Stranded or Reallocated? Firm Structure and the Real Effects of Transition Risk *

Ricardo Peña† Shikhar Singla‡

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Abstract

We study how firms respond to transition risk from anticipated U.S. conservation policy. We link polluting establishments to measures of unprotected endangered habitats and document differential responses across multi-plant and single-plant firms. High-exposure facilities of multi-plant firms reduce emissions and production, with firms reallocating activity to lower-exposure facilities. High-exposure single-plant firms substantially increase emissions and production, and scale back mitigation, consistent with a stranded-asset mechanism. These responses have ecological consequences: vegetation and avian biodiversity decline near exposed single-plant facilities, while reductions by multi-plant firms are insufficient to generate detectable improvements. This asymmetry highlights the unintended effects of transition risk.

Keywords: Transition Risk, Reallocation, Stranded Assets, Toxic Releases, Biodiversity

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†McCombs School of Business, University of Texas at Austin. Email: jesus.pena@utexas.edu.

‡McCombs School of Business, University of Texas at Austin. Email: shikhar.singla@utexas.edu.

I. Introduction

Conserving 30% of land and oceans has emerged as a global benchmark for biodiversity policy, with potentially large implications for economic activity. The prospect of such regulation generates transition risk, and a growing literature shows that environmental transition risk is priced in financial markets (Bolton and Kacperczyk, 2021; Ilhan et al., 2021; Seltzer et al., 2022; Garel et al., 2024; Zhang, 2025). However, less is known about the real effects of transition risk and the mechanisms through which firms adjust. In this study, we leverage a novel establishment-level measure of exposure to anticipated biodiversity policy to identify firm responses and their ecological consequences. We show that these responses differ fundamentally by organizational structure, causing the same transition risk to generate divergent ecological outcomes across firms.

Firms facing greater regulatory pressure can adjust through several channels, including investing in cleaner production, reallocating activity across assets, and shifting production intertemporally before regulation binds.[1] The relevance of these channels depends on organizational structure. Firms operating multiple establishments can reallocate production away from more exposed facilities toward less exposed ones,[2] whereas single-establishment firms lack this margin and instead face a binary choice: invest in costly mitigation or frontload production before regulation binds, extracting value from assets that will be stranded.

Empirically distinguishing these adjustment channels in the context of climate transi-

[1] While we focus on expected environmental regulation, the more general problem is how firms respond to changes in expected future profitability. For example, Barnett (2024) develop and test a model in which expectations of future climate policy and technologies induce accelerated resource extraction prior to a transition toward a green economy.

[2] In our empirical setting, we focus on spatial reallocation across facilities. More generally, the same logic applies to reallocation across "brown" and "green" assets within the firm.

tion risk is challenging. Credible shocks are rare and typically operate at the firm level, limiting within-firm variation in exposure.[3] In addition, exposure is difficult to measure, as potential regulatory regimes differ in scope (e.g., Scope 1, 2, or 3 emissions) and in how emissions are scaled or targeted. Biodiversity transition risk[4] induced by the U.S. "30 by 30" Executive Order provides a distinct empirical setting that addresses these challenges. Because conservation policy is inherently spatial, it generates heterogeneous exposure across facilities based on their geographic location, even within the same firm. Exploiting this variation using polluting plants covered by the Environmental Protection Agency's (EPA) Toxics Release Inventory (TRI),[5] we show that firms respond depending on their organizational structure, leading to differing ecological outcomes.

To measure exposure to biodiversity transition risk, we construct a spatial measure that links firm operations to endangered habitats lacking formal protection. Our approach builds on Hamilton et al. (2022), who combine information on species rarity, habitat ranges, and existing legal protections to construct Protection-Weighted Range-Size Rarity (PWRSR) scores across the continental United States. PWRSR identifies locations where endangered biodiversity is both highly concentrated and unprotected, making these areas plausible targets for future conservation policy.[6] A key feature of this measure is that it is forward-looking: by downweighting already protected areas, it isolates locations where

[3]Existing papers such as Bartram et al. (2022) find within-firm reallocation but importantly this is utilizing realized regulation in California's cap-and-trade program, which had well-defined targeting.

[4]Bolton and Kacperczyk (2023) define carbon-related transition risk as risk "reflecting the uncertain rate of adjustment toward carbon neutrality." We adopt an analogous definition for biodiversity transition risk, reflecting uncertainty surrounding the adjustment toward conservation policy objectives.

[5]For examples of TRI-based analyses in finance, see Akey and Appel (2021); Xu and Kim (2022); Bartram et al. (2022); Bisetti et al. (2026).

[6]The premise is that future conservation policy is likely to operate through existing regulatory frameworks, including habitat designation and land-use restrictions under the Endangered Species Act (ESA). Enacted in 1973, the ESA designates critical habitat and restricts permitting for activities that may impair listed species.

biodiversity remains exposed to future conservation intervention. We merge these spatial biodiversity measures with plant-level emissions data from the EPA's TRI, enabling us to map firm activity to local conservation exposure and generate within- and across-firm variation in transition risk.

We study these predictions in the context of Executive Order 14008, which launched the U.S. "30 by 30" conservation initiative. Before turning to firm-level responses, we first validate our exposure measure. Following the 2021 policy shift, counties with higher PWRSR exposure experience a relative decline in new facility reporting, driven by reduced entry into high-exposure areas. This pattern is consistent with firms anticipating greater regulatory costs and uncertainty in these locations, and provides evidence that our measure captures forward-looking conservation risk relevant for firm decisions.

We then examine firm responses, exploiting variation in exposure to unprotected endangered habitats. The relevant comparison differs by firm structure. For multi-plant firms, we leverage within-firm variation by comparing facilities in the same firm using firm×chemical×year and facility×chemical fixed effects. This design isolates whether more exposed facilities adjust differently from less exposed facilities within the same internal network. We find that more exposed facilities reduce both emissions and production following the policy announcement. A one-standard-deviation increase in exposure is associated with a 1.6% decline in emissions and a 2.4% decline in production. These results indicate that multi-plant firms respond to transition risk by reducing activity at exposed facilities and reallocating production within the firm.

For single-plant firms identification comes from comparing firms with different exposure within the same industry and time period. In this setting, we find the opposite response: more exposed firms increase both emissions and production following the pol-

icy announcement. A one-standard-deviation increase in exposure is associated with a 5.9% increase in on-site emissions and a 1.8% increase in production, implying that output becomes substantially dirtier. Consistent with this, on-site emissions intensity increases by 3.8%. More exposed firms also undertake fewer new abatement activities and reduce post-production treatment, indicating that the increase in emissions is accompanied by weaker mitigation. Taken together, these results are consistent with a stranded-asset mechanism, in which single-plant firms accelerate production from exposed assets that may be adversely affected by future regulation.

These firm responses have real natural consequences. Because conservation policy is ultimately aimed at improving ecological outcomes, the heterogeneous firm responses we document imply corresponding differences in local biodiversity. While directly measuring changes in endangered species at a granular spatial level is challenging, we draw on two complementary data sources to capture ecological conditions. We use NASA's MODIS data and measure vegetation using the Enhanced Vegetation Index (EVI), a widely used satellite-based indicator of plant health, which we observe at each facility over time. We complement this with the eBird dataset, a large-scale crowdsourced database of bird observations, to measure local avian biodiversity, defined as the number of unique bird species observed within a 20 km radius of each facility. Together, these datasets provide high-frequency, spatially detailed proxies for ecological outcomes.

Consistent with our firm-level results, we find that ecological outcomes deteriorate in areas surrounding exposed single-plant facilities. Both vegetation and local avian biodiversity decline following the policy announcement, in line with increased emissions and reduced mitigation. In contrast, areas surrounding exposed facilities of multi-plant firms exhibit little to no detectable improvement, despite reductions in activity at those locations.

This asymmetry is consistent with the relative magnitude of firm responses: increases in emissions among single-plant firms substantially exceed the reductions observed among multi-plant firms. These findings indicate that transition risk can generate unintended natural consequences: while some firms reallocate activity away from exposed areas, others intensify production and reduce mitigation.

These heterogeneous responses have important implications for environmental policy: even when regulation is intended to reduce ecological harm, the anticipation of such policies can induce offsetting behavior that weakens or reverses local environmental gains. More broadly, our results underscore that the consequences of transition risk are shaped not only by the design of policy, but also by the organizational structure of firms and the margins along which they are able to adjust. Because environmental policy targets are typically announced well before implementation, firms respond not only to realized regulation but to expectations of future policy. This creates a wedge between the effects of policy and the effects of anticipated policy, implying that transition risk may account for a substantial share of the total economic and environmental impact of regulation.

Related Literature

Our paper contributes to the growing literature on environmental transition risk and its effects on firms and asset prices. A large body of work shows that investors price exposure to climate and environmental risks, including carbon emissions, toxic pollution, and climate policy uncertainty (Bolton and Kacperczyk, 2021; Ilhan et al., 2021; Bolton and Kacperczyk, 2023; Hsu et al., 2023; Zhang, 2025). More recently, a rapidly growing literature examines whether analogous risks arise from biodiversity loss and nature-

related regulation. Garel et al. (2024) show that firms with larger biodiversity footprints experience valuation effects around major biodiversity-policy events, while Giglio et al. (2023), Coqueret et al. (2025), Xiong (2023), Flammer et al. (2025), and Giglio et al. (2025) develop measures of biodiversity risk and study their financial implications. We build on this literature by shifting the focus from whether environmental transition risk is priced to how it changes firms' real operating decisions before regulation is realized.

Our paper also relates to work on anticipatory responses to environmental regulation, stranded assets, and green-paradox mechanisms. Theoretical work shows that when firms expect future environmental policy to reduce the value of dirty or resource-intensive assets, they may accelerate extraction or production before policy binds (Sinn, 2008; Van der Ploeg and Withagen, 2012; Jensen et al., 2015; Kotlikoff et al., 2016). A related literature studies stranded assets and the effects of climate policy uncertainty on investment, production, and asset values (McGlade and Ekins, 2015; Van der Ploeg and Rezai, 2020; Caldecott et al., 2021; Fried et al., 2021). Recent empirical work provides evidence that firms and markets respond in advance of expected climate policy. For example, Barnett (2024) studies preemptive production responses to climate transition risk, while Norman and Schlenker (2024) shows that proposed climate legislation can shift fossil fuel consumption toward the present. We extend this logic beyond fossil fuel extraction by showing that anticipated biodiversity regulation can induce pollution-intensive frontloading among firms that lack internal reallocation margins.

Our findings show that anticipatory responses to transition risk depend on firms' organizational structure and the margins of adjustment available inside the firm. We therefore contribute to the literature on internal firm networks and the reallocation of economic activity across establishments. Prior work shows that multi-establishment firms

reallocate capital, labor, and production across plants in response to local shocks (Giroud and Mueller, 2015, 2019; Giroud et al., 2024). In environmental settings, firms may also shift pollution or dirty activity across locations in response to regulation, political pressure, or enforcement risk (Ben-David et al., 2021; Bartram et al., 2022; Bisetti et al., 2026; Chen, 2025). We contribute by showing that internal networks shape the sign of firms' responses to transition risk itself.

Finally, our paper contributes to the emerging literature on biodiversity regulation, conservation policy, and ecological externalities. We use the spatial biodiversity measures developed by Hamilton et al. (2022), which identify concentrations of unprotected imperiled habitat using protection-weighted range-size rarity. Related work studies the real effects of biodiversity-related regulation after conservation protections are in place. Akbari et al. (2025) examine establishments near newly designated protected areas and show that nearby firms reduce toxic emissions through production cutbacks and workforce contraction. Zhang et al. (2024) examine how realized critical-habitat designations under the Endangered Species Act affect firms' toxic releases and local biodiversity outcomes. We differ by studying transition risk prior to the implementation of binding conservation restrictions. We also show that the response to biodiversity policy risk depends critically on firm structure. For multi-plant firms, we likewise find evidence consistent with reallocation away from exposed locations. For single-plant firms, however, we find a distinct response margin: because these firms cannot shift activity across sites, they instead increase harmful activity at exposed facilities. This behavioral difference has important ecological consequences, leading to declines in local avian biodiversity around exposed single-plant facilities, whereas realized protections in prior work are associated with improved ecological outcomes. Our results therefore highlight that anticipated conservation

policy can produce very different effects from realized regulation, especially when firms differ in their ability to reallocate across assets.

II. Institutional Setting, Data, and Validation

This section provides institutional background on biodiversity conservation policy and the U.S. "30 by 30" initiative, and describes the data used to construct our measure of exposure to biodiversity transition risk. We then validate this measure by showing that it captures forward-looking regulatory exposure relevant for firm decisions.[7] Summary statistics for all variables are available in Tables 1 and 2.

A. Biodiversity and the 30 by 30 Initiative

Biodiversity loss has emerged as a central environmental concern, with a growing body of evidence documenting widespread declines in species and ecosystems due to human activity (Díaz et al. (2019), Marques et al. (2019)). These losses have direct economic and social consequences, affecting agricultural productivity, public health, and ecosystem services (Frank and Sudarshan (2024), Frank (2024)). In response, policymakers have increasingly focused on conservation efforts aimed at preserving ecologically sensitive areas.

A central policy initiative in this context is the "30 by 30" target, which aims to conserve 30% of land and marine areas by 2030. In the United States, this objective has been advanced through a series of policy actions under the Biden administration, including Executive Orders 14008 and 14072, as well as legislation such as the Inflation Reduction

[7] Table IA.A.1 provides definitions of all variables used in the analysis.

Act and the Bipartisan Infrastructure Law.[8] Despite these efforts, as of 2021, less than 13% of land in the United States is permanently protected for biodiversity (U.S. Geological Survey (2021)), implying substantial scope for future conservation expansion.

This gap between current protections and policy targets generates cross-sectional variation in exposure to future conservation efforts. Identifying which firms and facilities are most affected requires understanding which geographic areas are likely to be designated as conservation targets. Because biodiversity impacts are inherently spatial, firms operating in ecologically sensitive and currently unprotected regions face greater exposure to anticipated conservation policy. Figure 1 illustrates the current distribution of protected areas across the United States.

B. Environmental Data

Our analysis draws on three environmental data sources. First, we use NatureServe data on species distributions, ecosystem vulnerability, and climate exposure to construct establishment-level measures of exposure to biodiversity transition risk. Second, we use NASA's Moderate Resolution Imaging Spectroradiometer (MODIS) satellite products, which provide consistent, high-frequency vegetation indices used to measure ecological outcomes. Third, we use data from eBird, a large-scale crowdsourced database of bird observations, to measure local avian biodiversity around facilities.

[8] See here for Executive Order 14008; here for Executive Order 14072; here for Inflation Reduction Act; here for Bipartisan Infrastructure Law; here for Bureau of Land Management Regulation; here for ESA Regulations; here for the America the Beautiful Initiative.

B.1 Biodiversity Exposure

Hamilton et al. (2022)[9] provide the biodiversity measures used in our analysis. They estimate species' geographic ranges using habitat suitability models (HSMs), which combine environmental variables such as climate, land cover, and soil characteristics to map suitable habitats across the United States.

The analysis focuses on 2,216 imperiled species across four taxonomic groups: vertebrates, vascular plants, freshwater invertebrates, and pollinators. Only species classified as critically imperiled (G1) or imperiled (G2) by NatureServe, or listed under the U.S. Endangered Species Act, are included. By focusing on these high-priority species, the resulting measures identify regions with elevated conservation importance, consistent with our focus on areas likely to be affected by future conservation policy.

Hamilton et al. (2022) introduce two measures of biodiversity importance used in our analysis: Range-Size Rarity (RSR) and Protection-Weighted Range-Size Rarity (PWRSR). We describe each measure below.

Range-Size Rarity (RSR). Range-Size Rarity (RSR) quantifies species rarity within a geographic area and increases with the number of species present and with the inverse of their habitat areas (rarity). The measure is constructed in two steps. First, for each species e, the inverse of its total modeled habitat area is computed. Second, these values are summed across all species present in geographic area g to obtain the RSR score:

$$RSR_g = \sum_e RSR_{eg} = \sum_e \frac{1}{Habitat\ Area_e}.$$

[9] Although not formally published by NatureServe, the top three coauthors of this study are affiliated with NatureServe, underscoring the organization's involvement in developing the methodology.

Protection-Weighted Range-Size Rarity (PWRSR). Protection-Weighted Range-Size Rarity (PWRSR) extends RSR by incorporating the extent to which species' habitats are unprotected. Protected areas are defined as those with GAP Status 1 or 2 in the Protected Areas Database for the United States. For each species e, the PWRSR contribution equals its RSR component multiplied by the share of its habitat that is unprotected. These values are then summed across species within geographic area g:

$$PWRSR_g = \sum_e PWRSR_{eg} = \sum_e \frac{1}{Habitat\ Area_e} \times Share\ Unprotected_e.$$

Higher PWRSR values indicate areas where vulnerable species are more exposed due to limited habitat protection. These measures, RSR and PWRSR, cover the entire continental United States at a resolution of 990 meters×990 meters. In our empirical analysis, we use the 2020 raster of these measures to construct facility-level exposure. This approach treats biodiversity exposure as predetermined with respect to our sample period (2018–2023) and reflects the underlying spatial distribution of imperiled species and protected areas at the onset of the policy period. Importantly, the habitat suitability models underlying these measures do not capture realized species presence, but rather the environmental suitability of each location for supporting a given species based on persistent characteristics such as climate, land cover, and soil conditions. As a result, while biodiversity loss may evolve over time, our measure captures longer-run ecological suitability that is unlikely to change discretely over our sample period, supporting its use as a time-invariant proxy for exposure. Figure 2 plots these measures.

The economic relevance of PWRSR comes from the fact that future conservation policy is likely to bind most strongly in locations where imperiled habitat remains unprotected.

These areas are natural candidates for new conservation designations, critical-habitat review, permitting restrictions, mitigation requirements, and legal or administrative challenges to facility expansion. For polluting facilities, such exposure can affect expected operating costs even before formal protection occurs. Firms may anticipate greater scrutiny of new construction, plant expansion, changes in land use, water withdrawals, emissions permits, or other activities that could adversely affect listed species or their habitats. High-PWRSR locations may also face greater litigation and delay risk, since environmental groups, local communities, and regulators have stronger grounds to challenge industrial activity in areas with concentrated and unprotected imperiled biodiversity. Thus, PWRSR is not intended to measure current regulatory burden. Rather, it captures the spatial component of expected future conservation pressure: locations where biodiversity value is high, formal protection is limited, and future policy intervention is more likely to constrain facility operations or investment.

