April 9, 2025

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SENT VIA EMAIL to sengdahl@idem.in.gov

RE: Public Comments on LSA Document #25-204, NOx RACT for Lake and Porter Counties

Dear Mr. Engdahl,

We submit these public comments on behalf of Just Transition Northwest Indiana, Indiana Conservation Voters, Gary Advocates for Responsible Development (GARD), Citizens Action Coalition, Sierra Club Hoosier Chapter, Conservation Law Center, Environmental Law & Policy Center, Industrious Labs, and Mighty Earth (collectively, "Commenters'') regarding the rules proposed by the Indiana Department of Environmental Management ("IDEM") to address the reasonably available control technology ("RACT") requirements for nitrogen oxides ("NOx") emissions to be included as part of the Indiana State Implementation Plan ("SIP").[1] IDEM proposes to add rules at 326 IAC 10-7 to address the NOx RACT SIP requirements for the

[1] *See* Notice of First Public Comment Period, LSA Document #25-204, Nitrogen Oxides Reasonably Available Control Technologies of Lake and Porter County (April 26, 2025), https://iar.iga.in.gov/register/20250409-IR-250204FNA ("Public Notice").

portions of Lake and Porter Counties designated moderate nonattainment with the 2015 ozone national ambient air quality standard ("NAAQS").

As explained below, IDEM must take additional steps to comply with the requirements of the Clean Air Act ("CAA" or "Act") to address ozone pollution. After decades of being designated nonattainment for ozone pollution, IDEM's newly proposed NOx RACT rules do not require most air pollution sources in the Indiana nonattainment area to install additional controls to address NOx emissions and thus fail to reduce ozone pollution in a meaningful way. Allowing almost all sources in the ozone nonattainment area to simply continue with current operations does not control pollution and bring the area into expeditious attainment with the 2015 ozone NAAQS, as required by the CAA.[2] IDEM's actions thus far have been inadequate, and IDEM must take stronger action to protect public health and the environment. Specifically, IDEM must (1) provide adequate public notice and a meaningful opportunity to review and comment on these NOx RACT SIP rules, and (2) undertake a RACT analysis that considers less-polluting RACT technologies that can expeditiously and meaningfully lower NOx emissions sources throughout these nonattainment areas.

We appreciate the opportunity to comment and look forward to discussing the ideas below with IDEM staff.

I. Background

A. Longstanding Ozone Air Quality Problems

Lake and Porter Counties, either in whole or in part, have been part of the greater Chicago area designated in nonattainment of the federal ozone standards for decades, dating back to the 1979, 1997, and 2008 ozone NAAQS. Most recently, EPA designated specific townships in Lake and Porter County as part of the Chicago, IL-IN-WI nonattainment area for the 2015 ozone standard of 70 parts per billion ("ppb").[3] Because Illinois, Indiana, and Wisconsin failed to bring this "marginal" ozone nonattainment area into attainment within three years, EPA then reclassified the area to "moderate" ozone nonattainment in 2022.[4] The moderate classification triggered Indiana's responsibility to submit a number of SIP revisions required by the Clean Air Act, including new measures to bring down pollution levels and specific plans to continue achieving progress towards attainment.[5] However, IDEM failed to provide those SIP revisions in a timely manner, and EPA made a formal finding of failure to submit that triggered CAA permitting and highway funding sanctions if Indiana did not submit the missing SIP requirements.[6] In the current rulemaking, IDEM is finally addressing the SIP requirements

[2] 42 U.S.C. § 7502(c)(1).
[3] *See* 83 Fed. Reg. 25776, 25804 (June 4, 2018), and 86 Fed. Reg. 31438, 31446 (June 14, 2021) (together designating Calumet, Hobart, North, Ross, and St. John Townships in Lake County and Center, Jackson, Liberty, Pine, Portage, Union, Washington, and Westchester Townships in Porter County as part of the Chicago, IL-IN-WI nonattainment area).
[4] 87 Fed. Reg. 60897 (Oct. 7, 2022).
[5] *See* 42 U.S.C. § 7502, 7511a(b), (f).
[6] 88 Fed. Reg. 71757 (Oct. 18, 2023).

resulting from the moderate ozone nonattainment classification, as required by the CAA and as necessary to stop imposition of the Act's sanctions.[7]

Meanwhile, pollution levels in the Chicago, IL-IN-WI nonattainment area have remained above the current ozone health standard of 70 ppb. In December 2024, EPA reclassified both ozone areas to "serious" nonattainment.[8] By January 1, 2026, Indiana must submit additional SIP revisions, including more stringent NOx RACT requirements, to address the CAA's serious ozone nonattainment requirements.[9] Without meaningful emissions reductions throughout the Chicago, IL-IN-WI nonattainment area, it is likely that air quality in the Chicago, IL-IN-WI nonattainment area will continue to exceed the 2015 ozone NAAQS. Last summer, ozone levels in the nonattainment area exceeded the ozone standard on 15 days.[10] And such pollution is likely to continue or worsen as the Trump Administration seeks to roll back pollution limits on some of the largest sources of ozone-forming pollutants, like coal-fired power plants.[11]

B. Health and Environmental Impacts of Ozone Pollution

More than 650,000 Indiana residents live in Lake and Porter County, with more than 85% of those residents living in the specific townships designated nonattainment for the 2015 ozone NAAQS.[12] Exposure to ozone, the main component of smog, has detrimental effects on human health. Ozone exposure, even short-term exposure, is linked to chronic conditions affecting the respiratory, cardiovascular, reproductive, and central nervous systems, as well as mortality.[13] Respiratory symptoms of ozone exposure include coughing, wheezing, and shortness of breath.[14] Notably, ozone exacerbates asthma and can contribute to new onset asthma.[15] Accordingly, ozone exposure is associated with increased asthma attacks, emergency room visits, hospitalization, and medication for asthma.[16]

The health effects of ozone exposure are cumulative, increasing with higher ozone concentrations and increased exposure time.[17] The impacts of ozone exposure on the respiratory system can occur at concentration levels below the 2015 eight hour ozone NAAQS.[18] In fact,

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[7] *See generally* Public Notice at 1-2.
[8] 89 Fed. Reg. 101901 (Dec. 17, 2024).
[9] 40 C.F.R. § 51.1402(b)(1).
[10] United States Environmental Protection Agency ("EPA"), Air Data – Ozone Exceedances, *available at* https://www.epa.gov/outdoor-air-quality-data/air-data-ozone-exceedances.
[11] EPA Press Release, *EPA Launches Biggest Deregulatory Action in U.S. History* (Mar. 12, 2025), *available at* https://www.epa.gov/newsreleases/epa-launches-biggest-deregulatory-action-us-history.
[12] EPA, *Chicago, IL-IN-WI Nonattainment Area - Final Area Designations for the 2015 Ozone National Ambient Air Quality Standards - Technical Support Document (TSD) for Counties Remanded to EPA* (May 2021), https://www.epa.gov/sites/default/files/2021-05/documents/il_in_wi_chicago_tsd_remand_final.pdf ("EPA TSD"), at 15 and 13-14.
[13] *See* EPA, Policy Assessment for the Review of the Ozone National Ambient Air Quality Standards (Aug. 2014), EPA-HQ-OAR-2008-0699-0404.
[14] *Id*. at 3-27.
[15] *Id*. at 3-28.
[16] *See id*.
[17] *See id*.
[18] EPA, National Ambient Air Quality Standards for Ozone, 80 Fed. Reg. 65,292, 65,292 (Oct. 26, 2015).

ozone concentrations as low as 60 ppb can cause inflammation and decreased lung function in healthy, exercising adults after 6.6 hours of exposure.[19] Furthermore, studies have observed an association between short-term ozone exposure and hospital admission or emergency department visits at concentrations as low as 31 ppb.[20] Ozone concentrations are highest outdoors, but exposure occurs indoors as well.[21]

While the health impacts of ozone are ubiquitous, certain populations are at an increased risk for ozone-related health effects. Those populations include people with asthma and/or lung disease, children, people over the age of 65, pregnant people, people of color, and outdoor workers.[22] Factors contributing to an individual's risk of ozone-induced health burdens include exposure, susceptibility, access to healthcare, and psychosocial stress.[23] These factors can intersect to place certain individuals at even greater risk. For example, children experience increased exposure to ozone because they are more likely to spend time being active outdoors, and increased susceptibility to the health impacts due to their developing lungs and higher occurrences of respiratory infections than adults.[24]

The pervasive impacts of ozone exposure disproportionately burden communities of color and economically marginalized populations. Higher levels of exposure can be attributed to the historical siting of polluting facilities in marginalized communities as opposed to more affluent, predominantly white neighborhoods.[25] Accordingly, people of color, especially Black individuals, carry a higher asthma burden than white people, and are overrepresented in the nation's ozone nonattainment areas. Furthermore, people of color are more susceptible to the impacts of air pollution, such as asthma, diabetes, and heart condition, because they are more likely than white individuals to be living with one or more chronic conditions.[26]

