5
Option 2	$171.1	$332.4	$503.4
Option 3	$176.2	$668.1	$844.3
Option 1 with chlorides	$219.3	$84.0	$303.3
Option 2 with chlorides	$219.5	$404.2	$623.7
Option 3 with chlorides	$224.9	$740.4	$965.2

Source: U.S. EPA Analysis, 2023.

Table 8-3 presents estimates of the total annualized after-tax compliance costs with CPT, at 7.6 percent discount rate. As in Section 4.2, EPA calculated after-tax compliance costs assuming nonzero CPT by applying combined federal and state tax rates to pre-tax costs by facility, using a discount rate equal to the industry's estimated private cost of capital (7.6 percent). The after-tax compliance costs assuming nonzero CPT are about 22% smaller than the after-tax costs assuming zero CPT (Table 4-1).

Table 8-3: Estimated Total Annualized After-Tax Compliance Costs with CPT (in millions, 2022$)

Regulatory Option	Direct	Indirect	Total
Option 1	$155.1	$11.0	$166.0
Option 2	$155.4	$307.7	$463.1

Table 8-3: Estimated Total Annualized After-Tax Compliance Costs with CPT (in millions, 2022$)			
Regulatory Option	**Direct**	**Indirect**	**Total**
Option 3	$159.8	$621.5	$781.3
Option 1 with chlorides	$199.2	$77.0	$276.2
Option 2 with chlorides	$199.4	$373.4	$572.8
Option 3 with chlorides	$204.0	$687.6	$891.6
Source: U.S. EPA Analysis, 2023.			

8.3 Facility-Level Cost-to-Revenue Analysis

EPA estimated facility-level CTR with CPT following the same steps outlined in Section 4.3 using facility-level compliance costs assuming nonzero CPT. Table 8-4 presents the facility CTR analysis results with CPT by regulatory option. Similar to the results presented in Section 4.3.2, EPA estimates that most facilities would not experience costs exceeding one or three percent of revenue. Additional facilities would experience costs greater than one percent of revenue (and less than three percent of revenue) with regulatory Options 3 and 2 compared to Option 1. The number of facilities that would experience costs greater than one percent of revenue (and less than three percent of revenue) and greater than three percent of revenue for the preferred option (Option 1) is the same assuming nonzero and zero CPT.

Table 8-4: Facility-Level After-Tax Compliance Cost-to-Revenue Analysis Results by Discharge Type and Regulatory Option

Discharge Type	Total Number of Dischargers	Total Number of Facilities with Costs	Number of Facilities with a Ratio of				Percent of All Dischargers with a Ratio of			
			0%[a]	<1%	≥1 and <3%	≥3%	0%[a]	<1%	≥1 and <3%	≥3%
Option 1										
Direct	171	126	45	120	5	1	26%	70%	3%	0.6%
Indirect	3,708	719	2,989	718	0	1	81%	19%	0.00%	0.03%
Total	**3,879**	**845**	**3,034**	**838**	**5**	**2**	**78%**	**22%**	**0.1%**	**0.1%**
Option 2										
Direct	171	126	45	120	5	1	26%	70%	3%	0.6%
Indirect	3,708	719	2,989	709	6	4	81%	19%	0.2%	0.1%
Total	**3,879**	**845**	**3,034**	**829**	**11**	**5**	**78%**	**21%**	**0.3%**	**0.1%**
Option 3										
Direct	171	135	36	128	6	1	21%	75%	4%	1%
Indirect	3,708	1,485	2,223	1,454	23	8	60%	39%	0.6%	0.2%
Total	**3,879**	**1,620**	**2,259**	**1,582**	**29**	**9**	**58%**	**41%**	**0.7%**	**0.2%**
Option 1 with chlorides										
Direct	171	129	42	122	5	2	25%	71%	3%	1%
Indirect	3,708	817	2,891	811	0	6	78%	22%	0.0%	0.2%
Total	**3,879**	**946**	**2,933**	**933**	**5**	**8**	**76%**	**24%**	**0.1%**	**0.2%**

Table 8-4: Facility-Level After-Tax Compliance Cost-to-Revenue Analysis Results by Discharge Type and Regulatory Option

Discharge Type	Total Number of Dischargers	Total Number of Facilities with Costs	Number of Facilities with a Ratio of				Percent of All Dischargers with a Ratio of			
			0%[a]	<1%	≥1 and <3%	≥3%	0%[a]	<1%	≥1 and <3%	≥3%
Option 2 with chlorides										
Direct	171	129	42	122	5	2	25%	71%	3%	1%
Indirect	3,708	817	2,891	803	7	7	78%	22%	0.2%	0.2%
Total	**3,879**	**946**	**2,933**	**925**	**12**	**9**	**76%**	**24%**	**0.3%**	**0.2%**
Option 3 with chlorides										
Direct	171	136	35	128	5	3	20%	75%	3%	2%
Indirect	3,708	1,485	2,223	1,451	26	8	60%	39%	0.7%	0.2%
Total	**3,879**	**1,621**	**2,258**	**1,579**	**31**	**11**	**58%**	**41%**	**0.8%**	**0.3%**

a. These facilities already meet discharge requirements for the wastestreams controlled by a given regulatory option and therefore are not estimated to incur compliance costs.

Source: U.S. EPA analysis, 2023.

8.4 Parent Entity-Level Cost-to-Revenue Analysis

EPA estimated entity-level CTR analysis following the same steps outlined in Section 4.4 using facility-level compliance costs assuming nonzero CPT. Table 8-5 presents the entity-level impacts for each regulatory option with CPT. The results for the preferred option (Option 1) assuming nonzero CPT match the results of the entry-level impacts assuming zero CPT (Table 4-3).

Table 8-5: Entity-level cost-to-revenue analysis results

Regulatory Option	Total Number of Entities	Number of Entities with a Ratio of				Percent of Entities with a Ratio of [b]			
		0%[a]	>0 and <1%	≥1 and <3%	≥3%	0%[a]	>0 and <1%	≥1 and <3%	≥3%
Option 1	3,114	2,717	394	3	0	87%	13%	0.1%	0.0%
Option 2	3,114	2,717	393	3	1	87%	13%	0.1%	0.0%
Option 3	3,114	2,116	984	12	2	68%	32%	0.4%	0.1%
Option 1 with chlorides	3,114	2,659	451	3	1	85%	14%	0.1%	0.0%
Option 2 with chlorides	3,114	2,659	451	3	1	85%	14%	0.1%	0.0%
Option 3 with chlorides	3,114	2,116	983	12	3	68%	32%	0.4%	0.1%

a. These entities own only facilities that already meet discharge requirements for the wastestreams addressed by a given regulatory option and are therefore not estimated to incur any compliance technology costs.

b. Percentages may not add up to 100 percent due to rounding.

Source: U.S. EPA Analysis, 2023.

8.5 Facility Closures

EPA estimated facility closures using the same extrapolation approach outlined in Section 5.6 using the results of the facility CTR results assuming nonzero CPT. Table 8-6 presents the results of the facility closure analysis outlined in Section 5 with CPT. EPA estimates that the number of estimated closures for the preferred option (Option 1) is the same assuming nonzero and zero CPT.

Table 8-6: Facility Closure Extrapolation with CPT Results

	Option 1	Option 2	Option 3	Option 1 with chlorides	Option 2 with chlorides	Option 3 with chlorides
Number of estimated facility closures	16	21	49	25	29	52
Number of facilities with costs	845	845	1,620	946	946	1,621
Number of dischargers	3,879	3,879	3,879	3,879	3,879	3,879
% of facilities with costs	1.9%	2.5%	3.0%	2.6%	3.1%	3.2%
% of all dischargers	0.4%	0.5%	1.3%	0.6%	0.7%	1.3%

Source: U.S. EPA Analysis, 2023.

9 Assessment of Potential Impact of the Regulatory Options on Small Entities – Initial Regulatory Flexibility Act (IRFA) Analysis

The Regulatory Flexibility Act (RFA) of 1980, as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA) of 1996, requires federal agencies to consider the impact of their rules on small entities, to analyze alternatives that minimize those impacts,[25] and to make their analyses available for public comments. The RFA is concerned with three types of small entities: small businesses, small nonprofits, and small government jurisdictions.

