Economic Impact of the Regulation of Short-Cycle Herbaceous Crops under the Clean Air Act

Corn Refiners Association

Submitted by:

Policy Navigation Group

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Executive Summary

Policy Navigation Group (PNG) was asked by Corn Refiners Association (CRA) to identify the change in the economic impact of a reform to the U.S. Environmental Agency (EPA) Prevention of Significant Deterioration (PSD) and Nonattainment New Source Review (NNSR) permitting review programs associated with carbon dioxide (CO_2) emissions from processing of short-cycle herbaceous crops.

Federal agencies and many stakeholders have identified the PSD/NNSR programs as one of the most significant federal regulatory barriers to economic growth and to increased domestic manufacturing. Since 2010, EPA has sought to require facilities to seek NSR permits for, and accept emission limits of, greenhouse gas (GHG) emissions. In its latest action, EPA issued a proposed rulemaking in 2016 that would require facilities required to seek an NSR permit for other criteria pollutants to also control greenhouse gas emissions if their annual potential to emit is 75,000 tons of CO_2-equivalent (CO_2e) GHG emissions or greater. The CRA and other trade associations have submitted comments that EPA should exempt carbon dioxide emissions from processing of short-cycle herbaceous crops when determining this threshold. This analysis examines the gains in economic activity that would occur from this reform.

Since there is no practical GHG emission capture or destruction technology, GHG permit limits currently are expressed as GHG emission rate limits. Since processing biogenic raw materials inherently releases CO_2, these limits essentially constrain a facility's maximum production potential and become production limits.

As a result, past EPA actions to include GHG emissions limits in NSR permits and the current proposed rule discourage firms from building new or modifying existing facilities that require NSR permitting. We assume that some facilities that would have preferred to install larger modifications or build larger new facilities have instead reduced their projects so that they would qualify for minor source air permitting. By qualifying as a minor source, the facility could avoid the GHG production rate-limits that could be in an NSR permit.

With the proposed reform, firms face less costs if they build bigger facilities or conduct larger modifications. When they expand or replace aging capital equipment, they can consider whether a project that would require NSR permitting without the uncertainty and efficiency penalty of GHG limits due to biogenic emissions. Firms also could invest in the optimal project size, increasing economic activity and efficiency.

Therefore, the economic impacts of the reform are the following:

- Increased investment for each affected industry sector. By removing a permitting barrier to larger capital projects, companies will generate additional economic activity through their larger purchases; and,
- Expected return on this investment, as facilities annually generate more revenue from their larger investment.

This report analyzes the potential gains in economic activity that could be obtained through this NSR reform.[1] In this report we analyze the economic effect of the reform to six industry sectors, as defined by the North American Industry Classification System (NAICS):

NAICS 311221 – Wet corn milling;

[1] In this report, "NSR reform" refers to both, Nonattainment NSR and PSD permit programs.

NAICS 311224 – Soybean and other oilseed processing;

NAICS 311511 – Fluid milk manufacturing;

NAICS 311812 – Commercial bakeries;

NAICS 312120 – Breweries; and,

NAICS 325193 – Ethyl alcohol manufacturing. -

The six industry sectors have been selected based on their potential to emit biogenic CO_2. For efficiency, we did not model all U.S. states, but the states most relevant to these industries. The 13 states included in the scope of this analysis are: California, Colorado, Illinois, Indiana, Iowa, Minnesota, Missouri, Nebraska, North Carolina, North Dakota, Ohio, South Dakota, and Tennessee.

To conduct the analysis, we first determine the baseline, the current regulatory requirements and market conditions. We then craft a scenario to model the proposed policy reform. We measure the difference in estimated economic impact between the baseline and reform scenario to quantify the economic impact of the reform. Since the reform scenario is a projection from current conditions that has not existed before, there is inherent uncertainty in these estimates.

For the baseline we identify the NSR permits in EPA's RACT (Reasonable Available Control Technology) /BACT (Best Available Control Technology) /LAER (Lowest Achievable Emission Rate) Clearinghouse database.[2] We screened the database for permits issued between 2009 and 2020 for each of the NAICS codes and states listed above. Only 51 NSR permits over 11 years were issued for the over 2,000 facilities in these six industries. From the 51 permits we identified, we examined the permits that are triggered exclusively because of CO_2 emissions. We find that, between 2009-2017, only one permit for an ethyl alcohol manufacturing facility in Indiana was triggered solely due to the projected carbon dioxide emissions.

Based on this result, we determine that most of the gains in economic activity will arise from not just the facilities with NSR permits, but also all the facilities that have the potential for projects large enough to trigger NSR permitting. We assume that only larger establishments in a sector have the potential to emit enough pollutants to benefit from NSR reform. As a proxy to identify these larger facilities, we assume that those facilities with over 100 employees are sufficiently large enough to benefit from the policy reform.

Table 1 presents the number of establishments per industry sector and the assumed number of larger facilities per sector.

[2] U.S Environmental Protection Agency, "Technology Transfer Network, Clean Air Technology Center - RACT/BACT/LAER Clearinghouse."

Table 1: Number of Establishments per Industry and NSR CO_2-Only Permits from 2009-2020

NAICS	CODE DESCRIPTION	ESTABLISHMENTS IN STUDY AREA IN 2017	ESTABLISHMENTS OVER 100 EMPLOYEES IN STUDY AREA IN 2017	NUMBER OF CO_2E-ONLY NSR PERMITS (2009-2020)
311221	Wet corn milling	36	12	0
311224	Soybean and other oilseed processing	99	29	0
311511	Fluid milk manufacturing	272	107	0
311812	Commercial bakeries	1,116	237	0
312120	Breweries	1,305	75	0
325193	Ethyl alcohol manufacturing	121	42	1

For the proposed NSR reform, we assume that the largest economic effect will occur from enabling projects that currently are downsized or deferred due to the concern for NSR permitting restrictions. Owners will only invest in facility improvement if the expected project returns exceed the actual project costs, including its full permitting costs. The full permitting costs include the probability that the permit is not granted, the costs of the permit application, the opportunity cost of time to obtain the permit, and expected additional pollution control requirements applied to the entire facility and rate restrictions on output due to EPA's GHG regulation.

We estimate that facility owners would not seek NSR permitting for projects that cost approximately $4.2 million or less. The expected project return would not be large enough to offset the NSR permitting costs. Therefore, with the reform, we would expect that the incremental spending to take advantage of the reform would be at least $4.2 million in the more capital-intensive sectors in the analysis.

We assume that ethyl alcohol manufacturing, wet corn milling, and soybean and other oilseed processing have project costs of $4.2 million per project. Since bakeries, breweries, and milk producers rarely seek air permits for new equipment or facilities, the analysis does not include additional gains from this reform to these sectors. This assumption underestimates the likely impact of the policy reform.

Once we have an estimate of the typical deferred project size, we must estimate the frequency that owners will invest in these deferred projects. We use the baseline frequency in our minor permit database to assume how often a facility in an industry is likely to install new equipment that triggers permitting. The average frequency a facility seeks a minor air permit ranges from once every 69 years for milk producers to once every two years for ethyl alcohol. We divide the six sectors into two groups: sectors that seek minor permits very infrequently and not likely to benefit materially from the reform; and sectors that conduct more frequent and larger modifications. In the latter sector, each facility is expected to take advantage of the reform over time.

We undertake the following approach:

- Identify the number of establishments over 100 employees for each industry sector in every state. The number of establishments is obtained from U.S. Census data.[3]
- We scale the number of establishments over 100 employees by dividing the number of establishments by the corresponding frequency factor obtained from our minor permit database. By rescaling the number of establishments, we account for the fact that one project per establishment is expected to occur every two to 69 years, depending on the industry.
- To estimate the returns on capital to the owners of these facilities, we multiply the project value in each industry by the expected number of permits.
- We then multiply the product of the capital investments by the annual capital investment rate for each industry sector.[4]
- The total economic impact is the sum of both estimates (increased capital investment and return on capital).

Table 2 summarizes the estimate project cost per industry, the minimum acceptable rate of return rate and the resulting additional capital investment and return on capital due to the reform. In the analysis we use the weighted average cost of capital (WACC) rate as a proxy for the minimum acceptable rate of return rate (MARR). Businesses normally use the WACC as the MARR rate.[5]

The total impact from the reform ranges from $51 million for wet corn milling manufacturing up to $200 million for ethyl alcohol manufacturing.[6] This total includes both the capital investment and the return on capital for the corresponding capital investments. The impact will occur over several years as firms move forward with expansion projects.

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[3] U.S. Department of Commerce, Census Bureau, "Number of Establishments by NAICS Code"; U.S. Department of Commerce, Census Bureau, "Geography Area Series: County Business Patterns by Employment Size Class; 2014 Business Patterns."

[4] Damodaran, "Cost of Equity and Capital by Sector (U.S.)." For the MARR, we use weighted average cost of capital (WACC). WACC is a calculation of a firm's cost of capital in which each category of capital is proportionately weighted. All sources of capital, including common stock, preferred stock, bonds and any other long-term debt, are included in a WACC estimate.

[5] Corporate Finance Institute, "Hurdle Rate - Definition and Example - Guide to Hurdle Rates."

[6] All the monetary values in the report are presented in 2020 dollars.

Table 2: Annual U.S. Impact of NSR Reform for the Six Industries

INDUSTRY	ESTIMATED PROJECT COST (PER ESTABLISHMENT IN MILLIONS)	WEIGHTED AVERAGE COST OF CAPITAL (%)	ADDITIONAL CAPITAL INVESTMENT DUE TO NSR REFORM (MILLIONS)	RETURN ON CAPITAL (1 YEAR, MILLIONS)	TOTAL U.S. IMPACT (MILLIONS)
Breweries	$4.2	5.4	-	-	-
Commercial bakeries	$4.2	6.5	-	-	-
Ethyl alcohol manufacturing	$4.2	6.7	$190	$12	$200
Fluid milk manufacturing	$4.2	5.4	-	-	-
Soybean and other oilseed processing	$4.2	5.4	$130	$6.8	$130
Wet corn milling	$4.2	5.4	$48	$2.6	$51

With the total impact estimates presented in Table 2, we then calculate the economic impact on NAICS 311221, 311224, 312120, 311812, 311812, 311511, and 325193 on the U.S. economy. We predict the value added, the number of full-time jobs, wages, and tax payments of the policy reforms using IMPLAN, a commonly used economic impact model. We built IMPLAN model runs for the U.S. economy, as well as for 13 states. For the state impacts, we use the adjusted number of establishments over 100 employees for each industry in each state.

The economic impact has two components. First, each firm must secure labor, raw materials, and other services to build new facilities or to expand existing ones. Second, the owners of these resources spend money to secure additional goods and services or inputs for the products they sell. The combination of these activities, resource transfers, business growth, and gains in household income is the total economic activity that arises from new spending due to the policy reform. Since the IMPLAN model tracks these flows for all U.S. regions, we use this model in our analysis.

Table 3 summarizes the combined economic impact of the policy reform for the U.S. economy. Gains from the NSR reform will result in the addition of 2,100 U.S. full-time jobs and $130 million in wages. The NSR reform will also have an impact on government spending by increasing direct and indirect tax payments. The gain in economic activity caused by the policy reform for the six industries analyzed in this report will result in $27 million in federal tax payments and $17 million in state and local tax payments.

Table 3 also shows the industry sectors that gain by this regulatory action. Table 3 shows the indirect and induced gains to the industries, and the contributions to gross domestic product (GDP) outside the state. Since a firm expanding in Indiana buys equipment from other states, the economic gains from the reform also contribute to increased economic activity in other states.

The direct effects represent the impact change on the individual firm or sector. For example, if the production of corn-based sweeteners were to increase, wages and benefits (and number of employees) at corn refining plants would increase, as would payments to suppliers and income to owners.

The indirect effects represent additional (or reduced) spending by other industries because of the activities of the industry being studied. To continue with our example, if the demand for corn-based sweeteners increases by half, farm income increases. Growers then spend more on fertilizer, seed, and other inputs. This spending by the grower and associated industries is the indirect effect.