In addition to negative effects on human health, ozone pollution also harms Indiana's natural environment. Ozone pollution can impact plants by reducing photosynthesis, slowing growth, and increasing the risk of disease and damage from other events, and these impacts on plants can have negative impacts throughout the surrounding ecosystem.[27] Ozone pollution reduces insect populations and impedes the complex plant-pollinator relationship, while causing

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[19] EPA, Integrated Science Assessment for Ozone and Related Photochemical Oxidants (2020) at IS-1, *available at* https://www.epa.gov/isa/integrated-science-assessment-isa-ozone-and-related-photochemical-oxidants/.
[20] *Id*. at IS-27.
[21] EPA, Integrated Science Assessment for Ozone and Related Photochemical Oxidants (2013) at 1-3, *available at* https://www.epa.gov/isa/integrated-science-assessment-isa-ozone-and-related-photochemical-oxidants/.
[22] *Id*. at 2-30; EPA, National Ambient Air Quality Standards for Ozone, 80 Fed. Reg. 65,292, 65,310 (Oct. 26, 2015).
[23] American Lung Ass'n, State of the Air 2022, Tracking Air Pollution & Championing Clean Air 25 (2022), *available at* https://www.lung.org/getmedia/74b3d3d3-88d1-4335-95d8-c4e47d0282c1/sota-2022/.
[24] *Id*. at 26.
[25] *Id*.
[26] *Id*.
[27] EPA, Ecosystem Effects of Ozone Pollution, https://www.epa.gov/ground-level-ozone-pollution/ecosystem-effects-ozone-pollution.

respiratory, cardiovascular, and other impacts in animal species similarly to humans.[28] Air pollution from sources in Lake and Porter Counties, including those addressed by these proposed rules, have a direct, negative impact on the flora, fauna, and air quality natural sites in the area, including Indiana Dunes National Park and Indiana Dunes State Park. In fact, Indiana Dunes National Park is ranked among the top ten worst national parks for unhealthy air quality and hazy skies.[29] Accordingly, ozone pollution not only harms Indiana's natural environment but can impact the humans visiting area parks and the resulting tourism industry.[30]

II. IDEM Must Take Additional Actions to Satisfy Its Legal Obligations and Protect Public Health in the Chicago, IL-IN-WI Nonattainment Area

Despite the continuing air quality problems experienced in the Chicago, IL-IN-WI ozone nonattainment area and the accompanying public health and environmental impacts faced by more than half -a-million Indiana residents (plus millions more people living throughout the nonattainment area), IDEM has failed to take the necessary actions to control NOx pollution from sources in Lake and Porter County so that the area can expeditiously attain the 2015 ozone NAAQS. IDEM's NOx RACT Public Notice and accompanying Regulatory Analysis repeatedly discuss the potential impacts of CAA sanctions on Lake and Porter County.[31] However, nowhere in the publicly provided documents does IDEM discuss, or even attempt to quantify, the current NOx pollutions from sources in the nonattainment area or the NOx emission reductions expected from these rules, even though the sources in these counties are among the highest NOx emitters in the Chicago ozone nonattainment area.[32]

While IDEM is proposing to adopt rules that aim to address the NOx RACT requirement for relevant sources in the Indiana portion of the nonattainment area, these rules fail to provide meaningful reductions in NOx pollution and ignore modern technologies available to reduce NOx. IDEM's Public Notice of the proposed NOx RACT rules explains that:

> This rulemaking provides an enforceable mechanism that satisfies EPA's SIP requirements for NOx RACT. Specifically, this rulemaking imposes presumptive NOx RACT requirements that are applicable to all major

[28] *See generally* E. Agathakleous *et al.*, *Ozone affects plant, insect, and soil microbial communities: A threat to terrestrial ecosystems and biodiversity*, Sci. Adv. (Aug. 12 2020),6(33), https://pmc.ncbi.nlm.nih.gov/articles/PMC7423369; D.B. Menzel, *Ozone: an overview of its toxicity in man and animals*, J. Toxicol. Environ. Health (1984), 13(2-3), https://pubmed.ncbi.nlm.nih.gov/6376815.
[29] National Parks Conservation Association, *Polluted Parks: How Air Pollution and Climate Change Continue to Harm America's National Parks* (2024), *available at* https://www.npca.org/reports/air-climate-report, at 5 and 7.
[30] A. Hudson, *Indiana Dunes Tourism gives comprehensive look at State and National parks at State of the Dunes event* (April 18, 2025), https://nwi.life/article/indiana-dunes-tourism-gives-comprehensive-look-at-state-and-national-parks-at-state-of-the-dunes-event/ (noting that northwest Indiana's state and local dune parks generated $236.2 million in visitor spending and $25.6 million in state and local taxes during 2023).
[31] *See generally* Public Notice at 1-2 (2 mentions of sanctions); Regulatory Analysis - LSA Document #25-204, https://iar.iga.in.gov/register/20250409-IR-326250204RAA ("Regulatory Analysis"), at 1-3 (more than 12 mentions of the sanctions).
[32] EPA TSD at 11 (Lake County has 2nd-highest and Porter County has 6th-highest county-wide NOx emissions in the nonattainment area).

> stationary sources of NOx in the nonattainment area, with source-specific requirements for eleven affected sources–eight in Lake County and three in Porter County. [33]

However, as IDEM acknowledges in the Regulatory Analysis accompanying these proposed NOx RACT rules, the proposed rules require *only two* emission sources in Lake and Porter Counties to apply new NOx controls—all other major sources of NOx emissions are expected to be able to comply without *any* additional pollution controls or regulatory costs.[34] Not only do these rules reflect IDEM's continued failure to address the air pollution problems caused by sources in the Indiana nonattainment area, but as explained below, IDEM's proposed rules also fail to satisfy the NOx RACT requirements for the moderate nonattainment area SIP.

A. IDEM's Public Notice is Inadequate Because it Fails to Provide the Complete SIP Submission for These Proposed NOx RACT Rules

IDEM explains that this proposed rulemaking "provides an enforceable mechanism that satisfies U.S. EPA's SIP requirements for NOx RACT."[35] The Clean Air Act requires that states provide "reasonable notice" to the public prior to submitting a SIP to the EPA for approval.[36] The federal SIP implementation rules likewise require adequate public notice of any SIP submission.[37] Under those rules, adequate public notice must include access to the proposed SIP submission, including the technical support necessary to determine whether the submission meets the various SIP requirements.[38] With regard to RACT requirements for the 2015 ozone NAAQS, EPA has stated that such RACT submissions must conform with "well-established EPA policies and guidance," and that air agencies' RACT determinations "should also consider all other relevant information (including recent technical information and information received during the state's public comment period) that is available at the time they develop their RACT SIPs."[39]

In this case, IDEM has not provided the public with the information necessary to determine whether the proposed rules actually represent RACT for the sources that produce NOx emissions in Lake and Porter County. IDEM's Public Notice includes only a short summary of the process the Department used to determine the proposed RACT rules. IDEM explains that it began its RACT analysis following EPA's finding that the state had failed to submit a moderate

[33] Public Notice at 2.
[34] Regulatory Analysis at 4.
[35] Public Notice at 2.
[36] 42 U.S.C. § 7410(a)(1), (a) (2), and (l).
[37] 40 C.F.R. 51.102.
[38] *See* 40 C.F.R. 51.102(d)(2) and Appendix V 2.1(f) (requiring public notice of SIP submissions), and 40 C.F.R. Part 51, Appendix V 2.2 (SIP submissions include technical support).
[39] *Implementation of the 2015 National Ambient Air Quality Standards for Ozone: Nonattainment Area State Implementation Plan Requirements*, 83 Fed. Reg. 62998, 63007 (Dec. 6, 2018) ("2015 Ozone NAAQS SIP Rule"), *citing* 80 Fed. Reg. 12279 (Mar. 6, 2015).

area SIP, which Commenters note is more than a year after the area was reclassified to moderate nonattainment and the new SIP requirements applied. Thereafter:

> IDEM began consulting with the owners and operators of major stationary sources in the affected region. IDEM sought information on control technologies already in place at the relevant major stationary sources and which control technologies could be implemented, if reasonably practicable. The owners or operators of the major stationary sources provided relevant data to IDEM for the department to develop rules that impose reasonable NOx RACT requirements. …IDEM worked extensively with the owner or operator of each affected source and EPA to ensure that the state remains in compliance with the Clean Air Act while avoiding overly burdensome requirements on these sources.[40]