B.2 Vegetation Index

To measure ecological outcomes, we use vegetation data from NASA's Moderate Resolution Imaging Spectroradiometer (MODIS). MODIS provides vegetation indices at 16-day intervals and multiple spatial resolutions, enabling consistent comparisons of vegetation over time and across locations. We focus on the Enhanced Vegetation Index (EVI), which adjusts for canopy background noise and atmospheric distortions, providing a robust measure of vegetation density across a wide range of ecological conditions.

EVI is available at a spatial resolution of 250m $\times$ 250m and ranges between -1 and 1, where lower values indicate lower vegetation density.[10] We access these data through

[10] See here and here for more details regarding its construction.

Google Earth Engine, retain pixels with vegetation index quality assurance flags ≤ 1[11], and aggregate 16-day composites to annual means at the facility level using establishment coordinates.

B.3 Avian Biodiversity

To measure local biodiversity, we use bird observation data from eBird, a large-scale citizen science database managed by the Cornell Lab of Ornithology. eBird aggregates bird sightings from a global network of participants and is widely used in ecological and conservation research.

We focus on the number of unique bird species observed, which provides a more precise measure of biodiversity than total observation counts. Using geocoded observation data, we construct measures of avian biodiversity at the facility level by counting the number of unique species observed within 10 km and 20 km radii of each establishment in a given year.

C. EPA Facility Data

Our primary analysis relies on facility-chemical-level data from the EPA's Toxics Release Inventory (TRI).[12] The TRI reports toxic chemical releases, production activity, and pollution-control practices for polluting U.S. facilities. We use the geographic coordinates provided in the dataset to merge each facility with our PWRSR biodiversity exposure and outcome measures.

[11] The MODIS VI Quality Assurance (QA) bits categorize pixel reliability: 0 indicates highest quality, 1 indicates marginal quality, and values ≥ 2 represent likely snow/ice or clouds. We retain pixels with QA ≤ 1 following standard practice.

[12] For detailed descriptions of the TRI and its use in financial research, see (Akey and Appel, 2019, 2021; Xu and Kim, 2022; Bisetti et al., 2026).

Our primary sample covers 16,197 facilities[13] operated by 4,491 firms between 2018 and 2023. The overwhelming majority of facilities belong to multi-plant firms: 13,766 facilities are operated by 2,431 firms with more than one establishment in their network. We define single-plant facilities as those belonging to firms with only one reported TRI facility during the 2018–2023 sample period. We acknowledge that this classification is imperfect, since observing only one TRI-reporting facility does not necessarily imply that the firm operates only one facility overall. However, given TRI reporting requirements,[14] the absence of additional reported facilities over our sample period suggests that such firms have limited scope to reallocate production across other TRI-relevant establishments. In that sense, our distinction is designed to capture differences in operational flexibility within the set of facilities most relevant for our analysis. Figure 3 displays the geographic distribution of EPA facilities across the United States overlaid on PWRSR. As shown in the figure, most facilities are concentrated in the eastern portion of the country. The figure also suggests substantial variation in biodiversity exposure both within and across states.

Following Akey and Appel (2021) and Bisetti et al. (2026), we analyze several margins through which facilities can alter toxic releases. In addition to the standard TRI release measures—on-site releases, off-site releases, and total releases—we construct variables capturing changes in production, on-site emissions intensity, abatement, and post-production waste management. Production activity is measured using cumulative production, constructed from the TRI production ratio. The production ratio captures year-over-year changes in the production process for a given facility-chemical. We aggregate these changes multiplicatively over time to obtain a cumulative measure of production and normalize the series to one in the first year of observation.

[13] We exclude public administration facilities by excluding NAICS codes above 81.
[14] See here for detailed information on TRI reporting requirements.

To measure emissions conditional on production, we construct emissions intensity defined as on-site toxic emissions divided by cumulative production.[15] The TRI also reports source-reduction or pollution-prevention activities that eliminate or reduce the use of toxic chemicals or the creation of chemical waste, including raw material substitution, technology redesign, and process modifications. We construct a measure capturing the count of such abatement activities in a given facility-chemical-year. Finally, we measure post-production mitigation using the share of total generated chemical waste that is diverted to recycling, treatment, or energy recovery rather than released into the environment.

Table 3 examines whether facilities in areas with greater biodiversity exposure differ systematically prior to the policy period. The table reports facility-level regressions where PWRSR exposure is the dependent variable and facility characteristics are averaged over 2018–2020. For multi-plant firms, we find no evidence of systematic differences in production, emissions, abatement, or waste management across facilities with varying exposure, consistent with limited sorting on observables within firm networks. Among single-plant firms, while some specifications suggest higher abatement activity in more exposed areas, these differences are not robust and disappear in specifications that absorb the greatest amount of cross-sectional variation. Overall, the explanatory power of these regressions is low, with adjusted R^2 values near zero. These results indicate that, prior to 2021, operational differences across exposure levels are limited, with no consistent evidence of systematic pre-period differences.

[15] This methodology follows Akey and Appel (2019).

D. County-Level Validation

In this section, we examine whether firms appear to account for PWRSR exposure when planning facility presence. We ask whether this exposure is reflected in the extensive margin: where TRI-reporting facilities are located, opened, or closed. To do so, we aggregate our analysis to the county-year level. We construct a county-level measure of PWRSR exposure using the average PWRSR exposure of the grid points in the county. The outcome in the main specification is the number of TRI-reporting facilities in county c and year t. Given the nature of the data, we estimate Poisson models of the form

$$Facilities_{ct} = \exp\left(\beta Post_t \times Exposure_c + \gamma_c + \delta_t\right),$$

where $Post_t$ equals one for years 2021–2023, γ_c are county fixed effects, and δ_t are year fixed effects. Standard errors are clustered at the county level. We estimate this specification using both the continuous county PWRSR measure and indicators for counties in the upper tail of the exposure distribution.

Table 4 presents the static county-level results. Panel A shows that high-exposure counties experience a relative decline in TRI facility counts after 2021. The estimates are negative across the upper-tail exposure definitions and become larger in magnitude as the exposure threshold becomes more stringent. Counties in the top decile of PWRSR exposure experience an estimated decline of approximately 2.5% in reported TRI facility counts relative to lower-exposure counties. The estimated decline is larger for counties in the top 5 percent (4%) and remains similar for the top 3.33 percent and top 2.5 percent of exposed counties, with implied declines of roughly 4.7–4.8 percent. The continuous specification also points in the same direction. Using a one-standard-deviation increase

in county PWRSR exposure of 0.00047, the coefficient implies a change of approximately −0.8% Thus, counties with greater PWRSR exposure experience economically meaningful relative declines in facility presence after 2021.

We next examine the dynamic pattern underlying these estimates. Figure 4 plots event-time estimates from a specification that interacts county PWRSR exposure with year indicators, omitting 2020 as the reference year. The pre-period coefficients are close to zero and statistically indistinguishable from zero, indicating that high- and low-exposure counties were not differentially trending in TRI facility presence before the policy announcement. After 2021, the coefficients turn negative. This dynamic pattern supports the interpretation that the post-period decline reflects a change in facility presence associated with anticipated conservation policy rather than a continuation of pre-existing county-level trends.

A potential concern is that the decline in reported facility counts could reflect changes in reporting rather than changes in actual facility presence. While this interpretation cannot be ruled out completely, it is less consistent with the timing and nature of the evidence. A reporting explanation would require firms to stop reporting all TRI chemicals at a facility, rather than merely reducing reported emissions for a particular chemical. Moreover, the dynamic estimates in Figure 4 show little evidence of a discrete break immediately in 2021.[16] Instead, the decline appears after a lag, becoming more pronounced in subsequent years. This timing is more consistent with firms adjusting facility planning, entry, and continued presence in response to regulatory uncertainty than with an immediate reporting response.

Panel B of Table 4 provides evidence on the mechanism behind the decline in total facil-

[16]We provide specifications with state×year fixed effects and demonstrate robustness to a binary, rather than continuous, outcome in Figures IA.A.1 and IA.A.2.

ity counts. The reduction is concentrated in new facility openings rather than closures. In high-exposure counties, new facility openings fall sharply after 2021. Counties in the top 5 percent of PWRSR exposure experience an estimated decline in openings of approximately −29.4%. The continuous specification similarly implies that a one-standard-deviation increase in PWRSR exposure is associated with a sizable decline in new facility entry. By contrast, the closure regressions are small and statistically insignificant across specifications. This asymmetry is important: if PWRSR exposure primarily led firms to shut down existing facilities, we would expect the closure estimates to be positive and significant. Instead, the evidence points to fewer new TRI-reporting facilities appearing in exposed counties.

Taken together, the county-level evidence suggests that PWRSR exposure affected firms' extensive-margin decisions. High-exposure counties experienced relative declines in TRI facility counts after 2021, and these declines appear to be driven primarily by reduced entry of new facilities rather than increased closure of existing ones. This pattern is consistent with firms incorporating PWRSR exposure into forward-looking location and investment decisions under regulatory uncertainty.

III. Firm Responses

The county-level evidence suggests that exposure to unprotected endangered species habitat is relevant for firms' extensive-margin decisions. We next turn to the intensive margin and examine whether facilities that remain in the sample adjust their toxic releases after the policy announcement. This analysis serves two purposes. First, it tests whether biodiversity transition risk is associated with changes in environmental management at

existing operations. Second, it motivates the central heterogeneity analysis that follows, in which we distinguish between firms that can reallocate activity across facilities and firms that cannot. Economic theory offers competing predictions for how firms may respond to anticipated environmental regulation. On one hand, firms may reduce activity, invest in abatement, or shift production away from exposed assets in anticipation of future regulatory costs. On the other hand, when firms expect regulation to reduce the future value of existing assets, they may accelerate production before constraints bind, increasing emissions in the short run. The direction of the average response is therefore theoretically ambiguous.

A. Full Sample Toxic Releases

We begin with the full sample of TRI-reporting facilities and estimate whether toxic releases change differentially after 2021 at facilities with greater PWRSR exposure. The unit of observation is a facility-chemical-year. Our baseline specification is

$$y_{kct} = \beta \left(Post_t \times PWRSR_k \right) + \alpha_{kc} + \lambda_{ct} + \varepsilon_{kct}, \tag{1}$$

where y_{kct} is the natural logarithm of toxic releases for facility k, chemical c, and year t. We examine both on-site releases and total releases. $PWRSR_k$ is the facility-level measure of exposure to unprotected endangered species habitat, and $Post_t$ is an indicator equal to one for years 2021–2023. The coefficient of interest, β, captures whether more exposed facilities experience differential changes in toxic releases following the "30 by 30" policy announcement. We also estimate a binary-treatment version replacing $PWRSR_k$ with an indicator for facilities in the upper tail of the exposure distribution, where $HighPWRSR_k$ equals

one for facilities with $PWRSR_k \geq 0.0015$. This specification provides a more transparent comparison between facilities with especially high exposure and other facilities.

The specification includes facility-by-chemical fixed effects, α_{kc}, which absorb time-invariant differences in release levels across facility-chemical pairs. It also includes chemical-by-year fixed effects, λ_{ct}, which absorb aggregate shocks to the reporting, production, or regulation of each chemical in each year. In richer specifications, we additionally include industry-by-year and state-by-year fixed effects, allowing for differential trends across industries and states. The industry-by-year fixed effects are based on the facility's reported primary NAICS code at the six-digit level and absorb time-varying shocks common to firms in the same detailed industry, yielding a demanding comparison across facilities operating in narrowly defined industry-year cells; in the estimation sample, the median facility-year is compared within a six-digit NAICS-year cell containing 62 TRI facilities. Standard errors are clustered at the facility-chemical level, allowing for heteroskedasticity and serial correlation within facility-chemical pairs over time.

Table 5 reports the static full-sample estimates. Across specifications, the coefficient on $Post \times PWRSR$ is negative for both on-site and total releases. In the most saturated specification, a one-standard-deviation increase in facility PWRSR exposure is associated with an approximately 1.2 percent decline in on-site releases and a 0.9 percent decline in total releases after 2021. The binary treatment estimates are similar in direction. Facilities above the high-exposure threshold reduce on-site releases by roughly 7–9 percent relative to lower-exposure facilities, although the estimates for total releases are smaller and not statistically significant.[17]

[17] This is partially due to increases in off-site releases, which is to be expected as firms shift emissions away from exposed facilities. Table IA.A.2 presents facility-level clustering and demonstrate increased off-site releases.

Figure 5 presents the corresponding dynamic estimates using year-by-exposure interactions, with 2020 as the omitted year.[18] The pre-period coefficients are close to zero and statistically indistinguishable from zero, suggesting that more and less exposed facilities were not differentially trending in toxic releases prior to the policy announcement. After 2021, the coefficients turn negative, with the strongest decline appearing in 2023. The 2024 estimates are less precise, and we therefore interpret them cautiously but they indicate a return to baseline in emissions after President Trump's reelection. Taken together, the full-sample evidence indicates that facilities with greater biodiversity transition-risk exposure reduce toxic releases after 2021. However, these average estimates do not identify the margin of adjustment. A decline in releases could reflect lower production, cleaner production, changes in abatement, or reallocation of activity within firm networks. Conversely, the average effect may mask offsetting responses across different types of firms. We therefore next split the sample by firm structure.

B. Multi-Plant Firms

Multi-Plant firms provide the cleanest setting for studying real responses to biodiversity transition risk because they operate multiple facilities with potentially different exposure to unprotected endangered species habitat. If transition risk raises the expected cost of operating in exposed locations, multi-plant firms can adjust by reallocating activity away from high-exposure facilities and toward lower-exposure facilities within the same

[18]This dynamic chart presents the evidence using facility-chemical clustering. We provide dynamics with facility-level clustering in Figure IA.A.3. Separately, we also demonstrate robustness to using a binary outcome variable in Figure IA.A.4.

internal network. For the multi-plant subsample, we estimate specifications of the form

$$y_{ikct} = \beta \left(Post_t \times PWRSR_k \right) + \alpha_{kc} + \theta_{ict} + \varepsilon_{ikct}, \tag{2}$$

where y_{ikct} is an outcome for facility k, chemical c, parent firm i, and year t. The main outcomes are log on-site releases and log total releases. We also examine production, emissions intensity, off-site releases, abatement activities, and post-production reduction. $PWRSR_k$ is the facility-level exposure measure and $Post_t$ equals one for years 2021–2023. The coefficient β captures whether more exposed facilities within multi-plant firms change differentially after the policy announcement.

The key feature of this specification is the inclusion of firm-by-year-by-chemical fixed effects, θ_{ict}, together with facility-by-chemical fixed effects, α_{kc}. Facility-by-chemical fixed effects absorb permanent differences across facility-chemical pairs, including baseline differences in production technology, emissions levels, and local exposure. Firm-by-year-by-chemical fixed effects absorb any shock common to all facilities of the same firm reporting the same chemical in a given year. This includes firm-wide financial constraints, changes in demand, productivity shocks, and management decisions at the parent-firm level. Identification therefore comes from comparing high- and low-exposure facilities within the same firm, for the same chemical, in the same year. In some specifications, we additionally include state-by-year fixed effects to absorb time-varying state-level shocks. Standard errors are clustered at the facility-chemical level, allowing for heteroskedasticity and serial correlation within facility-chemical pairs over time.[19]

[19] Appendix Table IA.A.3 shows that the results are robust to clustering at the facility level. We also show that the multi-plant and single-plant results are robust to winsorizing the PWRSR exposure measure in Appendix Table IA.A.6. The interpretation of the coefficients remains largely the same across these specifications.

This design substantially reduces concerns that the estimates reflect differences across firms rather than responses to transition risk. For example, if financially constrained firms respond differently to anticipated regulation, or if some parent firms face different product-market shocks after 2021, these forces are absorbed by the firm-by-year-by-chemical fixed effects. The remaining identifying variation is within firm networks. The design therefore asks whether, conditional on the same parent firm producing or reporting the same chemical in the same year, the more exposed facility changes its behavior relative to the less exposed facility. This does not eliminate every possible concern about time-varying facility-level shocks, but the absence of systematic pre-period differences documented above, together with the fixed effects, makes such selection less likely to explain the results.

Table 6 reports the results. Panel A shows that high-PWRSR facilities within multi-plant firms reduce toxic releases after 2021. The coefficient on $Post \times PWRSR$ is negative and statistically significant for both on-site and total releases. In the most saturated specification, a one-standard-deviation increase in multi-plant facility PWRSR exposure, equal to 0.00228, is associated with an approximately 1.4 percent decline in on-site releases and a 1.3 percent decline in total releases. The binary treatment estimates are economically larger. Facilities above the high-exposure threshold reduce on-site releases by roughly 20 percent and total releases by roughly 13 percent relative to lower-exposure facilities within the same firm networks. The larger magnitudes in the binary specification are consistent with the fact that the high-exposure indicator isolates facilities in the far right tail of the PWRSR distribution, approximately the top 3% of exposed facilities. These estimates indicate that biodiversity transition exposure is especially consequential for facilities located in the most exposed areas, where anticipated conservation policy is most

likely to bind.

Panel B examines the mechanisms behind these reductions. More exposed facilities reduce production after 2021: the coefficient on $Post \times PWRSR$ implies that a one-standard-deviation increase in PWRSR exposure is associated with an approximately 2.4 percent decline in production. This decline is larger than the corresponding decline in releases, suggesting that the reduction in emissions is driven primarily by lower activity at exposed facilities rather than by a broad improvement in emissions efficiency.[20] The off-site release estimates are positive but statistically insignificant, indicating limited evidence that firms simply substitute on-site releases with off-site transfers at exposed facilities. Abatement activities increase modestly among more exposed facilities. In the continuous specification, a one-standard-deviation increase in PWRSR exposure is associated with an increase of approximately 0.0003 abatement activities. Post-production reduction does not change significantly.

Overall, the multi-plant results indicate that exposed facilities reduce releases and production relative to less exposed facilities inside the same firm. This pattern is consistent with internal reallocation away from locations more exposed to anticipated conservation policy.