The RFA describes the regulatory flexibility analyses and procedures that must be completed by federal agencies unless they certify that the rule, if promulgated, would not have a significant economic impact on a substantial number of small entities. This certification must be supported by a statement of factual basis, *e.g.*, addressing the number of small entities affected by the proposed action, estimated cost impacts on these entities, and evaluation of the economic impacts.

In accordance with RFA requirements and as it has consistently done in developing effluent limitations guidelines and standards, EPA assessed whether the proposed regulatory options would have "a significant impact on a substantial number of small entities" (SISNOSE). This assessment involved the following steps:

- Identifying the domestic parent entities of MPP facilities.
- Determining which of those domestic parent entities are small entities, based on SBA size criteria and USDA data.
- Assessing the change in potential impact of the proposed regulatory options on those small entities by comparing the estimated entity-level annualized compliance cost to entity-level revenue; the cost-to-revenue ratio indicates the magnitude of economic impacts. Following EPA and SBA guidance (U.S. EPA, 2006; U.S. Small Business Administration, 2017), EPA used threshold compliance costs of one percent or three percent of entity-level revenue to categorize the degree of *significance* of the economic impacts on small entities.
- Assessing the change in whether those small entities incurring potentially significant impacts represent a substantial number of small entities. Following EPA and SBA guidance (U.S. EPA, 2006; U.S. Small Business Administration, 2017), EPA determined whether the number of small entities impacted is *substantial* based on (1) the estimated *absolute numbers* of small entities incurring potentially significant impacts according to the two compliance cost impact thresholds, and (2) the *percentage of small entities* in the relevant entity categories that are estimated to incur these impacts.

[25] Section 603(c) of the RFA provides examples of such alternatives as: (1) the establishment of differing compliance or reporting requirements or timetables that take into account the resources available to small entities; (2) the clarification, consolidation, or simplification of compliance and reporting requirements under the rule for such small entities; (3) the use of performance rather than design standards; and (4) an exemption from coverage of the rule, or any part thereof, for such small entities.

EPA performed this assessment for each of the proposed options. This chapter describes why this action is being considered (Section 9.1), the objectives and legal basis for the proposed rule (Section 9.2), the small entities to which the proposed rule applies (Section 9.3), the compliance requirements (Section 9.4), other relevant Federal rule (Section 9.5), potential economic impacts on small entities (Section 9.6), how regulatory options developed by EPA served to mitigate the impact of the regulatory options on small entities (Section 9.7), and uncertainties and limitations (Section 9.8). EPA considers this chapter to be the Initial Regulatory Flexibility Analysis (IRFA) for this proposed rule.

9.1 Why this Action is being Considered

EPA is considering revisions to the current regulations that apply to wastewater discharges from MPP facilities because the industry discharges large quantities of nutrients, such as nitrogen and phosphorus, that enter the Nation's waters. Nutrient pollution is one of the most widespread, costly, and challenging environmental problems impacting water quality in the United States. Excessive nitrogen and phosphorus in surface water can lead to a variety of problems, including eutrophication and harmful algal blooms, that have negative impacts on human health and the environment. For a more detailed rationale for the proposed rulemaking see section I.A of the preamble to the proposed rule.

9.2 Objectives and Legal Basis for the Proposed Rule

The objectives of the rule are to reduce the nutrients directly discharged by the industry and to reduce the passthrough of pollutants and/or the interference of wastewater treatment at POTWs receiving indirect discharges from MPP facilities. For the legal basis of the proposed rulemaking see section III.C of the preamble to the proposed rule.

9.3 Description and Number of Small Entities to Which the Proposed Rule Will Apply

9.3.1 Determining Parent Entity of MPP Facilities

Consistent with the entity-level cost-to-revenue analysis (see Chapter 4), EPA conducted the IRFA at the highest level of domestic ownership, referred to as the "domestic parent entity" or "domestic parent firm". As was done for the entity-level cost-to-revenue analysis in Section 4.4, EPA identified the parent entity for each facility using responses to the census and detailed questionnaires, D&B Hoovers data, and corporate and financial websites.

9.3.2 Determining Whether Parent Entities of MPP Facilities are Small

EPA identified the size of each parent entity using the SBA size threshold guidelines in effect as of March 17, 2023 (U.S. Small Business Administration, 2023). The criteria for entity size determination vary by the NAICS sector of the parent entity. For entities with meat and poultry processing as a primary business (NAICS 3116), small entities are those with less than the threshold number of employees specified by SBA for each of the NAICS sectors (see Table 9-1). For entities with a primary business other than meat and poultry processing, the relevant size criteria are based on revenue or number of employees by NAICS sector.[26]

[26] Certain facilities affected by this rulemaking are owned by entities whose primary business is not meat and poultry processing. Some other primary businesses include NAICS, 445240 (Meat Retailers), 112340 (Poultry Hatcheries), 424510 (Grain and Field Bean Merchant Wholesalers), and 424470 (Meat and Meat Product Merchant Wholesalers).

Table 9-1: NAICS Codes and SBA Size Standards for Owners of MPP Facilities		
NAICS Code	**NAICS Description**	**SBA Size Standard[a]**
311611	Animal (Except Poultry) Slaughtering	1,150 employees
311612	Meat Processed From Carcasses	1,000 employees
311613	Rendering and Meat Byproduct Processing	750 employees
311615	Poultry Processing	1,250 employees
a. Based on size standards effective at the time EPA conducted this analysis (SBA size standards, effective March 17, 2023). *Source: U.S. Small Business Administration, 2023*		

To determine whether a firm is a small entity according to these criteria, EPA compared the relevant entity size criterion value estimated for each parent entity to the SBA threshold value. EPA used the following data sources and methodology to estimate the relevant size criterion values for each parent entity:

- **Employment**: EPA used entity-level employment values from the detailed and census questionnaires or D&B Hoovers, if those values were available.[27]
- **Revenue:** EPA determined revenue values based on information reported in the detailed questionnaire, the D&B Hoovers database, and from corporate or financial websites, if those values were available. If parent entity revenue was unavailable from these sources, EPA estimated revenue as the sum of facility revenue across all facilities owned by that parent entity.

Parent entities for which the relevant measure is less than the SBA size criterion were identified as small entities and carried forward in the RFA analysis.

EPA also used revenue and employment data for some parent entities with missing NAICS codes to identify their small business status. To do so, EPA calculated the minimum and maximum SBA employment and revenue thresholds using the NAICS codes identified for firms with MPP dischargers. These thresholds are presented in Table 9-2. If EPA could not identify a firm's NAICS code but had its revenue or employment data, EPA designated a firm as a small business if its revenue or employment data fell below the respective minimum threshold and large if its revenue or employment data fell above the respective maximum threshold. For example, a firm that has revenue below $2.5 million or employment under 100 employees is classified as small, while a firm with revenue over $47 million or over 1,400 employees is classified as large. EPA could not identify small business status for firms whose revenue or employment data fell between the respective minimum and maximum thresholds.

[27] EPA could not estimate employment for entities. The Agency reviewed the relationship between revenue and employment and did not find a correlation between the two that allows for estimating employment.

Table 9-2: Minimum and Maximum Revenue and Employment Thresholds Applied to Firms with Missing NAICS Codes	
Description of Threshold	**Thresholds for Firms with Missing NAICS Codes**
Minimum revenue	$2.5 million
Maximum revenue	$47 million
Minimum employment	100 employees
Maximum employment	1,400 employees
Source: U.S. EPA Analysis, 2023	

If EPA did not have sufficient data based on the approach described above to determine T status, the Agency used establishment size data from the USDA Meat, Poultry and Egg Product Inspection Directory. This dataset classifies facilities as "very small," "small", or "large" based on self-reported employment levels:

- Very small: Less than 10 employees (or less than $2.5 million in annual sales).
- Small: 10-499 employees.
- Large: 500 or more employees.

EPA used these establishment sizes to classify single-facility entities as small or large. If a single-facility entity is "very small" or "small" in the USDA data, EPA classified it as a small entity, and if a single-facility entity is "large" in the USDA data, EPA classified it as a large business.