The induced effects represent the impact of changes in household income. All owners and employees associated with either direct or indirect effects spend some portion of their income on goods and services not necessarily related to any of the industries associated with corn refining. They buy meals and homes and movie tickets. They pay taxes. The government buys goods and services with that tax money. All these activities fall into the category of induced effects. The economic impact is the sum of these three effects.

Contributions to GDP outside state refer to the additional spending occurring until all the money leaves the region (a phenomenon known as leakage). The larger and more economically diverse the region, the longer it will take for spending to leave the region, and the larger the impact is likely to be. For example, employees may spend some amount of their income on automobiles. If they are in a state that has no automotive production, this spending will leave the region and the multiplier effect will stop. However, at the national level some portion of that same spending by that same individual may go to a domestic auto producer. Therefore, that spending with a domestic auto producer would lead to more spending at the national level that would not be captured by a more regional model. As a result, the national impact will be larger than the sum of the individual states. To address this issue, we calculate the magnitude of this leakage and report it separately as a contribution of an individual state to the broader economy.

Table 3: Summary of Economic Impacts of NSR Reform at the National Level

SUMMARY OF IMPACTS FROM OPERATIONS			
Impact Type	Employment	Labor Income	Value Added
Direct Effect	390	33,000,000	68,000,000
Indirect Effects	1,200	65,000,000	110,000,000
Induced Effects	600	33,000,000	58,000,000
Total Impact from Operations	2,100	130,000,000	240,000,000

TEN MOST IMPACTED SECTORS (BY EMPLOYMENT)			
Grain farming	260	2,900,000	17,000,000
Construction of new manufacturing structures	260	12,000,000	22,000,000
Truck transportation	140	6,900,000	11,000,000
Wet corn milling	100	13,000,000	33,000,000
Other real estate	87	1,200,000	7,700,000
Support activities for agriculture and forestry	83	2,100,000	2,700,000
Oilseed farming	62	48,000	10,000,000
Services to buildings	41	740,000	1,300,000
Employment services	40	1,700,000	2,700,000
Full-service restaurants	39	980,000	1,600,000

	Tax Payments
Federal Tax Payments	27,000,000
State and Local Tax Payments	17,000,000

The results in Table 3 demonstrate that the potential economic gains of the policy reform for these industries in the 13 states would be approximately $240 million in a single year once the facilities expand.

The economic impact is a different metric than reduced social costs. Executive orders on regulatory review (e.g., Executive Order 12866) requires agencies to estimate the social benefits and social costs of their regulatory actions and to conduct social benefit-cost analysis for economically-significant regulatory action with one-year social benefits or social costs in excess of $100 million.

In Table 3, the value added estimate of $68 million of direct savings is the measure most closely related to avoided social costs since it reflects the gains from increased investment in these sectors. This amount only occurs once the reform is fully implemented. Therefore, even when fully effective, the avoided regulatory compliance costs from this policy change are less than $100 million.

Table 4 presents the impacts of the policy reform at the state level. In terms of employment, total impact ranges from 30 full time equivalents (FTE) in Missouri to 350 in Ohio. Employment impact ranges from $1.6 million in Missouri to $18 million in California. In just three states – California, Indiana, and Ohio – the total value added from the NSR reforms would represent over $91 million per year.

Table 4: Total Impact of NSR Reform for the Six Industries at the State Level

State	Impact Type	Employment	Labor Income ($ millions)	Value Added ($ millions)
California	Direct Effect	28	3	8
	Indirect Effects	120	11	16
	Induced Effects	66	4	7
	Total Impact from Operations	210	18	31
	Contribution to GDP Outside State			10
Illinois	Direct Effect	14	1.9	5.2
	Indirect Effects	120	7.6	14
	Induced Effects	52	2.9	5.2
	Total Impact from Operations	190	12	24
	Contribution to GDP Outside State			7.9
Indiana	Direct Effect	17	1.9	7.3
	Indirect Effects	170	8.5	14
	Induced Effects	57	2.8	4.7
	Total Impact from Operations	240	13	26
	Contribution to GDP Outside State			8.6
Iowa	Direct Effect	7.7	0.83	2.5

State	Impact Type	Employment	Labor Income ($ millions)	Value Added ($ millions)
	Indirect Effects	54	3	5.6
	Induced Effects	19	0.8	1.5
	Total Impact from Operations	80	4.6	9.6
	Contribution to GDP Outside State		3.1	
Minnesota	Direct Effect	11	1.2	3
	Indirect Effects	100	5.1	10
	Induced Effects	37	2	3.4
	Total Impact from Operations	150	8.3	17
	Contribution to GDP Outside State			5.4
Missouri	Direct Effect	2	0.16	0.74
	Indirect Effects	20	1.1	1.8
	Induced Effects	7	0.35	0.61
	Total Impact from Operations	30	1.6	3.1
	Contribution to GDP Outside State			1
North Carolina	Direct Effect	14	1.7	5.3
	Indirect Effects	77	7	8.7
	Induced Effects	46	2.2	4
	Total Impact from Operations	140	11	18

State	Impact Type	Employment	Labor Income ($ millions)	Value Added ($ millions)
	Contribution to GDP Outside State			5.9
Ohio	Direct Effect	21	2.8	9.4
	Indirect Effects	260	9.1	18
	Induced Effects	71	3.4	6.2
	Total Impact from Operations	350	15	34
	Contribution to GDP Outside State			11
Tennessee	Direct Effect	14	1.7	5.3
	Indirect Effects	120	4.3	7.9
	Induced Effects	31	1.7	2.8
	Total Impact from Operations	160	7.7	16
	Contribution to GDP Outside State			5.3

In 2017, the President issued two Executive orders, along with the U.S. Office of Management and Budget (OMB) guidance, to reduce regulatory burdens and to establish a Regulatory Reform Officer and a Regulatory Reform Task Force within most federal agencies. These task forces are to identify and to recommend for "repeal, replacement, or modification" burdensome regulations[7] including those that lack transparency and are not reproducible because the data is not publicly available.[8] This

[7] Executive Order 13771 defines "regulation" as an agency statement of general or applicability and future effect designed to implement, interpret, or prescribe law or **policy** (emphasis added) or to describe the procedure or practice requirements of an agency.

[8] Executive Order 13777: "[The] Regulatory Reform Task Force shall evaluate regulations … and make recommendations … regarding their repeal, replacement, or modification. [E]ach Regulatory Reform Task Force shall attempt to identify regulations that … are inconsistent with [Paperwork Reduction Act requirements for reproducibility and transparency] or the guidance issued pursuant to that provision, **in particular those regulations that rely in whole or in part on data, information, or methods that are not publicly available or that are insufficiently transparent to meet the standard for reproducibility** …. [emphasis added].

analysis demonstrates that this policy reform could be a significant opportunity for the Administration to reduce regulatory burden.

As with any projection, this analysis has important limitations and rests on key assumptions. The report below describes the major limitations in more detail.

Section 1 Introduction

Policy Navigation Group (PNG) was asked by Corn Refiners Association (CRA) to update its previous analysis of the economic impact and the social benefits of a reform to the U.S. Environmental Agency (EPA) Prevention of Significant Deterioration (PSD) and Nonattainment New Source Review (collectively called in this report "NSR") permitting review programs associated with carbon dioxide (CO_2) emissions from processing of short-cycle herbaceous crops.

Federal agencies and many stakeholders have identified the NSR/PSD programs as one of the most significant federal regulatory barriers to economic growth and to increased domestic manufacturing. The overwhelming conclusion from academic studies is that the life cycle emissions from short-cycle biogenic crop usage is effectively zero. The proposed policy reform is to exempt biogenic carbon dioxide emissions from NSR permitting calculations and requirements since any net CO_2 emission increase from processing annual crops is therefore de minimis.

This report analyzes the potential increased, near-term economic activity and economic impact from this NSR reform.[9]

Regulatory Background

On June 2010, EPA promulgated the PSD and Title V Greenhouse Gas Tailoring Final Rule.[10] The rule sets applicability criteria that determine which stationary sources and modification projects become subject to permitting requirements for greenhouse gas (GHG) emissions under the PSD and Title V programs of the Clean Air Act (CAA). The rule also sets emission thresholds for new and existing facilities, known as Steps 1 and 2 for PSD and Title V permits based on CO_2-equivalent emissions.[11] Under Step 1, PSD and Title V permit requirements applied only to sources that were previously required to obtain such permits for other regulated pollutants. Step 2 expanded permit requirements to any source with potential to emit GHG above certain annual emission thresholds.[12]

The rule did not address the issue of exemptions for biomass combustion or biogenic emissions. In the preamble of the rule, EPA stated the following:

> *…carbon dioxide has a very different life cycle compared to other GHGs, which have well-defined lifetimes. Instead, unlike the other gases, CO_2 is not destroyed by chemical, photolytic or other reaction mechanisms, but rather the carbon in CO_2 cycles between different reservoirs in the atmosphere, ocean, land vegetation, soils, and*

[9] In this report, "NSR reform" refers to both, Nonattainment NSR and PSD permit programs.

[10] U.S Environmental Protection Agency, "40 CFR Parts 51, 52, 70 et al. Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule; Final Rule."

[11] U.S Environmental Protection Agency, "Proposed Revisions to the Prevention of Significant Deterioration and Title V Permitting Regulations for Greenhouse Gases (GHG) and Establishment of a GHG Significant Emissions Rate"; U.S Environmental Protection Agency, "40 CFR Parts 51, 52, 70 et al. Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule; Final Rule."

[12] U.S Environmental Protection Agency, "Proposed Revisions to the Prevention of Significant Deterioration and Title V Permitting Regulations for Greenhouse Gases (GHG) and Establishment of a GHG Significant Emissions Rate."

sediments. There are large exchanges between these reservoirs, which are approximately balanced such that the net source or sink is near zero.[13]

Furthermore, in the preamble, EPA indicated that the rule did not:

examine burdens with respect to specific categories and thus we have not analyzed the administrative burden of permitting projects that specifically involve biogenic CO_2 emissions…we plan to seek further comment on how we might address emissions of biogenic carbon dioxide under the PSD and title V programs…[14]

In July 2011, EPA deferred the application of permitting requirements to biogenic carbon dioxide emissions from bioenergy and other biogenic stationary sources for three years so as to conduct a detailed examination of the issues associated with biogenic CO_2.[15] In September 2011, EPA published the draft document: Accounting Framework for Biogenic CO_2 Emissions from Stationary Sources.[16] The agency needed to consider how to include biogenic emissions in determining whether thresholds for regulation have been met. In September 2011, EPA's Science Advisory Board (SAB) started to review EPA's draft framework and completed the review in September 2012. In 2014, EPA revised its framework in response to the recommendations made by the SAB.[17]

In July 2012, EPA promulgated Step 3 of its phase-in approach to permitting sources of GHG emissions. In the final rule, EPA decided not to lower the current PSD and Title V thresholds. The rule also included revisions for the implementation of the permitting programs by establishing plantwide applicability limitations (PALs) for CO_2 emissions. The rule also revised the PAL regulations to allow a source that emits or has the potential to emit at least 100,000 tons per year of CO_2e, but that has minor source emissions of all other regulated NSR pollutants, to apply for a GHG PAL while still maintaining its minor source status.[18]

On June 23, 2014 the Supreme Court issued a decision on the case *Utility Air Regulatory Group (UARG) v. EPA*.[19] In addition, on April 10, 2015 a decision on another case was issued by the Court of Appeals for the District of Columbia (D.C. Circuit) on a separate case: *Coalition for Responsible*

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[13] U.S Environmental Protection Agency, "40 CFR Parts 51, 52, 70 et al. Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule; Final Rule," 31591.

[14] Ibid, 31591.

[15] U.S. Environmental Protection Agency, "Deferral for CO2 Emissions From Bioenergy and Other Biogenic Sources Under the Prevention of Significant Deterioration (PSD) and Title V Programs; Final Rule."

[16] U.S Environmental Protection Agency, Office of Atmospheric Programs, "Accounting Framework for Biogenic CO2 Emissions from Stationary Sources."