C. Single-Plant Firms

We next examine firms that operate only one TRI-reporting facility. This subsample provides a sharp contrast to the multi-plant setting. Unlike multi-plant firms, single-plant

[20] The emissions-intensity estimates are consistent with this interpretation. In the continuous specification, emissions per unit of production increase modestly, suggesting that production falls somewhat more than emissions at exposed facilities. However, this pattern does not hold for the most exposed facilities: the high-exposure specification shows a decline in emissions intensity, indicating that facilities in the far right tail reduce emissions by more than production.

firms cannot reallocate production across facilities within the same internal network. If the facility is exposed to future conservation restrictions, the firm faces a more constrained adjustment problem: it can reduce activity, invest in mitigation, or accelerate production before regulation binds. When firms expect future regulation to reduce the value of an exposed asset, they may have incentives to monetize that asset in the present by increasing production, even if doing so raises emissions.

Because single-plant firms do not provide within-firm variation in exposure, the empirical design necessarily differs from the multi-plant specification. We estimate regressions of the form

$$y_{kct} = \beta \left(Post_t \times PWRSR_k \right) + \alpha_{kc} + \lambda_{ct} + \eta_{jt} + \psi_{st} + \varepsilon_{kct}, \tag{3}$$

where y_{kct} is an outcome for facility k, chemical c, and year t. As before, $PWRSR_k$ measures facility-level exposure to unprotected endangered species habitat and $Post_t$ equals one for years 2021–2023. The specification includes facility-by-chemical fixed effects, α_{kc}, which absorb permanent differences across facility-chemical pairs, and chemical-by-year fixed effects, λ_{ct}, which absorb aggregate shocks to each chemical in each year. In the richer specifications, we additionally include industry-by-year fixed effects, η_{jt}, and state-by-year fixed effects, ψ_{st}. The industry-by-year fixed effects are based on the facility's reported primary NAICS code, at the six-digit level, and absorb time-varying shocks common to firms in the same detailed industry, yielding a very tight comparison among single-plant firms: in this estimation sample, the median facility-year is compared within a six-digit NAICS-year cell containing only 9 TRI facilities. Standard errors are clustered at the facility-chemical level.

This design compares exposed and less-exposed single-plant firms within the same chemical-year, and in the saturated specifications within the same industry-year and

state-year. It is therefore a weaker test than the multi-plant design, which compares facilities within the same parent firm. However, the fixed effects absorb a large set of potential confounds, including permanent facility-chemical differences, chemical-specific aggregate shocks, industry-specific shocks, and state-specific shocks. The high adjusted R^2 values across outcomes indicate that these fixed effects explain most of the variation in the dependent variables, reducing the possibility for omitted factors to drive the estimates, though they do not eliminate all concerns about time-varying facility-level shocks.[21]

Table 7 reports the results. Panel A shows that, in contrast to multi-plant firms, exposed single-plant firms increase toxic releases after 2021. The coefficient on $Post \times PWRSR$ is positive across specifications and statistically significant for on-site releases throughout; for total releases, the estimate becomes statistically significant once industry-by-year and state-by-year fixed effects are included. A one-standard-deviation increase in single-plant facility PWRSR exposure, equal to 0.00145, is associated with an approximately 5.7–7.8% increase in on-site releases and up to a 7.8% increase in total releases. The binary treatment estimates are even larger: high-exposure single-plant facilities increase on-site releases by roughly 18–35% and total releases by roughly 22–48% relative to lower-exposure single-plant facilities.

Panel B provides evidence on the mechanism. Exposed single-plant firms increase production, but the increase in emissions is substantially larger than the increase in output. A one-standard-deviation increase in PWRSR exposure is associated with an approximately 1.8 percent increase in production, while on-site emissions intensity rises by approximately 3.7 percent. The high-exposure specification tells a similar story: production rises

[21] Appendix Table IA.A.5 reports pooled specifications that interact the treatment effect with an indicator for single-plant firms, directly testing whether the response differs between single- and multi-plant firms. Appendix Table IA.A.4 reports our main regressions but with facility-level clustered errors.

by about 5 percent, while emissions intensity rises by roughly 16 percent. Thus, exposed single-plant firms are not merely producing more; they are producing more pollution-intensive output.

The mitigation outcomes reinforce this interpretation. More exposed single-plant firms reduce abatement activities after 2021. In the continuous specification, a one-standard-deviation increase in PWRSR exposure is associated with a decline of approximately 0.013 abatement activities, while high-exposure firms reduce abatement activities by about 0.20 activities. Exposed firms also reduce post-production waste management. The continuous specification implies a decline in the post-production reduction ratio of about 0.5 percentage points for a one-standard-deviation increase in exposure, and the high-exposure specification implies a decline of about 1.5 percentage points. These estimates indicate that exposed single-plant firms recycle, treat, or recover a smaller share of generated waste after the policy announcement.

The contrast with the multi-plant results is economically important. Multi-plant firms reduce production and emissions at exposed facilities, consistent with shifting activity away from locations more likely to face future conservation constraints. Single-plant firms, by contrast, increase production, increase emissions, become more emissions-intensive, and reduce mitigation. The magnitudes are also substantially larger for single-plant firms. This pattern is consistent with a stranded-asset response: when firms lack internal reallocation margins, exposure to anticipated biodiversity regulation induces them to extract more value from exposed assets before future constraints bind. These results highlight an unintended consequence of transition risk in unprotected endangered habitats. We therefore next examine whether these divergent facility responses translate into measurable changes in local ecological outcomes around exposed facilities.

IV. Ecological Outcomes

We next examine whether the operational responses observed above are reflected in ecological conditions surrounding TRI facilities. To do so, we combine two complementary sources of environmental outcome data. First, we use NASA MODIS satellite imagery to measure local vegetation conditions through the Enhanced Vegetation Index (EVI), a widely used measure of vegetation density and health. Second, we use eBird observations to measure local avian biodiversity, defined as the number of unique bird species observed within a fixed radius of each facility-year. These outcomes allow us to move beyond reported facility behavior and test whether transition-risk-induced changes in toxic releases are associated with measurable changes in nearby ecological conditions. Because the firm-response results predict the strongest adverse effects around exposed single-plant facilities, we examine ecological outcomes separately by firm structure and focus on whether the same asymmetry appears in vegetation and avian biodiversity.

A. Vegetation

We first examine vegetation outcomes using EVI from NASA MODIS satellite imagery. EVI is a remote-sensing measure of vegetation density and health that is bounded between -1 and 1, with higher values indicating denser or healthier vegetation. Because EVI is not naturally interpretable in levels, and because almost all facility-year observations in our sample have positive EVI values, we use ln(EVI) as our preferred outcome. This transformation allows the coefficients to be interpreted approximately as percentage changes. We also report specifications using EVI in levels to show that the relationship is not driven by the log transformation.

The vegetation outcome is measured at the facility-year level, while the TRI data are observed at the facility-chemical-year level. We retain the facility-chemical-year structure for two reasons. First, different chemicals have heterogeneous environmental impacts, making it important to account for chemical-specific shocks and reporting patterns.[22] Second, facilities report different sets of chemicals over time, so collapsing to the facility-year level would remove the ability to absorb chemical-by-year variation. We therefore aggregate our data to the firm-time level for each chemical. For multi-plant firms, we continue to use firm-by-year-by-chemical fixed effects, which compare exposed and less-exposed facilities within the same firm, chemical, and year. Standard errors are clustered at the facility-chemical level.

We use the same empirical structure as in the facility-response analysis. For single-plant firms, we estimate Equation (3), replacing the toxic-release outcome with either EVI or ln(EVI). The richer specifications include industry-by-year and state-by-year fixed effects. For multi-plant firms, we use the corresponding within-firm specification from Equation (2), replacing chemical-by-year fixed effects with firm-by-year-by-chemical fixed effects. Thus, the multi-plant estimates compare vegetation changes around more- and less-exposed facilities within the same firm, chemical, and year.

Table 8 reports the results. Panel A shows that vegetation declines around exposed single-plant facilities after 2021. In the preferred log specification with industry-by-year and state-by-year fixed effects, the coefficient on $Post \times PWRSR$ is negative and statistically significant. A one-standard-deviation increase in PWRSR exposure among single-plant firms is associated with an approximately 0.6% decline in EVI. The corresponding level specification is also negative, indicating that the result is not an artifact of the log trans-

[22]The EPA's CompTox Chemicals Dashboard documents chemical-specific toxicity, exposure, and environmental fate information.

formation.

Panel B shows no comparable decline around exposed facilities of multi-plant firms. The coefficients are small, statistically insignificant, and close to zero across both EVI levels and log EVI. This pattern mirrors the facility-response results: the firms that increase emissions and reduce mitigation exhibit measurable deterioration in nearby vegetation, while facilities belonging to multi-plant firms do not exhibit detectable vegetation improvements.

Figure 6 plots the corresponding dynamic estimates for single-plant firms using ln(EVI) as the outcome. The pre-period estimates are statistically indistinguishable from zero, suggesting limited evidence of differential pre-trends in vegetation around more exposed facilities before the policy announcement. The coefficients turn negative after 2021 and become more pronounced in the post-period. Overall, the vegetation evidence is consistent with the interpretation that the increase in emissions among exposed single-plant firms has adverse local ecological consequences.

B. Avian Biodiversity

We next examine avian biodiversity using eBird observations around TRI facilities. Our main measure is the annual number of unique bird species observed within a 20 km radius of each facility, which we use to construct ln(AB). We focus on unique species rather than total bird counts because species richness is less sensitive to short-run fluctuations in the number of observed individual birds. We use the 20 km radius as our main aggregation window to smooth local measurement noise in observation activity and species movement,

and report analogous estimates using a 10 km radius in the Internet Appendix.[23]

As with the vegetation analysis, avian biodiversity is measured at the facility-year level, while TRI outcomes are reported at the facility-chemical-year level. We therefore assign the facility-year avian biodiversity measure to each facility-chemical-year observation and use the same empirical structure as above. We report both continuous-exposure specifications using $Post \times PWRSR$ and binary specifications using $Post \times HighPWRSR$, where $HighPWRSR$ identifies facilities with $PWRSR \geq 0.0015$.

Table 9 reports the results. Panel A shows that avian biodiversity declines around exposed single-plant facilities after 2021. In the continuous specification with industry-by-year and state-by-year fixed effects, the coefficient on $Post \times PWRSR$ implies that a one-standard-deviation increase in single-plant PWRSR exposure, is associated with an approximately 0.2% decline in unique bird species observed within 20 km of the facility. The binary treatment estimates are larger: high-exposure single-plant facilities experience a decline in avian biodiversity of roughly 2.4–3.5% relative to lower-exposure facilities.

Panel B shows no comparable decline around facilities belonging to multi-plant firms. The coefficients are small, statistically insignificant, and close to zero in both the continuous and binary specifications. The continuous estimates imply economically negligible changes in avian biodiversity. This mirrors the vegetation results and the underlying facility-response patterns: adverse ecological changes are concentrated around exposed single-plant facilities, where firms increase emissions and reduce mitigation.

Figure 7 presents the corresponding dynamic estimates for single-plant firms. The pre-period coefficients are statistically indistinguishable from zero, providing limited evidence of differential pre-trends in avian biodiversity before the policy announcement.

[23] Appendix Table IA.A.12 reports avian biodiversity results using unique species observed within a 10 km radius of each facility.

The post-period estimates turn negative, with the clearest decline appearing after 2021. These dynamics are consistent with the static estimates and suggest that the decline in avian biodiversity emerges after the increase in toxic releases among exposed single-plant firms.

We also examine whether the ecological results are stronger in the subsample of facility-chemical-year observations with positive on-site emissions, where toxic releases are more directly relevant for local environmental conditions. The Appendix shows that the vegetation and avian biodiversity estimates for exposed single-plant facilities are generally larger in this sample.[24] This pattern supports the interpretation that the ecological results are tied to actual emitting activity rather than to exposure alone.

V. Conclusion

This paper studies how firms respond to biodiversity transition risk created by anticipated conservation policy. We find that firms respond differently depending on their ability to adjust across assets. Multi-plant firms reduce production and toxic releases at exposed facilities. In contrast, exposed single-plant firms increase production, increase toxic releases, become more emissions-intensive, and reduce mitigation activity. These responses are consistent with a stranded-asset mechanism: when firms lack internal reallocation margins, anticipated regulation can induce them to extract more value from exposed assets before constraints bind.

These firm responses have ecological consequences. Around exposed single-plant

[24] Appendix Tables IA.A.8 and IA.A.11 restrict the sample to facility-chemical-year observations with positive on-site releases. The adverse effects for single-plant firms become larger in the saturated specifications, while the multi-plant estimates remain small and statistically insignificant.

facilities, vegetation declines and avian biodiversity falls after the policy announcement. We find no comparable improvement around exposed facilities of multi-plant firms. Our findings have broader implications for the design and evaluation of environmental policy. Policies aimed at protecting ecologically valuable areas may alter firm behavior well before formal regulation takes effect. These anticipatory responses can either reduce local environmental pressure or intensify it, depending on the margins available to exposed firms. More broadly, the real effects of transition risk depend not only on the location of exposed assets, but also on the internal structure of the firms that own them.

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Figure 1: Protected Areas

This figure shows the areas that are permanently protected for biodiversity conservation. Protected areas are those classified with GAP Status 1 or 2 in the Protected Areas Database for the United States, which are areas mandated for biodiversity conservation. The areas are colored by the type of agency that owns the land. Note, Designation here demonstrates territory that is not owned in the traditional sense, instead, they are lands protected by designation rather than explicit ownership.

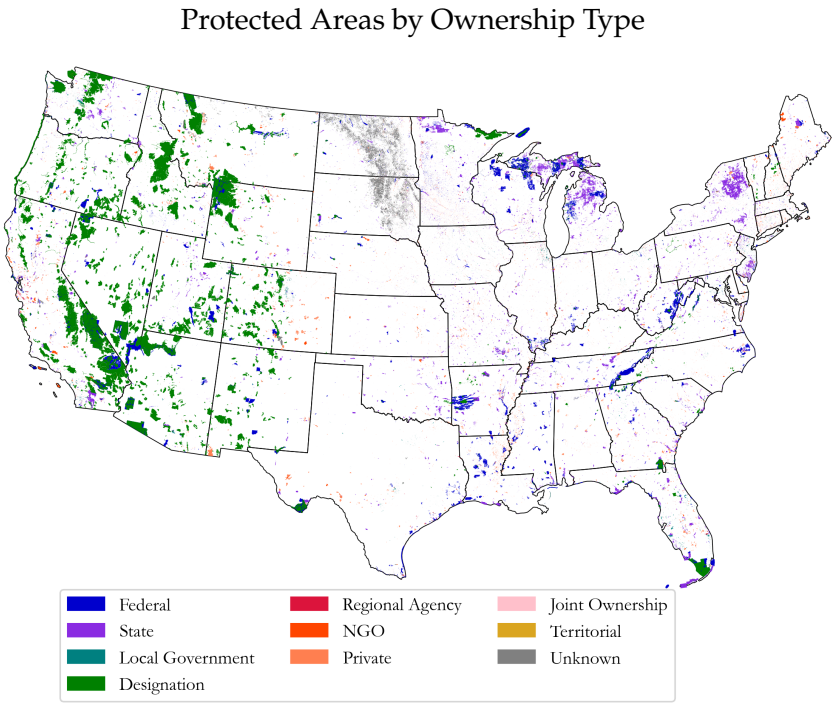
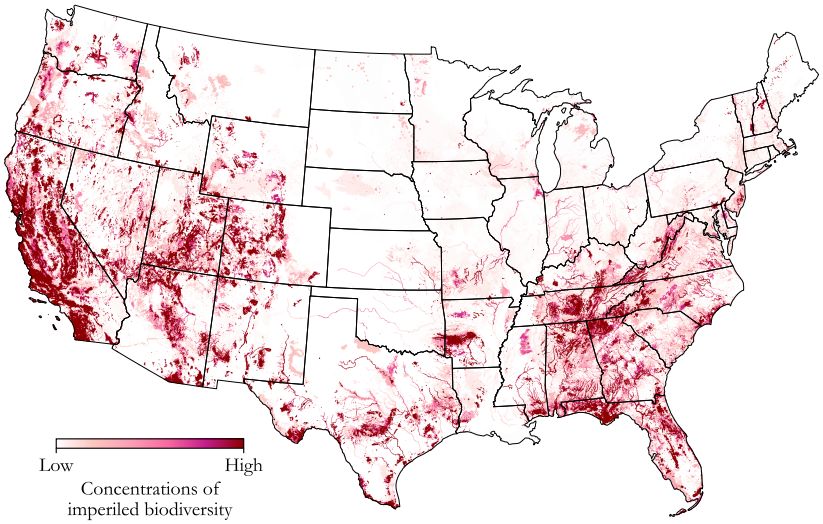


Figure 2: Measures of Endangered Biodiversity

This figure shows the primary measures of biodiversity risk that we adopted from NatureServe. Panel A shows range-size rarity (RSR), which is the inverse of the modeled habitat area. Panel B shows the main continuous measure, Protection-weighted Range-size Rarity (PWRSR). For each species, PWRSR is the product of two components: range-size rarity and the percentage of this habitat that lies outside protected areas. Both RSR and PWRSR metrics are determined at a resolution of 990 meters, providing a detailed spatial scale for biodiversity risk.