Table 9-3 presents the total number of entities with meat and poultry processing as a primary business as well as the number and percentage of those entities determined to be small.

Table 9-3: Number of Entities by NAICS Code and Size				
NAICS Code	**Small Entity Size Standard (# of employees)**	**Entities in the MPP Industry**		
		Total	**# Small**	**% Small**
311611	1,150	276	260	94%
311612	1,000	341	322	94%
311613	750	23	19	83%
311615	1,250	146	121	83%
Total		**786**	**722**	**92%**
Source: U.S. EPA Analysis, 2023.				

9.4 Projected Compliance Requirements, Classes of Small Entities Subject to the Compliance Requirements, and Professional Skills Needed to Comply

9.4.1 Projected Compliance Requirements

As described in this RIA and in the preamble for this proposed rule, EPA is proposing a regulation to revise the technology-based ELGs for the MPP point source category. Under the proposed rule, MPP facilities (and their owners) would be required to implement control technologies upon which the proposed BAT and BPT limitations and pretreatment standards are based. MPP dischargers are not

required to use the technologies specified as the basis for the rule. They are free to identify other perhaps less expensive technologies as long as they meet the BAT limitations and pretreatment standards in the rule.

In addition to the installation of treatment technology, MPP facilities would be subject to new reporting and recordkeeping requirements (i.e., collect and ship samples, review and report pollutant data monthly, and develop compliance reports).

9.4.2 Classes of Small Entities Subject to the Compliance Requirements

The small entities that would be potentially directly regulated by this rule are small entities that engage in meat and/or poultry slaughter, further processing, and/or rendering.

9.4.3 Professional Skills Needed to Comply

EPA assumes that facility reporting and recordkeeping activity would require engineering support. For additional discussion of reporting and recordkeeping activity, see the Information Collection Request Supporting Statement (U.S Environmental Protection Agency, 2023).

9.5 Other Federal Rule that may Duplicate, Overlap, or Conflict with the Proposed Rule

EPA is revising the existing ELGs, which were last revised in 2004. These proposed revisions do not duplicate, overlap, or conflict with any other existing federal rules.

9.6 Potential Economic Impact on Small Entities

As outlined in the introduction to this chapter, two criteria are assessed in determining whether the regulatory options would qualify for a no-SISNOSE finding:

- Is the *absolute number* of small entities estimated to incur a potentially significant impact, as described above, *substantial*?

and

- Do these *significant impact* entities represent a *substantial* fraction of small entities in the MPP industry that could potentially be within the scope of a regulation?

A measure of the potential impact of the regulatory options on small entities is the fraction of small entities that have the potential to incur a significant impact. For example, if a high percentage of potentially small entities incur significant impacts *even though the absolute number of significant impact entities is low*, then the rule could represent a substantial burden on small entities.

To assess the extent of economic/financial impact on small entities, EPA compared estimated compliance costs to estimated entity revenue (a comparison also referred to as the "sales test"). The analysis is based on the ratio of estimated annualized after-tax compliance costs to annual revenue of the entity. For this analysis, EPA categorized entities according to the magnitude of economic impacts that entities would incur due to the regulatory options. EPA identified entities for which annualized compliance costs are at least one percent and three percent of revenue. EPA then evaluated the absolute number and the percent of entities in each impact category.

The Agency assumed that entities incurring costs below one percent of revenue are unlikely to face significant economic impacts, while entities with costs of at least one percent of revenue have a higher chance of facing significant economic impacts, and entities incurring costs of at least three percent of revenue have a still higher probability of significant economic impacts. Consistent with the parent-level cost-to-revenue analysis discussed in Chapter 4, EPA assumed that MPP facilities, and consequently, their parents, would not be able to pass any of the increase in their production costs to consumers (zero cost pass-through). This assumption is used for analytic convenience and provides a worst-case scenario of regulatory impacts to MPP facilities. As discussed in Chapter 8, entities can be expected to pass on some of their compliance costs upstream and/or downstream although the analysis in Chapter 8 show small market impacts.

A detailed summary of how EPA developed these entity-level compliance cost and revenue values is presented in Chapter 3 and Chapter 4.

As described above, EPA developed estimates of the number of small parent entities in the specified CTR impact ranges. Table 9-4 presents the results of the CTR test for all entities that own MPP dischargers. EPA conservatively assumes that entities with an unidentified size are large. While this assumption potentially reduces the number of identified small entities, it provides a conservative estimate of the *percentage* of small entities with impacts, since none of the entities with an unidentified size have a CTR ratio greater than one percent under any of the regulatory options.

Table 9-4: Entity-Level CTR Analysis Results by Entity Type											
		Aggregate Costs (in millions, 2022$)	Cost per entity (in millions, 2022$)[c]	Number Entities with a Ratio of				Percent of Entities with a Ratio of			
Entity Type	Total # of Entities			0%[a]	> 0 and <1%	≥1 and <3%	≥3%	0%[a]	> 0 and <1%	≥1 and <3%	≥3%
Option 1											
Small	2,296	$22.3	$0.01	2,200	95	1	0	96%	4%	0.0%	0.0%
Large	725	$187.5	$0.3	443	280	2	0	61%	39%	0.3%	0.0%
Unidentified size[b]	93	$0.6	$0.01	74	19	0	0	80%	20%	0.0%	0.0%
Total	3,114	$210.3	$0.1	2,717	394	3	0	87%	13%	0.1%	0.0%
Option 2											
Small	2,296	$78.5	$0.03	2,200	94	1	1	96%	4%	0.0%	0.0%
Large	725	$502.4	$0.7	443	280	2	0	61%	39%	0.3%	0.0%
Unidentified size[b]	93	$9.6	$0.1	74	19	0	0	80%	20%	0.0%	0.0%
Total	3,114	$590.4	$0.2	2,717	393	3	1	87%	13%	0.1%	0.0%
Option 3											
Small	2,296	$168.6	$0.1	2,034	247	11	4	89%	11%	0%	0%
Large	725	$806.1	$1.1	23	699	3	0	3%	96%	0%	0%
Unidentified size[b]	93	$20.9	$0.2	61	32	0	0	66%	34%	0%	0%
Total	3,114	$995.6	$0.3	2,118	978	14	4	68%	31%	0%	0%
Option 1 with chlorides											
Small	2,296	$50.8	$0.02	2,158	136	1	1	94%	6%	0.0%	0.0%
Large	725	$300.8	$0.4	432	291	2	0	60%	40%	0.3%	0.0%
Unidentified size[b]	93	$2.6	$0.0	69	24	0	0	74%	26%	0.0%	0.0%
Total	3,114	$354.1	$0.1	2,659	451	3	1	85%	14%	0.1%	0.0%
Option 2 with chlorides											
Small	2,296	$106.9	$0.05	2,158	136	1	1	94%	6%	0.0%	0.0%
Large	725	$615.7	$0.8	432	291	2	0	60%	40%	0.3%	0.0%
Unidentified size[b]	93	$11.6	$0.1	69	24	0	0	74%	26%	0.0%	0.0%
Total	3,114	$734.2	$0.2	2,659	451	3	1	85%	14%	0.1%	0.0%
Option 3 with chlorides											
Small	2,296	$197.1	$0.1	2,034	247	11	4	89%	11%	0%	0%

Table 9-4: Entity-Level CTR Analysis Results by Entity Type

Entity Type	Total # of Entities	Aggregate Costs (in millions, 2022$)	Cost per entity (in millions, 2022$)[c]	Number Entities with a Ratio of				Percent of Entities with a Ratio of			
				0%[a]	> 0 and <1%	≥1 and <3%	≥3%	0%[a]	> 0 and <1%	≥1 and <3%	≥3%
Large	725	$919.4	$1.3	23	699	3	0	3%	96%	0%	0%
Unidentified size[b]	93	$22.9	$0.2	61	32	0	0	66%	34%	0%	0%
Total	3,114	$1,139.4	$0.4	2,118	978	14	4	68%	31%	0%	0%

a. These entities own only facilities that already meet discharge requirements for the wastestreams addressed by a given regulatory option and are therefore not estimated to incur any compliance technology costs. Entities with no MPP dischargers are excluded from this table.

b. EPA could not identify the small business status of these entities since their revenue or employment values fall between the thresholds presented in Table 9-2.

c. EPA calculated the cost per entity by dividing aggregate costs by the total number of entities.