[17] U.S Environmental Protection Agency, Science Advisory Board, "Biogenic Carbon Dioxide Emissions from Stationary Sources - Assessment Framework."

[18] Federal Register, "77 FR 41051. Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule Step 3 and GHG Plantwide Applicability Limits. Final Rule."

[19] Supreme Court of the United States, "Case 12-1146. Utility Air Regulatory Group v. EPA (06/23/2014)."

Regulation v. EPA.[20] The Supreme Court held that EPA may not treat GHGs as an air pollutant for purposes of determining whether a source is a major source required to obtain a NSR or Title V permit.[21] The D.C. Circuit decision vacated the regulations that implemented Step 2 of the Tailoring rule. Thus, stationary sources do not need to obtain an NSR or Title V permit solely because the source emits – or has the potential to emit – GHGs above the applicable major source thresholds. As a practical matter, NSR permitting requirements solely due to CO_2 emissions ended at the time of this 2014 Supreme Court decision.

The Supreme Court decision indicated that the Best Available Control Technology (BACT) requirement of the NSR program applies to GHG emissions from sources requiring an NSR permit because their construction or modification will result in emissions of pollutants already above applicable thresholds. The decision recognizes EPA's authority to limit the application of the BACT requirements when a source is only releasing a relatively small amount of GHGs.

On August 26, 2016, EPA proposed changes to its air permitting regulations to comply with the Supreme Court and D.C. Circuit decisions. On October 3, 2016, EPA issued a proposed rulemaking with these changes. In addition, in this proposed rulemaking, EPA proposed to establish a GHG significant emission rate of 75,000 tons per year of CO_2 equivalent.[22] EPA proposed that this amount is a de minimis increase for the purposes of NSR threshold calculations.

EPA has announced the Agency will propose a new deregulatory action that would remove from NSR applicability biogenic CO_2 emitted from the processing of biomass feedstocks at stationary sources.[23] The proposed rule will clarify the specific framework for biomass neutrality following EPA's 2018 policy statement which said future regulatory actions would treat as carbon neutral biomass from managed forests used to produce energy.[24]

Description of the Issue and Proposed Reform

Facilities that make products using natural raw materials are subject to the same NSR permitting requirements as other manufacturers. NSR permits are required when a facility's new or modified sources of emissions have the potential to release conventional pollutants such as lead, particulate matter (PM), oxides of nitrogen (NOx), carbon monoxide (CO), and sulfur dioxide (SO_2) above certain thresholds. These pollutants are often associated with fuel combustion to generate steam to generate electricity and to power other manufacturing processes.

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[20] United States Court of Appeals for the District of Columbia Circuit, "USCA Case No. 09-1322. Coalition for Responsible Regulation, Inc, et al v EPA (4/10/2015)."

[21] U.S Environmental Protection Agency, "Proposed Revisions to the Prevention of Significant Deterioration and Title V Permitting Regulations for Greenhouse Gases (GHG) and Establishment of a GHG Significant Emissions Rate."

[22] U.S Environmental Protection Agency, "40 CFR Parts 51, 52, 60, 70 and 71. Revisions to the Prevention of Significant Deterioration (PSD) and Title V Greenhouse Gas (GHG) Permitting Regulations and Establishment of a Significant Emissions Rate (SER) for GHG Emissions Under the PSD Program."

[23] Office of Information and Regulatory Affairs, Office of Management and Budget, "Spring 2020 Unified Agenda of Regulatory and Deregulatory Actions."

[24] Environmental Protection Agency, "EPA's Treatment of Biogenic Carbon Dioxide (CO2) Emissions from Stationary Sources That Use Forest Biomass for Energy Production."

Based on the Supreme Court and DC Circuit decisions outlined in the previous subsection, facilities only need to undergo NSR permitting review for GHG emissions if they already must seek an NSR permit for conventional pollutants. EPA has proposed that these "anyway" manufacturing facilities control for GHG emissions if their potential to emit exceeds 75,000 tons per year CO_2e.

Since there is no effective emission capture or destruction technology for carbon dioxide, GHG emission reductions can primarily be achieved only through limits on production or mandated energy/production efficiency. Since carbon dioxide is produced naturally in fermentation, efficiency gains face fundamental physical limits. Therefore, the most common GHG emission NSR permit condition is to limit production.

Production rate limits reduce the facility's output, revenue, and net income. Since start-up and shut-down conditions are variable and less efficient, firm may exceed their rate limits during these periods. Firms then must operate at greater efficiency during "normal" operations. However, since natural feedstocks are variable, product demand can shift, and equipment can malfunction, "normal" operating conditions may change or be in flux. Firms as a result must shut down or slow production to remain within its GHG permit limit.

Many facilities affected by this proposed reform process or ferment short-cycle crops into other products such as corn ethanol. In addition, combustion of vegetation, natural fermentation processes also release GHG emissions, especially CO_2. Production rate limits for processes that naturally emit GHG emissions can pose significant operational constraints and can reduce the rate of return for new facilities and for new equipment installed at existing facilities.

Under the proposed NSR reform, a firm's CO_2 emissions from biogenic sources would be excluded from NSR GHG emission threshold calculations. Therefore, emitting sources face NSR permit limits only when they exceed the thresholds for the National Ambient Air Quality Standards (NAAQS) criteria pollutants.

Thus, the practical implications of this reform are the following:

- Facilities that received an NSR permit with GHG limits could seek to have those limits removed as part of their Title V permit renewal, if allowed; and,
- Projects that are now delayed, modified, or limited so that they do not trigger the GHG emission threshold could be carried out in their full scope or at the optimal time.

As a result, we would expect more production and more NSR permits with this reform. Increased production in turn yields greater economic activity, net income, and U.S. employment.

Project Scope

This report analyzes the economic impact and savings of such potential NSR reform. In this report we analyze six industry sectors with biogenic emissions, as defined by the North American Industry Classification System (NAICS):

311221 – Wet corn milling;

311224 – Soybean and other oilseed processing;

311511 – Fluid milk manufacturing;

311812 – Commercial bakeries;

312120 – Breweries; and,

325193 – Ethyl alcohol manufacturing.

The six industry sectors were selected by the client based on their potential to emit biogenic CO_2. The 13 states included in the scope of this analysis are: California, Colorado, Illinois, Indiana, Iowa, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Tennessee. The states were chosen due to their economic relevance for these industries.

Report Structure

The remainder of this report is organized as follows:

- Section 2 provides a description of the six industry sectors analyzed in this report;
- Section 3 discusses this study's methodology for the economic impact of the NSR reform and the data sources;
- Section 4 discusses IMPLAN, the economic impact model used in this study; and,
- Section 5 presents the IMPLAN results.

Section 2 Industry Sectors Included in this Analysis

Corn Refining and Other Industries with Biogenic CO_2 Emissions

This analysis estimates the economic impact to six sectors with biogenetic carbon dioxide emissions from their production processes. The six sectors are listed below with a description of the industries as defined by the U.S. Census North American Industry Classification System (NAICS):[25]

- 311221. Establishments primarily engaged in wet corn milling and other vegetables (except to make ethyl alcohol), including products such corn sweeteners, corn oil, and starches (except laundry).[26]
- 311224. Establishments primarily engaged in crushing oilseeds and tree nuts, such as soybeans, cottonseeds, linseeds, peanuts, and sunflower seeds. Examples of products produced in these establishments are oilseed oils, cakes, meals, and protein isolates and concentrates.[27]
- 311511. Establishments engaged in manufacturing processed milk products, such as pasteurized milk or cream and sour cream, or manufacturing fluid milk dairy substitutes from soybeans and other nondairy substances.[28]
- 311812. Establishments primarily engaged in manufacturing fresh and frozen bread and bread-type rolls, and other fresh bakery (except cookies and crackers) products.[29]
- 312120. Establishment primarily engaged in brewing beer, ale, malt liquors, and nonalcoholic beers.[30]
- 325193. Establishments primarily engaged in manufacturing non-potable ethyl alcohol.[31]

To illustrate how biogenic emissions arise from these sectors, we present in more detail the wet corn milling sector. Refining corn yields a range of products including (but not limited to): corn oil,

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[25] U.S. Department of Commerce, Census Bureau, "North American Industry Classification System."

[26] U.S. Department of Commerce, Census Bureau, "2017 NAICS Definition: 311221 Wet Corn Milling."

[27] U.S. Department of Commerce, Census Bureau, "2012 NAICS Definition: 311224 Soybean and Other Oilseed Processing."

[28] U.S. Department of Commerce, Census Bureau, "2012 NAICS Definition: 311511 Fluid Milk Processing."

[29] U.S. Department of Commerce, Census Bureau, "2012 NAICS Definition: 311812 Commercial Bakeries."

[30] U.S. Department of Commerce, Census Bureau, "2012 NAICS Definition: 312120 Breweries."

[31] U.S. Department of Commerce, Census Bureau, "2012 NAICS Definition: 325193 Ethyl Alcohol Manufacturing."

corn germ, corn gluten feed, corn gluten meal, corn starch, sweeteners, bioproducts, biogas, and other specialty food ingredients.[32] Fabricating these products involves multiple processes. For example, some grains are first placed through a starch gluten separation process, followed by either a starch dryer or a gluten dryer to produce either corn starch or corn gluten meal, respectively. To make sweeteners, grains undergo sweetener refining and, subsequently, starch refining processes. Fiber wash and fiber press are used to produce corn gluten feed. Other grains are fermented to yield bioproducts, specialty food ingredients, and other uses (bottling, dry ice, etc.). Another major process entails the use of hydroclones and germ washing, pressing, and drying to produce corn oil and corn germ. Lastly, biogas is produced when grains undergo steeping and then is passed through an evaporator/condenser and, ultimately, an anaerobic digestor.

The three main products obtained from corn kernels are sweeteners (60 percent), co-products (30 percent), and starches (10 percent). Corn sweeteners comprise products such as glucose syrups, high fructose syrup, and dextrose. High fructose corn syrup product uses include beverages and syrups, food products, baking and confectionery, alcoholic beverages, and dairy products. Glucose syrups and dextrose products are primarily used for industrial applications, but also in baking and confectionary, alcoholic beverages, dairy, and other food products. Corn co-products comprise of products such as corn gluten feed and corn oil meal, as well as steepwater, corn gluten meal, and crude and refined corn oil. Starch product uses include paper products, food products, baking and confectionary, building materials, and pharmaceuticals, and chemicals.