The accompanying Regulatory Analysis provides a bit more information, discussing outreach to the affected NOx-producing sources and noting that those sources provided a RACT analysis to IDEM.[41] IDEM also discusses general EPA guidance for determining NOx RACT, use of EPA presumptive NOx RACT levels, and its internal comparison of the proposed rules to a recent Ohio NOx RACT SIP.[42]

However, nowhere in the currently available documents does IDEM provide any specific information about the selection of NOx RACT controls for the specific sources in the Indiana ozone nonattainment area. The Department does not produce a list of the specific sources or source categories that would be subject to these rules, explain the different types of control technologies that IDEM considered for the different RACT source groups, or show how the controls in the proposed rules compare to RACT selected for similar sources in other ozone nonattainment areas. This lack of information is especially concerning since, as noted above, the rules do not result in any additional pollution controls for most of the sources addressed by them. In fact, IDEM's Regulatory Analysis takes great efforts to emphasize the lack of real-world pollution control that these rules would produce. The Department notes that for the source-specific RACT rules, "[o]nly two affected sources would be required to apply new controls," and that in formulating presumptive RACT rules "[i]n several instances, IDEM revised the presumptive limit deriving from Ohio to accommodate the concerns of affected sources. **All affected sources expect to be able to comply with the draft presumptive limits without additional cost or controls.**"[43] Simply put, IDEM's public notice does not provide any information showing that these rules – most of which do not actually require additional control of NOx emissions – represent NOx RACT for the specific sources that must be addressed in this

[40] Public Notice at 2.
[41] Regulatory Analysis at 1, 3, and 4.
[42] It is not clear which EPA presumptive NOx RACT levels are being referenced by IDEM. No such list is provided on EPA's RACT Information website (https://www.epa.gov/ground-level-ozone-pollution/ract-information) and an on-line search only produced a 1994 EPA guidance document (*see https://www3.epa.gov/ttn/naaqs/aqmguide/collection/cp2/19940316_berry_nox_ract.pdf)*.
[43] *Id.* at 4 (emphasis in original).

nonattainment areas under the 2015 ozone NAAQS. IDEM must provide the public with the technical information regarding control technologies it considered to control NOx emissions from major sources in Lake and Porter Counties, as necessary to fulfill the federal RACT implementation requirements for the 2015 ozone standard.[44]

While existing SIP guidance makes clear that states can rely on previously adopted controls or rules to fulfill SIP requirements, the states must show that the RACT sources addressed in the current rule "do not need to implement additional controls to meet the [current] ozone RACT requirement…because the fundamental control techniques…are still applicable."[45] EPA has provided additional information about the type of review that states must conduct in demonstrating that their ozone SIP submissions contain RACT and noted that "a RACT SIP revision that simply declares a new or existing regulation meets a presumptive level of RACT with no discussion of due diligence review to be inconsistent with national policy and not approvable."[46] As EPA noted, documenting RACT determinations "help illustrate for the public and the EPA that an air agency considered 'all relevant information (including recent technical information and information received during the public comment period) that is available at the time that they are developing their RACT SIPs'" as required by the 2008 and 2015 ozone SIP requirements rules.[47] In these proposed NOx RACT rules, IDEM has failed to provide any such showing for the public to assess and thus has not provided a meaningful opportunity to comment on whether these rules actually represent NOx RACT for these applicable sources.[48]

Accordingly, the public notice provided by IDEM for this NOx RACT SIP requirement is inadequate. IDEM must provide technical support showing that these rules represent NOx RACT for applicable Indiana sources for the 2015 ozone NAAQS and re-notice the NOx RACT rules to the public so that they can review and comment on that analysis and the resulting proposed rules.[49]

[44] 2015 Ozone NAAQS SIP Rule, 83 Fed. Reg. at 63007.

[45] *Implementation of the 2008 National Ambient Air Quality Standards for Ozone: State Implementation Plan Requirements*, 80 Fed. Reg. 12264, 12279 (Mar. 6, 2015), cited in the 2015 Ozone NAAQS SIP Rule, 83 Fed. Reg. at 63007.

[46] EPA, *Ozone NAAQS Resource Document: Due Diligence Review Framework For Air Agencies Developing RACT SIP Revisions* (Dec. 19, 2024), *available at* https://www.epa.gov/system/files/documents/2024-12/o3_ract_dd_resource_12-19-24.pdf ("*RACT SIP Diligence Review Guidance*"), at 3.

[47] *Id*. at 5.

[48] Commenters note that consistent with the Public Notice, IDEM was contacted to request the underlying RACT analysis showing how each of the proposed rules represents RACT for the applicable sources. IDEM noted that such analysis was not available at this time but would be prepared and presented for public comment with the moderate nonattainment area SIP submission.

[49] If IDEM fails to provide such an analysis with these propose NOx RACT rules, IDEM cannot rely on this public notice opportunity to argue that comments on the substance and adequacy of the NOx RACT rules or changes to those rules are outside the scope of any future public process concerning the 2015 ozone moderate nonattainment area SIP submission. *See n. 48, supra.*

B. IDEM Should Adopt Additional Rules to Address RACT and Other Ozone Nonattainment Area Requirements

As discussed above, IDEM has not shown that the proposed rules fulfill the NOx RACT requirements for the moderate ozone nonattainment areas in Lake and Porter Counties. EPA has defined RACT as "the lowest emission limitation that a particular source is capable of meeting by the application of control technology that is reasonably available considering technological and economic feasibility."[50] As discussed above, EPA has made clear that in determining RACT for each SIP submission, states are required to consider not only the existing state and federal control requirements, but "all other relevant information (including recent technical information and information received during the state's public comment period) that is available at the time they develop their RACT SIPs."[51] In so doing, states are directed to "show[] the work" that the proposed rules currently represent RACT for the given source categories, such as providing a demonstration showing how the selected RACT rules compare to federal CTGs and other states' RACT submissions and/or describing the state's RACT review process and how they concluded that the submitted rules represent current RACT.[52]

Not only has IDEM failed to provide any such analysis for the NOx RACT rules listed in the current notice, but the information that is available does not provide any evidence that IDEM considered the latest technology available to reduce NOx emissions from the relevant source categories. As explained below, technologies exist to reasonably reduce NOx pollution from sources in the nonattainment portions of Lake and Porter Counties, and IDEM must consider them before finalizing any NOx RACT rules to address 2015 ozone moderate nonattainment SIP requirements. [53]

1. IDEM's NOx RACT Analysis Must Consider Less-Polluting Control Options in Steel Production

Half of the NOx emission sources addressed by IDEM in the source-specific emission limitations proposed in 326 IAC 10-7-8 and proposed as NOx RACT for this moderate ozone nonattainment area are part of the steel supply industry: US Steel Gary Works, Cleveland-Cliffs Steel Indiana Harbor East and West, Indiana Harbor Coke, and Cleveland-Cliffs Burns Harbor. In general, these facilities either produce or support the production of steel in blast furnace-basic oxygen furnace configuration that relies on coke produced from coal. Thus, IDEM's proposed NOx RACT rules must address the technological advances in steel production that are currently underway. If the U.S. Steel and Cleveland-Cliffs facilities were converted from their current coke-based blast furnace-basic oxygen furnace technology to green hydrogen direct reduced iron ("DRI") and electric arc furnace ("EAF") technology (which can use renewable energy resources

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[50] *State Implementation Plans; Nitrogen Oxides Supplement to the General Preamble for the Implementation of Title I of the Clean Air Act Amendments of 1990*, 57 Fed. Reg. 55,620, 55,624 (Nov. 25, 1992) (*citing* 44 Fed. Reg. 53,762 (Sept. 17, 1979)), *available at* https://www.regulations.gov/document/EPA-R09-OAR-2016-0215-0012.
[51] 2015 Ozone NAAQS SIP Rule, 83 Fed. Reg. at 63007.
[52] *RACT SIP Diligence Review Guidance* at 3-5.
[53] We generally note that the NOx emissions reductions that would result from RACT rules implementing these NOx-reducing technologies would also help fulfill Indiana's regional haze obligations under CAA section 169A.

to make steel), NOx emissions from these facilities would be greatly reduced.[54] Likewise, as Cleveland-Cliffs' Indiana Harbor facilities are presumed to be the biggest customer of Indiana Harbor Coke, such a transition would lead to greatly reduced coke production and accompanying NOx emission reductions from Indiana Harbor Coke.