Source: U.S. EPA Analysis, 2023

Overall, this analysis suggests that the analyzed regulatory options are unlikely to have a significant economic impact or a substantial impact on small entities. Table 9-5 summarizes the results of the analysis.

Table 9-5: Estimated Cost-to-Revenue Impact on Small Parent Entities, by Facility Type

Type of dischargers owned by parent entities	Cost-to-revenue			
	≥1%		≥3%[a]	
	Number of small entities	% of all small entities[b]	Number of small entities	% of all small entities[b]
Option 1				
Direct only	1	3%	0	0%
Indirect only	0	0%	0	0%
Both	0	0%	0	0%
Total	**1**	**3%**	**0**	**0%**
Option 2				
Direct only	1	3%	0	0%
Indirect only	0	0%	1	0%
Both	0	0%	0	0%
Total	**1**	**3%**	**1**	**0%**
Option 3				
Direct only	1	3%	1	3%
Indirect only	9	1%	3	0%
Both	1	13%	0	0%
Total	**11**	**16%**	**4**	**4%**
Option 1 with chlorides				
Direct only	1	3%	0	0%
Indirect only	0	0%	1	0%
Both	0	0%	0	0%
Total	**1**	**3%**	**1**	**0%**
Option 2 with chlorides				
Direct only	1	3%	0	0%
Indirect only	0	0%	1	0%
Both	0	0%	0	0%
Total	**1**	**3%**	**1**	**0%**
Option 3 with chlorides				
Direct only	1	3%	1	3%
Indirect only	9	0%	3	0%
Both	1	13%	0	0%
Total	**11**	**16%**	**4**	**4%**

a. The number of entities with cost-to-revenue impact of at least three percent is a subset of the number of entities with such ratios exceeding one percent.

b. The percent of all small entities is rounded.

Source: U.S. EPA Analysis, 2023

Table 9-6 presents aggregate revenue and costs for small firms by process type. EPA summed process type-specific production for all facilities owned by each parent entity and assigned process type at the firm-level based on the category with the highest production. For small firms with costs under each of the

regulatory options, EPA summed firm-level revenue (based on the approach to estimating revenue described in Sections 4.3.1.3 and 9.3.2) and costs. Of the 2,296 small firms EPA identified, 96 would incur $22.3 million in costs under Option 1 (also reported in Table 9-4). EPA estimated an aggregate revenue of approximately $180 billion.

Table 9-6: Aggregate Revenue and Costs for Small Firms by Process Type

Option 1				
Process Type[a]	Total # Small Firms with Dischargers	Total # Small Firms with Costs	Aggregate Revenue (millions, 2022$)	Aggregate Costs (millions, 2022$)
Meat first	372	22	$83,328	$4.5
Meat further	1,799	31	$61,517	$0.1
Poultry first	55	16	$20,008	$13.6
Poultry further	47	20	$9,363	$3.0
Render	23	7	$6,019	$1.0
Total	2,296	96	$180,235	$22.3
Option 2				
Process Type[a]	Total # Small Firms with Dischargers	Total # Small Firms with Costs	Aggregate Revenue (millions, 2022$)	Aggregate Costs (millions, 2022$)
Meat first	372	22	$83,328	$32.7
Meat further	1,799	31	$61,517	$0.1
Poultry first	55	16	$20,008	$41.6
Poultry further	47	20	$9,363	$3.0
Render	23	7	$6,019	$1.0
Total	2,296	96	$180,235	$78.5
Option 3				
Process Type[a]	Total # Small Firms with Dischargers	Total # Small Firms with Costs	Aggregate Revenue (millions, 2022$)	Aggregate Costs (millions, 2022$)
Meat first	372	54	$97,768	$44.8
Meat further	1,799	149	$151,897	$38.8
Poultry first	55	25	$20,627	$63.1
Poultry further	47	25	$9,521	$11.9
Render	23	9	$6,029	$10.0
Total	2,296	262	$285,841	$168.6

a. Process type assigned to firms based on highest production.

9.7 Minimization of Economic Impacts on Small Entities Consistent with Statutory Objectives, and Consideration of Alternatives

As described in the introduction to this chapter, the RFA requires federal agencies to consider the impact of their regulatory actions on small entities and to analyze alternatives that minimize those impacts. As shown in Table 1-1, EPA defined the regulatory options to exclude the smallest facilities and reduce impacts on small businesses. In conjunction with the Office of Management and Budget and the Small Business Administration, EPA convened a Small Business Advocacy Review (SBAR) panel, and EPA adopted the recommendations of the panel. The SBAR panel was meant to give small businesses an opportunity to provide input into the rulemaking process to ensure that their unique concerns were carefully considered. As detailed in this chapter, EPA conducted a SBREFA screening analysis which demonstrates that none of the considered options are likely to have a significant impact on a substantial number of small businesses within the MPP industry. Therefore, the rule is presumed not to have a

significant economic impact on a substantial number of small entities, and the EPA certifies that the proposed rule has no SISNOSE.

9.8 Uncertainties and Limitations

Despite EPA's use of the best available information and data, the IRFA discussed in this chapter has sources of uncertainty, including:

- EPA was unable to identify NAICS codes, revenue, or employment information for some parent entities and therefore could not determine their small business status. EPA also could not determine the small business status of entities whose revenue or employment values are between the minimum and maximum SBA thresholds. While these data gaps limit EPA's ability to fully characterize impacts on small entities, none of the entities of undetermined size under any regulatory option were assessed to have costs greater than 1 percent of revenue and therefore the findings that the analyzed regulatory options are unlikely to have a significant economic impact or a substantial impact on small entities would hold even if the Agency were to conservatively assume that all of the entities of undetermined size are small.

- In cases where EPA estimated entity-level revenue from facility revenue, there is uncertainty regarding both an entity's small business designation and ratio of costs to revenue, as actual facility and entity revenue may differ from estimated revenue.

- EPA's assumptions regarding small business determinations based on USDA establishment size do not account for firm-specific NAICS codes and SBA thresholds. In addition, the information is self-reported to USDA and may contain errors. As a result, some firms may be misclassified as small or large based on this approach. However, EPA considers its assumptions to be reasonable based on USDA's establishment size definitions and the typical small business thresholds across relevant industries.

- As discussed in Chapter 4, the zero-cost pass-through assumption represents a worst-case scenario from the perspective of the facilities and parent entities. To the extent that some entities can pass at least some compliance costs downstream to consumers or upstream to farmers, this analysis overstates the potential impact of the regulatory options on small entities.

- If EPA could not find ownership data for a facility, the Agency assumed that facility is a single-facility entity. As a result, the analysis may be underestimating entity-level compliance costs if an entity classified as a single-facility entity owns multiple facilities, but the ratio of costs to revenue could be smaller or larger depending on the overall entity revenue.

10 Unfunded Mandates Reform Act (UMRA) Analysis

Title II of the Unfunded Mandates Reform Act of 1995, Pub. L. 104-4, requires that federal agencies assess the effects of their regulatory actions on State, local, and Tribal governments and the private sector. Under UMRA section 202, EPA generally must prepare a written statement, including a cost-benefit analysis, for proposed and final rules with "Federal mandates" that might result in expenditures by State, local, and Tribal governments, in the aggregate, or by the private sector, of $100 million (adjusted annually for inflation) or more in any one year (*i.e.*, about $184 million in 2022 dollars). Before promulgating a regulation for which a written statement is needed, UMRA section 205 generally requires EPA to "identify and consider a reasonable number of regulatory alternatives and adopt the least costly, most cost-effective, or least burdensome alternative that achieves the objectives of the rule." (2 U.S.C. 1535(a)) The provisions of section 205 do not apply when they are inconsistent with applicable law. Moreover, section 205 allows EPA to adopt an alternative other than the least costly, most cost-effective, or least burdensome alternative, if the Administrator publishes with the rule an explanation of why that alternative was not adopted. Before EPA establishes any regulatory requirements that might significantly or uniquely affect small governments, including Tribal governments, it must develop a small government agency plan, under UMRA section 203. The plan must provide for notifying potentially affected small governments, enabling officials of affected small governments to have meaningful and timely input in the development of EPA regulatory proposals with significant intergovernmental mandates, and informing, educating, and advising small governments on compliance with regulatory requirements.