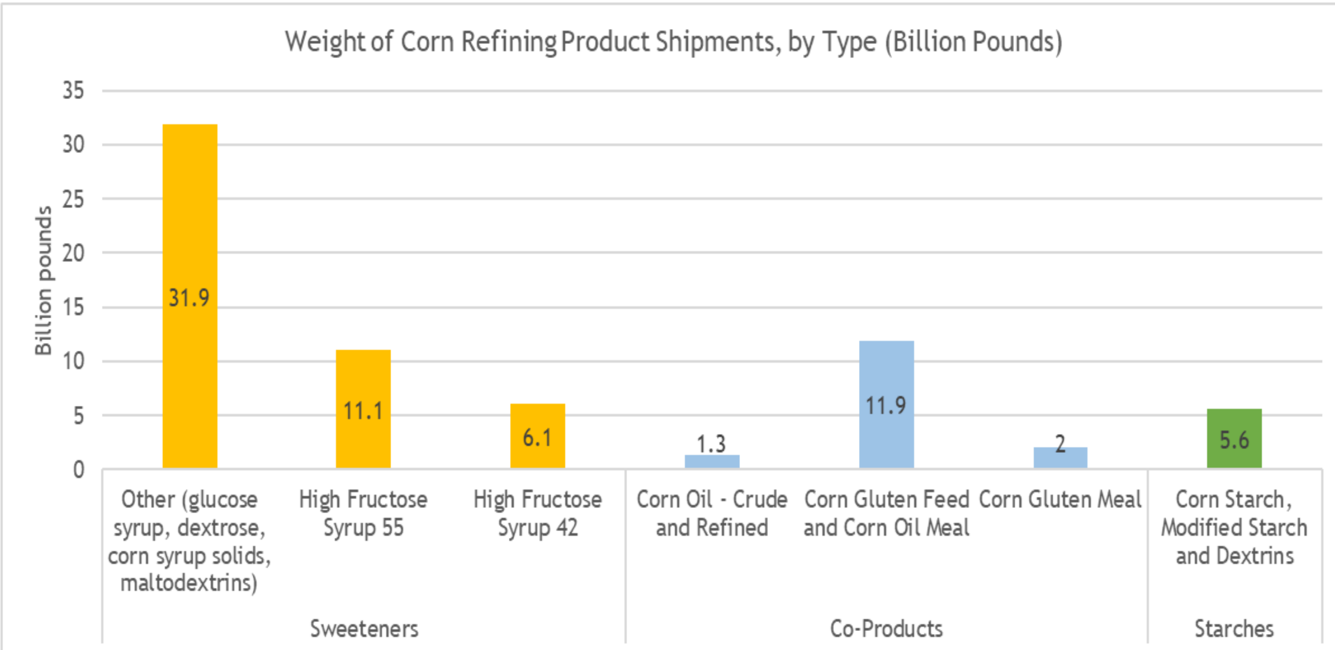
In addition to traditional milling for food, consumer demand and subsidies for bio-based products has spurred additional production lines. While biofuels such as ethanol are the largest bioproduct, other products include bioplastics, bio-resins, and other feedstock chemicals. Like petroleum refineries, biorefineries produce multiple feedstocks from the raw material stream.[33] Many wet corn mills now also contain biorefineries. In 2015, USDA estimated that there were 213 biorefineries in the United States, most co-located with wet corn mills.

Figure 1 below provides a recent breakdown of the main products manufactured by the corn refining industry. The information is based on product shipments for the industry.

[32] Corn Refiners Associations, "Industry Overview 2017." Available at: https://corn.org/wp-content/uploads/2016/04/CRA-Industry-Overview-2017-1.pdf.

[33] Golden, J.S., Handfield, R.B., Daystar, J. and, T.E. McConnell (2015). An Economic Impact Analysis of the U.S. Biobased Products Industry: A Report to the Congress of the United States of America. A Joint Publication of the Duke Center for Sustainability & Commerce and the Supply Chain Resource Cooperative at North Carolina State University.

Figure 1: Breakdown of Corn Refining Products in 2018



Source: Corn Refiners Association[34]

Facility Locations

To better understand the significance of the six industry sectors included in this study, we identify the number of establishments for each sector in California, Colorado, Illinois, Indiana, Iowa, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Tennessee. Table 5 below presents the total number of establishments per industry sector from the 2017 U.S. Census data.[35]

The two largest sectors based on number of establishments are bakeries and breweries (1,305 and 1,116 facilities, respectively, in the 13 states we analyze). The sector with the lowest number of establishments is wet corn milling (36 establishments). From the states included in this report, California, Ohio, and Illinois have the largest number of establishments for these six sectors, with 907, 318, and 310 establishments, respectively.

[34] Corn Refiners Association, "Industry Overview 2019."

[35] U.S. Census Bureau, "2017 SUSB Annual Data Tables by Establishment Industry."

Table 5: Number of Establishments for Six Industry Sectors

States	Number of Establishments (2017)					
	Breweries	Commercial bakeries	Ethyl alcohol manufacturing	Fluid Milk Manufacturing	Soybean and other oilseed processing	Wet corn milling
CA	449	384	17	38	14	5
CO	62	53	2	5	2	1
IL	154	131	6	13	5	2
IN	90	77	3	8	3	1
IA	38	32	1	3	1	0
MN	83	71	3	7	3	1
MO	67	57	3	6	2	1
NE	20	17	1	2	1	0
NC	99	85	4	8	3	1
ND	8	7	0	1	0	0
OH	157	135	6	13	5	2
SD	12	10	0	1	0	0
TN	66	57	3	6	2	1
Total in 13 states	1,305	1,116	49	110	40	15
U.S. Total	3,214	2,750	121	272	99	36

Section 3 Methodology and Data Sources

Overview of the Methodology

To estimate the economic impact of this policy reform, we must estimate the number of facilities that will benefit and how much they will benefit. Permitting authorities evaluate NSR applicability when a firm proposes to build a new facility or to expand or to modify sources at an existing facility. Since this reform changes NSR permitting thresholds, a firm must either have an existing NSR permit or is considering changing its projects to avoid receiving its first NSR permit. The latter firms currently accept design or permit limits to allow for minor source permitting.

Therefore, the firms in the six sectors that will benefit from this reform are the firms with NSR permits that would avoid GHG limits due to their status as "anyway" facilities after the 2014 UARG decision and the larger facilities that currently have minor air permits. Larger facilities are more likely to approach the NSR emission thresholds than smaller operations.

Prior to the policy reform, if a facility is a minor source and considered expansion, a major permit will include both NSR review of conventional pollutants and GHGs. The facility can expect production limits as the BACT for GHG emissions. If the policy reform is enacted, the facility would still undergo an NSR permit review, but the review would be limited to conventional pollutants. While installing more stringent control devices would have costs, the facility would not face potential production limits for GHG controls and the associated loss in revenue. The policy reform therefore removes some of the uncertainty of the financial viability of a major expansion.

For each opportunity at these facilities, this NSR reform can achieve the following gains in economic activity:

- Reduced costs (and/or greater investment or equity returns) for firms and increased project revenue for projects that require NSR permits; and,
- The economic activity from NSR-sized projects shelved, built in other countries, or downsized due to NSR permitting costs and uncertainty.

Based on this foundational analysis, first we identify the baseline, or the number of NSR permits issued to facilities in the six industries between 2009-2020. Second, we gather a sample of minor state air permits for these sectors. The annual number of minor air permits gives a likely frequency of projects that might have been larger but for the prospect of GHG limits in an NSR permit. Third, we estimate how much facility owners may increase the size of their additions and modifications once GHG limits are not applicable to biogenic emissions. Fourth, we project how frequently firms in each sector will make these larger investments once the policy change is made. Fifth, we estimate the expected returns in capital for these projects. The sum of the increased capital investments and expected returns in capital constitute the economic changes of the reform.

This analysis is based on four main data sources, including: EPA's RACT (Reasonable Available Control Technology) /BACT (Best Available Control Technology) /LAER (Lowest Achievable Emission Rate) Clearinghouse database; U.S. Census data with number of establishments; PNG's own database with information on minor permits issued in certain states; and capital stock and weighted-average return of capital (WAA) rates.

The subsections below provide further detail on our methodology.

Number of Large Facilities

We identify the largest facilities in the six sectors. We use the number of employees at a location as a proxy for the likely size of the facility's air emissions; the more employees at a site, the more likely it will be a major source or a larger minor source and could possibly benefit from the policy reform. Data by establishment size is only available at the national level for six-digit NAICS industries, whereas state-level data is presented for the manufacturing industry more broadly (NAICS codes 31-33). Thus, we use the national data to create ratios to extrapolate from the state data estimates at a six-digit NAICS level. For example, of the 250,000 manufacturing firms nationwide (NAICS 31-33), about 3,200 are breweries (or 1.3 percent). We use this percentage to estimate that, from California's total of 35,000 manufacturing firms (NAICS 31-33), the state has approximately 450 large breweries.

Table 6 lists the number of facilities in each state and sector that had employed more than 100 workers in 2017.

Table 6: Number of Establishments Over 100 Employees for Six Industry Sectors Included in the Analysis

States	Number of Establishments OVER 100 EMPLOYEES (2017)					
	Breweries	Commercial bakeries	Ethyl alcohol manufacturing	Fluid Milk Manufacturing	Soybean and other oilseed processing	Wet corn milling
CA	16	47	8	20	5	2
CO	3	9	2	4	1	0
IL	9	29	5	13	4	1
IN	8	24	4	11	3	1
IA	3	11	2	5	1	1
MN	5	16	3	8	2	1
MO	4	14	3	6	2	1
NE	2	6	1	3	1	0
NC	7	23	4	11	3	1
ND	1	2	0	1	0	0
OH	11	34	6	15	4	2
SD	1	3	1	1	0	0
TN	6	19	4	9	3	1
Total in 13 states	75	237	42	107	29	12

Number of NSR Permits in the Six Sectors

We use EPA's RACT / BACT /LAER Clearinghouse database to identify projects that required NSR permitting.[36] We assume that all permits in EPA's database are NSR permits and are potentially eligible the reforms. We search for all facilities with NAICS or Standard Industry Codes (SIC) that are within the scope of this analysis.

[36] U.S Environmental Protection Agency, "Technology Transfer Network, Clean Air Technology Center - RACT/BACT/LAER Clearinghouse."

We use a study period of 2009 to 2020. We select this period of study considering that EPA's proposed the GHG Tailoring Rule in October 2009.[37] While EPA's database includes older permits, our primary interest is in permits since 2009 that reflect the new GHG requirements.

For these permits, we next gather information about each project and associated permit. For each of the permits in our dataset we gather the following information, if available:

- NAICS codes;
- Facility name and location;
- Permit application date;
- Permit issue date;
- Permit type (A - New/Greenfield Facility; B - Add New Process to Existing Facility; C - Modify Existing Process at Existing Facility; D - Both B and C; and U - Unspecified);
- Process type;
- Number of processes;
- Pollutants of concern; and,
- Control technologies.

Based on our analysis of this information, we determine that in this period there were 51 NSR permits for the six industry sectors issued in the 11-year period between 2009 and 2020. However, of these 51 permits, only one permit was trigged solely because of GHG emissions (see Table 7 below).[38] This permit occurred prior the 2014 UARG court decision.

The baseline frequency of NSR permitting in these industries is low. The approximately 500 large facilities in these 13 states shown in Table 6 only sought 51 NSR permits over an eleven-year period, or 0.009 NSR permits per facility-year. The effect of the reform, therefore, would be relatively low on facilities currently subject to NSR permitting.[39] As a result, we concentrate this analysis on the economic effect that will occur from firms with minor air permits that would be willing to invest in larger projects if they were not subject to NSR permitting for GHGs.

[37] U.S Environmental Protection Agency, "40 CFR Parts 51, 52, 70 et al. Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule; Final Rule," 31518.

[38] Based on our conversations with state permitting staff, we are aware that EPA's NSR permit database has gaps and does not contain all major NSR permits in some of the 13 states during the study period. Some states such as California enter very little information into EPA's database. Thus, it is possible that the total number of NSR permits in the baseline could be understated.

[39] If EPA promulgates a final rule requiring consideration on GHG emissions for facilities subject to NSR permitting, the facilities could face rate-limits once their permit is renewed. In this scenario, there would be a negative economic impact.

Table 7: Number of NSR and Minor Permits Approved in 13 States from 2009-2020

INDUSTRY	NUMBER OF NSR PERMITS APPROVED	NUMBER OF CO_2E-ONLY NSR PERMITS	TOTAL NUMBER OF MINOR PERMITS	TOTAL LARGE FACILITIES
Breweries	1	0	30	75
Commercial bakeries	16	0	129	237
Ethyl alcohol manufacturing	16	1	225	42
Fluid milk manufacturing	0	0	17	107
Soybean and other oilseed processing	5	0	73	29
Wet corn milling	13	0	44	12
TOTAL	**51**	**1**	**518**	**502**

Source: Policy Navigation Group, "Database with Minor Permits Issued in Selected States (2009-2020)."

Minor Source Air Permitting Information

We have previously constructed a database of minor air permits issued by some states. Our database includes states with substantial manufacturing footprints and with readily available permitting information. From the state databases, we collected minor new source construction or modification air permits. We excluded minor permits that were permit renewals, administrative amendments, and other permitting actions that were not for new facility construction or new equipment/production line installation.

From our database, we extracted the minor source permits that have been issued in the six sectors during the 11 years of our study period in the 13 states considered. Our existing database does not include all 13 states in this analysis. The following table summarizes the minor permitting data we ascertained.