In fact, publicly available information reveals that the three steel primary steel facilities located in the Indiana ozone nonattainment area produce more NOx emissions per ton of iron produced than almost all other steel producers in the United States, as shown below:[55]

Owner	Plant	State	Tons of NOx per thousand tons of iron produced (2020 data)
Cleveland-Cliffs	Burns Harbor	Indiana	1.96
Cleveland-Cliffs	Middletown Works	Ohio	0.91
Cleveland-Cliffs	Indiana Harbor	Indiana	0.76
U.S. Steel	Gary Works	Indiana	0.68
Cleveland-Cliffs	Cleveland Works	Ohio	0.60
Cleveland-Cliffs	Dearborn Works	Michigan	0.17
U.S. Steel	Edgar Thomson	Pennsylvania	0.13

These high amounts of NOx emissions from northwest Indiana steel sources support a transition to much lower-emitting DRI operations. Use of such technology would greatly reduce NOx emissions and thus qualify as RACT under the ozone nonattainment area SIP requirements in CAA section 182,[56] and would also reduce the health impacts of other air pollution (such as particulate matter and sulfur dioxide) on the communities surrounding these facilities.[57]

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[54] Lakes Energy, Elizabeth Boatman PhD, *Dearborn Works: An Integrated Steel Mill Transition Study* (October 2024), https://5lakesenergy.com/wp-content/uploads/2024/10/Dearborn-Works-An-Integrated-Steel-Mill-Transition-Study_5-Lakes-Energy_October-2024.pdf ("Dearborn Works Study"), at 30. *See also* Attachment A, *Industrious Labs: Steel* at 1 (comparing the traditional coal-based blast furnace-basic oxygen furnace steel production, and DRI-EAF steel production).

[55] This table was created using facility-level NOx emissions data from EPA's 2020 National Emissions Inventory (https://awsedap.epa.gov/public/single/?appid=20230c40-026d-494e-903f-3f112761a208&sheet=5d3fdda7-14bc-4284-a9bb-cfd856b9348d&opt=ctxmenu,currsel) and iron production information from Global Energy Monitor's Global Iron and Steel Tracker (https://globalenergymonitor.org/projects/global-iron-and-steel-tracker/).

[56] M. Masterson *et al.*, Reline or Revitalize: The Narrowing Window to Modernize the US Steel Industry (Jan. 30, 2025), https://rmi.org/reline-or-revitalize-the-narrowing-window-to-modernize-the-us-steel-industry/, at Exhibit 4 (estimating more than a 30% reduction in NOx emissions by transitioning away from coal-based steel production, a figure which would likely be even higher for the northwest Indiana sources given their higher-than-average NOx emissions per ton of steel produced).

[57] *See generally* Industrious Labs, *Dirty Steel, Dangerous Air: The Health Harms of Coal-Based Steelmaking* (Oct. 2024), https://cdn.sanity.io/files/xdjws328/production/71057afa03f9784a6599a762149bd87fe735c06a.pdf, and *id.* at

In fact, the other high NOx emissions producer identified above – Cleveland-Cliffs' Middletown Works in Ohio – is already embarking on a plan to transition steel operations from coke-based blast furnace-basic oxygen furnace to a direct reduction furnace followed by electric-powered smelting, then basic oxygen furnace processing (also known as DRI-EMF-BOF).[58] The Middleton facility will be modified to produce iron from iron ore using natural gas and/or hydrogen as the chemical reducing agent, further reducing pollution emissions, including SO_2, from the facility. As Cleveland-Cliffs itself notes, the use of natural gas based DRI-EAF technology is "well established," and the potential use of hydrogen instead of natural gas would lead to meaningful reductions in emissions of both climate and health-harming pollution.[59] Cleveland-Cliffs expects this steel transition project to cause substantial emission reductions, drive down operating costs by $150 per ton, and add 170 permanent good-paying union jobs in Wayne County.[60]

In addition, a recent report by 5 Lakes Energy shows that consideration of cleaner steel production at the Cleveland-Cliffs Dearborn Works facility in Wayne County, Michigan would improve air quality, and result in other health, environmental, and non-air impacts.[61] The Dearborn Works Study provides a roadmap that could reduce harmful pollution from similar steel industries in Lake and Porter Counties. The Study observes that the interior lining of the blast furnace at Dearborn Works is nearing the end of its lifetime, and that to continue production of steel from iron ore at the facility, Cleveland-Cliffs will have to commit upwards of $470 million to reline its blast furnace – which would lock SO_2-intensive, coke-based steel production into Dearborn Works' future through the 2040s.[62] The alternative, as the Study points out, is that the facility could instead invest that capital into the construction of a new DRI-EAF steel mill at the Dearborn Works site, and electrify all operations at the facility using renewable energy, eventually fueling the new DRI furnace with green hydrogen.[63] The Dearborn Works Study makes clear that in addition to reducing air pollution, such a transition would result in strong benefits to the health and environment of the surrounding communities.[64] These communities would face dramatically lower amounts of all air pollutants, including NOx, while the transition to clean steel production would also reduce water use, consumption, and pollution, and would be an economic driver throughout the state.[65]

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13 (noting that residents of Gary, Indiana, where the US Steel Gary Works plant is located, are in the top 10% of U.S. residents nationwide that are most at risk for developing asthma and having low life expectancy).

[58] *See* https://www.clevelandcliffs.com/news/news-releases/detail/629/cleveland-cliffs-selected-to-receive-575-million-in-us.

[59] *Id.*

[60] *Id.*

[61] *See generally* Dearborn Works Study.

[62] *Id. at 18.*

[63] *Id.* at 15.

[64] *Id.* at 11, 27-30.

[65] *Id.* at 29-30, 21-22, and 37-38, respectively.

The results discussed above for Middletown Works and Dearborn Works could also be achieved at the steel-related facilities in the northwest Indiana nonattainment area, especially given the scope of steel production in Lake and Porter Counties and the upcoming investments being contemplated for these facilities.[66] Technologies to transition major sources in Lake and Porter Counties away from coal-based steel production are available and would result in better control of NOx emissions in the Indiana ozone nonattainment area. Accordingly, IDEM must consider the technologies discussed above when developing the NOx RACT rules for steel production facilities in the 2015 ozone moderate nonattainment area SIP.

2. IDEM's NOx RACT Analysis Must Consider Less-Polluting Control Options for Industrial Boilers[67]

Aside from the steel-focused source-specific NOx rules discussed above, most of the other proposed NOx RACT rules address emissions from other boilers, turbines, engines, and furnaces at other industrial sources. Lower NOx-emitting technologies exist for these sources that IDEM must consider in this rulemaking. Industrial sources around the country that have historically relied on fossil-fuel burning boilers to produce steam for manufacturing processes that require low- to medium-heat (0–500º C) have applied industrial heat pump technology to eliminate fossil fuel use—and correspondingly eliminate ozone-producing NOx and VOC emissions—at their facilities. Following the lead of other air regulators facing stubbornly high ozone levels, IDEM could obtain significant NOx reductions by revising its NOx RACT rules to require certain industrial facilities to transition from fossil fuel-fired boilers to industrial heat pumps. As discussed below, industrial electrification technologies qualify as RACT since they are readily available to replace boilers for many industrial applications and economically feasible.[68] The Department must consider these technologies in the context of the NOx RACT requirement (as well other serious nonattainment area SIP requirements, such as Reasonable Further Progress, Reasonably Available Control Measures, and the Attainment Demonstration).

While the industrial sector encompasses a wide range of products, processes, and technologies, an outsized share of industrial pollution results from one process that is common across subsectors: industrial heating.[69] The nonattainment portions of Lake and Porter Counties contain more than 40 boilers included in the National Emissions Inventory, the vast majority of

[66] M. Masterson *et al.*, Reline or Revitalize: The Narrowing Window to Modernize the US Steel Industry (Jan. 30, 2025), https://rmi.org/reline-or-revitalize-the-narrowing-window-to-modernize-the-us-steel-industry/, at Exhibit 1 (noting expected relining of the blast furnaces at the NW Indiana steel facilities between 2025 and 2041).
[67] Much of the information in this section is drawn from a forthcoming white paper to be published by Sierra Club and Evergreen Action. Commenters will provide the full white paper to IDEM when available.
[68] If IDEM declines to adopt new revisions as part of the current RACT analysis for the moderate ozone nonattainment, IDEM must at a minimum consider these technologies as part of SIP revisions due for the serious ozone nonattainment areas, affecting sources emitting 50 tons of NOx per year and up, *and again* in conducting the NOx RACT analysis for the SIP submission that would be required if/when the Chicago, IL-IN-WI nonattainment area is redesignated to severe nonattainment, affecting sources emitting 25 tons of NOx per year and up.
[69] *See* U.S. Dept. of Energy, Industrial Heat Shot, https://www.energy.gov/topics/industrial-heat-shot ("Industrial heating accounts for about 9% of the entire U.S. emissions footprint and nearly half of the energy-related emissions that the manufacturing sector creates.").

which burn fossil fuels to create the heat needed for industrial processes.[70] An additional tool examining small boilers that might not be captured in the National Emissions Inventory shows an additional 80 small boilers in the Indiana moderate ozone nonattainment area.[71] The concentration of more than 120 industrial boilers in Lake and Porter Counties represents an important opportunity for IDEM to further reduce ozone-producing emissions in this NOx RACT rulemaking.