EPA estimated the compliance costs associated with each of the regulatory options for different categories of entities. No MPP facilities are owned by government entities, nor do the regulatory options result in material administrative costs to government entities. The proposed rule therefore does not contain a federal mandate on the basis of expenditures incurred by State, local, and Tribal governments. The *maximum* compliance cost *in any given year* to the private sector ranges from $1,034 million under Option 1 to $6,388 million under Option 3 with chlorides. Accordingly, EPA determined that the proposed rule does contain a federal mandate that may result in expenditures of $184 million (in 2022 dollars) or more for the private sector in any one year.

This chapter contains additional information to support the above statements, including information on compliance and administrative costs, and on impacts to small governments. The annualized costs presented in this UMRA analysis are calculated using the social cost framework presented in Chapter 3 of this RIA. Specifically, this analysis uses costs in 2024 stated in 2022 dollars and accounts for costs in the year they are anticipated to be incurred between 2024 and 2063. The discounted stream of costs is then annualized over a 40-year period. As discussed in Chapter 11 (Other Administrative Requirements; see Section 11.6) in this document, this proposed rule would increase the reporting and recordkeeping burden for the review, oversight, and administration of the rule relative to baseline requirements.

10.1 UMRA Analysis of Impact on Government Entities and the Private Sector

This section reports the compliance costs projected to be incurred by government and private entities.

Table 10-1 summarizes the total annualized costs (at a 3 percent discount rate), maximum one-year costs, and the year when maximum costs are incurred by government entities and the private sector. EPA

estimates the total annualized pre-tax compliance costs for private entities to range from $232 million under Option 1 to $1,234 million under Option 3 with chlorides.

Table 10-1: Compliance Costs by Sector (in millions, 2022$)

Sector	Total Annualized Costs (3%)	Maximum One-Year Costs	Year of Maximum Costs
Option 1			
Government (excl. federal)	$0.2	$0.5	2028
Private	$231.5	$365.2	2049
Option 2			
Government (excl. federal)	$0.2	$0.5	2028
Private	$642.5	$2,403.2	2028
Option 3			
Government (excl. federal)	$0.4	$0.9	2028
Private	$1,076.7	$4,941.0	2028
Option 1 with chlorides			
Government (excl. federal)	n.e.	n.e.	n.e.
Private	$389.2	$879.8	2028
Option 2 with chlorides			
Government (excl. federal)	n.e.	n.e.	n.e.
Private	$800.2	$2,930.4	2028
Option 3 with chlorides			
Government (excl. federal)	n.e.	n.e.	n.e.
Private	$1,234.4	$5,468.3	2028

n.e. = not estimated

Source: U.S. EPA Analysis, 2023.

10.2 UMRA Analysis Summary

EPA estimates that the private sector would incur expenditures greater than $184 million, in the aggregate, in any one year. Furthermore, as discussed above, permitted facilities and permitting authorities are estimated to incur minor additional administrative costs as the result of the regulatory options.

11 Other Administrative Requirements

This chapter presents analyses conducted in support of the regulatory options to address the requirements of applicable Executive Orders and Acts. These analyses complement EPA's assessment of the compliance costs, economic impacts, and economic achievability of the proposed rule, and other analyses done in accordance with the RFA and UMRA, presented in previous chapters.

11.1 Executive Order 12866: Regulatory Planning and Review and Executive Order 14094: Modernizing Regulatory Review

Under Executive Order (E.O.) 12866 (58 FR 51735, October 4, 1993), as amended by E.O. 13563 (76 FR 3821, January 21, 2011)[28] and E.O. 14094 (88 FR 21879, Apr. 11, 2023), EPA must determine whether the regulatory action is "significant" and therefore subject to review by the Office of Management and Budget (OMB) and other requirements of the Executive Order. The order defines a "significant regulatory action" as one that is likely to result in a regulation that may:

- Have an annual effect on the economy of $200 million or more (adjusted every 3 years by the Administrator of the Office of Information and Regulatory Affairs (OIRA) for changes in gross domestic product), or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local, or Tribal governments or communities; or
- Create a serious inconsistency or otherwise interfere with an action taken or planned by another agency; or
- Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or
- Raise novel legal or policy issues for which centralized review would meaningfully further the President's priorities or the principles set forth in this Executive order, as specifically authorized in a timely manner by the Administrator of OIRA in each case.

Pursuant to the terms of E.O. 12866, as amended by E.O. 14094, EPA determined that the proposed rule is a "significant regulatory action" because the action is likely to have an annual effect on the economy of $200 million or more. As such, the action is subject to review by OMB. Any changes made in response to OMB suggestions or recommendations will be documented in the docket for this action.

EPA prepared an analysis of the potential benefits and costs associated with this action; this analysis is described in Chapter 8 of the BCA (U.S. Environmental Protection Agency, 2023a).

[28] E.O. 13563 was issued on January 18, 2011 and supplements Executive Order 12866 by outlining the President's regulatory strategy to support continued economic growth and job creation, while protecting the safety, health and rights of all Americans. E.O. 13563 requires considering costs, reducing burdens on businesses and consumers, expanding opportunities for public involvement, designing flexible approaches, ensuring that sound science forms the basis of decisions, and retrospectively reviewing existing regulations.

11.2 Executive Order 12898: Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, Executive Order 14008: Tackling the Climate Crisis at Home and Abroad, and Executive Order 14096: Revitalizing our Nation's Commitment to Environmental Justice for All

Executive Order 12898 (59 FR 7629 (Feb. 16, 1994)) establishes federal executive policy on environmental justice. Its main provision directs federal agencies, to the greatest extent practicable and permitted by law, to make environmental justice part of their mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations in the United States. Executive Order 14008 (86 FR 7619, February 1, 2021) expands on the policy objectives established in E.O.12898 and directs federal agencies to develop programs, policies, and activities to address the disproportionately high and adverse human health, environmental, climate-related and other cumulative impacts on disadvantaged communities, as well as the accompanying economic challenges of such impacts.

EPA analyzed the distribution of impacts of this proposed regulatory action across all potentially affected communities and sought input from stakeholders representing communities with potential EJ concerns. The analysis included a literature search of the effects MPP operations may have on potential population groups of concern, multiple analyses to identify which communities and populations within tribal areas may be impacted by MPP facilities, and an assessment of how water quality improvements may be distributed across population groups. Findings from these analyses are listed below:

- The relevant literature reviewed in this effort suggests that communities and surrounding watersheds in close proximity to MPP facilities could be at risk of pollutant exposure via wastewater piped directly into waterways, sprayed onto land, or sent to a nearby town or county wastewater treatment plant, even with some level of treatment. The literature suggested that these communities are frequently located in rural, low-income communities (Pelton, 2018; The Environmental Integrity Project, 2018; Winders et al., 2021).

- EPA found that approximately 26 million people live within one mile of an MPP facility, and communities within this buffer distance have greater proportions of low-income individuals and individuals identifying as Asian, Black, and/or Hispanic than the national average. EPA also found that communities living within one mile of the 25-mile downstream path from MPP direct discharge process wastewater outfalls had a higher proportion of low-income individuals than the national average.

- EPA estimated that over 7.5 million people are served by a public water system (PWS) whose source water is downstream of an MPP direct discharge process wastewater outfall. EPA found that these communities have greater proportions of low-income individuals and those identifying as Black individuals than the national average.

- EPA estimates that around 13 million people live within 50 miles of the downstream path from an MPP direct discharge process wastewater outfall (representing the population that may be willing to travel to those waterbodies to fish) and that communities within that distance have greater proportions of low-income individuals than the national average.

- EPA found that there are 10 unique direct dischargers in the general proximity (within five miles) of seven unique tribal lands and 135 unique indirect dischargers in the general proximity of 66 unique tribal lands. EPA also found that there are 50 unique MPP direct dischargers whose downstream flowpath is within 50 miles of 44 unique tribal areas.

- As a result of these analyses, EPA presented an overview of the rulemaking to the Office of Environmental Justice and External Civil Rights management team and held a discussion session with participants of the National Environmental Justice Community Engagement Call in early 2023.