Panel A: Range Size Rarity (RSR)



Panel B: Protected Weighted Range Size Rarity (PWRSR)

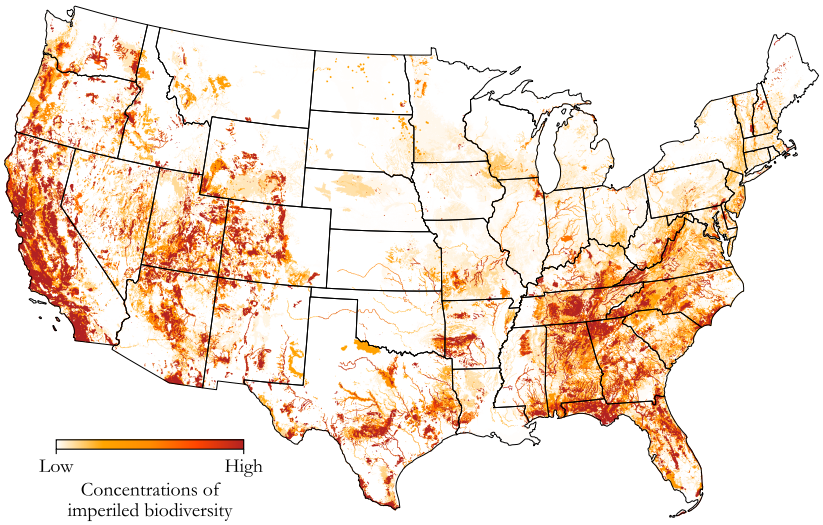


Figure 3: PWRSR and TRI Facilities

This figure plots facilities in the EPA Toxics Release Inventory (TRI) over our main continuous measure of biodiversity transition risk, Protection-Weighted Range Size Rarity (PWRSR). The sample is restricted to facilities in NAICS $\leq$ 81 observed between 2018 and 2023. Each green dot represents a unique TRI facility. The shaded raster indicates higher PWRSR values for darker areas.

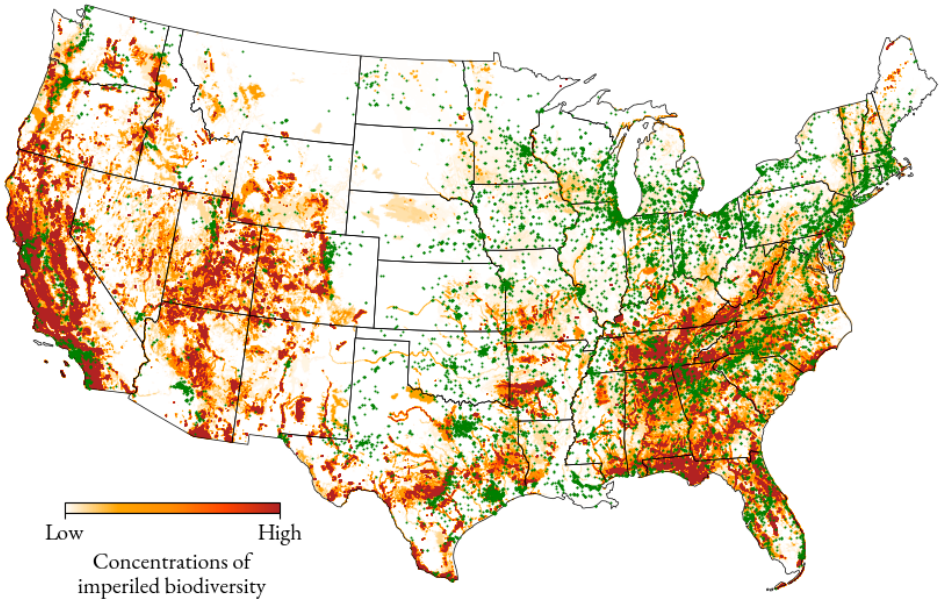


Figure 4: Dynamic Effects on Facility Presence in Exposed Counties

This figure reports dynamic county-level Poisson estimates using interactions between year indicators and the county PWRSR measure, with 2020 as the omitted reference year. The dependent variable is the number of TRI facilities in each county-year. The specification includes county and year fixed effects, and standard errors are clustered at the county level. Error bars show 95% confidence intervals; red markers denote estimates significant at the 5% level. Vertical shaded bands mark 2021 ("30 by 30" Executive Order) and 2024 (presidential re-election).

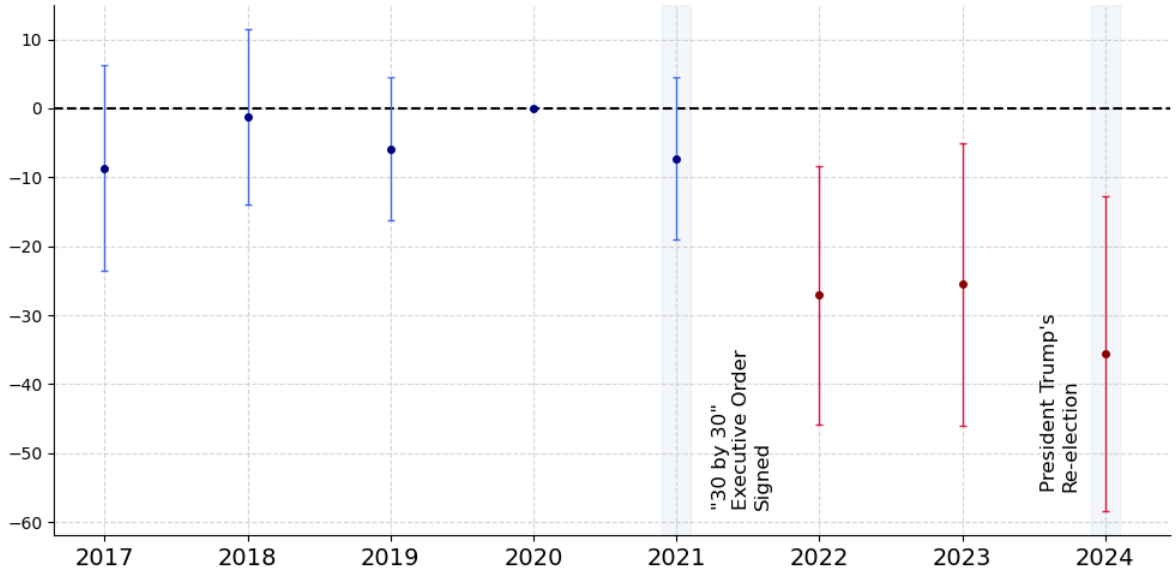
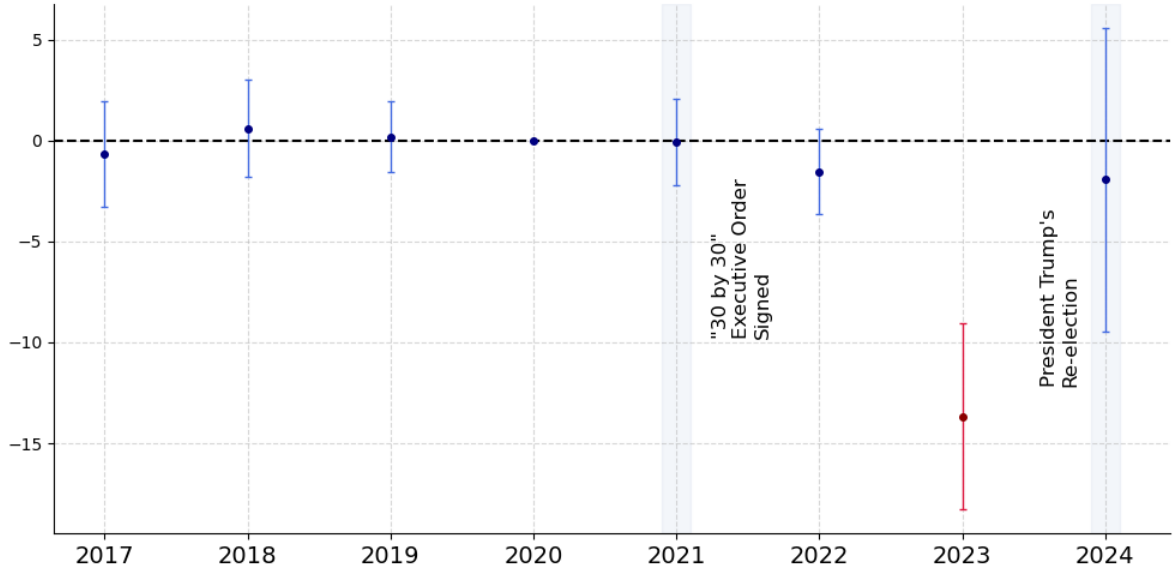


Figure 5: Full-Sample Dynamic Effects of PWRSR on Toxic Releases

These panels show the dynamic counterpart of the static full-sample specification in Table 5. For each outcome, we estimate interactions between year indicators and continuous facility-level PWRSR exposure, using 2020 as the omitted reference year. Coefficients therefore represent the marginal effect of PWRSR in each year relative to 2020. Panel A uses log on-site releases as the dependent variable; Panel B uses log total releases. Regressions include fixed effects (industry×year, year×chemical, facility×chemical, and state×year fixed effects) with standard errors clustered at the facility-chemical level. Error bars are 95% confidence intervals; red markers denote significance at the 5% level. Shaded markers indicate 2021 ("30 by 30" Executive Order) and 2024 (presidential re-election).

Panel A: On-Site Releases



Panel B: Total Releases

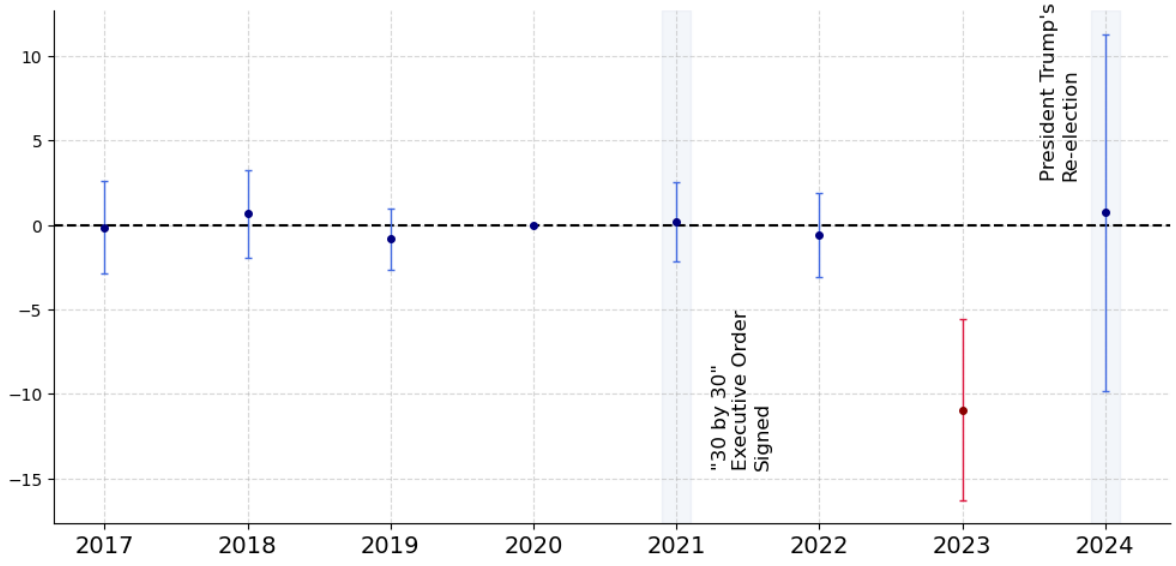


Figure 6: Dynamic Effects on Vegetation Outcomes: Single-Plant Firms

This figure reports dynamic facility-level estimates from regressions of ln(EVI) on interactions between year indicators and facility PWRSR exposure, with 2020 as the omitted reference year. The sample is TRI facility-chemical-year observations from 2017–2024 for single-plant parent firms. The specification includes facility×chemical, year×chemical, industry×year, and state×year fixed effects. Standard errors are clustered at the facility×chemical level. Error bars show 95% confidence intervals; red markers denote estimates significant at the 5% level. Vertical shaded bands mark 2021 ("30 by 30" Executive Order) and 2024 (presidential election year).

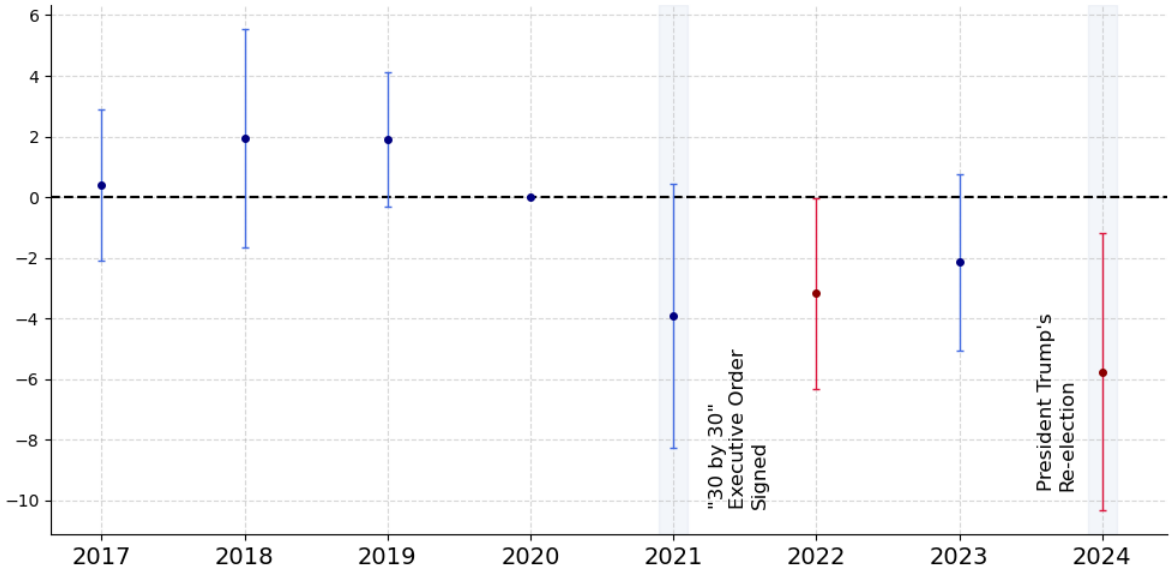


Figure 7: Dynamic Effects on Avian Biodiversity: Single-Plant Firms

This figure plots dynamic coefficients from facility-chemical-year regressions of avian biodiversity on interactions between year indicators and facility PWRSR exposure, with 2020 as the omitted reference year. Avian biodiversity is measured as the annual number of unique bird species observed within a 20 km radius of each TRI facility using eBird data, and the dependent variable is ln(AB). The sample includes TRI facility-chemical-year observations from 2017–2024 for facilities whose parent firms operate a single TRI plant in the sample. The specification includes industry×year, year×chemical, facility×chemical, and state×year fixed effects. Standard errors are clustered at the facility×chemical level. Error bars denote 95% confidence intervals; red markers indicate coefficients significant at the 5% level. Vertical shaded bands mark 2021 ("30 by 30" Executive Order) and 2024 (presidential re-election).

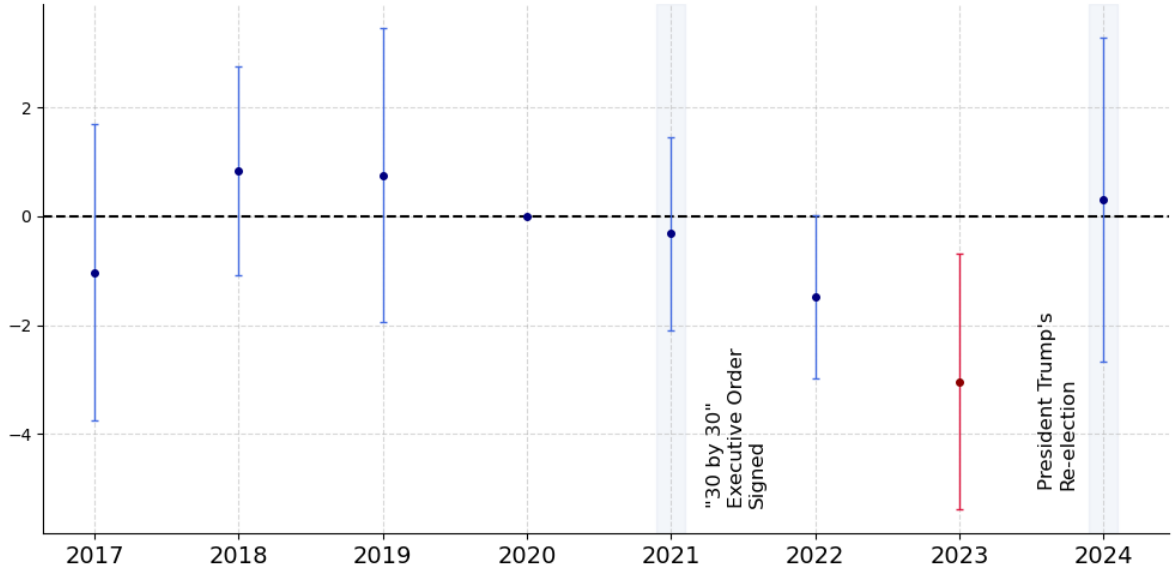


Table 1: Summary Statistics: Full Sample

This table presents summary statistics for biodiversity exposure, emissions, production, abatement, and vegetation variables used in the analysis for the full sample. The sample period is 2018–2023, and we restrict attention to facilities with primary NAICS ≤ 81. Facility-level PWRSR is measured at the TRI facility level. County PWRSR is a county-level measure constructed from PWRSR grid cells, equivalent to the county-wide average grid-cell PWRSR. EPA emissions and production variables are measured at the annual facility-chemical level. On-site releases, off-site releases, and total releases are converted to pounds before constructing derived variables. On-site releases, off-site releases, total releases, on-site emissions intensity, cumulative production, production ratio, and post-production reduction ratio are winsorized at the 1st and 99th percentiles, and log variables are constructed from the corresponding transformed level variables. EVI is constructed in the facility-chemical-year sample by retaining valid-quality observations and averaging to annual values before merging to TRI observations; Log EVI is defined as ln(EVI) for EVI > 0. Avian Biodiversity (10km and 20km) is defined as the count of unique eBird species observed within a 10km or 20km radius and reported at the facility-chemical-year level in the analysis sample.