Much of the pollution from industrial heating taking place in the Indiana nonattainment area could be eliminated with technologies that already exist and are being implemented to replace fossil-fuel burning boilers at facilities around the country. Indirect heating—heat generated by boilers and typically delivered through fluids such as steam—requires lower temperatures, and therefore typically can be achieved with electric heat pumps, which are cost-competitive with fossil fuel alternatives. The industrial heat landscape is typically broken down into three tiers: low (<130°C), medium (130–500°C), and high (>500°C) heat. Industrial facilities that employ gas-burning boilers for low- and medium-temperature applications are best able to adopt electric technology to replace these boilers and eliminate NOx and VOC emissions. Industrial heat pump technology is already proven and available to replace boilers in processes ranging from 60–200°C,[72] and electric boilers (including electric resistance and electrode-

[70] Evergreen Action, National Boiler Map, *available at* https://clausa.app.carto.com/map/07d7be74-69f7-4a7f-9cd7-bb92a84b5db3?lat=39.691781&lng=-102.380210&zoom=4 (using lasso tool). Evergreen Action has not yet officially released its National Boiler Map as it is still making adjustments to the map interface, but the tool is cited with permission here. The National Boiler Map relies upon a boiler dataset drawing upon EPA's National Emissions Inventory (2020) and prepared by AJW, Inc. AJW, Inc's methodology is available upon request. While the Evergreen map is limited to boilers listed in EPA's National Emissions Inventory, other studies have identified additional boilers not included there (see next footnote).

[71] ACEEE, Small Industrial Boilers and Ozone Pollution Across the United States, *available at* https://www.aceee.org/small-industrial-boilers-and-ozone-pollution-across-united-states. The ACEEE database relies on Schoeneberger et al.'s boiler inventory to locate boilers with capacities less than or equal to 50 million British thermal units per hour (MMBtu/hr). *See also* Carrie Schoeneberger, et al. "Electrification potential of U.S. industrial boilers and assessment of the GHG emissions impact," (Feb. 2022), Advances in Applied Energy, Vol. 5, *available at* https://doi.org/10.1016/j.adapen.2022.100089.

[72] Renewable Thermal Collaborative, Industrial Decarbonization Package (Sept. 2023), https://www.renewablethermal.org/wp-content/uploads/2018/06/Decarbonization_FullPackage_Updated-Sept-2023.pdf; ACEEE, *Topic Brief: Net-zero industry by 2050: a scenario analysis of boiler replacement with industrial heat pumps* (Dec. 2024), https://www.aceee.org/sites/default/files/pdfs/net-zero_industry_by_2050_-_a_scenario_analysis_of_boiler_replacement_with_industrial_heat_pumps.pdf; ACEEE, How to Decarbonize Industrial Process Heat While Building American Manufacturing Competitiveness (Apr. 2024), https://www.aceee.org/sites/default/files/pdfs/how_to_decarbonize_industrial_process_heat_while_building_american_manufacturing_competitiveness.pdf; Schoeneberger, et al, *supra* n. 71; M. Jibran S. Zuberi, et al., "Electrification of Boilers in U.S. Manufacturing," Lawrence Berkeley National Laboratory, LBNL-2001436, https://eta-publications.lbl.gov/sites/default/files/lbnl_2001436_boiler_final.pdf; Jeffrey Rissman. "Decarbonizing Low-Temperature Industrial Heat in the U.S," (Oct. 2022), Energy Innovation Policy And Technology, https://energyinnovation.org/wp-content/uploads/Decarbonizing-Low-Temperature-Industrial-Heat-In-The-U.S.-Report-2.pdf; Energy Innovation Policy & Technology LLC, Industrial Electrification as a Decarbonization Strategy, https://icc.illinois.gov/api/web-management/documents/downloads/public/future-of-gas/Industrial%20Electrification%20Presentation_11-4-2024.pdf. Commenters are providing IEPA with copies of these materials in an Appendix to this comment letter.

equipped units) can replace gas boilers for applications up to 500°C (and, in fact, as high as 1,800ºC).[73]

Although there is an upfront capital cost for such retrofits, the significant efficiency gains from industrial heat pumps in comparison to fossil fuel boilers help reduce fuel costs, especially when paired with a thermal battery that could allow the facility to take advantage of off-peak electric rates.[74] Moreover, electricity has historically had more price stability than natural gas. A recently published book discussing pollution-cutting innovations in the industrial sector explains that "[e]lectricity has efficiency advantages that can partially or fully compensate for higher prices [compared to fossil fuels]."[75] In particular, "a heat pump may provide several times more heat than the amount of electricity consumed."[76] Further, because "thermal batteries can enable industrial facilities to purchase more electricity in hours when it is cheaper and avoid buying electricity in hours when it is more expensive," leveraging storage of heat in batteries "can lower an industrial facility's cost of electrical heat by one half to two thirds, making it competitive with the cost of natural gas heating."[77] In addition to fuel cost savings, replacing a facility's gas boiler with a heat pump has other benefits, such as reduced need for cooling water, reduced noise, reduced waste generation and disposal fees, and improved workplace health and safety.[78]

Even if not every individual facility in the ozone nonattainment portions of Lake and Porter Counties would make a business decision to electrify its heating operations, IDEM must still consider whether zero-emission technologies available for industrial heating needs satisfy the RACT definition. In evaluating RACT, EPA

> presumes that *it is reasonable for similar sources to bear similar costs of emission reductions. Economic feasibility rests very little on the ability of a particular source to 'afford' to reduce emissions to the level of similar sources.* Less efficient sources would be rewarded by having to bear lower emission reduction costs if affordability were given high consideration. Rather, economic feasibility for RACT purposes is largely determined by evidence that other sources in a source category have in fact applied the control technology in question.[79]

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[73] *See, e.g.*, Zuberi et al., *supra* note 72, for a discussion of electric boilers, which the report views as a "mature technology" that still faces some financial barriers depending on local energy costs; *see also* Renewable Thermal Collaborative, *supra* note 72 at 11-12; Renewable Thermal Collaborative, Electrification Action Plan (Jan. 2024), https://www.renewablethermal.org/wp-content/uploads/2018/06/01.19.24_Final_RTC-Electrification-Action-Plan_Updated.pdf.
[74] *See, e.g.*, Brattle, Thermal Batteries: Opportunities to Accelerate Decarbonization of Industrial Heat (Oct. 2023), https://www.renewablethermal.org/wp-content/uploads/2018/06/2023-10-04-RTC-Thermal-Battery-Report-Final-.pdf.
[75] Jeffrey Rissman, ZERO-CARBON INDUSTRY (2024), at 153.
[76] *Id.* at 137.
[77] *Id.* at 146.
[78] *See* Energy Innovation Policy & Technology LLC, *supra* note 72.
[79] 57 Fed. Reg. at 18,074 (emphasis added).

That evidence exists for industrial heat pumps and thermal batteries (and for electric resistance boilers in some contexts). Heat pumps and thermal batteries have been successfully demonstrated in the pharmaceutical, food, and pulp and paper sectors, among others. Numerous facilities in these sectors have adopted electrification technology to replace the use of fossil fuel-fired boilers, and a number of states are implementing programs to advance industrial electrification technology further.[80] In Indiana, a lumber mill in Monon (located directly south of the nonattainment areas) is already operating an industrial heat pump in its dry kilns, and the Kraft Heinz Foods Company in Kendallville is planning to replace fossil fuel-fired boilers with electric heating technology.[81] A database of industrial electrification deployments shows a number of facilities throughout the Midwest that are using or plan to use industrial heat pumps for industrial purposes, including facilities in Ohio, Illinois, Michigan, and Wisconsin.[82] In addition, other air regulators facing persistent ozone problems similar to those in the Chicago, IL-IN-WI nonattainment area have finalized or are developing rules requiring a transition away from fossil-fuel fired boilers in light of readily available heat pump technology.[83] Industrial heat pumps are thus both technologically and economically feasible at Indiana facilities using boilers to create heat for similar processes.

As discussed above, many industrial boilers are located in the Indiana moderate ozone nonattainment area at issue in these proposed NOx RACT rules. Industrial boilers burning natural gas account for far higher NOx (and carbon dioxide) emissions per mmbtu than electric technologies, even considering anticipated upstream emissions from electricity production.[84] Ending these facilities' reliance on fossil fuels represents an enormous opportunity to improve public health while also advancing the Chicago, IL-IN-WI ozone nonattainment area towards attainment of the 2015 ozone NAAQS.[85] Electrification of boilers at these sources represent a

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[80] *See, e.g.*, RISE PA program, https://www.pa.gov/agencies/dep/programs-and-services/energy-programs-office/rise-pa.html; Minnesota Public Utility Commission, Natural Gas Innovation Act, https://mn.gov/puc/activities/economic-analysis/ngia/, and related Xcel Energy and CenterPoint Energy plans linked therein; Center for American Progress, State Efforts To Decarbonize Key Industrial Sectors (Nov. 14, 2014), https://www.americanprogress.org/article/state-efforts-to-decarbonize-key-industrial-sectors/, fn. 92-94 and related text (describing Colorado incentives for industrial heat pumps).