See Chapter 7 of the EA for additional discussion of the EJ analysis (U.S. EPA, 2023b).

11.3 Executive Order 13045: Protection of Children from Environmental Health Risks and Safety Risks

Executive Order 13045 (62 FR 19885, April 23, 1997) applies to any rule that (1) is determined to be "economically significant" as defined under Executive Order 12866 and (2) concerns an environmental health or safety risk that EPA has reason to believe might have a disproportionate effect on children. If the regulatory action meets both criteria, the Agency must evaluate the environmental health and safety effects of the planned rule on children and explain why the planned regulation is preferable to other potentially effective and reasonably feasible alternatives considered by the Agency.

This action is not subject to E.O. 13045 because the EPA does not believe the environmental health risks or safety risks addressed by this action present a disproportionate risk to children.

11.4 Executive Order 13132: Federalism

Executive Order 13132 (64 FR 43255, August 10, 1999) requires EPA to develop an accountable process to ensure "meaningful and timely input by State and local officials in the development of regulatory policies that have federalism implications." Policies that have federalism implications are defined in the Executive Order to include regulations that have "substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government."

Under section 6 of Executive Order 13132, EPA may not issue a regulation that has federalism implications, that imposes substantial direct compliance costs, and that is not required by statute unless the federal government provides the funds necessary to pay the direct compliance costs incurred by State and local governments or unless EPA consults with State and local officials early in the process of developing the regulation. EPA also may not issue a regulation that has federalism implications and that preempts State law, unless the Agency consults with State and local officials early in the process of developing the regulation.

EPA has concluded that this action will not have federalism implications. No MPP facilities are owned by government entities. As discussed in earlier chapters of this document, EPA anticipates that the proposed rule will impose only a minor incremental administrative burden on States from issuing, reviewing, and overseeing compliance with discharge requirements.

EPA estimated the compliance costs associated with each of the regulatory options for different categories of entities. The *maximum* compliance cost *in any given year* to government entities is $0.5 million under Options 1 and 2, and $0.9 million under Option 3. The *maximum* compliance cost *in any given year* to the private sector ranges from $365.2 million under Option 1 to $5,468.3 million under Option 3 with chlorides (see Chapter 9, *Unfunded Mandates Reform Act (UMRA)*, for details).

11.5 Executive Order 13175: Consultation and Coordination with Indian Tribal Governments

Executive Order 13175 (65 FR 67249, November 6, 2000) requires EPA to develop an accountable process to ensure "meaningful and timely input by tribal officials in the development of regulatory policies that have tribal implications." "Policies that have tribal implications" is defined in the Executive Order to include regulations that have "substantial direct effects on one or more Indian Tribes, on the relationship between the Federal government and the Indian Tribes, or on the distribution of power and responsibilities between the federal government and Indian Tribes."

EPA assessed potential tribal implications for the regulatory options arising from three main changes, as described below: (1) direct compliance costs incurred by MPP facilities; (2) impacts on drinking water systems downstream from MPP dischargers; and (3) administrative burden on governments that implement the NPDES program.

- Direct compliance costs: EPA's analyses show that no MPP facility estimated to be affected by the regulatory options is owned by tribal governments.
- Impacts on drinking water systems: Building from the drinking water service are analysis described in Section 7.4 of the Environmental Assessment, EPA determined that none of the impacted drinking water systems are located on tribal land or operated by a tribe.
- Administrative burden: No tribal governments are currently authorized pursuant to section 402(b) of the CWA to implement the NPDES program.

Due to the above findings, EPA determined that EO 13175 does not apply to this rulemaking. However, consistent with EPA Policy on Consultation and Coordination with Indian Tribes, EPA consulted with tribal officials during the development of this action.

Before initiating outreach, EPA conducted a proximity analysis to determine potential impacts MPP facilities and their wastewater discharge may have to tribes or tribal lands. First, EPA screened a five-mile buffer zone around each direct discharging MPP facility. Over with these buffers and EJSCREEN tribal datasets, which include including National Land Area Representation, American Indian Alaska Native, and Tribal Statistical Areas, was determined. Through this analysis, EPA identified 145 MPP facilities in the general proximity of 73 unique tribal lands.[29] Second, to identify potential surface waters that may be used or valued by tribes that are impacted by MPP wastewater discharge, the overlap between 50-mile buffers[30] around 25-mile flow paths downstream of MPP process wastewater outfalls and EJSCREEN

[29] Within a five mile distance of

[30] The 50-mile buffer distance is based on observations of fishers' behavior and practices have made similar observations in terms travel distance (e.g., Sohngen et al., 2015 and Sea Grant - Illinois-Indiana, 2018).

tribal area datasets were determined. This analysis resulted in 46 unique tribal areas identified as having overlap with these buffer zones.

EPA initiated consultation and coordination with federally recognized tribal governments in January 2023. EPA shared information about the Meat and Poultry Products effluent guidelines rulemaking (MPP ELG) with all federally recognized tribes by sending a letter and detailed plan describing the rulemaking (available in the docket), the potential impact to tribes, and opportunities for tribal involvement. Tribes identified as being in close proximity to either 10 or more MPP facilities or a waterbody potentially impacted by MPP wastewater discharge, were notified of these screening results in the letter they were sent to promote awareness.[31]

EPA continued this government-to-government dialogue by hosting two identical listening sessions as webinars on February 6 and 13, 2023, attended by ten and seven tribal representatives, respectively. Tribal representatives were invited to participate in further discussions about the rulemaking process and objectives, with a focus on identifying specific ways the rulemaking may affect tribes.

The consultation process ended on March 10, 2023. No tribal governments requested direct government-to-government consultations, and EPA has not received written comments from any tribes to date.

11.6 Paperwork Reduction Act of 1995

The Paperwork Reduction Act of 1995 (PRA) (superseding the PRA of 1980) is implemented by OMB and requires that agencies submit a supporting statement to OMB for any information collection that solicits the same data from more than nine parties. The PRA seeks to ensure that Federal agencies balance their need to collect information with the paperwork burden imposed on the public by the collection.

The definition of "information collection" includes activities required by regulations, such as permit development, monitoring, record keeping, and reporting. The term "burden" refers to the "time, effort, or financial resources" the public expends to provide information to or for a Federal agency, or to otherwise fulfill statutory or regulatory requirements. PRA paperwork burden is measured in terms of annual time and financial resources the public devotes to meet one-time and recurring information requests (44 U.S.C. 3502(2); 5 C.F.R. 1320.3(b)). Information collection activities may include:

- reviewing instructions;
- using technology to collect, process, and disclose information;
- adjusting existing practices to comply with requirements;
- searching data sources;
- completing and reviewing the response; and
- transmitting or disclosing information.

[31] The statistics reported in these letters have since been updated to reflect the most current MPP facility location information and therefore are not aligned with the data presented in this analysis.

Agencies must provide information to OMB on the parties affected, the annual reporting burden, the annualized cost of responding to the information collection, and whether the request significantly impacts a substantial number of small entities. An agency may not conduct or sponsor, and a person is not required to respond to, an information collection unless it displays a currently valid OMB control number.

EPA is proposing new reporting and recordkeeping requirements under 40 CFR Part 432.[32] The proposed rule would require:

- Certain MPP facilities to control for additional pollutants, resulting in new burden for completion of a compliance monitoring program (i.e., burden to collect and ship samples, review and report pollutant data monthly, and develop compliance reports).
- Control authorities to establish monitoring requirements and review pollutant data submitted by MPP facilities.
- EPA to review pollutant data submitted by MPP facilities.

Table 11-1 Facilities will incur additional O&M costs through sampling materials, sample preservation, shipping, and sample analysis costs. Under the preferred option (Option 1), the estimated total annual O&M costs are $1,338,087. There are no capital costs associated with any of the monitoring or reporting. For additional discussion of this estimated burden, see the Information Collection Request Supporting Statement (U.S Environmental Protection Agency, 2023).