Table 8: Summary of Ascertained Minor Permit

STATE	METHOD OF ASCERTAINING
Indiana[40]	Downloaded online using SIC codes that correspond to the NAICS codes included in this study.
Minnesota[41]	Downloaded online using SIC codes that correspond to the NAICS codes included in this study.
Missouri[42]	Search for “CP-Minor” (Construction Permit-Minor) and open each entry to retrieve relevant information.
Nebraska[43]	Downloaded permit documents online using the relevant NAICS codes.[44]
North Carolina[45]	Downloaded “synthetic minor” and “small” permits online using the relevant NAICS codes and years as parameters.
North Dakota[46]	Downloaded all permits within the relevant NAICS industries. To distinguish between minor and NSR permits, we scan each permit to assess the permit type.[47]
Ohio[48]	Downloaded the full dataset of permits. We use Manta[49] and CareerOneStop[50] to determine which companies fall within the relevant NAICS industries and extract the corresponding permits.

[40] Indiana Department of Environmental Management, “Air Quality Permit Database Search.”

[41] Minnesota Pollution Control Agency, “Air Permits in Minnesota.”

[42] Missouri Department of Natural Resources, “Missouri Minor Air Permits.”

[43] Nebraska Department of Environmental Quality, “Nebraska Minor Air Permits.”

[44] This data was ascertained in 2018. The NE DEQ website was temporarily down, and we could not download data from 2019-2020.

[45] North Carolina Department of Environmental Quality, “Air Quality Permitting.”

[46] North Dakota Department of Environmental Quality, “Air Quality Permits - Construction.”

[47] North Dakota permits do not specify the permit type within the permit documents. We exclude those that mention “Title V” or reflect a complexity typical of NSR projects.

[48] Ohio Environmental Protection Agency, “Public Records Search.”

[49] Manta Media Inc.

[50] Career One Stop, “Business Finder.”

STATE	METHOD OF ASCERTAINING
Tennessee[51]	We determine the companies within the relevant NAICS industries using CareerOneStop[52] and download the corresponding permits online.

We were unable to obtain minor permit data for five states included in this study: CA, CO, IA, IL, and SD. For these five states, we extrapolate to estimate the number of minor permits. First, based exclusively on the states we did collect (see Table 8), we create ratios between the number of large facilities in those states and the total number of minor permits in our database for those states. Then, for each of the five states, we use these ratios to estimate the number of minor permits based on the number of large facilities in those states.

Table 9 below summarizes the total permit count. We collected a total of 287 minor permits and extrapolated another 231 minor permits, resulting in a total estimate of 518 permits for the 13 states. This means that, as shown in Table 7 above, of the 502 large facilities in the 13 states, 518 minor permits were obtained in the six industries. We also see the two smallest counts of minor permits in Breweries and Fluid Milk Manufacturing, which is consistent with the lack of NSR permits obtained in those industries over the study period in the 13 states.

Table 9: Total Minor Permits in the 13 States by Industry

Industry	Minor Permits in Database	Extrapolated Minor Permits	Total Minor Permits
Breweries	**16**	**14**	**30**
Commercial Bakeries	**71**	**58**	**129**
Ethyl Alcohol Manufacturing	**125**	**100**	**225**
Fluid Milk Manufacturing	**9**	**8**	**17**
Soybean and other oilseed processing	**41**	**32**	**73**
Wet Corn Milling	**25**	**19**	**44**
Total	**287**	**231**	**518**

[51] Tennessee Division of Air Pollution Control, “Tennessee Air Permits.”

[52] Career One Stop, “Business Finder.”

Sector Growth and Expansion Assumptions

As Table 7 shows, the number of NSR and minor permits vary across the six sectors. The difference in permitting reflects differences in their markets, products, and production technologies. For example, bakeries and breweries benefit from proximity to customers. Bakeries must deliver fresh goods to consumers quickly and repeatedly. Since liquids are heavy, dairies and breweries can reduce costs by locating their facilities close to consumers. It is difficult for these sectors to raise prices substantially to support the increased transportation costs necessary to expand their geographic market. Therefore, these sectors have many production establishments across the country instead of several large facilities that can serve national markets.

These markets are well-established; growth in consumer demand for these sectors has been less than three percent the past five years. Facilities modifications and equipment replacement are the most likely triggers for air permitting rather than new facility construction.

Because of these characteristics, the dairy, bakery, and brewery sectors have relatively few minor permits and a handful of NSR permits during the study period. The dairy industry in fact did not obtain a single NSR permit in the 13 states in the eleven-year study period, while the brewery industry only obtained one NSR permit. These sectors also averaged less than one minor permit per facility over 11 years.

In contrast, the other three sectors – wet corn milling, soybean oil processing, and ethyl alcohol production -- have sought a greater number of NSR permits proportionately to the number of facilities. Many of these permits were to build new facilities. Facilities in these sectors averaged more than one minor permit per facility over the 11-year period.

These sectors also use a great deal more capital than the other three sectors in the analysis; these three sectors use four to 15 times more capital per facility than bakeries, dairies, and breweries. Since the facilities use more capital and serve more geographically dispersed markets, these facilities are larger and are more likely to require air permits to operate and to expand.

These differences also affect the theoretical likelihood of increased investments due to this policy reform. For the three sectors with established markets, the effect is limited. The slow market growth, consumer demand, and characteristics of their goods play a more fundamental role determining facility size and expansions in these sectors than permitting costs. In the immediate period after the reform, a few firms may take advantage of the lower permitting costs to expand to become more efficient in a region and to take market share from competitors. This expansion would have a positive economic impact in the near term. Over time, as either the expansion effort falters or rivals cut back production in response, these gains in economic impact would likely diminish. Some economic gain would remain. In the long-run, theory states that the permitting reform would allow these sectors to become more efficient and to lower consumer prices. This reform then would lead to long-term consumer gains.

For the three sectors that have had growing markets, the theoretical economic impact from reform would likely be more substantial. Firms seeking to grow could add larger projects that would trigger NSR permitting. Without the GHG limits and the associated uncertainty on how the permit conditions would affect revenue, NSR permitting costs and uncertainty is reduced. In these sectors, we expect firms would shift more projects out of minor permitting programs and into NSR permitting if the policy reform is promulgated.

The COVID-19 pandemic has upended these theoretical expectations and limits our confidence that past trends will carry forward. Overall, the COVID pandemic has forced countries to rethink food security and consumers to alter their behaviors substantially. Firms are retooling to meet increased demand for milk and other foods to be made at home. Bakeries and breweries are also shifting production substantially as consumer purchase fewer food and drink for consumption outside their homes.

The biorefining sector also has mixed prospects. Combining various models of structural and economic trends, business models, and changes in attitudes, a recent report prepared for the UN's 75th anniversary identifies the biogrowth economy as one of six trends important to a post-COVID19 recovery.[53] The report projects the biogrowth economy to drive innovations and grow in significant ways. For example, by 2021, the global biorefining market is expected to grow to $715 billion. Moreover, the global market for agricultural biotechnology is expected to grow from $29 billion in 2016 to $52 billion by 2020.

At the same time, growth prospects for the US biofuel market is projected to decrease, with an estimated loss in demand of one million tons expected in 2020 alone.[54] International trade demand for corn and soybeans used in biofuels has declined as prices for oil and energy fall and as travel restrictions remain in place.[55] Oil prices, in particular, are expected to decline by 15 percent on average in 2020 due to COVID-19.[56]

Crop commodity prices are also expected to be negatively impacted by COVID-19, including a 9.4% price decrease for corn and a 6.5% decrease for soybeans between 2020 and 2021.[57] In Iowa alone, COVID-19 may cost the corn and soybean industries annual damages of $788 million and $213 million, respectively, while falling ethanol prices may equate to $347 million in losses in the state.[58] Corn ingredients will nevertheless serve a role in the production of important products such as medical gloves, sanitizers, hand soaps, and medical supplies that use corn-based plastics, including protective gear like face shields and filtration masks.

Therefore, since the Covid-19 pandemic's economic changes will eventually subside, in this analysis we use the long-run theoretical changes to estimate economic impact. We recognize that the report's estimated gains in economic activity may overstate near-term gains as the U.S. and the world economies recover from the Covid-19 pandemic.

Estimated Increase in Project Size

In the policy reform scenario, firms shift from projects eligible for minor permits to projects with sufficient potential emissions to require NSR permitting. However, firms do not have to expand or take advantage of the policy change. NSR permitting itself is costly and uncertain even without GHG emission limits. The financial returns from a larger expansion must be greater than the permitting costs and the opportunity cost of the firm's capital.

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[53] Centennial Lab, United Arab Emirates and United Nations, "Future Possibilities Report 2020."

[54] IHS Markit, "How COVID-19 Will Affect Global Biofuels Demand."

[55] Barichello, "The COVID-19 Pandemic: Anticipating Its Effects on Canada's Agricultural Trade."

[56] Westhoff et al., "Early Estimates of the Impacts of COVID-19 on U.S. Agricultural Commodity Markets, Farm Income and Government Outlays."

[57] Westhoff et al.

[58] Hart et al., "The Impact of COVID-19 on Iowa's Corn, Soybean, Ethanol, Pork, and Beef Sectors."

We simulate the facility owner considering a project that could require NSR permitting. The project's expected returns must be greater than the project's costs, including its permitting costs. Permitting costs include the probability the permit is not granted, the costs of the permit application, the opportunity cost of time needed to obtain the permit, and the expected additional pollution control costs applied to the entire source as EPA defines it. These pollution control costs are for conventional pollutants such as nitrous oxides, volatile organic carbon, and particulate matter.

A rational owner will go ahead with a project if the expected discounted value of the returns on the capital invested are greater that the costs of the permit process. The financial returns on the project are assumed to be the industry's average return on capital in excess of the risk-free rate of return, assumed to be the rate on the 10-year U.S. Treasury note. The additional permitting cost is split between the costs if the firm receives its NSR permit and the costs if it applies but does not obtain the permit. The permit costs are the application costs, the opportunity cost of these resources, and additional pollution control costs. We use the following initial equation to determine the minimum size of a project that could require NSR permitting:

$$r_c x + (r_c x/(1+r)) + (r_c x/(1+r)^2) - (r_c x/(1+r)^n = p(c_p + (t_{NSR})(r_c)(x) + c_{NSR}) + (1-p)(C_p + (r_c)(x)(t_{NSR}))$$

Following is a list with the variables used in the equation:

Variable	**Description**
x	Minimum size of capital project
r_c	Capital rate of return
c_p	Cost of permit application
t_{NSR}	Extra length of permit time (years)
c_{NSR}	Capital costs of extra pollution controls due to NSR review
p	Probability that the permit will be approved
r	Risk-free rate of return
n	Years in analysis

We solve for x in the equation above. To obtain the actual NSR project cost using this equation, we substitute the variables with a representative set of inputs. Table 10 provides the values we use in the equation and a description of how these values were derived.

Table 10: Determination of Minimum NSR Project Costs

VARIABLE	ASSUMED VALUE AND UNITS	DESCRIPTION
r_c	0.066 percent	Average return on capital annual rate for the industries in the study
c_p	$1 million	Costs in this category include preparation of project documentation, engineering design, testing/monitoring fees, contractor fees, meetings with officials, administrative overhead, and application fees[59]
t_{NSR}	1 year	Average length of NSR permit review from the permits we evaluated
c_{NSR}	$2 million	Costs in this category include control equipment not previously owned, installation, process integration and control, auxiliary buildings, final engineering design, ambient air monitoring equipment [60]
p	0.8 percent	We assume that 8 out each 10 permit applications are approved. Permits may be denied or withdrawn to local opposition, proposed regulatory limits, litigation, and other factors.
r	0.01 percent	10-Year Treasury yield rate[61]
n	10 years	Simplification of infinite series
		MINIMUM PROJECT COST: $4.2 MILLION

Using these inputs, facility owners would seek NSR permitting only for projects that cost at least $4.2 million above the size of a project they could permit with a minor source permit. This value is of course dependent on the assumptions in Table 10. The value with the greatest uncertainty is the additional pollution control costs that may be required at the facility or source unrelated to the

[59] A list with the cost categories involved in NSR permits is available at: https://www.tceq.texas.gov/assets/public/permitting/air/Forms/NewSourceReview/Tables/10196tbl.pdf

[60] A list with the cost categories involved in NSR permits is available at: https://www.tceq.texas.gov/assets/public/permitting/air/Forms/NewSourceReview/Tables/10196tbl.pdf

[61] U.S. Department of the Treasury, "Daily Treasury Yield Curve Rates."

project modification or the new facility's design. The $2 million amount in Table 10 is more representative of a larger facility with many emission sources and substantial capital.