[81] ACEEE, *Industrial Electrification Across the United States* (Feb. 11, 2025), https://www.aceee.org/industrial-electrification-across-united-states; *see also* https://news.kraftheinzcompany.com/press-releases-details/2024/Kraft-Heinz-Seeks-EPCm-Company-to-Support-its-Delicious-Decarbonization-Project/default.aspx.

[82] *Id.*

[83] *See* South Coast Air Quality Management District, Rule 1146.2 (adopted June 2024), https://www.aqmd.gov/home/rules-compliance/rules/support-documents/rule-1146-2-details (phasing in zero-NOx emission requirements for small boilers, large water heaters, and process heaters); Proposed Amended Rules 1146 and 1146.1 (currently in workshop development), https://www.aqmd.gov/home/rules-compliance/rules/scaqmd-rule-book/proposed-rules/rule-1146-1146-1 (assessing zero-NOx emission requirements for larger boilers).

[84] *See* Center for Applied Environmental Law and Policy/E3, *Decarbonizing Industrial Heat: Measuring Economic Potential and Policy Mechanisms*, https://static1.squarespace.com/static/5a1aca61ccc5c5ef7b931da7/t/67212e1d2feca83d67300002/1730227748077/CAELP+Industrial+Electrification+Report+FINAL.pdf, at 40.

[85] *See* Environmental Integrity Project, *Pollution from Outdated Industrial Boilers and Heaters in Illinois* (Mar. 24, 2025), https://environmentalintegrity.org/wp-content/uploads/2025/04/UTF-82025.03.25-IL-Heaters-Boilers-EIP.pdf (discussing opportunities for such electrification in Illinois).

huge opportunity for reductions of ozone precursors, including the NOx emissions targeted in the proposed rules, and must be considered in IDEM's NOx RACT analysis.[86]

III. Conclusion

As discussed above, the NOx RACT rules currently proposed by IDEM fail to satisfy the procedural and technical requirements of the Clean Air Act to address the moderate nonattainment SIP requirements for the 2015 ozone NAAQS. To meet those requirements and advance the Chicago, IL-IN-WI nonattainment area towards expeditious attainment of the ozone standards, IDEM must provide the public with the technical basis for its NOx RACT rules and, in so doing, consider less-polluting RACT technologies to lower NOx emissions sources throughout the Indiana nonattainment areas. IDEM should then re-notice the analysis and resulting rules for public comment.

Please contact us if you should have any questions regarding these comments or would like to set up a meeting to discuss them.

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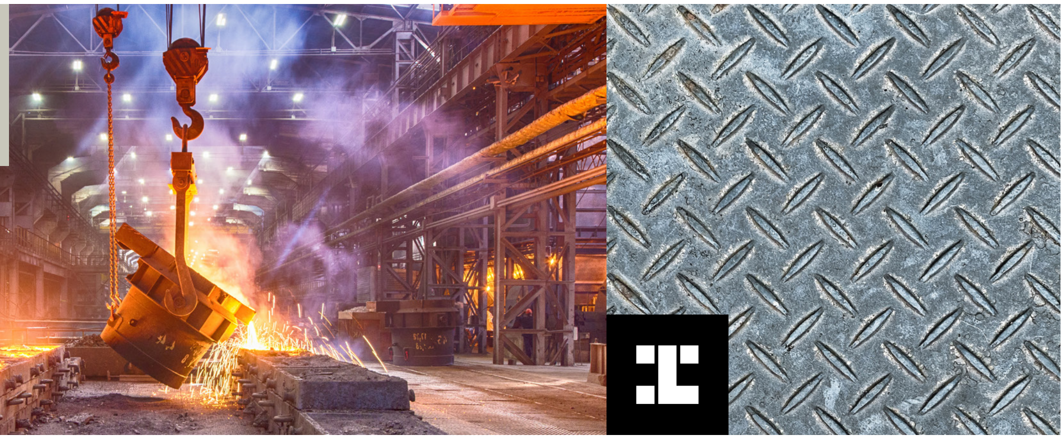
[86] *See* National Boiler Map (average NOx emissions for all boilers in the nonattainment area multiplied by total number boilers). The industrial boilers in the Indiana ozone nonattainment areas emit more than 3000 tpy of NOx and likely significantly more as this figure is based only on boilers that appear in the National Emissions Inventory.

Attachment A

Steel



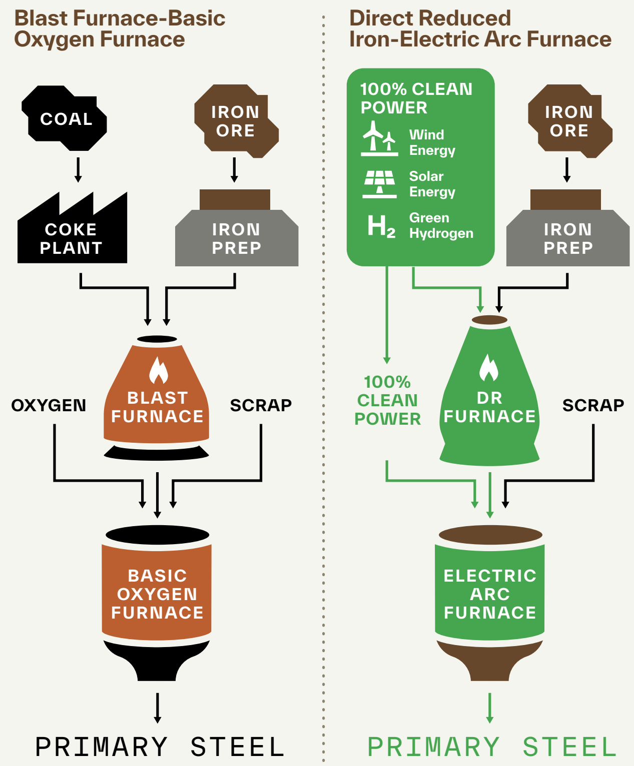
Steel is a foundational material of modern life. From wind turbines to electric vehicles and heat pumps, we need steel to build a clean economy. However, most steel manufacturing relies on coal, producing dangerous pollution.

The emissions impact is significant: iron and steelmaking account for 11% of anthropogenic greenhouse gas pollution and is a major source of other health-harming pollution, from soot and smog to lead pollution and more. Action now by governments, large buyers, and the steel industry itself can put it on a path to a fossil-free future over the next two decades. This primer provides an overview of today's steel industry, the drivers that can unlock steel modernization, and the opportunity green steel presents for our climate, health, and economy.

INDUSTRY BASICS

Steel production relies on coal-burning blast furnaces, a technology that has existed for centuries. Blast furnaces (BF) produce 90% of the world's iron, which basic oxygen furnaces (BOF) transform into steel.[1] These steel mills are often referred to as integrated mills as they purify iron and transform it into steel at the same site. Steel made directly with pure iron is often referred to as primary steel. Primary steel is of higher quality than recycled steel produced in secondary mills (electric arc furnaces, or EAFs) that use scrap. In 2023, the world produced 1,900 million metric tons of steel. China's production (and domestic demand) has risen significantly in recent decades. Today, China produces 68% of the world's primary

How Primary Steel is Made



How to Make Steel: There are two main pathways to making primary steel today. The BF-BOF pathway relies on massive quantities of coal to fuel blast furnaces. Historically, the DRI-EAF pathway relied on fossil gas. But, equipping shaft furnaces to run on green hydrogen is possible and eliminates nearly all the greenhouse gas emissions associated with steelmaking.

How Steel is Used: Steel has a diverse array of applications. The automotive sector is a particularly important consumer: automotive manufacturing represents 10-13% of global steel demand.

steel, while Japan, India, Russia, and South Korea round out the top five largest national producers.[2] To meet domestic demand, the U.S. imports more than 20 million metric tons (net); Canada, Mexico, Brazil, and South Korea are the largest sources of imports.[3]

Across these steelmaking pathways, BF-BOFs produce both the majority of global steel (71% and a disproportionate share of greenhouse gases and other pollutants due to their reliance on coal. In the U.S., for example, BF-BOFs make 30% of the country's steel but produce nearly 70% of the sector's emissions.[4]

While steel is used in everything from buildings to wind turbines, cars, and appliances, specific industries like auto manufacturing require higher quality steel produced in integrated mills. Secondary or recycled steel must play a critical role in decarbonizing steel globally, but the world will still rely on primary production to meet 60% of global demand in 2050.[5] Thus, cleaning up ironmaking is essential to decarbonizing the steel industry.