11.7 National Technology Transfer and Advancement Act

Section 12(d) of the National Technology Transfer and Advancement Act (NTTAA) of 1995, Pub L. No. 104-113, Sec. 12(d) directs EPA to use voluntary consensus standards in its regulatory activities unless doing so would be inconsistent with applicable law or otherwise impractical. Voluntary consensus standards are technical standards (*e.g.*, materials specifications, test methods, sampling procedures, and business practices) that are developed or adopted by voluntary consensus standard bodies. The NTTAA directs EPA to provide Congress, through the OMB, explanations when the Agency decides not to use available and applicable voluntary consensus standards.

The regulatory options do not involve technical standards, for example in the measurement of pollutant loads. Nothing in the regulatory options would prevent the use of voluntary consensus standards for such measurement where available, and EPA encourages permitting authorities and regulated entities to do so. Therefore, EPA did not include any voluntary consensus standards in the proposed rule.

[32] OMB has assigned control number 2040-0306 to this information collection request (ICR number 2701.02).

12 Cited References

A. Soliman, M. (1971). Econometric Model of the Turkey Industry in the United States. *Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie, 19*(2), 47-60. doi:https://doi.org/10.1111/j.1744-7976.1971.tb01151.x

Ahmad, S., & Riker, D. (2020). Updated Estimates of the Trade Elasticity of Substitution. *US International Trade Commission, Economics Working Paper*.

Brennan, T., Katz, J., Quint, Y., & Spencer, B. (2021). *Cultivated meat: Out of the lab, into the frying pan*. Retrieved from McKinsey & Company Our Insights: https://www.mckinsey.com/industries/agriculture/our-insights/cultivated-meat-out-of-the-lab-into-the-frying-pan

Chavas, J.-P. (1982). On the Use of Price Ratio in Aggregate Supply Response: Some Evidence from the Poultry Industry. *Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie, 30*(3), 345-358. doi:https://doi.org/10.1111/j.1744-7976.1982.tb01990.x

Chavas, J.-P., & Johnson, S. R. (1982). Supply Dynamics: The Case of U.S. Broilers and Turkeys. *American journal of agricultural economics, 64*(3), 558-564. doi:10.2307/1240650

Deese, B., Fazili, S., & Ramamurti, B. (2021a). Addressing Concentration in the Meat-Processing Industry to Lower Food Prices for American Families [Press release]. Retrieved from https://www.whitehouse.gov/briefing-room/blog/2021/09/08/addressing-concentration-in-the-meat-processing-industry-to-lower-food-prices-for-american-families/

Deese, B., Fazili, S., & Ramamurti, B. (2021b). Recent Data Show Dominant Meat Processing Companies Are Taking Advantage of Market Power to Raise Prices and Grow Profit Margins [Press release]. Retrieved from https://www.whitehouse.gov/briefing-room/blog/2021/12/10/recent-data-show-dominant-meat-processing-companies-are-taking-advantage-of-market-power-to-raise-prices-and-grow-profit-margins/

Economic Research Service. (2023a). Livestock and Meat Domestic Data. from United States Department of Agriculture https://www.ers.usda.gov/data-products/livestock-and-meat-domestic-data/

Economic Research Service. (2023b). Livestock and Meat International Trade Data. from United States Department of Agriculture https://www.ers.usda.gov/data-products/livestock-and-meat-international-trade-data/

Epple, D., & McCallum, B. T. (2006). Simultaneous equation econometrics: the missing example. *Economic inquiry, 44*, 374+.

Food and Agriculture Organization. (2022). FAOSTAT. from United Nations https://www.fao.org/faostat/en/#data

Haley, M. (2020). Livestock, Dairy, and Poultry Monthly Outlook: May 2020. from USDA ERS https://www.ers.usda.gov/publications/pub-details/?pubid=98462

Haley, M., & Matthews, K. (2015a). Livestock, Dairy, amd Poultry Monthly Outlook: April 2015. https://www.ers.usda.gov/publications/pub-details/?pubid=37607

Haley, M., & Matthews, K. (2015b). Livestock, Dairy, and Poultry Outlook: April 2015. from USDA ERS https://www.ers.usda.gov/publications/pub-details/?pubid=37607

Haley, M., & Matthews, K. (2016). Livestock, Dairy, and Poultry Outlook: April 2016. from USDA ERS https://www.ers.usda.gov/publications/pub-details/?pubid=37661

Holt, M. T., & Aradhyula, S. V. (1990). Price Risk in Supply Equations: An Application of GARCH Time-Series Models to the U. S. Broiler Market. *Southern Economic Journal, 57*(1), 230-242. doi:10.2307/1060492

Holt, M. T., & Johnson, S. R. (1988). Supply Dynamics in the U.S. Hog Industry. *Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie, 36*(2), 313-335. doi:https://doi.org/10.1111/j.1744-7976.1988.tb03278.x

Jeong, S. (2019). *The Change in Price Elasticities in the US Beef Cattle Industry and the Impact of Futures Prices in Estimating the Price Elasticities*. Retrieved from

Knight, R., Hahn, W., Taylor, H., Terán, A., Haley, M., Grossen, G., & Valcu-Lisman, A. (2023). Livestock, Dairy, and Poultry Outlook: April 2023. from USDA ERS https://www.ers.usda.gov/publications/pub-details/?pubid=106355

Lee, J. Y., Qian, Y., Gustavsen, G. W., Nayga Jr, R. M., & Rickertsen, K. (2020). Effects of consumer cohorts and age on meat expenditures in the United States. *Agricultural Economics, 51*(4), 505-517. doi:https://doi.org/10.1111/agec.12568

MacDonald, J. M., Hoppe, R. A., & Newton, D. (2018). *Three decades of consolidation in US agriculture*. Retrieved from https://www.ers.usda.gov/publications/pub-details/?pubid=88056#:~:text=Crop%20production%20has%20seen%20a,the%20associated%20cow%2Dcalf%20sector.

MacDonald, J. M., & Ollinger, M. E. (2000). Scale Economies and Consolidation in Hog Slaughter. *American journal of agricultural economics, 82*(2), 334-346.

MacDonald, J. M., Ollinger, M. E., Nelson, K. E., & Handy, C. R. (2000). *Consolidation in US meatpacking*. Retrieved from https://www.ers.usda.gov/publications/pub-details/?pubid=41120

Marsh, J. M. (1994). Estimating Intertemporal Supply Response in the Fed Beef Market. *American journal of agricultural economics, 76*(3), 444-453. doi:https://doi.org/10.2307/1243656

McKendree, M. G. S., Tonsor, G. T., Schroeder, T. C., & Hendricks, N. P. (2020). Impacts of Retail and Export Demand on United States Cattle Producers. *American journal of agricultural economics, 102*(3), 866-883. doi:https://doi.org/10.1093/ajae/aaz034

Meilke, K. D., Zwart, A. C., & Martin, L. J. (1974). NORTH AMERICAN HOG SUPPLY: A COMPARISON OF GEOMETRIC AND POLYNOMIAL DISTRIBUTED LAG MODELS*. *Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie, 22*(2), 15-30. doi:https://doi.org/10.1111/j.1744-7976.1974.tb00925.x

National Institute of Standards and Technology. (2022). Jaro-Winkler. In P. E. Black (Ed.), *Dictionary of Algorithms and Data Structures*.

Newton, P., & Blaustein-Rejto, D. (2021). Social and Economic Opportunities and Challenges of Plant-Based and Cultured Meat for Rural Producers in the US. *Frontiters in Sustainable Food Systems, 5*, 11. doi:10.3389/fsufs.2021.624270

OECD/FAO. (2021). *OECD-FAO Agricultural Outlook 2021-2030*. Paris: OECD Publishing Retrieved from https://www.fao.org/3/cb5332en/cb5332en.pdf

Okrent, A., & Alston, J. (2012). *The demand for disaggregated food-away-from-home and food-at-home products in the United States*. Retrieved from

Ollinger, M., MacDonald, J. M., & Madison, M. (2005). Technological Change and Economies of Scale in U.S. Poultry Processing. *American journal of agricultural economics, 87*(1), 116-129.

Pelton, T. (2018). Investigation Finds 75 Percent of Large Slaughterhouses Violate Water Pollution Limits.