	Number of Obs.	Mean	Std Dev	p5	p25	Median	p75	p95
PWRSR	16,197	0.00025	0.00217	0.00000	0.00000	0.00001	0.00005	0.00079
Winsorized PWRSR	16,197	0.00017	0.00058	0.00000	0.00000	0.00001	0.00005	0.00079
County PWRSR	3,108	0.00021	0.00047	0.00000	0.00001	0.00004	0.00018	0.00098
On-site Releases	321,415	12,278.63	53,473.83	0.00	0.00	20.00	1,169.00	52,000.00
Off-site Releases	321,415	2,157.13	10,878.03	0.00	0.00	0.00	8.00	7,489.30
Total Releases	321,415	16,979.25	68,121.48	0.00	0.18	131.00	3,246.88	74,464.62
Log On-site Releases	235,187	4.99	4.29	-2.63	2.23	5.45	8.19	11.28
Log Off-site Releases	107,603	4.79	3.84	-1.62	2.03	5.14	7.72	10.72
Log Total Releases	255,043	5.71	4.16	-2.12	3.09	6.24	8.78	11.51
Cumulative Production	284,326	1.04	0.56	0.49	0.87	1.00	1.04	1.69
Log Cumulative Production	284,326	-0.07	0.55	-0.71	-0.14	0.00	0.04	0.53
Production Ratio	279,205	1.04	0.41	0.60	0.90	1.00	1.10	1.58
On-site Emissions Intensity	231,974	18,035.93	64,371.63	0.07	9.53	241.07	3,953.62	88,664.82
Log On-site Emissions Intensity	231,974	5.05	4.32	-2.66	2.25	5.49	8.28	11.39
Abatement Activities	321,413	0.04	0.22	0.00	0.00	0.00	0.00	0.00
Post-Production Reduction Ratio	272,975	0.53	0.45	0.00	0.00	0.72	0.99	1.00
EVI	319,335	0.2045	0.0912	0.0675	0.1311	0.1996	0.2714	0.3618
Log EVI	319,243	-1.7074	0.5289	-2.6947	-2.0313	-1.6109	-1.3042	-1.0165
Avian Biodiversity (20km)	321,415	218.57	60.17	107.00	184.00	226.00	259.00	312.00
Avian Biodiversity (10km)	321,415	168.03	65.54	47.00	124.00	177.00	215.00	265.00
Log Avian Biodiversity (20km)	321,113	5.34	0.36	4.67	5.21	5.42	5.56	5.74
Log Avian Biodiversity (10km)	319,971	5.01	0.60	3.91	4.83	5.18	5.38	5.58

Table 2: Summary Statistics: Single-Plant and Multi-Plant Firms

This table presents summary statistics for biodiversity exposure, emissions, production, abatement, and vegetation variables used in the analysis, reported separately by parent-firm structure. Panel A reports facilities belonging to single-plant firms, and Panel B reports facilities belonging to multi-plant firms. The sample period is 2018–2023, and we restrict attention to facilities with primary NAICS $\leq$ 81. Facility-level PWRSR is measured at the TRI facility level. EPA emissions and production variables are measured at the annual facility-chemical level. On-site releases, off-site releases, and total releases are converted to pounds before constructing derived variables. On-site releases, off-site releases, total releases, on-site emissions intensity, cumulative production, production ratio, and post-production reduction ratio are winsorized at the 1st and 99th percentiles, and log variables are constructed from the corresponding transformed level variables. EVI is constructed in the facility-chemical-year sample by retaining valid-quality observations and averaging to annual values before merging to TRI observations; Log EVI is defined as ln(EVI) for EVI $>$ 0. Avian Biodiversity (10km and 20km) is defined as the count of unique eBird species observed within a 10km or 20km buffer and reported at the facility-chemical-year level in the analysis sample.

	Number of Obs.	Mean	Std Dev	p5	p25	Median	p75	p95
Panel A: Single-Plant Firms								
PWRSR	2,431	0.00022	0.00145	0.00000	0.00000	0.00001	0.00004	0.00067
Winsorized PWRSR	2,431	0.00015	0.00052	0.00000	0.00000	0.00001	0.00004	0.00067
On-site Releases	45,635	12,478.34	54,187.73	0.00	0.00	40.00	1,473.50	51,080.09
Off-site Releases	45,635	2,276.68	10,998.67	0.00	0.00	0.00	8.72	8,949.75
Total Releases	45,635	17,253.69	68,510.32	0.00	1.70	220.00	3,917.12	72,628.40
Log On-site Releases	34,212	5.31	4.01	-1.51	2.57	5.56	8.25	11.22
Log Off-site Releases	15,140	4.92	3.94	-2.04	2.20	5.41	7.88	10.75
Log Total Releases	37,184	6.01	3.90	-0.69	3.64	6.45	8.87	11.44
Cumulative Production	41,597	1.05	0.65	0.42	0.84	1.00	1.03	1.87
Log Cumulative Production	41,597	-0.09	0.62	-0.87	-0.17	0.00	0.03	0.63
Production Ratio	40,811	1.05	0.46	0.55	0.89	1.00	1.10	1.68
On-site Emissions Intensity	33,894	19,092.50	68,790.23	0.22	14.52	285.83	4,330.85	88,646.78
Log On-site Emissions Intensity	33,894	5.38	4.05	-1.53	2.68	5.66	8.37	11.39
Abatement Activities	45,635	0.06	0.28	0.00	0.00	0.00	0.00	1.00
Post-Production Reduction Ratio	40,136	0.53	0.46	0.00	0.00	0.71	0.99	1.00
EVI	45,428	0.2102	0.0904	0.0695	0.1399	0.2063	0.2789	0.3633
Log EVI	45,428	-1.6747	0.5202	-2.6664	-1.9671	-1.5783	-1.2771	-1.0126
Avian Biodiversity (20km)	45,635	216.81	63.28	103.00	181.00	224.00	259.00	313.00
Avian Biodiversity (10km)	45,635	167.92	69.10	34.00	125.00	177.00	219.00	267.00
Log Avian Biodiversity (20km)	45,388	5.32	0.41	4.66	5.20	5.41	5.56	5.75
Log Avian Biodiversity (10km)	44,998	5.00	0.64	3.81	4.85	5.18	5.39	5.59
Panel B: Multi-Plant Firms								
PWRSR	13,766	0.00026	0.00228	0.00000	0.00000	0.00001	0.00005	0.00081
Winsorized PWRSR	13,766	0.00017	0.00059	0.00000	0.00000	0.00001	0.00005	0.00081
On-site Releases	275,780	12,245.58	53,354.81	0.00	0.00	18.00	1,114.00	52,037.18
Off-site Releases	275,780	2,137.35	10,857.83	0.00	0.00	0.00	8.00	7,286.05
Total Releases	275,780	16,933.84	68,056.93	0.00	0.10	119.00	3,150.09	74,800.25
Log On-site Releases	200,975	4.94	4.33	-2.81	2.13	5.41	8.18	11.29
Log Off-site Releases	92,463	4.77	3.83	-1.61	1.98	5.10	7.69	10.71
Log Total Releases	217,859	5.65	4.21	-2.30	3.00	6.22	8.77	11.52
Cumulative Production	242,729	1.04	0.54	0.50	0.87	1.00	1.04	1.67
Log Cumulative Production	242,729	-0.06	0.54	-0.69	-0.14	0.00	0.04	0.51
Production Ratio	238,394	1.04	0.40	0.60	0.90	1.00	1.10	1.56
On-site Emissions Intensity	198,080	17,855.14	63,583.22	0.06	8.76	232.23	3,885.67	88,679.69
Log On-site Emissions Intensity	198,080	5.00	4.36	-2.82	2.17	5.45	8.27	11.39
Abatement Activities	275,778	0.03	0.21	0.00	0.00	0.00	0.00	0.00
Post-Production Reduction Ratio	232,839	0.53	0.45	0.00	0.00	0.72	0.99	1.00
EVI	273,907	0.2036	0.0914	0.0673	0.1299	0.1981	0.2701	0.3617
Log EVI	273,815	-1.7129	0.5301	-2.6962	-2.0408	-1.6187	-1.3088	-1.0169
Avian Biodiversity (20km)	275,780	218.86	59.63	107.00	184.00	226.00	258.00	312.00
Avian Biodiversity (10km)	275,780	168.04	64.94	49.00	124.00	178.00	215.00	264.00
Log Avian Biodiversity (20km)	275,725	5.34	0.35	4.68	5.21	5.42	5.55	5.74
Log Avian Biodiversity (10km)	274,973	5.01	0.60	3.91	4.83	5.18	5.37	5.58

Table 3: PWRSR and Pre-Period Facility Characteristics

This table reports facility-level regressions where the dependent variable is facility-level PWRSR exposure. Panel A reports estimates for the full sample of TRI facilities observed between 2018 and 2020. Panel B reports estimates separately by firm structure, with columns (1)–(5) for multi-plant firms and columns (6)–(9) for single-plant firms. Explanatory variables are measured using pre-2021 averages. Abatement Activities is the average of facility-level source reduction totals aggregated across chemicals. Post-Production Reduction is the average of the ratio of post-production waste management activities to total produced waste, aggregated to the facility-year level before averaging across years. On-site Releases is the average of the log of total on-site releases aggregated across chemicals within a facility-year. Production is the average of the log of cumulative production, where production ratios are first constructed at the facility-chemical-year level and then averaged to the facility level using pre-2021 on-site releases as chemical weights within each facility-year. Fixed effects included in each specification are indicated in the bottom rows. Coefficients and standard errors are multiplied by 10,000. Robust standard errors are clustered at the facility level and reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Full Sample

	(1)	(2)	(3)
On-site Releases	-0.0044	0.0400	-0.0775*
	(0.0303)	(0.0331)	(0.0466)
Production	0.0173	-0.1690	-0.0494
	(0.2960)	(0.2920)	(0.3190)
Abatement Activities	0.0693	-0.0377	0.0331
	(0.0886)	(0.0895)	(0.0952)
Post-Production Reduction	-0.1710	0.1050	0.1880
	(0.4840)	(0.4810)	(0.6010)
R-squared	0.0000	0.0239	0.0189
Adj. R-squared	-0.0003	0.0193	-0.0119
Obs.	10,922	10,922	10,886
State FE	No	Yes	No
Industry FE	No	No	Yes

Panel B: By Firm Structure

	Multi-Plant Firms					Single-Plant Firms			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
On-site Releases	0.0014	0.0477	-0.0889	0.1050	0.0146	0.0004	0.0273	0.0070	0.0654
	(0.0343)	(0.0374)	(0.0547)	(0.0890)	(0.0848)	(0.0496)	(0.0556)	(0.0605)	(0.0731)
Production	-0.1160	-0.3740	-0.2270	-0.3400	-0.5010	0.5120	0.7300	1.3980	1.7440*
	(0.3450)	(0.3390)	(0.3630)	(0.3790)	(0.3840)	(0.4030)	(0.4600)	(0.8910)	(0.9460)
Abatement Activities	-0.0689	-0.1730*	-0.1040	-0.0845	-0.1520	0.3780***	0.2980***	0.3220	0.2500
	(0.0815)	(0.0966)	(0.0893)	(0.0938)	(0.1380)	(0.1230)	(0.1080)	(0.2170)	(0.1850)
Post-Production Reduction	-0.2180	0.0859	0.2480	0.5800	0.4960	0.2030	0.3710	-0.1950	0.0332
	(0.5680)	(0.5540)	(0.7300)	(0.7880)	(0.8450)	(0.6010)	(0.6300)	(0.8490)	(0.8660)
R-squared	0.0000	0.0240	0.0214	0.1145	0.1666	0.0043	0.0581	0.1678	0.2245
Adj. R-squared	-0.0004	0.0184	-0.0129	-0.0660	-0.0497	0.0020	0.0297	0.0297	0.0650
Obs.	9,178	9,178	9,143	8,944	8,899	1,744	1,744	1,666	1,666
Firm FE	No	No	No	Yes	Yes	No	No	No	No
State FE	No	Yes	No	No	Yes	No	Yes	No	Yes
Industry FE	No	No	Yes	No	Yes	No	No	Yes	Yes

Table 4: High Exposure Counties and Facility Counts

This table reports county-year Poisson regressions using TRI-based county panels for 2018–2023 (*Post*= 1 for 2021–2023). Treatment intensity is county-level PWRSR. Panel A estimates effects on the number of toxic-releasing facilities in a county-year. Panel B estimates effects on facility transitions: openings (a facility's first observed year, excluding the first sample year) and closures (a facility's last observed year, excluding the last sample year). Within each panel, columns are organized as continuous intensity specifications (*Post*×*PWRSR*) and high-exposure specifications (*Post*×*High PWRSR*) based on upper-tail PWRSR cutoffs. All models include county and year fixed effects. Standard errors are in parentheses and clustered at the county level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Total Facilities

	(1) Continuous	(2) Top 10%	(3) Top 5%	(4) Top 3.33%	(5) Top 2.5%
Post × Exposure	-17.5458**				
	(8.6749)				
Post × High Exposure		-0.0250**	-0.0405**	-0.0486**	-0.0491**
		(0.0116)	(0.0171)	(0.0200)	(0.0228)
Pseudo R^2	0.7295	0.7295	0.7295	0.7295	0.7295
Obs.	13,500	13,500	13,500	13,500	13,500
County FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes

Panel B: Facility Openings and Closures

	Opened Facilities			Closed Facilities		
	(1) Continuous	(2) Top 5%	(3) Top 3.33%	(4) Continuous	(5) Top 5%	(6) Top 3.33%
Post × Exposure	-164.8046***			-2.3711		
	(63.6799)			(51.8873)		
Post × High Exposure		-0.3478**	-0.3180**		-0.0697	-0.1613
		(0.1515)	(0.1553)		(0.1236)	(0.1356)
Pseudo R^2	0.2133	0.2133	0.2131	0.2839	0.2840	0.2840
Obs.	7,200	7,200	7,200	8,262	8,262	8,262
County FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 5: Toxic Release Responses: All Firms

This table reports full-sample facility-chemical regressions using TRI observations from 2018–2023. Columns alternate between continuous treatment intensity (*Post*×*PWRSR*) and binary treatment (*Post*×*High PWRSR*), where *High PWRSR*=1[*PWRSR*≥0.0015]. The table reports log on-site and log total releases: for each outcome, the first pair excludes industry×year and state×year fixed effects, while the second pair includes both sets of fixed effects in addition to year×chemical and facility×chemical fixed effects. On-site and total releases are converted to pounds and winsorized at the 1st and 99th percentiles before log transformations. Standard errors are in parentheses and clustered at the facility-chemical level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	On-site Releases				Total Releases			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post × PWRSR	-5.277***		-5.439***		-3.994***		-4.004***	
	(1.419)		(1.422)		(1.533)		(1.532)	
Post × High PWRSR		-0.069**		-0.092***		-0.029		-0.044
		(0.033)		(0.035)		(0.035)		(0.038)
Adj. R^2	0.9500	0.9500	0.9526	0.9526	0.9217	0.9217	0.9252	0.9252
Obs.	219,453	219,453	219,290	219,290	238,420	238,420	238,277	238,277
Chemical × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Facility × Chemical FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry × Year FE	No	No	Yes	Yes	No	No	Yes	Yes
State × Year FE	No	No	Yes	Yes	No	No	Yes	Yes

Table 6: Toxic Release and Mechanism Responses: Multi-Plant Firms

This table reports facility-chemical regressions for the multi-plant firm subsample, using TRI observations from 2018–2023. Columns alternate between continuous treatment intensity (*Post*×*PWRSR*) and binary treatment (*Post*×*High PWRSR*), where *High PWRSR*=1[*PWRSR*≥ 0.0015]. Panel A reports log on-site and log total releases, where the first pair for each outcome excludes state×year fixed effects and the second pair includes state×year fixed effects along with firm×year×chemical and facility×chemical fixed effects. Panel B reports log production, log on-site emissions intensity, log off-site releases, abatement activities, and post-production reduction, using firm×year×chemical and facility×chemical fixed effects. Standard errors are in parentheses and clustered at the facility-chemical level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: On-site and Total Toxic Release Responses

	On-site Releases				Total Releases			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post × PWRSR	-7.007***		-6.196***		-6.682***		-5.702***	
	(1.495)		(1.504)		(1.561)		(1.586)	
Post × High PWRSR		-0.230***		-0.223***		-0.163***		-0.143***
		(0.041)		(0.041)		(0.047)		(0.048)
Adj. R^2	0.9564	0.9564	0.9565	0.9565	0.9321	0.9321	0.9322	0.9322
Obs.	146,912	146,912	146,912	146,912	160,559	160,559	160,559	160,559
Firm × Year × Chemical FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Facility × Chemical FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State × Year FE	No	No	Yes	Yes	No	No	Yes	Yes

Panel B: Production, Intensity, Off-Site, and Abatement Responses

	Production		On-site Intensity		Off-site Releases		Abatement Activities		Post-Production Reduction	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Post × PWRSR	-10.744***		3.796**		1.244		0.129**		0.251	
	(0.848)		(1.908)		(2.352)		(0.060)		(0.361)	
Post × High PWRSR		-0.069***		-0.108***		0.180		0.018***		0.006
		(0.019)		(0.041)		(0.123)		(0.007)		(0.007)
Adj. R^2	0.5230	0.5211	0.9568	0.9568	0.8567	0.8567	0.5181	0.5181	0.8751	0.8751
Obs.	183,872	183,872	145,454	145,454	58,479	58,479	210,323	210,323	173,124	173,124
Firm × Year × Chemical FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Facility × Chemical FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 7: Toxic Release and Mechanism Responses: Single-Plant Firms

This table reports facility-chemical-year regressions for the single-plant firm subsample using TRI observations from 2018–2023 (*Post*= 1 for 2021–2023). Columns alternate between continuous treatment intensity (*Post*×*PWRSR*) and binary treatment (*Post*×*High PWRSR*), where *High PWRSR*=1[*PWRSR*≥0.0015]. Panel A reports log on-site and log total releases. For each outcome in Panel A, the first pair uses Chemical×Year and Facility×Chemical fixed effects; the second pair additionally includes Industry×Year and State×Year fixed effects. Panel B reports log production, log on-site emissions intensity, log off-site releases, abatement activities, and post-production reduction using year×chemical and facility×chemical fixed effects. Standard errors are in parentheses and clustered at the facility-chemical level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: On-site and Total Toxic Release Responses

	On-site Releases				Total Releases			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post × PWRSR	39.298**		54.041**		20.614		54.048**	
	(15.265)		(23.056)		(20.342)		(23.165)	
Post × High PWRSR		0.169***		0.299***		0.196***		0.395***
		(0.059)		(0.081)		(0.072)		(0.094)
Adj. R^2	0.9370	0.9370	0.9421	0.9421	0.9104	0.9105	0.9151	0.9151
Obs.	32,881	32,881	32,564	32,564	35,727	35,727	35,446	35,446
Year × Chemical FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Facility × Chemical FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry × Year FE	No	No	Yes	Yes	No	No	Yes	Yes
State × Year FE	No	No	Yes	Yes	No	No	Yes	Yes