An average BF-BOF emits roughly as much CO_2e as a coal-fired power plant. Taken together, the world's 397 coal-based integrated mills are responsible for 4.2 gigatonnes of CO_2e annually, approximately 11% of anthropogenic global climate pollution, making the steel industry one of the most significant contributors to climate change.[6]

In addition to greenhouse gasses, coal-based steel production releases health-harming pollution, including heavy metals and particulate matter. Peer-reviewed studies have linked integrated steel mills, including coke making, to health problems, including COPD, asthma, cardiac disease, increased levels of cancer, and premature death. In the United States, this pollution disproportionately harms low-income communities and communities of color in the Midwest.

Coke Facility Closure Yields Immediate Public Health Benefits

Integrated steel mills like Burns Harbor or Dearborn Works rely on coke—a coal-based fuel—as a heat source and reducing agent during the iron-making phase. Coke production produces more than 40 different toxins like arsenic and benzene, as well as criteria pollutants like sulfur dioxide.

A 2023 paper from researchers at NYU foundation that the closure of one coke-making facility in Pennsylvania led to an immediate 90% drop in SO_2 emissions and a 42% drop in cardiovascular disease driven emergency room visits. Four years after the closure, ER visits for cardiovascular disease had fallen 61%.

"(It's) sort of similar to when somebody quits smoking," noted co-author George Thurston.[7]

THE OPPORTUNITY

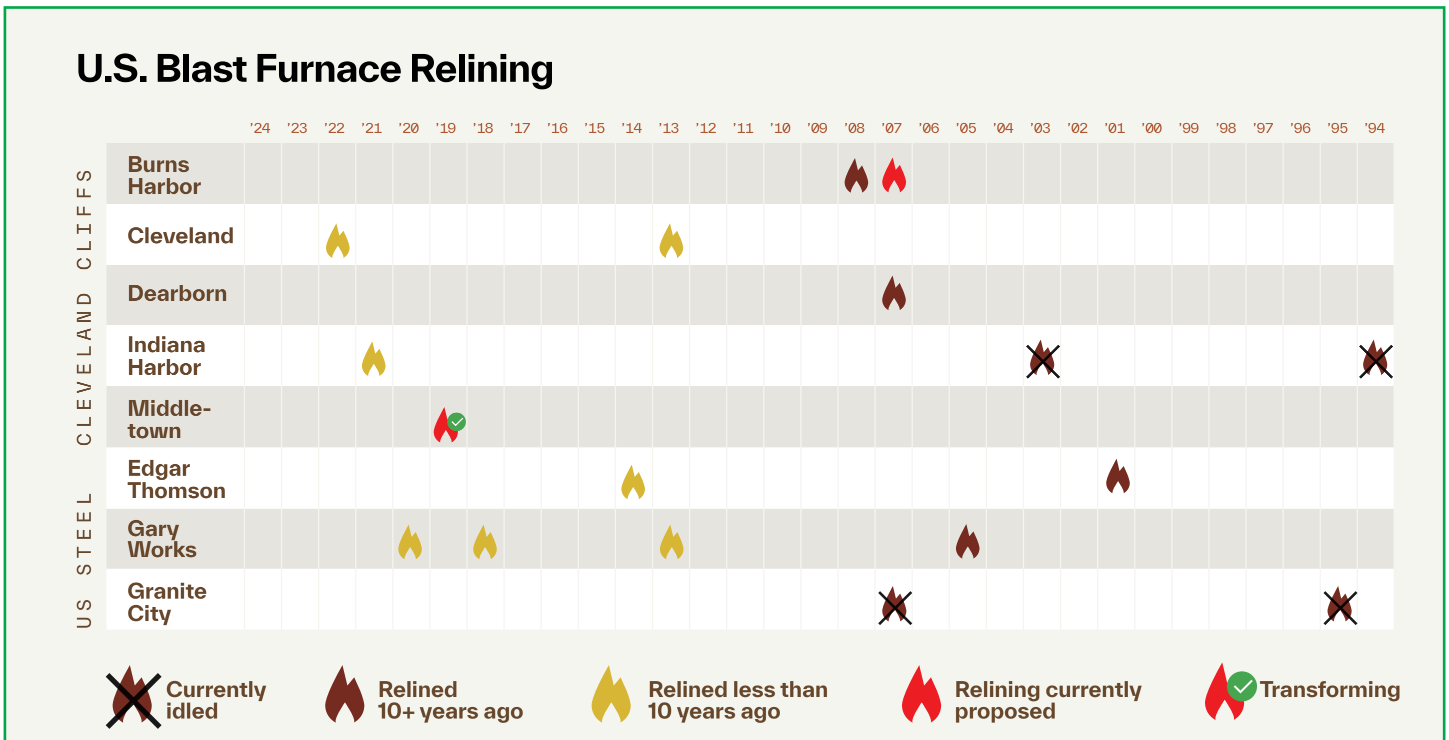
Long a source of industrial pollution, the steel industry can now modernize and transition away from fossil fuels. A well-planned transition to cleaner, modern steelmaking technology has many benefits. Moving away from fossil fuels will rapidly reduce the emissions heating the planet and harming the health of nearby communities. Investments in new and retrofitted facilities can spur new jobs and local investment. Private and government investments to modernize facilities can strengthen the existing steel industry and position the U.S. as a global leader in the production of green steel.

Proven alternatives to coal-based iron and steelmaking exist today. Direct reduced iron (DRI), made in a shaft furnace, eliminates coal and already accounts for 10% of global iron production. While existing industrial-scale DRI facilities use fossil gas, green hydrogen-powered DRI projects have secured funding in Sweden and Germany. Emerging technologies that rely on electrification are also nearing commercial viability.

Ohio River Valley Case Study

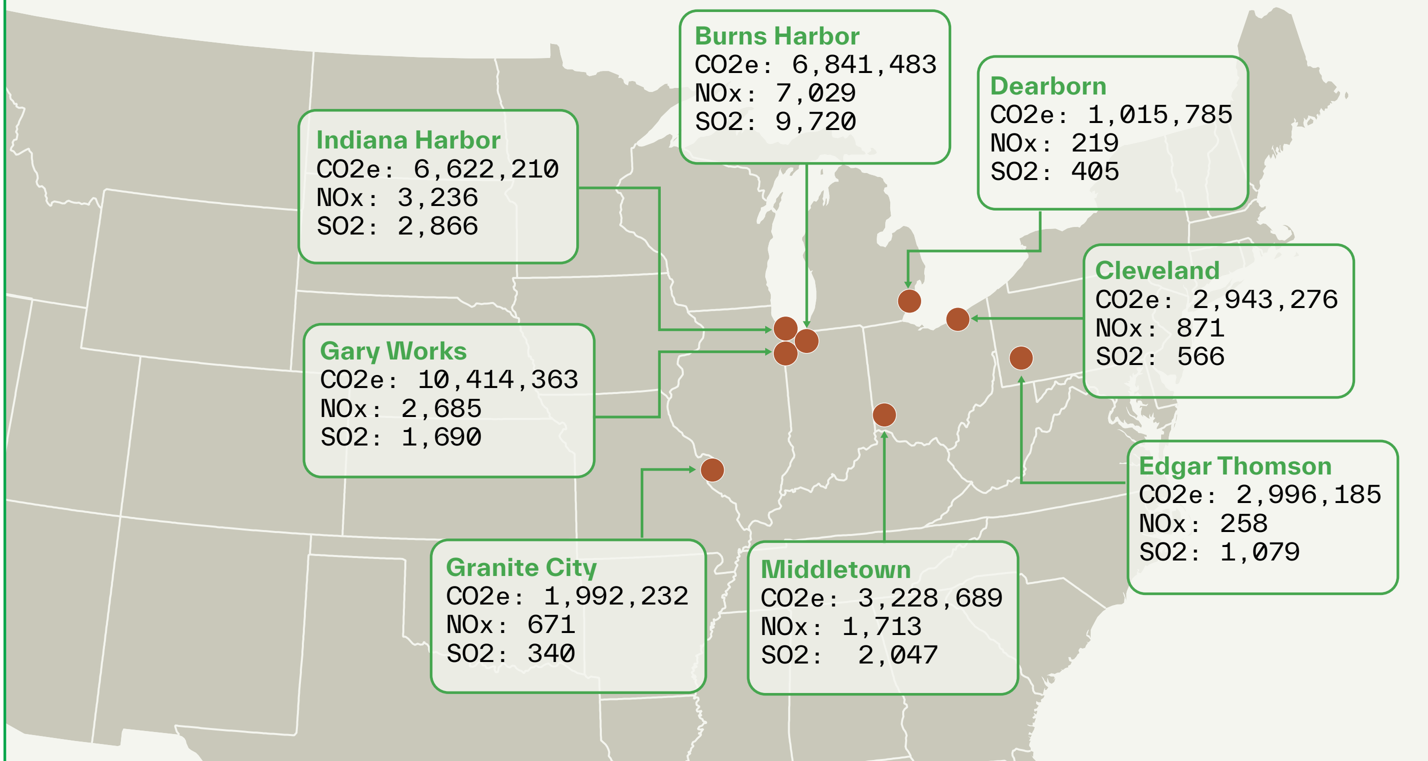
A recent study by the Ohio River Valley Institute in Pennsylvania found that a transition to fossil fuel-free steelmaking could grow total jobs supported by steelmaking in the region by 27% to 43% by 2031, forestalling a projected 30% drop in the same period without action. Transitioning to fossil fuel-free steelmaking will also cut Pennsylvania's industrial sector emissions by 4 million metric tons of CO_2e/year, improving quality of life and saving the state $380 million in health, community, and environmental costs.[8]