Sarmiento, C., & Allen, P. G. (2000). Estimating Intertemporal Supply Response in the Fed Beef Market: Comment. *American journal of agricultural economics, 82*(3), 630-634. doi:https://doi.org/10.1111/0002-9092.00052

Sea Grant - Illinois-Indiana. (2018). Lake Michigan anglers boost local Illinois and Indiana economies.

Sohngen, B., Zhang, W., Bruskotter, J., & Sheldon, B. (2015). Results from a 2014 survey of Lake Erie anglers. *Columbus, OH: The Ohio State University, Department of Agricultural, Environmental and Development Economics and School of Environment & Natural Resources*.

Tax Foundation. (2023). *State Corporate Income Tax Rates and Brackets for 2023*. Retrieved from https://taxfoundation.org/state-corporate-income-tax-rates-brackets-2023/

The Environmental Integrity Project. (2018). *Water Pollution from Slaughterhouses*. Retrieved from https://www.environmentalintegrity.org/wp-content/uploads/2018/10/Slaughterhouse_Report_Final.pdf

The National Provisioner. (n.d.). 2021 Top 100 Meat and Poultry Processors. Retrieved from https://www.provisioneronline.com/2021-top-100-meat-and-poultry-processors

U.S Environmental Protection Agency. (2023). *Information Collection Request Supporting Statement: Effluent Limitations Guidelines and Standards for the Meat and Poultry Products Category Proposed Rule*. Retrieved from https://www.epa.gov/system/files/documents/2022-03/mpp-icr-supporting-statement_feb-2022.pdf

U.S. Bureau of Economic Analysis. (2023). *Table 1.1.9 Implicit Price Deflators for Gross Domestic Product (GDP Deflator)*. Retrieved from https://apps.bea.gov/iTable/?reqid=19&step=3&isuri=1&1921=survey&1903=11

U.S. Census Bureau. (2017a). *2017 Core Business Statistics*. Retrieved from: https://www.census.gov/data/datasets/2017/econ/economic-census/naics-sector-00.html

U.S. Census Bureau. (2017b). *Manufacturing (NAICS Sector 31-33)*. Retrieved from: https://www.census.gov/data/tables/2017/econ/economic-census/naics-sector-31-33.html

U.S. Census Bureau. (2020). *Business Dynamics Statistics Datasets*. Retrieved from: https://www.census.gov/data/datasets/time-series/econ/bds/bds-datasets.html

U.S. Census Bureau. (2023). 2020 SUSB Annual Datasets by Establishment Industry. https://www.census.gov/data/datasets/2020/econ/susb/2020-susb.html

U.S. Department of the Treasury Internal Revenue Service. (2022). *Publication 946 (2022), How to Depreciate Property*. Retrieved from https://www.irs.gov/publications/p946#en_US_2020_publink1000107747

U.S. Department of the Treasury Internal Revenue Service. (2023). *Instructions for Form 1120 U.S. Corporate Income Tax Return*. Retrieved from https://www.irs.gov/pub/irs-pdf/i1120.pdf

U.S. Environmental Protection Agency. (2002). *Economic Analysis of Proposed Effluent Limitations Guidelines and Standards for the Meat and Poultry Products Industry*.

U.S. Environmental Protection Agency. (2006). *Final Guidance for EPA Rulewriters: Regulatory Flexibility Act as Amended by the Small Business Regulatory Enforcement Fairness Act*.

U.S. Environmental Protection Agency. (2023a). *Benefit and Cost Analysis for Revisions to the Effluent Limitations Guidelines and Standards for the Meat and Poultry Products Point Source Category*. Retrieved from

U.S. Environmental Protection Agency. (2023b). *Environmental Assessment for Revisions to the Effluent Limitations Guidelines and Standards for the Meat and Poultry Products Point Source Category*. Retrieved from

U.S. Environmental Protection Agency. (2023c). *Technical Development Document for Proposed Effluent Limitations Guidelines and Standards for the Meat and Poultry Products Point Source Category*. Retrieved from

U.S. Small Business Administration. (2017). *A Guide for Government Agencies: How to Comply With The Regulatory Flexibility Act*. Retrieved from https://advocacy.sba.gov/resources/the-regulatory-flexibility-act/a-guide-for-government-agencies-how-to-comply-with-the-regulatory-flexibility-act/

U.S. Small Business Administration. (2023). *Table of Small Business Size Standards Matched to North American Industry Classification System Codes. Effective March 17, 2023*. Retrieved from https://www.sba.gov/document/support-table-size-standards

USDA. (2022). Biden-Harris Administration Announces New Actions to Strengthen Food Supply Chains, Level the Playing FIeld for Growers, and Lower Prices for American Consumers [Press release]. Retrieved from https://www.usda.gov/media/press-releases/2022/05/26/biden-harris-administration-announces-new-actions-strengthen-food

Whitehead, D., & Kim, Y. H. B. (2022). The Impact of COVID 19 on the Meat Supply Chain in the USA: A Review. *Food Science of Animal Resources, 42*(5), 762.

Winders, D., & Abrell, E. (2021). Slaughterhouse Workers, Animals, and the Environment: The Need for a Rights-Centered Regulatory Framework in the United States That Recognizes Interconnected Interests. *Health and Human Rights Journal. Vol. 23: No. 2*.

Yang, R., Raper, K. C., & Pruitt, J. R. (2019). The influence of recession and income strata on consumer demand for protein sources. *Applied Economics, 51*(42), 4615-4628. doi:10.1080/00036846.2019.1593940

Appendix A. Proposed Rule Costs at 7 Percent Discount Rate

Table 12-1 and Table 12-2 present the total social costs of the proposed rule, discounted at 7 percent, by regulatory option and discharge type.

Table 12-1: Estimated Total Social Costs by Regulatory Option and Discharge Type (in millions, 2022$, at 2025)

Regulatory Option	7 percent discount rate		
	Direct	Indirect	Total
Option 1	$211.7	$15.3	$227.0
Option 2	$211.7	$420.0	$631.7
Option 3	$218.7	$848.9	$1,067.5
Option 1 with chlorides	$273.7	$107.9	$381.7
Option 2 with chlorides	$273.7	$512.7	$786.4
Option 3 with chlorides	$280.7	$941.5	$1,222.2

Source: U.S. EPA Analysis, 2023.

Table 12-2: Time Profile of Costs to Society (in millions, 2022$)

Year	Option 1	Option 2	Option 3	Option 1 with chlorides	Option 2 with chlorides	Option 3 with chlorides
2025	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
2026	$191.9	$191.9	$198.1	$251.1	$251.1	$257.3
2027	$229.7	$229.7	$237.2	$300.2	$300.2	$307.7
2028	$353.1	$2,403.8	$4,942.3	$880.4	$2,931.1	$5,469.5
2029	$321.7	$682.8	$1,043.3	$499.6	$860.7	$1,221.2
2030	$361.3	$722.4	$1,084.2	$550.4	$911.5	$1,273.4
2031	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2032	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2033	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2034	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2035	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2036	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2037	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2038	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2039	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2040	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2041	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2042	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2043	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2044	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2045	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2046	$316.1	$677.2	$1,037.6	$490.9	$852.0	$1,212.3
2047	$316.1	$677.2	$1,037.6	$490.9	$852.0	$1,212.3
2048	$316.1	$677.2	$1,037.6	$490.9	$852.0	$1,212.3
2049	$365.6	$1,909.4	$3,795.0	$792.8	$2,336.6	$4,222.2
2050	$316.1	$677.2	$1,037.6	$490.9	$852.0	$1,212.3
2051	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2052	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2053	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0

Table 12-2: Time Profile of Costs to Society (in millions, 2022$)						
Year	**Option 1**	**Option 2**	**Option 3**	**Option 1 with chlorides**	**Option 2 with chlorides**	**Option 3 with chlorides**
2054	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2055	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2056	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2057	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2058	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2059	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2060	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2061	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2062	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2063	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2064	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
2065	$210.7	$571.8	$928.8	$351.9	$713.0	$1,070.0
PV, 7%	**$3,025.8**	**$8,421.7**	**$14,232.1**	**$5,088.3**	**$10,484.2**	**$16,294.6**
Annualized costs, 7%	**$227.0**	**$631.7**	**$1,067.5**	**$381.7**	**$786.4**	**$1,222.2**

Source: U.S. EPA Analysis, 2023.