Panel B: Production, Intensity, Off-Site, and Abatement Responses

	Production		On-site Intensity		Off-site Releases		Abatement Activities		Post-Production Reduction	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Post × PWRSR	12.402**		25.655*		-27.411		-8.929**		-3.429***	
	(5.720)		(13.521)		(43.530)		(3.951)		(1.283)	
Post × High PWRSR		0.050**		0.147**		0.142		-0.200***		-0.015**
		(0.022)		(0.059)		(0.244)		(0.046)		(0.008)
Adj. R^2	0.5174	0.5173	0.9364	0.9364	0.8657	0.8657	0.5959	0.5998	0.8865	0.8865
Obs.	40,241	40,241	32,666	32,666	14,038	14,038	43,912	43,912	38,582	38,582
Year × Chemical FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Facility × Chemical FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 8: Vegetation Outcomes: Single-Plant and Multi-Plant Firms

This table reports facility-chemical-year regressions of vegetation outcomes on the interaction between post-period timing and facility exposure. The coefficient of interest is *Post* × *PWRSR*, where *Post* equals one for years 2021 and later, and PWRSR is the facility-level exposure measure. The sample is TRI facility-chemical-year observations from 2018–2023. Outcomes are EVI (levels) and ln(EVI). Panel A uses facilities whose parent firm operates a single TRI plant in the sample. Panel B uses facilities whose parent firm operates multiple TRI plants. Within each firm-structure sample, the first pair uses baseline high-dimensional fixed effects and the second pair adds richer controls. Standard errors are clustered at the facility-chemical level and reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Single-Plant Firms

	(1) EVI	(2) ln(EVI)	(3) EVI	(4) ln(EVI)
Post × PWRSR	-0.4931***	-5.5635***	-0.1995*	-4.0400***
	(0.1367)	(1.5141)	(0.1101)	(1.4839)
Adj. R^2	0.9610	0.9641	0.9709	0.9737
Obs.	43,685	43,685	43,434	43,434
Year × Chemical FE	Yes	Yes	Yes	Yes
Facility × Chemical FE	Yes	Yes	Yes	Yes
State × Year FE	No	No	Yes	Yes
Industry × Year FE	No	No	Yes	Yes

Panel B: Multi-Plant Firms

	(1) EVI	(2) ln(EVI)	(3) EVI	(4) ln(EVI)
Post × PWRSR	-0.0072	0.0083	-0.0078	-0.0071
	(0.0141)	(0.1030)	(0.0131)	(0.0962)
Adj. R^2	0.9637	0.9654	0.9659	0.9674
Obs.	208,482	208,394	208,482	208,394
Firm × Year × Chemical FE	Yes	Yes	Yes	Yes
Facility × Chemical FE	Yes	Yes	Yes	Yes
State × Year FE	No	No	Yes	Yes

Table 9: Avian Biodiversity Outcomes: Single-Plant and Multi-Plant Firms

This table reports facility-chemical-year regressions of avian biodiversity outcomes on interactions between post-period timing and facility exposure. Avian biodiversity (AB) is measured as the annual number of unique bird species observed within a 20 km radius of each TRI facility using eBird data; the dependent variable is ln(AB). The sample is TRI facility-chemical-year observations from 2018–2023. We report both a continuous-exposure specification, where the coefficient of interest is *Post* × *PWRSR* (*Post*=1 for years 2021 and later; PWRSR is facility-level exposure), and a binary-exposure specification, where the coefficient of interest is *Post* × *High PWRSR* (*High PWRSR*=1{*PWRSR*≥0.0015}). Panel A uses facilities whose parent firm operates a single TRI plant in the sample. Panel B uses facilities whose parent firm operates multiple TRI plants. Single-plant specifications move from year×chemical and facility×chemical fixed effects to additionally include industry×year and state×year fixed effects. Multi-plant specifications include firm×year×chemical and facility×chemical fixed effects, with the richer pair additionally including state×year fixed effects. Standard errors are clustered at the facility×chemical level and reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Single-Plant Firms

	(1)	(2)	(3)	(4)
Post × PWRSR	-1.3935*		-1.5663**	
	(0.8394)		(0.6206)	
Post × High PWRSR		-0.0241***		-0.0358***
		(0.0041)		(0.0059)
Adj. R^2	0.9266	0.9266	0.9398	0.9399
Obs.	43,661	43,661	43,408	43,408
Year × Chemical FE	Yes	Yes	Yes	Yes
Facility × Chemical FE	Yes	Yes	Yes	Yes
State × Year FE	No	No	Yes	Yes
Industry × Year FE	No	No	Yes	Yes

Panel B: Multi-Plant Firms

	(5)	(6)	(7)	(8)
Post × PWRSR	0.0012		-0.0056	
	(0.0813)		(0.0886)	
Post × High PWRSR		0.0030		0.0006
		(0.0029)		(0.0032)
Adj. R^2	0.9318	0.9318	0.9369	0.9369
Obs.	210,302	210,302	210,302	210,302
Firm × Year × Chemical FE	Yes	Yes	Yes	Yes
Facility × Chemical FE	Yes	Yes	Yes	Yes
State × Year FE	No	No	Yes	Yes

Internet Appendix for:
"Stranded or Reallocated? Firm Structure and the Real Effects of Transition Risk"

Ricardo Peña and Shikhar Singla

IA.A Firm Responses

Figure IA.A.1: County Dynamics in TRI Facility Counts by PWRSR Exposure–State×Year FEs

This figure reports dynamic county-level poisson estimates using interactions between year indicators and the county PWRSR measure, with 2020 as the omitted reference year. The dependent variable is the number of TRI facilities in each county-year. The specification includes county and state×year fixed effects, and standard errors are clustered at the county level. Error bars show 95% confidence intervals; red markers denote estimates significant at the 5% level. Vertical shaded bands mark 2021 ("30 by 30" Executive Order) and 2024 (presidential re-election).

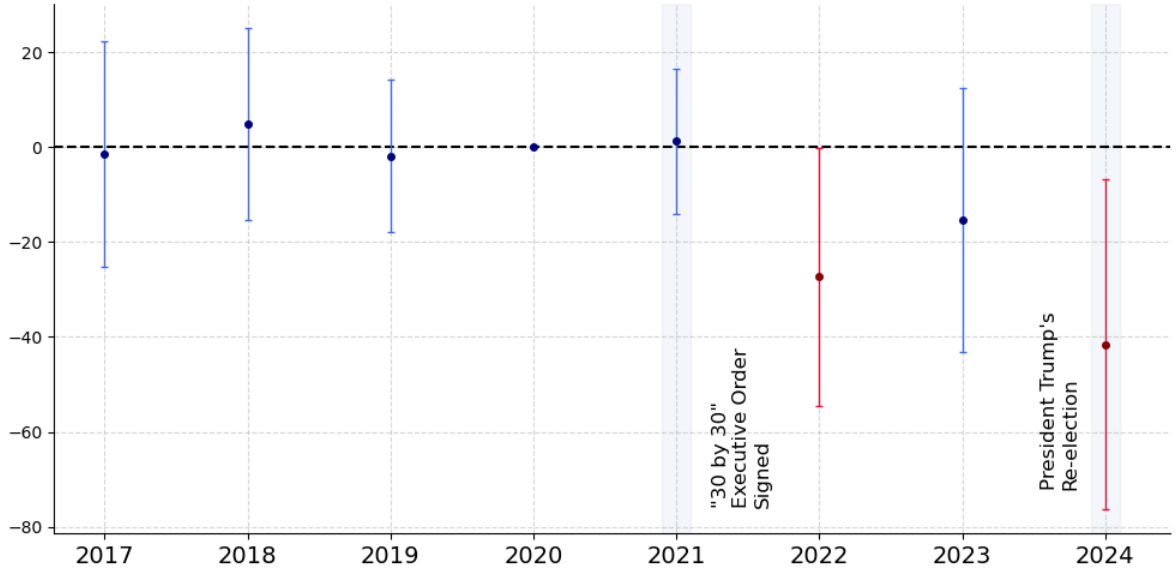


Figure IA.A.2: County Dynamics in TRI Facility Counts by High-PWRSR Exposure

This figure plots event-time coefficients from county-level poisson regressions where the outcome is the number of TRI facilities in a county-year. The treatment indicator equals one for counties in the top decile of County-level PWRSR and zero otherwise. Coefficients are from interactions between year indicators and the treated-county indicator, with 2020 as the omitted reference year, so each point is the treated-minus-control difference in that year relative to 2020. The specification includes county and year fixed effects, and standard errors are clustered at the county level. Error bars are 95% confidence intervals; red markers denote significance at the 5% level. Vertical shaded bands mark 2021 ("30 by 30" Executive Order) and 2024 (presidential re-election).

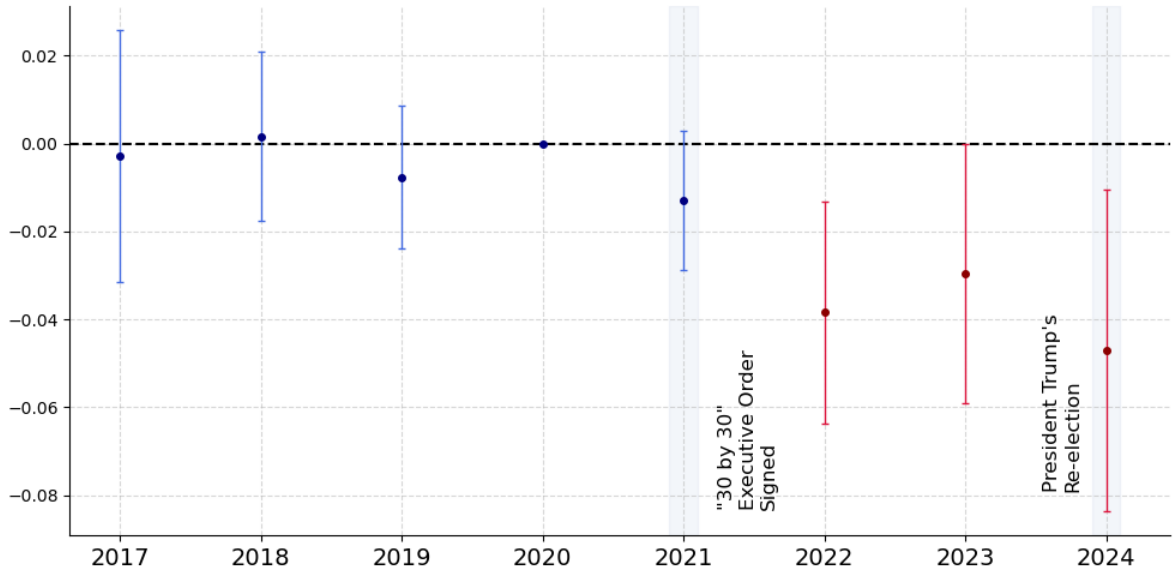
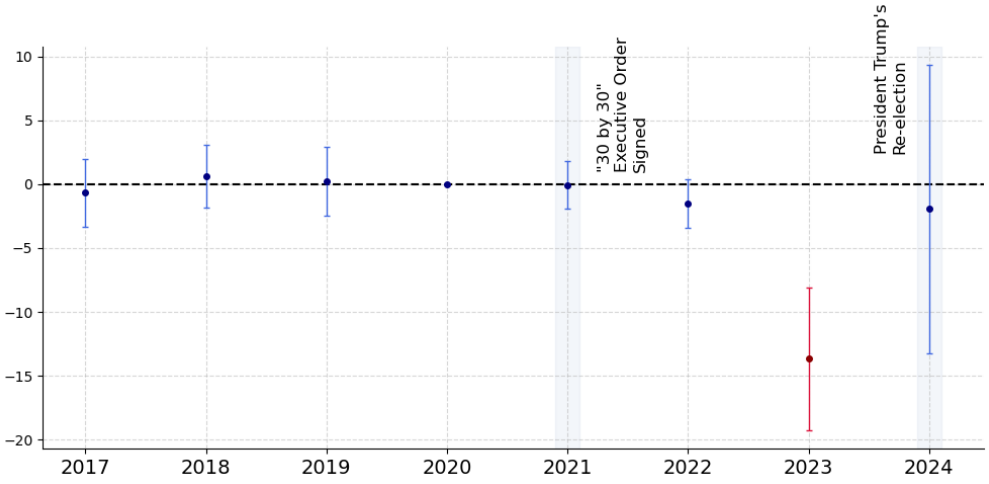


Figure IA.A.3: Full-Sample Dynamic Effects of PWRSR on Toxic Releases– Facility Clustering

These panels show the dynamic counterpart of the static full-sample specification in Table 5. For each outcome, we estimate interactions between year indicators and continuous facility-level PWRSR exposure, using 2020 as the omitted reference year. Coefficients therefore represent the marginal effect of PWRSR in each year relative to 2020. Panel A uses log on-site releases as the dependent variable; Panel B uses log total releases. Regressions include fixed effects (Facility × Chemical, Chemical × Year, State × Year, and Industry × Year) with standard errors clustered at the facility level. Error bars are 95% confidence intervals; red markers denote significance at the 5% level. Shaded markers indicate 2021 ("30 by 30" Executive Order) and 2024 (presidential re-election).

Panel A: On-Site Releases



Panel B: Total Releases

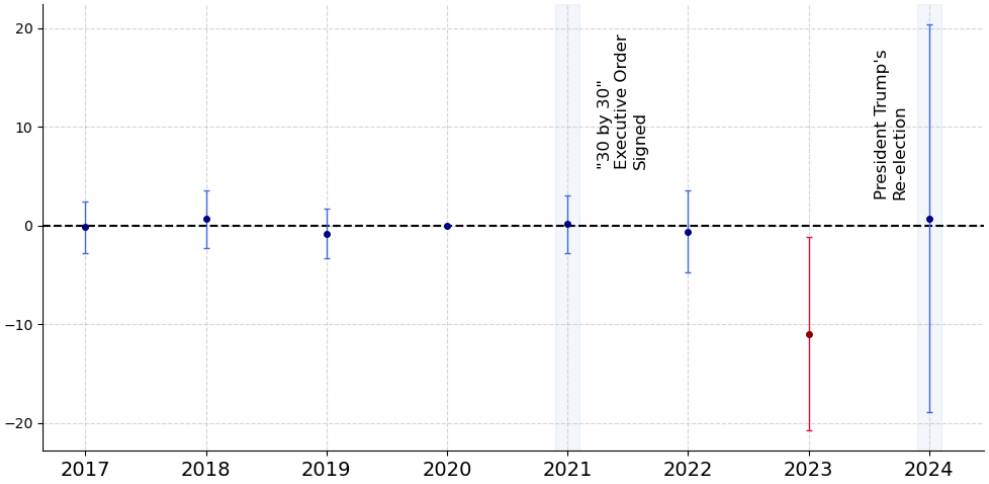


Figure IA.A.4: Full-Sample Dynamic Effects of High PWRSR on On-Site Toxic Releases

This figure shows the dynamic counterpart of the static binary-treatment specification in Table 5. We estimate interactions between year indicators and *High PWRSR*, where *High PWRSR*= 1[*PWRSR* ≥ 0.0015], with 2020 as the reference year. Coefficients therefore measure year-specific differences in log on-site releases for high-exposure facilities relative to low-exposure facilities, normalized to 2020. The dependent variable is log on-site releases (in pounds, winsorized at the 1st and 99th percentiles before logging). Regressions include fixed effects (Facility×Chemical, Chemical×Year, State×Year, and Industry×Year), and standard errors are clustered at the facility-chemical level. Error bars are 95% confidence intervals; red markers denote significance at the 5% level. Shaded markers indicate 2021 ("30 by 30" Executive Order) and 2024 (President Trump's Re-election).

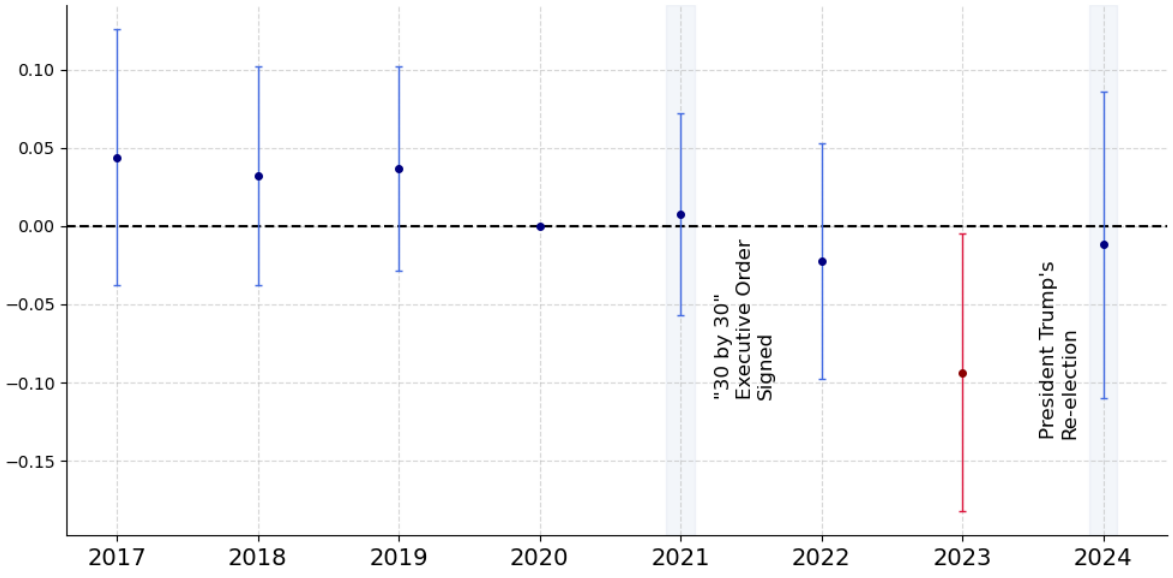


Figure IA.A.5: Dynamic Effects on Vegetation Outcomes: Single-Plant Firms–Chemical Clustering

This figure reports dynamic facility-level estimates from regressions of ln(EVI) on interactions between year indicators and facility PWRSR exposure, with 2020 as the omitted reference year. The sample is TRI facility-chemical-year observations from 2017–2024 for single-plant parent firms. The specification includes facility×chemical, year×chemical, industry×year, and state×year fixed effects. Standard errors are clustered at the chemical level. Error bars show 95% confidence intervals; red markers denote estimates significant at the 5% level. Vertical shaded bands mark 2021 ("30 by 30" Executive Order) and 2024 (presidential election year).