While our data is incomplete, our search of available project cost data for the NSR permits that were issued in the industry found that most projects associated with an NSR permits were much larger. Therefore, the permit reform could spur incremental project increases of greater than $4.5 million.

Projection of the Incremental Project Investments Frequency by Industry Sector

From the previous sections, we determine that larger firms would be more likely to invest in larger projects of at least $4.2 million greater in size when the policy reform is promulgated. The question is how frequently they would take advantage of the changed requirements and carry out these larger projects. To project a future reform scenario, we examine how often on average firms in these states in the past have sought to expand or to modify their facilities. Greater expansion in the future should be anchored off this historic frequency.

Whether a firm uses the policy flexibility to invest in larger projects depends on the sector's structure, its capital use, its growth, and its market. As discussed earlier, we find the six sectors can be separated into groups based on their past history of seeking minor permits.

Capital-Intensive Sectors: Wet Corn Milling, Soybean Oil Processing, Ethyl Alcohol Production

To create the frequency estimate for these larger, capital intensive industries with higher growth rates, we compare the number of NSR and minor permits in our database to the number of possible permit opportunities. The opportunities are the product of the large facilities and the number of years in our dataset; each year each large facility had the opportunity to expand or modify its operations. We divide the number of NSR and minor permits by the product of the large facilities and the number of years in our dataset to estimate the frequency of that firms add new sources or modify their existing facilities to trigger air permitting requirements.

Table 11 shows these calculations for all six sectors. For ethyl alcohol facilities, across the 13 study states and the 32 large facilities, we expect one permit applications per year. We also expect one permit per year in soybean oil processing sectors and in wet corn milling.

We assume that each one of these opportunities will be increased in size by the values in Table 10. It is also possible that some projects, especially new facilities, would have incremental investments much larger than these values. It is well established that the current NSR program provides incentives for firms to locate and to expand operations in other countries. It is reasonable to believe that GHG production limits and NSR permitting costs have diverted some investment to Canada or to other countries. This production could return to these study states if policy reform is promulgated. Given the inherent uncertainty in offering a projecting, we believe the combination of the incremental project size and the frequency of incremental projects is reasonable.

Established Market Sectors: Bakeries, Breweries, and Dairies

The methodology for expanding sectors does not work well with the three sectors with established markets. Based on the calculations in Table 11, the methodology would over-predict the frequency of incremental projects.

For dairy manufacturers, there have never been any NSR permits in these two sectors during the study period. We also observe that no facility in this sector sought an NSR permit after the Supreme Court removed EPA's requirement for GHG permit limits in NSR permits. Similar to dairy manufacturers, breweries only obtained one NSR permit during the study period. Minor permits are also rare; a typical facility operates at least two decades before seeking a minor air permit for operational change. Given the lack of NSR and minor permits over the study period, we assume that no firms in the bakery, dairy, and the brewery sector will expand their facilities and trigger NSR permitting with the reform. However, definitive EPA support to exempt biogenic CO_2 emissions could give firms more confidence to expand. In this case, the analysis underestimates the economic impact of the reform.

Table 11: Frequency of Minor Permits for the Six Industries in the Study[62]

INDUSTRY	TOTAL MINOR PERMITS	LARGE FACILITIES	AVERAGE YEARS TO A MINOR PERMIT AT A FACILITY	ADJUSTED FREQUENCY PER YEAR
Breweries	30	75	27	0
Commercial bakeries	129	237	20	0
Ethyl alcohol manufacturing	225	42	2	1
Fluid milk manufacturing	17	107	69	0
Soybean and other oilseed processing	73	29	4	1
Wet corn milling	44	12	3	1
TOTAL	**518**	**502**		

Increased Capital Investments for Each Industry Sector

We then combine the incremental project investments and the projected frequency to calculate the capital investment by sector and by state. First, we use the number of establishments over 100 employees for each industry sector in every state presented in Table 7. We adjust the number of establishments from Table 6 by multiplying them by the frequency provided in Table 11.

To determine the return on capital investments we look at the hurdle rate or minimum acceptable rate of return (MARR). MARR is the minimum rate of return that investors are expecting to receive from an investment. The MARR rate considers the cost of capital, investment risks, and opportunity costs related to an investment. Most companies use the weighted average cost of capital (WACC) as their MARR rate when considering possible investments.[63] Therefore, we use the WAA rate to determine the annual returns on capital investments. WACC is a calculation of a firm's cost of capital in which each category of capital is proportionately weighted. All sources of capital, including common stock, preferred stock, bonds, and any other long-term debt, are included in a WACC estimate.

Table 12 presents the MARR/WACC rates for each industry sector included in the analysis. Since WACC rates are not available at six-digit-level NAICS codes, but they are provided for more general industry categories, we match each NAICS with either, food processing, alcoholic beverage, and chemical industry sectors.

[62] Policy Navigation Group, “Database with Minor Permits Issued in Selected States (2009-2020).”

[63] Corporate Finance Institute, “Hurdle Rate - Definition and Example - Guide to Hurdle Rates.”

Table 12: Minimum Acceptable Rate of Return Rates Used in the Analysis

ORIGINAL INDUSTRY	EQUIVALENT INDUSTRY	MARR/WACC RATE (2015)
Breweries	Beverage alcoholic	6.6
Commercial bakeries	Food processing	5.4
Ethyl alcohol manufacturing	Chemical basic	6.7
Fluid milk manufacturing	Food processing	5.4
Soybean and other oilseed processing	Food processing	5.4
Wet corn milling	Food processing	5.4

Third, to estimate the increased capital investment of the NSR reform, we multiply the adjusted number of establishments over 100 employees and multiply them by the minimum $4.2 million incremental project value. To estimate the returns on capital to the owners of these facilities, we multiply the previous product by the annual capital investment rate for each industry sector.[64] The total impact is the sum of both estimates (increased capital investment and return on capital). We follow the same methodology to calculate the national impact and each state impact. The only variation between both approaches is that for the state estimates we use the adjusted number of establishments over 100 employees per NAICS code. For the U.S. estimates we use the total number of establishments per NAICS code in the 13 states we modelled.

Table 13 and Table 14 provide the total impact of the reform for the U.S. and the 13 states we analyzed.

[64] Damodaran, "Cost of Capital by Sector (US)." For the annual returns on capital investment we use weighted average cost of capital (WACC). WACC is a calculation of a firm's cost of capital in which each category of capital is proportionately weighted. All sources of capital, including common stock, preferred stock, bonds and any other long-term debt, are included in a WACC estimate.

Table 13: Annual U.S. Impact of NSR Reform for the Six Industries

INDUSTRY	ESTIMATED PROJECT COST (PER ESTABLISHMENT IN MILLIONS)	WEIGHTED AVERAGE COST OF CAPITAL (%)	ADDITIONAL CAPITAL INVESTMENT DUE TO NSR REFORM (MILLIONS)	RETURN ON CAPITAL (1 YEAR, MILLIONS)	TOTAL U.S. IMPACT (MILLIONS)
Breweries	$4.2	5.4	-	-	-
Commercial bakeries	$4.2	6.5	-	-	-
Ethyl alcohol manufacturing	$4.2	6.7	$190	$12	$200
Fluid milk manufacturing	$4.2	5.4	-	-	-
Soybean and other oilseed processing	$4.2	5.4	$130	$6.8	$130
Wet corn milling	$4.2	5.4	$48	$2.6	$51

Table 14: Annual State Impacts of NSR Reform[65]

STATE	INDUSTRY	ADDITIONAL CAPITAL INVESTMENT DUE TO NSR REFORM (MILLIONS $)	RETURN ON CAPITAL (1 YEAR, MILLION $)	TOTAL STATE IMPACT (MILLION $)
CA	Wet corn milling	$9	$0.5	$9
CO		$0	$0	$0
IA		$4	$0.2	$5
IL		$4	$0.2	$5
IN		$4	$0.2	$5
MN		$4	$0.2	$5
MO		$4	$0.2	$5
NC		$4	$0.2	$5
ND		$0	$0	$0
NE		$0	$0	$0
OH		$9	$0.5	$9
SD		$0	$0	$0
TN		$4	$0.2	$5
CA	Soybean and other oilseed processing	$22	$1.2	$23
CO		$4	$0.2	$5
IA		$4	$0.2	$5
IL		$13	$0.7	$14
IN		$17	$0.9	$18
MN		$9	$0.5	$9
MO		$9	$0.5	$9
NC		$13	$0.7	$14
ND		$0	$0	$0
NE		$4	$0.2	$5
OH		$17	$0.9	$18
SD		$0	$0	$0
TN		$13	$0.7	$14
CA	Ethyl alcohol manufacturing	$35	$2.3	$37
CO		$9	$0.6	$9
IA		$9	$0.6	$9
IL		$17	$1.2	$19
IN		$22	$1.5	$23
MN		$13	$0.9	$14
MO		$13	$0.9	$14

[65] *Values marked with an asterisk have been adjusted to zero to reflect the fact that the corresponding industries in these states do not have any output in IMPLAN.

STATE	INDUSTRY	ADDITIONAL CAPITAL INVESTMENT DUE TO NSR REFORM (MILLIONS $)	RETURN ON CAPITAL (1 YEAR, MILLION $)	TOTAL STATE IMPACT (MILLION $)
NC		$17	$1.2	$19
ND		$0	$0	$0
NE		$4	$0.3	$5
OH		$26	$1.7	$28
SD		$4	$0.3	$5
TN		$17	$1.2	$19

Limitations of the Methodology

There are always limitations in any analysis due to the availability of data and of the objective to estimate a scenario that does not exist. We list some of the most important limitations so that they can be considered along with the quantitative estimates.

One of the key assumptions is the incremental increase in project size when the reform happens. We project how a rational owner would decide when to seek an NSR permit. The data from this modeling is uncertain. PNG has assembled a database of information about NSR permits, NSR permit project costs, NSR permit review duration, and other characteristics from over 1,100 NSR permits. Our assumptions of permit review duration, capital rates, and costs for additional pollution control are informed by our larger dataset. However, there is uncertainty as to whether these six sectors have similar costs for owners and thus have similar investment decisions.

Similarly, our prediction of the frequency of incremental larger projects rests upon our dataset of minor state air permits. We have data for eight of the 13 states in this analysis. This eight-state sample may bias our frequency calculation in an unknown manner.

Based on conversations with states, not all states add all their NSR permit data to EPA's database. For some states like North Carolina, virtually no state NSR data is in the EPA database. We therefore may have undercounted the true number of NSR permits issued to facilities in the six industries due this data source limitation.

Section 4 IMPLAN Modeling

To measure the total economic impact of the NSR permit reform, this study uses an input-output model of analysis with dataset developed and maintained by IMPLAN Group LLC (formerly Minnesota IMPLAN Group, Inc.). This section provides an overview of IMPLAN, a commonly used economic impact model and how we use it to measure the total economic impact for the U.S. economy, as well as for the 13 states included in the scope of the analysis.
As discussed in Section 3, the impact of the NSR reform is the sum of increased capital investment and return on capital (see
Table 13 and Table 14). The combination of increased spending from these two categories comprises the total economic impact of the NSR reform.

IMPLAN Approach

With the increased spending resulting from the NSR reform, we predict the value added, the number of full-time jobs, wages, and tax payments produced by the reform using IMPLAN. We built IMPLAN model runs for the U.S. economy, as well as for California, Colorado, Illinois, Indiana, Iowa, Minnesota, Missouri, Nebraska, North Carolina, North Dakota, Ohio, South Dakota, and Tennessee.