In the next two decades, every blast furnace will face a reinvestment decision that creates a moment to break from the coal-based past and pivot to the clean energy future. On a 15-to-20-



A Decision Point for the Steel Industry as Relining Approaches: The "relining" decision presents a critical opportunity to remake the steel industry and break with dirty coal. Older furnaces on the right of the chart present a more imminent opportunity as they near the end of their current serviceable life cycle. By investing in clean energy-powered alternatives, the steel industry can modernize and break from coal.

Map of U.S. Primary Steel Mills



There are seven remaining primary steel mills in the U.S., clustered in the Midwest. The eighth, Granite City, was idled in 2023 and, as of publication, remains idled. CO_2e numbers are 2022 Scope 1 emissions and are from EPA GHGRP. NOx and SO_2 values are from 2020 EPA NEI data.[17]

year schedule, blast furnaces require relining, a process that replaces the refractory materials that line the insides of the high-temperature furnaces. Fully relining a blast furnace typically costs $100-$150 million per million metric tons of blast furnace capacity; for the blast furnace currently announced for relining, that's approximately $300 million and will lock in dependence on coal for 20 more years.[9] These events provide a decision point for the companies and policymakers: should a steel company invest hundreds of millions of dollars to retrofit and extend the life of a coal-burning blast furnace, or should the company pivot to fossil-free production methods?

With clean alternatives available now, the relining decision point presents an unmissable intervention opportunity to ensure a swift, managed transition away from coal-based steel production to more modern, clean energy-based solutions.

U.S. LANDSCAPE

There are just seven operating U.S. integrated steel mills producing 25 million metric tons of steel yearly, enough to build 28 million cars.[10] Together, they directly employ 18,000 people, including 14,500 union workers, in four states: Indiana, Michigan, Ohio, and Pennsylvania.[11] Upgrading these facilities with clean, modern technology will eliminate the need for 11 million metric tons of coal,[12] reduce local health-harming air pollution, future-proof family-sustaining jobs, and bring a climate-friendly solution to market for global adoption.

There are currently only two blast furnace operators in the United States, Cleveland-Cliffs and U.S. Steel.[13] However, companies including Nucor and ArcelorMittal compete for their steel customers via their DRI facilities in Louisiana and Texas. New entrants like H2 Green Steel and Boston Metal have also recently announced their intentions to pursue

Photo Credit: Matthew Kaplan Photography

green steel opportunities in North America. The steel industry is at the cusp of the most significant technology transition in decades, with major implications for our climate, public health, and future jobs.

PROGRESS

In March of 2024, the U.S. Department of Energy announced award negotiations for two major new steel projects that can catapult the U.S. into a leadership position in the race to green steel. SSAB, a Swedish steelmaker, is proposing to build North America's first fossil-free iron facility in Mississippi. The company has a letter of intent with the regional hydrogen hub Hy Stor to provide green hydrogen to make the iron. In Ohio, Cleveland Cliffs will retire its blast furnace at Middletown Works and replace it with a hydrogen-ready DRI furnace. The blast furnace was previously planned for a relining in the latter half of this decade. By retiring the blast furnace, Cleveland Cliffs avoids a $300 million expenditure to extend the use of coal at the site, and it retains the high-quality union jobs. While major questions remain about the timeline and source of hydrogen, the potential trajectory—retiring coal, replacing it with green hydrogen, retaining good jobs, and lowering air pollution—can be a model for other facilities.

Collectively, these two projects represent a turning point for steelmaking in the U.S. SSAB's proposed project can demonstrate fossil-free technology, establishing a new bar for steelmaking. And if Cleveland Cliffs is able to secure green hydrogen, it can create a model for transforming integrated steel mills for other facilities to follow.

DRIVERS

How do we unlock the steel industry's industrial transformation in the United States? Four drivers can help: market demand, government support, favorable trade policy, and environmental regulation.

Demand

Steel producers must be confident that the market is willing to pay for their products, and green steel may initially reward steelmakers with a 10-30% price premium.[14] Primary steel producers' biggest end-market, automakers, have already indicated their willingness to pay. In 2022, Ford and GM joined the First Movers Coalition, a commitment to buy 10% "near-zero emissions steel" by 2030.[15] While pledges are helpful, more formal advanced market commitments from large buyers like the auto industry or the federal government are critical to derisking green steel investments.

Funding

The transition to green steel requires significant investment. A new DRI-EAF facility can cost approximately $2 billion, though the cost varies based on the size of the plant and other factors.[16] While the steel industry must strategically invest its resources to pivot from coal to green steel, governments play a critical role. The Inflation Reduction Act and Bipartisan Infrastructure Law set aside more than $6 billion for industrial demonstration projects, including steel. Additional government incentives, such as hydrogen and renewable energy tax credits, can further reduce costs. However, analysis from Industrious Labs and Public Citizen found that European capital expenditure subsidies lead those available in the U.S. by 35%, demonstrating the opportunity for further investment through new legislation.

Trade

Being an early investor in green steel is a financial risk. To protect American investments, producers need favorable trade policies that will protect against foreign dumping and dirty imports, which not only drive climate change but threaten union jobs. Trade policies like the Global Arrangement on Sustainable Steel and Aluminum, or tariffs on the carbon intensity of imported materials and products, are needed to reduce emissions.

Environmental Regulation

While the first three drivers are all necessary to ease the transition, direct regulation of the industry's coal-based pollution is equally essential to drive change. The steel industry's dependence on coal makes it a significant source of air pollution that sickens nearby communities, yet the sector benefits from lax standards that enable high pollution levels. Too often, significant toxic releases and persistent hazardous air pollution emissions result in small fines that are insufficient to change behavior or operations in ways that would lead to tighter health protections for local communities. Stricter standards and new pollution controls for climate and traditional air pollutants are essential to forcing change within an industry slow to embrace its future.

WHY NOW

American steel manufacturing and the jobs that come with it have sharply declined for decades. Finally, the technology to bring steelmaking into the 21st century is here. It will reduce health and climate-harming pollution, require more skilled workers, and modernize an industry critical to the clean energy economy. With government support and critical buyers accountable to their net-zero timelines, leading steel companies have a generational opportunity to invest in green steel and ditch fossil fuels for good.

1. World Steel Association (2023). World Steel in Figures 2023.
2. World Steel Association (2023). World Steel in Figures 2023.
3. USGS (2024). Iron and Steel Mineral Commodity Summary.
4. RMI (2023). Forging a Clean Steel Economy in the United States.
5. World Economic Forum (2022). Net-Zero Industry Tracker 2022 Edition.
6. SteelWatch (2023). Sunsetting Coal in Steel Production. Calculations include upstream coal mine methane emissions.
7. Wuyue Yu and George D Thurston (2023). An interrupted time series analysis of the cardiovascular health benefits of a coal coking operation closure.
8. Ohio River Valley Institute (2023). Green Steel in the Ohio River Valley: The Timing is Right for the Rebirth of a Clean, Green Steel Industry.
9. International Energy Agency (2020). Iron and Steel Technology Roadmap.
10. US Steel's Granite City Works was recently idled.
11. Prior to the idling of Granite City Works, these figures totaled 20,000 people, including 16,000 union workers
12. U.S. Energy Information Administration (2023). Coal and coke.
13. At the time of publication, US Steel was under a pending sale to Nippon Steel at the time of publication. Nippon has stated that it intend to continue operating the US Steel facilities.
14. Reuters (2023). ArcelorMittal CEO says decarbonisation would drive steel prices up 10%-20%.
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ABOUT INDUSTRIOUS LABS

Industrious Labs exists to deliver unstoppable policies, people power, and analysis to drastically reduce dangerous emissions, hold industry accountable to communities and workers, and develop a circular economy. To learn more about us, visit **www.industriouslabs.org**.

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