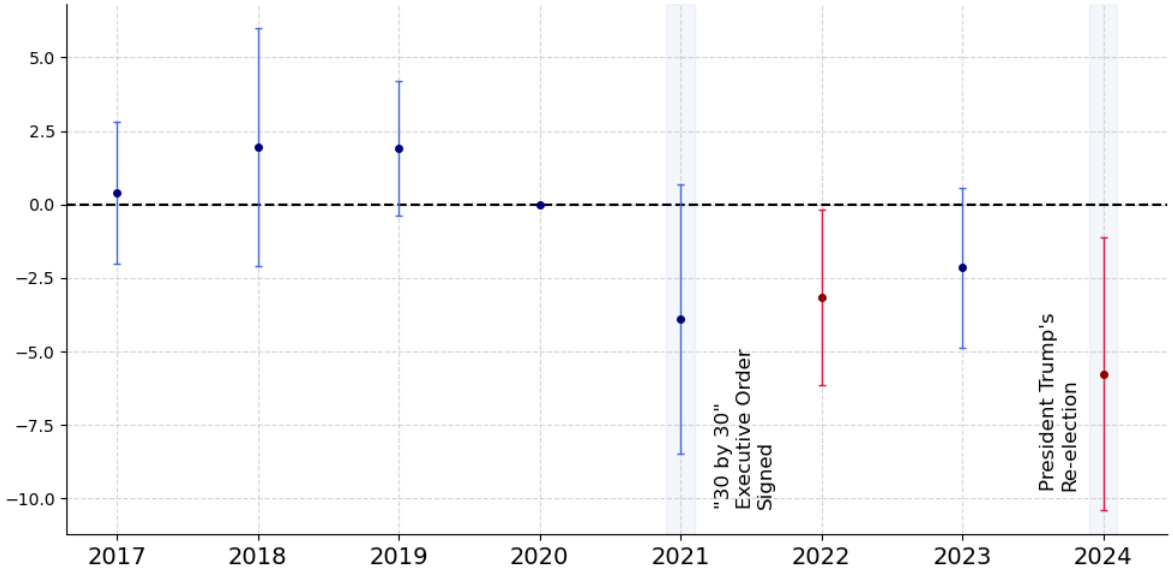


Figure IA.A.6: Dynamic Effects on Avian Biodiversity: Single-Plant Firms– Chemical Clustering

This figure plots dynamic coefficients from facility-chemical-year regressions of avian biodiversity on interactions between year indicators and facility PWRSR exposure, with 2020 as the omitted reference year. Avian biodiversity is measured as the annual number of unique bird species observed within a 20 km radius of each TRI facility using eBird data, and the dependent variable is ln(AB). The sample includes TRI facility-chemical-year observations from 2017–2024 for facilities whose parent firms operate a single TRI plant in the sample. The specification includes industry×year, year×chemical, facility×chemical, and state×year fixed effects. Standard errors are clustered at the chemical level. Error bars denote 95% confidence intervals; red markers indicate coefficients significant at the 5% level. Vertical shaded bands mark 2021 ("30 by 30" Executive Order) and 2024 (presidential re-election).

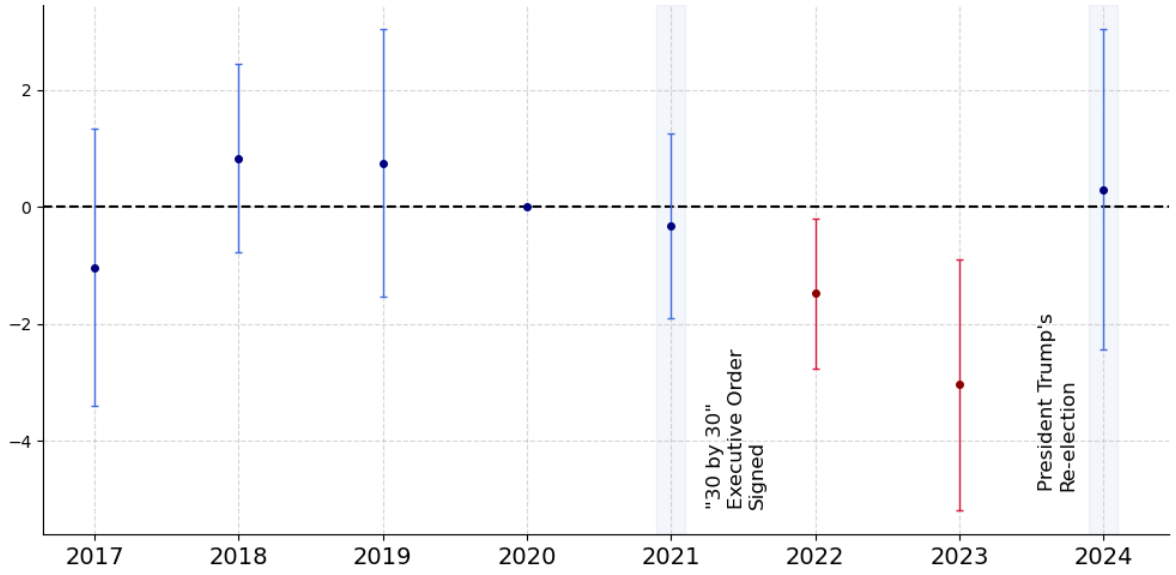


Figure IA.A.7: Dynamic Effects of High PWRSR on Avian Biodiversity (Single-Plant Firms)

This figure plots dynamic coefficients from facility-chemical-year regressions of avian biodiversity on interactions between year indicators and *High PWRSR*, where *High PWRSR*= 1[*PWRSR* ≥ 0.0015], with 2020 as the omitted reference year. Avian biodiversity is measured as the annual number of unique bird species observed within a 20 km radius of each TRI facility using eBird data, and the dependent variable is ln(AB). The sample includes TRI facility-chemical-year observations from 2017–2024 for facilities whose parent firms operate a single TRI plant in the sample. The specification includes industry×year, year×chemical, facility×chemical, and state×year fixed effects. Standard errors are clustered at the chemical level. Error bars denote 95% confidence intervals; red markers indicate coefficients significant at the 5% level. Vertical shaded bands mark 2021 ("30 by 30" Executive Order) and 2024 (presidential re-election).

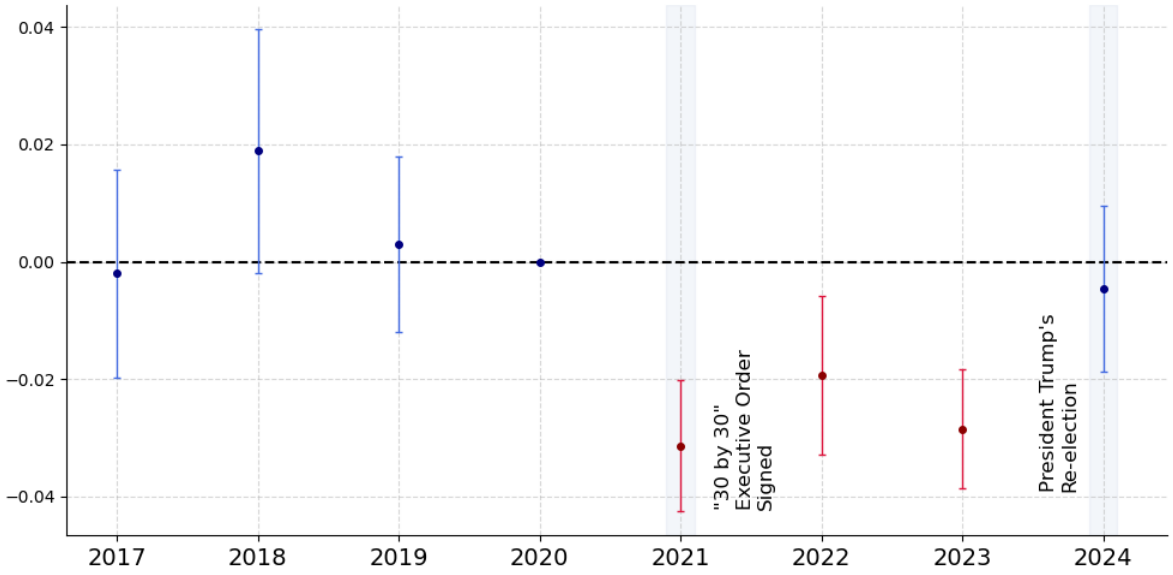


Table IA.A.1: Variable Definitions

Variables	Definitions	Sources
	Biodiversity Exposure Variables	
RSR	Range-size rarity. First, compute the inverse of modeled habitat area for each species. Second, sum across 2,216 endangered species to aggregate rarity at the geographic level (990m resolution). Facility, Static.	Hamilton et al. (2022)
PWRSR	Protection-weighted range-size rarity. For each of 2,216 species, multiply range-size rarity by the share of habitat outside protected areas, then sum across all species to aggregate at the geographic level (990m resolution). Facility, Static.	Hamilton et al. (2022)
High PWRSR	Indicator equal to 1 if summed PWRSR is $\geq$ 0.0015, and 0 otherwise. Facility, Static.	Hamilton et al. (2022)
County PWRSR	County-average PWRSR over county geography. County, Static.	Constructed
	Vegetation and Avian Biodiversity Variables	
EVI	Enhanced Vegetation Index from MODIS MOD13Q1 (16-day, 250m pixel product). In construction, we keep SummaryQA values 0 or 1 (good or marginal-useful quality), aggregate 16-day observations to monthly means, then average equally across months to form facility-year EVI. Facility-Year.	NASA MOD13 + Constructed
AB	Avian biodiversity measure based on eBird checklist data (crowdsourced/citizen-science bird observations). For each facility-year, AB is the number of unique bird species reported within a given radius. Facility-Year.	eBird + Constructed
	Toxic Releases and Waste Management Variables[25]	
On-Site Releases	Total on-site disposal or other releases of TRI chemicals at the reporting facility, including point-source (stack) air emissions, fugitive air emissions, surface water discharges, and land release/disposal categories. Facility-Chemical-Year.	EPA TRI
Off-Site Releases	Off-site transfers of TRI chemicals in waste to separate facilities for disposal, treatment, recycling, energy recovery, or POTWs. Amounts are quantities leaving the reporting facility boundary. Facility-Chemical-Year.	EPA TRI
Total Releases	Sum of on-site releases and off-site transfer quantities for TRI chemicals in waste. We use the Total Releases variable directly from EPA TRI. Facility-Chemical-Year.	EPA TRI

(Continued on next page)

[25]Definitions aligned to EPA TRI common terms: Common TRI Terms.

Table IA.A.1 (Continued)

Variables	Definitions	Sources
Production Ratio	Ratio indicating how the production process associated with the toxic chemical changed year over year. Facility-Chemical-Year.	EPA TRI
Cumulative Production	Built from Production ratio as follows: (i) collapse to one value per Facility-Chemical-Year, (ii) create a balanced annual panel from first to last observed year for each Facility-Chemical, (iii) drop Facility-Chemicals with all values missing/zero, (iv) fill remaining missing values with 1, (v) take cumulative product over time, and (vi) normalize by each Facility-Chemical's first cumulative value (base = 1).	EPA TRI (constructed)
Abatement	Source reduction (pollution prevention): Sum of the amount of new activities (in a given year) that eliminate or reduce chemical use and chemical waste generation (e.g., material substitution, reformulation/redesign, and process/equipment modifications). Facility-Chemical-Year.	EPA TRI (constructed)
Post-Production Reduction Activity	Constructed from TRI post-generation waste management channels (treatment, recycling, and energy recovery), measured as the share of gross waste managed through these activities. Define $$R = E_{\text{on}} + E_{\text{off}} + Rc_{\text{on}} + Rc_{\text{off}} + T_{\text{on}} + T_{\text{off}},$$ $$W = \texttt{total_releases} + R,$$ $$\texttt{Post-Production Reduction} = \frac{R}{W} \quad \text{if } W > 0 \text{ (missing otherwise).}$$ where E_{on} = `energy_recover_on`, E_{off} = `energy_recover_of`, Rc_{on} = `recycling_on_site`, Rc_{off} = `recycling_off_sit`, T_{on} = `treatment_on_site`, and T_{off} = `treatment_off_site`. Facility-Chemical-Year.	EPA TRI (constructed)

Table IA.A.2: Full-Sample Toxic Release Responses– Facility Clustering

This table reports full-sample facility–chemical regressions using TRI observations from 2018–2023. The dependent variables are log on-site releases, log total releases, log production, log on-site emissions intensity, log off-site releases, abatement activities, and post-production reduction. On-site, off-site, and total releases are converted to pounds and winsorized at the 1st and 99th percentiles before log transformations; emissions intensity is defined as on-site releases divided by cumulative production and then winsorized at the 1st and 99th percentiles. *Post* is an indicator for years 2021–2023. In continuous specifications, treatment intensity is captured by *PWRSR*; in binary specifications, *Treat*=1[*PWRSR* $\geq$0.0015]. For each outcome, columns alternate between continuous and binary treatment specifications. All columns use the saturated fixed-effects structure with year×chemical, facility×chemical, industry×year, and state×year fixed effects. Errors are reported in parentheses and clustered at the facility level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	On-site Releases		Total Releases		Production		Emissions Intensity		Off-site Releases		Abatement		Post-Production Reduction	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Post × PWRSR	-5.439***		-4.004*		-9.307***		4.265***		4.521***		0.135		0.369*	
	(1.241)		(2.076)		(1.909)		(1.264)		(1.529)		(0.148)		(0.221)	
Post × High PWRSR		-0.092		-0.044		-0.027		-0.033		0.106		-0.019		-0.003
		(0.056)		(0.060)		(0.036)		(0.056)		(0.155)		(0.029)		(0.008)
Adj. R^2	0.9526	0.9526	0.9252	0.9252	0.5117	0.5110	0.9571	0.9571	0.8680	0.8680	0.5182	0.5182	0.8829	0.8829
Obs.	219,290	219,290	238,277	238,277	277,261	277,261	224,939	224,939	100,639	100,639	311,420	311,420	263,934	263,934
Chemical × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Facility × Chemical FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table IA.A.3: Multi-Plant Firm Responses– Facility Clustering

This table reports facility–chemical regressions for the multi-plant firm subsample using TRI observations from 2018–2023. The dependent variables are log on-site releases, log total releases, log production, log on-site emissions intensity, log off-site releases, abatement activities, and post-production reduction. On-site, off-site, and total releases are converted to pounds and winsorized at the 1st and 99th percentiles before log transformations; emissions intensity is defined as on-site releases divided by cumulative production and then winsorized at the 1st and 99th percentiles. *Post* is an indicator for years 2021–2023. In continuous specifications, treatment intensity is captured by *PWRSR*; in binary specifications, *Treat*=1[*PWRSR* ≥0.0015]. For each outcome, columns alternate between continuous and binary treatment specifications. All columns include firm×year×chemical, facility×chemical, and state×year fixed effects. Errors are reported in parentheses and clustered at the facility level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	On-site Releases		Total Releases		Production		Emissions Intensity		Off-site Releases		Abatement		Post-Production Reduction	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Post × PWRSR	-6.196***		-5.702***		-10.488***		4.198***		1.235		-0.080		0.155	
	(1.082)		(1.190)		(1.257)		(1.571)		(2.932)		(0.168)		(0.305)	
Post × High PWRSR		-0.223***		-0.143*		-0.056		-0.120*		0.175		0.014		0.004
		(0.072)		(0.074)		(0.053)		(0.069)		(0.230)		(0.014)		(0.014)
Adj. R^2	0.9565	0.9565	0.9322	0.9322	0.5293	0.5275	0.9569	0.9569	0.8578	0.8578	0.5211	0.5211	0.8755	0.8755
Obs.	146,912	146,912	160,559	160,559	183,872	183,872	145,454	145,454	58,479	58,479	210,323	210,323	173,124	173,124
Firm × Year × Chemical FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Facility × Chemical FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table IA.A.4: Single-Plant Firm Responses– Facility Clustering

This table reports facility–chemical regressions for the single-plant firm subsample, using TRI observations from 2018–2023. The dependent variables are log on-site releases, log total releases, log production, log on-site emissions intensity, log off-site releases, abatement activities, and post-production reduction. On-site, off-site, and total releases are converted to pounds and winsorized at the 1st and 99th percentiles before log transformations; emissions intensity is defined as on-site releases divided by cumulative production and then winsorized at the 1st and 99th percentiles. *Post* is an indicator for years 2021–2023. In continuous specifications, treatment intensity is captured by *PWRSR*; in binary specifications, *Treat*=1[*PWRSR* $\geq$0.0015]. For each outcome, columns alternate between continuous and binary treatment specifications. All columns include industry×year, year×chemical, facility×chemical, and state×year fixed effects. Errors are reported in parentheses and clustered at the facility level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	On-site Releases		Total Releases		Production		Emissions Intensity		Off-site Releases		Abatement		Post-Production Reduction	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Post × PWRSR	54.041*		54.048**		13.081*		39.589		20.907		-5.413		-1.491	
	(28.981)		(23.837)		(7.873)		(26.440)		(38.212)		(7.754)		(2.722)	
Post × High PWRSR		0.299***		0.395***		0.024		0.297***		0.811**		-0.211		0.002
		(0.111)		(0.152)		(0.071)		(0.106)		(0.361)		(0.163)		(0.024)
Adj. R^2	0.9421	0.9421	0.9151	0.9151	0.5617	0.5615	0.9419	0.9419	0.8750	0.8752	0.6270	0.6304	0.8937	0.8937
Obs.	32,564	32,564	35,446	35,446	40,003	40,003	32,358	32,358	13,717	13,717	43,659	43,659	38,331	38,331
Industry × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Chemical × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Facility × Chemical FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table IA.A.5: Pooled Sample Facility Responses: Single-Plant and Multi-Plant Firms