Overview of IMPLAN Model

The most common and widely accepted methodology for measuring the economic impacts of industrial sectors is input-output (I-O) analysis. At its core, an I-O analysis is a table that records the flow of resources to and from firms and individuals within a region at a given time. For a specified region, such as a state or the nation, the I-O table accounts for all dollar flows between different sectors of the economy in a given time period. With this information, a model can then follow how a dollar added into one sector is spent and re-spent in other sectors of the economy, generating outgoing ripples of subsequent economic activity. This chain of economic activity generated by one event is called the “economic multiplier” effect. More information on IMPLAN is found in Appendix A.

Since IMPLAN is a fixed price model, we change the model’s inputs to simulate the industry’s response to NSR reform.

Industry Sectors

To be able to model the economic impacts of the NSR reform, first we link each industry sector to its corresponding IMPLAN sector. Table 15 below provides a summary of the IMPLAN sectors corresponding to each of the NAICS codes included in the scope of this analysis. Most NAICS correspond to a specific IMPLAN industry sector. The only exception is IMPLAN Sector 70, which encompasses ethyl alcohol manufacturing and wet corn milling. Thus, for the purposes of IMPLAN modeling, the impacts for ethyl alcohol manufacturing and wet corn milling are summed together and modelled in IMPLAN sector 70.

Table 15: Correspondence of NAICS and IMPLAN Industry Sectors

INDUSTRY	CORRESPONDING IMPLAN SECTOR	COMMODITIES INCLUDED IN IMPLAN SECTOR
Breweries	106: Breweries	3108: Beer, ale, malt liquor and nonalcoholic beer
Commercial bakeries	93: Bread and bakery products, except frozen manufacturing	3094: Bread and bakery products except frozen 3095: Frozen cakes and other pastries 3096: Cookies and crackers
Ethyl alcohol manufacturing	68: Wet corn milling	3070: Wet corn 3165: Other basic organic chemicals
Fluid milk manufacturing	84: Fluid milk milling	3081: Canned fruits and vegetables 3084: Fluid milk 3087: Dry, condensed and evaporated dairy products 3088: Ice cream and frozen dessert 3106: Bottled and canned drinks and water
Soybean and other oilseed processing	69: Soybean and other oilseed processing	3067: Flour 3071: Soybean and other oilseed processing 3072: Fats and oils refining and blending
Wet corn milling	68: Wet corn milling	3070: Wet corn 3165: Other basic organic chemicals

Values Modelled in IMPLAN

To conduct the economic impact analysis of the NSR reforms in IMPLAN, we use the total impact values provided in
Table 13 and Table 14 and enter them as spending events. The IMPLAN model does not have output values for a two industry sectors in a number of states (see Table 16). The absence of no output values implies that those particular industry sectors do not currently have manufacturing operations in those states. Therefore, we do not model those industry sectors in those states. The values in
Table 13 and Table 14, are already adjusted to reflect this condition.

Table 16: States and Industry Sectors with Zero Output Value in IMPLAN

IMPLAN SECTOR	STATES WITH ZERO OUTPUT VALUE
68: Wet corn milling	Colorado, Nebraska, North Dakota, South Dakota
69: Soybean and other oilseed processing	Colorado, Nebraska, North Dakota, South Dakota

Capital Expenses Calculated Outside IMPLAN

Since many capital goods are procured outside of a particular study area, a national model better captures the indirect and induced economic activity. A portion of spending by the six industries result in capital purchases. For example, a plant in Kentucky may buy supplies from a company in Missouri. With a portion of the money received, that Missouri company will invest in capital equipment to increase its production. Due to the modeling structure, neither the Kentucky nor Missouri state model may completely capture the full economic impact of that purchase completely. These capital expenses need to be calculated outside IMPLAN. We only estimate the impacts of capital spending at the national level since data on capital investments are not available at the state level.

To model capital spending outside IMPLAN, we first identify the net capital expenses/sales ratios for the industries in this study. For each category, we use the ratio and the purchasing amount spent in each sector to estimate the actual capital expenditures.[66] Once the capital expenditures are estimated, we add the sum of the expenditures for each category to the national model in IMPLAN by entering it as an industry output using IMPLAN Sector 51 (Construction of New Manufacturing Structures). We then run the national IMPLAN model to estimate the employment, labor income, and value added from these capital expenditures (see Table 17).

[66] Damodaran, "Capital Expenditures by Sector (U.S.)."

Table 17: Estimation of Capital Expenditures in the Analysis

INDUSTRY	RATE	EXPENDITURE AMOUNT ENTERED IN IMPLAN (MILLIONS $)	CAPITAL EXPENDITURE (MILLIONS $)
Breweries	0.13	0	0
Commercial Bakeries	0.1	0	0
Ethyl Alcohol Manufacturing	0.14	170	23
Fluid Milk Manufacturing	0.1	0	0
Soybean and Other Oilseed Manufacturing	0.1	129	13
Wet Corn Milling	0.1	46	4.6

The following section presents the economic impact results from the IMPLAN model.

Section 5 IMPLAN Results

This section presents the estimated total economic impact of the NSR reform for the six industries we analyzed. As discussed in Section 4, we combine the impacts from the NSR reform at the U.S. and state level. We present the impacts in terms of employment, labor income, and value added.

We provide the results of the national IMPLAN model, which summarizes the direct, indirect and induced impacts of the NSR reform in Table 18. The national model is followed by a summary of the impacts at the state level (Tables 20 to 32).

U.S. Impacts

The total economic impact of the U.S. for the six industries is listed in Table 18. Gains from the NSR reform will result in the addition of 2,100 U.S. full-time jobs and over $130 million in wages. The NSR reform will also have an impact on government spending by increasing direct and indirect tax payments. The gain in economic activity caused by the NRS reform for the six industries analyzed in this report will result in $27 million in federal tax payments and $17 million in state and local tax payments.

Table 18: Summary of NSR Reform Impacts on the U.S. Economy

SUMMARY OF IMPACTS FROM OPERATIONS			
Impact Type	Employment	Labor Income	Value Added
Direct Effect	390	33,000,000	68,000,000
Indirect Effects	1,200	65,000,000	110,000,000
Induced Effects	600	33,000,000	58,000,000
Total Impact from Operations	2,100	130,000,000	240,000,000

TEN MOST IMPACTED SECTORS (BY EMPLOYMENT)			
Grain farming	260	2,900,000	17,000,000
Construction of new manufacturing structures	260	12,000,000	22,000,000
Truck transportation	140	6,900,000	11,000,000
Wet corn milling	100	13,000,000	33,000,000
Other real estate	87	1,200,000	7,700,000
Support activities for agriculture and forestry	83	2,100,000	2,700,000
Oilseed farming	62	48,000	10,000,000
Services to buildings	41	740,000	1,300,000
Employment services	40	1,700,000	2,700,000
Full-service restaurants	39	980,000	1,600,000

	Tax Payments
Federal Tax Payments	27,000,000
State and Local Tax Payments	17,000,000

State Impacts

Tables 21 to 29 provide the state-level impact of the NSR reform for California, Illinois, Indiana, Iowa, Minnesota, Missouri, Ohio, and Tennessee. In terms of employment, total impact ranges from 30 full time equivalents (FTE) in Missouri to 350 in Ohio. Employment impact ranges from $1.6 million in labor income in Missouri to $18 million in California. In just three states – California, Indiana, and Ohio – the total value added from the NSR reforms would represent over $91 million per year.

Table 19: Summary of NSR Reform Impacts in California

SUMMARY OF IMPACTS FROM OPERATIONS			
Impact Type	Employment	Labor Income	Value Added
Direct Effect	28	3,000,000	7,500,000
Indirect Effects	120	11,000,000	16,000,000
Induced Effects	66	4,000,000	7,400,000
Total Impact from Operations	**210**	**18,000,000**	**31,000,000**

TEN MOST IMPACTED SECTORS (BY EMPLOYMENT)			
Truck transportation	28	1,100,000	2,400,000
Wet corn milling	23	2,600,000	5,900,000
Grain farming	7	200,000	3,000,000
Scenic and sightseeing transportation and support activities for transportation	6	430,000	560,000
Services to buildings	6	120,000	210,000
Employment services	5	270,000	440,000
Soybean and other oilseed processing	5	360,000	1,800,000
Other real estate	5	90,000	690,000
Full-service restaurants	4	140,000	220,000
Support activities for agriculture and forestry	4	170,000	190,000

	Tax Payments
Federal Tax Payments	3,600,000
State and Local Tax Payments	2,800,000

Contribution to U.S. GDP Outside of the State	**$10,000,000**

Table 20: Summary of NSR Reform Impacts in Illinois

SUMMARY OF IMPACTS FROM OPERATIONS			
Impact Type	Employment	Labor Income	Value Added
Direct Effect	14	1,900,000	5,200,000
Indirect Effects	120	7,600,000	14,000,000
Induced Effects	52	2,900,000	5,200,000
Total Impact from Operations	190	12,000,000	24,000,000

TEN MOST IMPACTED SECTORS (BY EMPLOYMENT)			
Grain farming	29	300,000	2,000,000
Truck transportation	15	710,000	1,200,000
Other real estate	11	210,000	1,200,000
Wet corn milling	11	1,600,000	4,000,000
Oilseed farming	10	7,700	2,200,000
Support activities for agriculture and forestry	8	200,000	310,000
Services to buildings	5	96,000	150,000
Employment services	4	170,000	270,000
Full-service restaurants	4	98,000	160,000
Scenic and sightseeing transportation and support activities for transportation	3	230,000	270,000

	Tax Payments
Federal Tax Payments	2,600,000
State and Local Tax Payments	1,800,000

Contribution to U.S. GDP Outside of the State	$7,900,000

Table 21: Summary of NSR Reform Impacts in Indiana

SUMMARY OF IMPACTS FROM OPERATIONS			
Impact Type	Employment	Labor Income	Value Added
Direct Effect	17	1,900,000	7,300,000
Indirect Effects	170	8,500,000	14,000,000
Induced Effects	57	2,800,000	4,700,000
Total Impact from Operations	240	13,000,000	26,000,000

TEN MOST IMPACTED SECTORS (BY EMPLOYMENT)			
Grain farming	55	2,900,000	17,000,000
Truck transportation	18	6,900,000	11,000,000
Support activities for agriculture and forestry	14	2,100,000	2,700,000
Wet corn milling	13	13,000,000	33,000,000
Other real estate	13	1,200,000	7,700,000
Oilseed farming	12	48,000	10,000,000
Employment services	5	1,700,000	2,700,000
Services to buildings	5	740,000	1,300,000
Full-service restaurants	5	980,000	1,600,000
Hospitals	4	2,400,000	3,000,000

	Tax Payments
Federal Tax Payments	2,600,000
State and Local Tax Payments	1,600,000

Contribution to U.S. GDP Outside of the State	$8,600,000

Table 22: Summary of NSR Reform Impacts in Iowa

SUMMARY OF IMPACTS FROM OPERATIONS			
Impact Type	Employment	Labor Income	Value Added
Direct Effect	8	830,000	2,500,000
Indirect Effects	54	3,000,000	5,600,000
Induced Effects	19	800,000	1,500,000
Total Impact from Operations	80	4,600,000	9,600,000

TEN MOST IMPACTED SECTORS (BY EMPLOYMENT)			
Grain farming	11	200,000	1,100,000
Truck transportation	7	380,000	610,000
Wet corn milling	7	750,000	2,000,000
Support activities for agriculture and forestry	5	130,000	200,000
Other real estate	5	48,000	340,000
Services to buildings	2	41,000	59,000
Wholesale - Other nondurable goods merchant wholesalers	2	150,000	320,000
Full-service restaurants	2	31,000	48,000
Oilseed farming	1	2,200	500,000
Employment services	1	55,000	91,000