This table reports pooled facility-chemical-year regressions of facility outcomes on the interaction between post-period timing, facility exposure, and parent-firm structure. The coefficient of interest is *Post* × *PWRSR*, where *Post* equals one for years 2021–2023 and PWRSR is the facility-level exposure measure. PWRSR is not winsorized in this specification. The sample is TRI facility-chemical-year observations from 2018–2023. Outcomes are log on-site releases, log total releases, log production, log on-site emissions intensity, log off-site releases, abatement activities, and post-production reduction. On-site, off-site, and total releases are converted to pounds and winsorized at the 1st and 99th percentiles before log transformation. Cumulative production, on-site emissions intensity, and post-production reduction are also winsorized at the 1st and 99th percentiles. Each column is estimated using a pooled regression of the outcome on *PWRSR* × *Post* × *Multi-Plant Parent*. Panel A reports the implied *Post* × *PWRSR* effect for facilities whose parent firm operates multiple TRI plants in the sample. Panel B reports the implied effect for facilities whose parent firm operates a single TRI plant in the sample. Panel C reports the difference between multi-plant and single-plant firms. All regressions include year-by-chemical and facility-by-chemical fixed effects. Standard errors are clustered at the facility×chemical level and reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	(1) On-site Releases	(2) Total Releases	(3) Production	(4) Emissions Intensity	(5) Off-site Releases	(6) Abatement	(7) Post-Production Reduction
Panel A: Multi-Plant Firms							
Post × PWRSR	-5.703***	-4.223***	-10.043***	4.324**	5.960***	0.224**	0.445
	(1.415)	(1.520)	(0.816)	(1.751)	(1.547)	(0.088)	(0.280)
Panel B: Single-Plant Firms							
Post × PWRSR	40.425***	21.736	12.574**	25.672**	-25.852	-8.615**	-3.365**
	(14.568)	(19.774)	(5.673)	(12.904)	(42.462)	(3.893)	(1.425)
Panel C: Difference, Multi-Plant Minus Single-Plant							
Post × PWRSR × Multi-Plant	-46.128***	-25.959	-22.616***	-21.348	31.812	8.839**	3.811***
	(14.640)	(19.833)	(5.731)	(13.026)	(42.484)	(3.896)	(1.453)
Adj. R^2	0.9542	0.9292	0.4900	0.9547	0.8642	0.5048	0.8807
Obs.	227,123	246,365	277,384	225,086	100,822	311,541	264,057
Year × Chemical FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Facility × Chemical FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table IA.A.6: Facility Responses: Single-Plant and Multi-Plant Firms: Winsorized PWRSR

This table reports facility-chemical-year regressions of facility outcomes on the interaction between post-period timing and facility exposure. The coefficient of interest is *Post* × *PWRSR*, where *Post* equals one for years 2021–2023 and PWRSR is the facility-level exposure measure winsorized at the 1st and 99th percentiles. The sample is TRI facility-chemical-year observations from 2018–2023. Outcomes are log on-site releases, log total releases, log production, log on-site emissions intensity, log off-site releases, abatement activities, and post-production reduction. On-site, off-site, and total releases are converted to pounds and winsorized at the 1st and 99th percentiles before log transformation. Cumulative production, on-site emissions intensity, and post-production reduction are also winsorized at the 1st and 99th percentiles. Panel A uses facilities whose parent firm operates multiple TRI plants in the sample. Panel B uses facilities whose parent firm operates a single TRI plant in the sample. Standard errors are clustered at the facility×chemical level and reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Multi-Plant Firms

	(1) On-site Releases	(2) Total Releases	(3) Production	(4) Emissions Intensity	(5) Off-site Releases	(6) Abatement	(7) Post-Production Reduction
Post × PWRSR	-49.279***	-39.613***	-32.847***	-9.776	5.718	4.976***	2.355
	(12.393)	(14.285)	(6.130)	(12.776)	(31.879)	(1.781)	(2.138)
Adj. R^2	0.9564	0.9321	0.5213	0.9573	0.8567	0.5181	0.8751
Obs.	146,912	160,559	183,872	145,454	58,479	210,323	173,124
Firm × Year × Chemical FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Facility × Chemical FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Panel B: Single-Plant Firms

	(1) On-site Releases	(2) Total Releases	(3) Production	(4) Emissions Intensity	(5) Off-site Releases	(6) Abatement	(7) Post-Production Reduction
Post × PWRSR	63.687***	49.722	32.824***	38.090*	-0.907	-55.044***	-6.586**
	(23.066)	(31.017)	(10.336)	(23.076)	(97.402)	(11.814)	(2.775)
Adj. R^2	0.9370	0.9104	0.5174	0.9364	0.8657	0.5983	0.8865
Obs.	32,881	35,727	40,241	32,666	14,038	43,912	38,582
Year × Chemical FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Facility × Chemical FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table IA.A.7: Vegetation Outcomes: Single-Plant and Multi-Plant Firms

This table reports facility-chemical-year regressions of vegetation outcomes on the interaction between post-period timing and facility exposure. The coefficient of interest is *Post* × *PWRSR*, where *Post* equals one for years 2021 and later, and PWRSR is the facility-level exposure measure. The sample is TRI facility-chemical-year observations from 2018–2023. Outcomes are EVI (levels) and ln(EVI). Panel A uses facilities whose parent firm operates a single TRI plant in the sample. Panel B uses facilities whose parent firm operates multiple TRI plants. Standard errors are clustered at the chemical level and reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Single-Plant Firms

	(1) EVI	(2) ln(EVI)	(3) EVI	(4) ln(EVI)
Post × PWRSR	-0.4931***	-5.5635***	-0.1995**	-4.0400***
	(0.1168)	(1.4056)	(0.0900)	(1.5096)
Adj. R^2	0.9610	0.9641	0.9709	0.9737
Obs.	43,685	43,685	43,434	43,434
Year × Chemical FE	Yes	Yes	Yes	Yes
Facility × Chemical FE	Yes	Yes	Yes	Yes
State × Year FE	No	No	Yes	Yes
Industry × Year FE	No	No	Yes	Yes

Panel B: Multi-Plant Firms

	(1) EVI	(2) ln(EVI)	(3) EVI	(4) ln(EVI)
Post × PWRSR	-0.0072	0.0083	-0.0078	-0.0071
	(0.0114)	(0.0662)	(0.0094)	(0.0672)
Adj. R^2	0.9637	0.9654	0.9659	0.9674
Obs.	208,482	208,394	208,482	208,394
Firm × Year × Chemical FE	Yes	Yes	Yes	Yes
Facility × Chemical FE	Yes	Yes	Yes	Yes
State × Year FE	No	No	Yes	Yes

Table IA.A.8: PWRSR and Vegetation Outcomes by Firm Plant Structure– Robust Sample

This table reports facility-chemical-year regressions of vegetation outcomes on the interaction between post-period timing and facility exposure. The coefficient of interest is *Post* × *PWRSR*, where *Post* equals one for years 2021 and later, and PWRSR is the facility-level exposure measure. The sample is TRI facility-chemical-year observations from 2018–2023. Outcomes are EVI (levels) and ln(EVI). Panel A uses facilities whose parent firm operates a single TRI plant in the sample. Panel B uses facilities whose parent firm operates multiple TRI plants. Relative to the original table, this version restricts estimation to the sample where ln(onsite_release_total) is defined, using the anchor ln(onsite emissions) regressions to fix the estimation sample and demonstrate robustness. Standard errors are clustered at the chemical level and reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Single-Plant Firms

	(1) EVI	(2) ln(EVI)	(3) EVI	(4) ln(EVI)
Post × PWRSR	-0.8268***	-10.2182***	-0.4761**	-9.5248***
	(0.1755)	(2.0166)	(0.2067)	(2.6593)
Adj. R^2	0.9618	0.9640	0.9726	0.9749
Obs.	32,405	32,405	32,405	32,405
Year × Chemical FE	Yes	Yes	Yes	Yes
Facility × Chemical FE	Yes	Yes	Yes	Yes
State × Year FE	No	No	Yes	Yes
Industry × Year FE	No	No	Yes	Yes

Panel B: Multi-Plant Firms

	(5) EVI	(6) ln(EVI)	(7) EVI	(8) ln(EVI)
Post × PWRSR	-0.0038	0.0404	0.0071	0.0882
	(0.0113)	(0.0735)	(0.0103)	(0.0795)
Adj. R^2	0.9648	0.9656	0.9670	0.9678
Obs.	145,698	145,630	145,698	145,630
Firm × Year × Chemical FE	Yes	Yes	Yes	Yes
Facility × Chemical FE	Yes	Yes	Yes	Yes
State × Year FE	No	No	Yes	Yes

Table IA.A.9: High PWRSR Exposure and Vegetation Outcomes by Firm Plant Structure

This table reports facility-chemical-year regressions of vegetation outcomes on the interaction *Post*×*High PWRSR*, where *Post*=1 for years 2021 and later and *High PWRSR*=1[*PWRSR*≥0.0015]. The sample uses TRI facility-chemical-year observations from 2018–2023. Columns (1)–(4) use facilities whose parent firm operates a single TRI plant; columns (5)–(8) use facilities whose parent firm operates multiple TRI plants. Outcomes alternate between EVI levels and ln(EVI). Single-plant specifications include year×chemical and facility×chemical fixed effects; multi-plant specifications include firm×year×chemical and facility×chemical fixed effects. Standard errors are reported in parentheses. The last row reports the clustering level used in each specification. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Single-Plant Firms				Multi-Plant Firms			
	(1) EVI	(2) ln(EVI)	(3) EVI	(4) ln(EVI)	(5) EVI	(6) ln(EVI)	(7) EVI	(8) ln(EVI)
Post × High PWRSR	-0.0030***	-0.0378***	-0.0030**	-0.0378***	0.0008	0.0157***	0.0008	0.0157***
	(0.0009)	(0.0063)	(0.0012)	(0.0079)	(0.0006)	(0.0034)	(0.0006)	(0.0037)
Adj. R^2	0.9610	0.9641	0.9610	0.9641	0.9637	0.9654	0.9637	0.9654
Obs.	43,685	43,685	43,685	43,685	208,482	208,394	208,482	208,394
Year × Chemical FE	Yes	Yes	Yes	Yes	-	-	-	-
Firm × Year × Chemical FE	No	No	No	No	Yes	Yes	Yes	Yes
Facility × Chemical FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clustering Level	Chem.	Chem.	Fac.×Chem.	Fac.×Chem.	Chem.	Chem.	Fac.×Chem.	Fac.×Chem.

Table IA.A.10: Avian Biodiversity Outcomes: Single-Plant and Multi-Plant Firms–Chemical Clustering

This table reports facility-chemical-year regressions of avian biodiversity outcomes on interactions between post-period timing and facility exposure. Avian biodiversity (AB) is measured as the annual number of unique bird species observed within a 20 km radius of each TRI facility using eBird data; the dependent variable is ln(AB). The sample is TRI facility-chemical-year observations from 2018–2023. We report both a continuous-exposure specification, where the coefficient of interest is *Post* × *PWRSR* (*Post*=1 for years 2021 and later; PWRSR is facility-level exposure), and a binary-exposure specification, where the coefficient of interest is *Post* × *High PWRSR* (*High PWRSR*=1{*PWRSR*≥0.0015}). Panel A uses facilities whose parent firm operates a single TRI plant in the sample. Panel B uses facilities whose parent firm operates multiple TRI plants. Standard errors are clustered at the chemical level and reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Single-Plant Firms

	(1)	(2)	(3)	(4)
Post × PWRSR	-1.3935*		-1.5663***	
	(0.7488)		(0.5913)	
Post × High PWRSR		-0.0241***		-0.0358***
		(0.0033)		(0.0060)
Adj. R^2	0.9266	0.9266	0.9398	0.9399
Obs.	43,661	43,661	43,408	43,408
Year × Chemical FE	Yes	Yes	Yes	Yes
Facility × Chemical FE	Yes	Yes	Yes	Yes
State × Year FE	No	No	Yes	Yes
Industry × Year FE	No	No	Yes	Yes

Panel B: Multi-Plant Firms

	(5)	(6)	(7)	(8)
Post × PWRSR	0.0012		-0.0056	
	(0.0803)		(0.0915)	
Post × High PWRSR		0.0030		0.0006
		(0.0024)		(0.0029)
Adj. R^2	0.9318	0.9318	0.9369	0.9369
Obs.	210,302	210,302	210,302	210,302
Firm × Year × Chemical FE	Yes	Yes	Yes	Yes
Facility × Chemical FE	Yes	Yes	Yes	Yes
State × Year FE	No	No	Yes	Yes

Table IA.A.11: PWRSR and Avian Biodiversity Outcomes by Firm Plant Structure–Robust Sample

This table reports facility-chemical-year regressions of avian biodiversity outcomes on interactions between post-period timing and facility exposure. Avian biodiversity (AB) is measured as the annual number of unique bird species observed within a 20 km radius of each TRI facility using eBird data; the dependent variable is ln(AB). The sample is TRI facility-chemical-year observations from 2018–2023. We report both a continuous-exposure specification, where the coefficient of interest is *Post* × *PWRSR* (*Post*=1 for years 2021 and later; PWRSR is facility-level exposure), and a binary-exposure specification, where the coefficient of interest is *Post* × *High PWRSR* (*High PWRSR*=1{*PWRSR*≥0.0015}). Panel A uses facilities whose parent firm operates a single TRI plant in the sample. Panel B uses facilities whose parent firm operates multiple TRI plants. Relative to the baseline specification, this version restricts estimation to the anchor sample where ln(onsite_release_total) is defined (constructed separately for single- and multi-plant firms). Standard errors are clustered at the chemical level and reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Single-Plant Firms

	(1)	(2)	(3)	(4)
Post × PWRSR	-1.3343**		-2.6443*	
	(0.6559)		(1.4375)	
Post × High PWRSR		-0.0269***		-0.0383***
		(0.0037)		(0.0069)
Adj. R^2	0.9273	0.9273	0.9440	0.9441
Obs.	32,346	32,346	32,346	32,346
Year × Chemical FE	Yes	Yes	Yes	Yes
Facility × Chemical FE	Yes	Yes	Yes	Yes
State × Year FE	No	No	Yes	Yes
Industry × Year FE	No	No	Yes	Yes

Panel B: Multi-Plant Firms

	(5)	(6)	(7)	(8)
Post × PWRSR	-0.0125		-0.0600	
	(0.0920)		(0.1130)	
Post × High PWRSR		0.0019		-0.0006
		(0.0028)		(0.0034)
Adj. R^2	0.9297	0.9297	0.9364	0.9364
Obs.	146,886	146,886	146,886	146,886
Firm × Year × Chemical FE	Yes	Yes	Yes	Yes
Facility × Chemical FE	Yes	Yes	Yes	Yes
State × Year FE	No	No	Yes	Yes

Table IA.A.12: PWRSR and Avian Biodiversity Outcomes by Firm Structure– 10 km Aggregation

This table reports facility-chemical-year regressions of avian biodiversity outcomes on interactions between post-period timing and facility exposure. Avian biodiversity (AB) is measured as the annual number of unique bird species observed within a 10 km radius of each TRI facility using eBird data; the dependent variable is ln(AB). The sample is TRI facility-chemical-year observations from 2018–2023. We report both a continuous-exposure specification, where the coefficient of interest is *Post* × *PWRSR* (*Post*=1 for years 2021 and later; PWRSR is facility-level exposure), and a binary-exposure specification, where the coefficient of interest is *Treat* × *Post* (*Treat*=1{*PWRSR*≥0.0015}). Columns (1)–(2) use facilities whose parent firm operates a single TRI plant in the sample; columns (3)–(4) use facilities whose parent firm operates multiple TRI plants. Single-plant specifications include industry×year, year×chemical, facility×chemical, and state×year fixed effects. Multi-plant specifications include firm×year×chemical, facility×chemical, and state×year fixed effects. Standard errors are clustered at the chemical level and reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Single-Plant Firms		Multi-Plant Firms	
	(1)	(2)	(3)	(4)
Post × PWRSR	-4.9721**		-0.0034	
	(2.5017)		(0.2506)	
Post × High PWRSR		-0.0763***		0.0091
		(0.0153)		(0.0093)
Adj. R^2	0.9207	0.9207	0.8807	0.8807
Obs.	42,995	42,995	209,488	209,488
Firm × Year × Chemical FE	No	No	Yes	Yes
Year × Chemical FE	Yes	Yes	-	-
Facility × Chemical FE	Yes	Yes	Yes	Yes
State × Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	Yes	Yes	No	No

Table IA.A.13: Ecological Outcomes: Multi-Plant Firms

This table reports facility-chemical-year regressions of ecological outcomes on interactions between post-period timing and facility exposure for facilities whose parent firms operate multiple TRI plants in the sample. Columns (1)–(2) report vegetation outcomes, where the dependent variable is EVI. Columns (3)–(4) report avian biodiversity outcomes, where avian biodiversity is measured as the annual number of unique bird species observed within a 20 km radius of each TRI facility and the dependent variable is ln(AB). We report both a continuous-exposure specification, where the coefficient of interest is *Post* × *PWRSR* (*Post*=1 for years 2021 and later; PWRSR is facility-level exposure), and a binary-exposure specification, where the coefficient of interest is *Post* × *High PWRSR* (*High PWRSR*=1{*PWRSR*≥0.0015}). All specifications include parent-firm×year, year×chemical, facility×chemical, and state×year fixed effects. Standard errors are clustered at the facility×chemical level and reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Vegetation		Avian Biodiversity	
	(1) EVI	(2) EVI	(3) ln(AB)	(4) ln(AB)
Post × PWRSR	-0.0180*		0.0235	
	(0.0104)		(0.0756)	
Post × High PWRSR		0.0011**		0.0010
		(0.0005)		(0.0025)
Adj. R^2	0.9731	0.9731	0.9512	0.9512
Obs.	264,697	264,697	266,630	266,630
Firm × Year FE	Yes	Yes	Yes	Yes
Year × Chemical FE	Yes	Yes	Yes	Yes
Facility × Chemical FE	Yes	Yes	Yes	Yes
State × Year FE	Yes	Yes	Yes	Yes