	Tax Payments
Federal Tax Payments	930,000
State and Local Tax Payments	720,000

Contribution to U.S. GDP Outside of the State	$3,100,000

Table 23: Summary of NSR Reform Impacts in Minnesota

SUMMARY OF IMPACTS FROM OPERATIONS			
Impact Type	Employment	Labor Income	Value Added
Direct Effect	11	1,200,000	3,000,000
Indirect Effects	100	5,100,000	10,000,000
Induced Effects	37	2,000,000	3,400,000
Total Impact from Operations	150	8,300,000	17,000,000

TEN MOST IMPACTED SECTORS (BY EMPLOYMENT)			
Grain farming	27	370,000	2,000,000
Truck transportation	11	530,000	960,000
Other real estate	10	130,000	740,000
Wet corn milling	9	980,000	2,200,000
Support activities for agriculture and forestry	8	200,000	310,000
Oilseed farming	4	4,600	910,000
Services to buildings	3	62,000	100,000
Wholesale - Other nondurable goods merchant wholesalers	3	280,000	550,000
Full-service restaurants	3	68,000	100,000
Employment services	3	120,000	180,000

	Tax Payments
Federal Tax Payments	1,800,000
State and Local Tax Payments	1,300,000

Contribution to U.S. GDP Outside of the State	$5,400,000

Table 24: Summary of NSR Reform Impacts in Missouri

SUMMARY OF IMPACTS FROM OPERATIONS			
Impact Type	Employment	Labor Income	Value Added
Direct Effect	2	160,000	740,000
Indirect Effects	20	1,100,000	1,800,000
Induced Effects	7	350,000	610,000
Total Impact from Operations	30	1,600,000	3,100,000

TEN MOST IMPACTED SECTORS (BY EMPLOYMENT)			
Oilseed farming	6	2,700	750,000
All other crop farming	3	6,900	8,800
Truck transportation	2	110,000	170,000
Support activities for agriculture and forestry	2	46,000	53,000
Soybean and other oilseed processing	2	140,000	760,000
Other real estate	1	15,000	71,000
Wholesale - Grocery and related product wholesalers	1	53,000	81,000
Cotton farming	1	17,000	28,000
Full-service restaurants	1	12,000	17,000
Hospitals	0	34,000	42,000

	Tax Payments
Federal Tax Payments	310,000
State and Local Tax Payments	150,000

Contribution to U.S. GDP Outside of the State	$1,000,000

Table 25: Summary of NSR Reform Impacts in North Carolina

SUMMARY OF IMPACTS FROM OPERATIONS			
Impact Type	Employment	Labor Income	Value Added
Direct Effect	14	1,700,000	5,300,000
Indirect Effects	77	7,000,000	8,700,000
Induced Effects	46	2,200,000	4,000,000
Total Impact from Operations	140	11,000,000	18,000,000

TEN MOST IMPACTED SECTORS (BY EMPLOYMENT)			
Truck transportation	13	630,000	980,000
Wet corn milling	11	1,400,000	3,700,000
Grain farming	8	130,000	1,200,000
Support activities for agriculture and forestry	7	220,000	260,000
Other real estate	6	70,000	440,000
Services to buildings	4	66,000	100,000
Full-service restaurants	3	77,000	120,000
Employment services	3	140,000	220,000
Oilseed farming	3	4,000	1,800,000
Limited-service restaurants	3	53,000	90,000

	Tax Payments
Federal Tax Payments	2,100,000
State and Local Tax Payments	840,000

Contribution to U.S. GDP Outside of the State	$5,900,000

Table 26: Summary of NSR Reform Impacts in Ohio

SUMMARY OF IMPACTS FROM OPERATIONS			
Impact Type	Employment	Labor Income	Value Added
Direct Effect	21	2,800,000	9,400,000
Indirect Effects	260	9,100,000	18,000,000
Induced Effects	71	3,400,000	6,200,000
Total Impact from Operations	350	15,000,000	34,000,000

TEN MOST IMPACTED SECTORS (BY EMPLOYMENT)			
Grain farming	90	910,000	3,200,000
Support activities for agriculture and forestry	25	560,000	510,000
Truck transportation	23	1,200,000	1,900,000
Oilseed farming	19	15,000	1,700,000
Other real estate	18	210,000	1,200,000
Wet corn milling	17	2,400,000	7,200,000
Services to buildings	7	110,000	210,000
Employment services	6	230,000	390,000
Full-service restaurants	6	130,000	200,000
Wholesale - Other nondurable goods merchant wholesalers	5	390,000	860,000

	Tax Payments
Federal Tax Payments	3,300,000
State and Local Tax Payments	2,800,000

Contribution to U.S. GDP Outside of the State	$11,000,000

Table 27: Summary of NSR Reform Impacts in Tennessee

SUMMARY OF IMPACTS FROM OPERATIONS			
Impact Type	Employment	Labor Income	Value Added
Direct Effect	14	1,700,000	5,300,000
Indirect Effects	120	4,300,000	7,900,000
Induced Effects	31	1,700,000	2,800,000
Total Impact from Operations	160	7,700,000	16,000,000

TEN MOST IMPACTED SECTORS (BY EMPLOYMENT)			
Grain farming	37	150,000	1,000,000
Truck transportation	14	810,000	1,200,000
Wet corn milling	11	1,400,000	3,600,000
Support activities for agriculture and forestry	9	220,000	230,000
Oilseed farming	7	2,000	540,000
Other real estate	5	69,000	440,000
All other crop farming	5	7,000	8,100
Services to buildings	3	55,000	110,000
Employment services	3	120,000	200,000
Soybean and other oilseed processing	3	310,000	1,800,000

	Tax Payments
Federal Tax Payments	1,600,000
State and Local Tax Payments	920,000

Contribution to U.S. GDP Outside of the State	$5,300,000

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Appendix A. Description of IMPLAN

The primary tool used in the performance of this study is the I-O model and dataset developed and maintained by IMPLAN Group LLC (formerly Minnesota IMPLAN Group, Inc.). IMPLAN is a widely accepted and used software model first developed by the U.S. Forest Service in 1972.[67] The data used in the baseline IMPLAN model and dataset come largely from Federal agency databases. The input-output tables themselves come from the Bureau of Economic Analysis. Much of the annual data on labor, wages, final demand, and other market data comes from the Bureau of Labor Statistics, the Census Bureau, and other government sources.[68]

Government agencies, companies, and researchers use IMPLAN to estimate the economic activities associated with spending in a particular industry or on a particular project. The IMPLAN model extends conventional I-O modeling to include the economic relationships between government, industry, and household sectors, allowing IMPLAN to model transfer payments such as taxes.

The model works by tracking the flow of resources to and from firms and individuals within a region. Producers of goods and services must secure labor, raw materials, and other services to fabricate their product. The owners of these resources then, in turn, spend money to secure additional goods and services or inputs for the products they sell. For example, a corn refining plant in Indiana may buy $1 million of corn from a company in Kentucky. The company in Kentucky will pay its suppliers, principally farmers. Farmers may then spend $500,000 on wages and benefits, $200,000 at agricultural equipment suppliers, $100,000 on fertilizer, $50,000 on transportation, and $50,000 on various professional services associated with operating a business (e.g., attorneys and accountants).

Farm workers and owners will also buy goods and services from other firms in the area (e.g. restaurants, gas stations, and taxes). The suppliers, employees, and owners of this economic activity will, in turn, spend those resources on other goods and services either within the study region or elsewhere. The cycle continues until all the money leaves the region.

The combination of these activities, resource transfers, business growth, and gains in household income is the total economic activity that arises from new spending. Since the IMPLAN model tracks these flows for all U.S. regions, we use this model in our analysis.

IMPLAN Methodology

The model uses national production functions for over 530 industries to determine how an industry spends its operating receipts to produce its goods and services. These production functions are derived from U.S. Census Department data. IMPLAN couples the national production functions with a variety of county-level economic data to determine the impacts at a state and Congressional district level.

IMPLAN combines this data to generate a series of economic multipliers for the study area. The multiplier measures the amount of total economic activity generated by the corn refining industry's spending an additional dollar in the study area. Based on these multipliers, IMPLAN generates a series of tables to show the economic event's direct, indirect, and induced impacts to gross receipts or output within each of the model's more than 530 industries.

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[67] U.S. Department of Agriculture (USDA), Forest Service, "Economic Analysis Applications."

[68] IMPLAN Group LLC, "IMPLAN Data Sources."

The model calculates three types of effects:

Direct effects. These effects represent the effects of a change on the individual firm or sector. For example, if the production of corn-based sweeteners were to increase, wages and benefits (and number of employees) at corn refining plants would increase, as would payments to suppliers and income to owners.

Indirect effects. These effects represent additional (or reduced) spending by other industries because of the activities of the industry being studied. To continue with our example, if the demand for corn-based sweeteners increases by half, farm income increases. Growers then spend more on fertilizer, seed, and other inputs. This spending by the grower and associated industries is the indirect effect.

Induced effects. These effects represent the effect of changes in household income. All owners and employees associated with either direct or indirect effects spend some portion of their income on goods and services not necessarily related to any of the industries associated with corn refining. They buy meals and homes and movie tickets. They pay taxes. The government buys goods and services with that tax money. All these activities fall into the category of induced effects.

The economic impact is the sum of these three effects.

Considerations Concerning IMPLAN

There are four important points about our use of IMPLAN (or any other input-output model):

First, it is a fixed price model. The model assumes that changes in consumption are not limited by capacity and do not affect prices. For example, changing the output of an industry does not affect wages in the region. This simplifying assumption does not cause a problem for the analysis because we are taking a snapshot of the economy in one given year. Therefore, the spending and prices are based on what was spent in that given year, not what might be spent if prices or demand change in the future.

Second, as with many studies using this type of model, the direct impacts are not calculated by the model; they reflect actual spending levels and patterns. Changing the level of direct spending allows us to calculate the magnitude of the indirect and induced effects associated with the historical level of spending.

Third, because the model continues to calculate additional spending until all of the money leaves the region (we will refer to this phenomenon as "leakage"), the larger and more economically diverse the region, the longer it will take for spending to leave the region, and the larger the impact is likely to be. For example, employees may spend some amount of their income on automobiles. If they are in a state or district that has no automotive production, this spending will leave the region and the multiplier effect will stop. However, at the national level some portion of that same spending by that same individual may go to a domestic auto producer. Therefore, that spending with a domestic auto producer would lead to more spending at the national level that would not be captured by a more regional model. As a result, the national impact will be larger than the sum of the individual states.

An additional consideration is that a proportion of major products manufactured by the industry sectors in this analysis are imported. For example, due to regulation, imports of products such as sweeteners or starches could increase as producers in other jurisdictions would not be subject to the same costs as their U.S. counterparts. Food manufacturing companies could import more sweeteners or starch from other countries to reduce their costs. Similarly, consumers could buy products made with imported ingredients to save money. These potential impacts are not estimated by IMPLAN and are a limitation of this analysis.

To address the third issue, we calculate the magnitude of this leakage and report it separately as a contribution of an individual state to the broader economy. For the purposes of this study we make the simplifying assumption that the amount of leakage attributable to a given region is proportional to that region's share of the broader area in which it is located. In the leakage calculations we exclude capital expenses that were modeled outside the state model. The reason behind this decision is to not overemphasize a state contribution outside that particular state.

Employment is defined as the number of payroll and self-employed jobs, including part time jobs. Specifically, a job in IMPLAN = the annual average of monthly jobs in that industry (this is the same definition used by BLS and BEA nationally). A job can be either full-time or part-time. Thus, one job lasting 12 months = two jobs lasting six months each = three jobs lasting four months each.

Labor income is all forms of employment income, including employee compensation (wages and benefits) and proprietor income from self-employment.

Value added is the additional value created by a firm or sector. It is calculated by subtracting the cost of all non-labor inputs (including contract labor) from the value of shipments. It includes employee compensation, income to owners, proprietor's income, and income from property and indirect business taxes. Total value added by an industry represents the contribution of the industry to GDP. According to the Bureau of the Census, value added is the best value measure available for comparing the relative economic importance of manufacturing among industries and geographic areas.