Lucy Family Institute for Data & Society

From Risk to Resilience: AI-Driven Policies for Environmental Health Equity

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UNIVERSITY OF NOTRE DAME

EPA Faces Funding Shortage

Decades Decline

- **Since 1980**, Federal EPA funding has been **cut in half**
- Spending on environmental programs was **45% higher in 2004** than today

Current Administrative Stance

- EPA staff has been **cut by over 3,000** people **since Jan. 2025**
- **$320 million less allocated** to the EPA **compared to 2025**

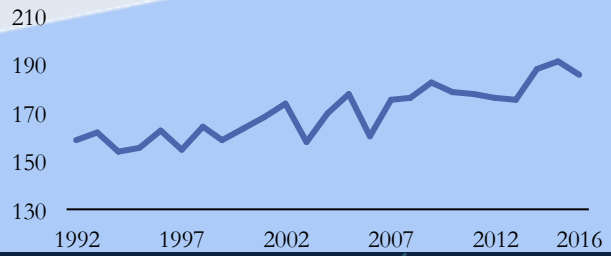
States Feeling the Pressure

- "EPA is **deserting the states** to deal with serious climate and pollution issues on their own, while… **giving polluters free passes to poison our community**."

Frank Pallone (D-NJ)

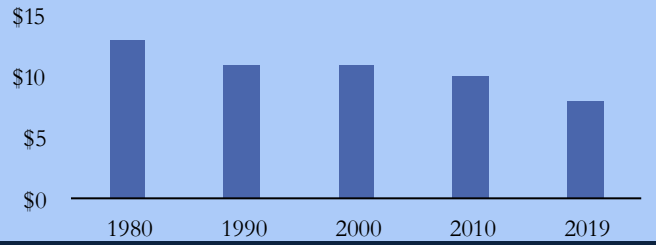
Why this matters

Cancer Incidence in Children (cases per million)



Demanding more from less, the **EPA is reducing spending** in the **face of elevated levels of negative health outcomes**

EPA Average Annual Spending (in billions)



Case Study: Benefits of Policies Targeting Burdened Communities

Case Study: California in Action

Senate Bill 535

Senate Bill 535: **35%** California Climate Investments allocated to **disadvantaged** communities,

Overall Impacts

From 2018-2024, cumulative **increase in PM 2.5 reduction: 2,101.3%**

Burdened Communities

GHG emissions from large facilities in **disadvantaged communities fell by 21%** between 2013 and 2020, compared to a 13.8% reduction in non-disadvantaged areas.

Takeaway

Pollution levels falling at **faster rate** and more consistently in the most **burdened** areas due to policy implementation

Benefits of County Tracts

Target Environmental Hotspots

- Focusing on **county level** allows the model to find **exact areas** that are **most exposed to environmental risks**
- Can **tailor policies** specifically to **exact regions**

Maintain Clarity and Protect Privacy

- Analyzing the census block level reveals **a 3x larger disparity** when compared to looking at county level.
- Does **not compromise privacy** as amount of data is still large enough to **protect privacy**

Datasets Utilized

EPA

- **environmental data** with **socioeconomic data**
- Identifies communities facing disproportionate environmental burdens

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

- Assesses **human health risks** specifically related to toxic substance exposures.
- Adds health outcomes and social resilience scores

- Constructed **reproducible pipeline development** within a **Jupyter Notebook.**
- Performed **data cleaning, preprocessing**, and **transformation** to ensure data quality.

Methodology

Analyzed **EJ Screen and ATSDR Data,** compiling **16 unique factors** per census tract

Identified **two significant risk factors** contributing to negative health outcomes

Outputs are fed into **policy-generation pipeline**

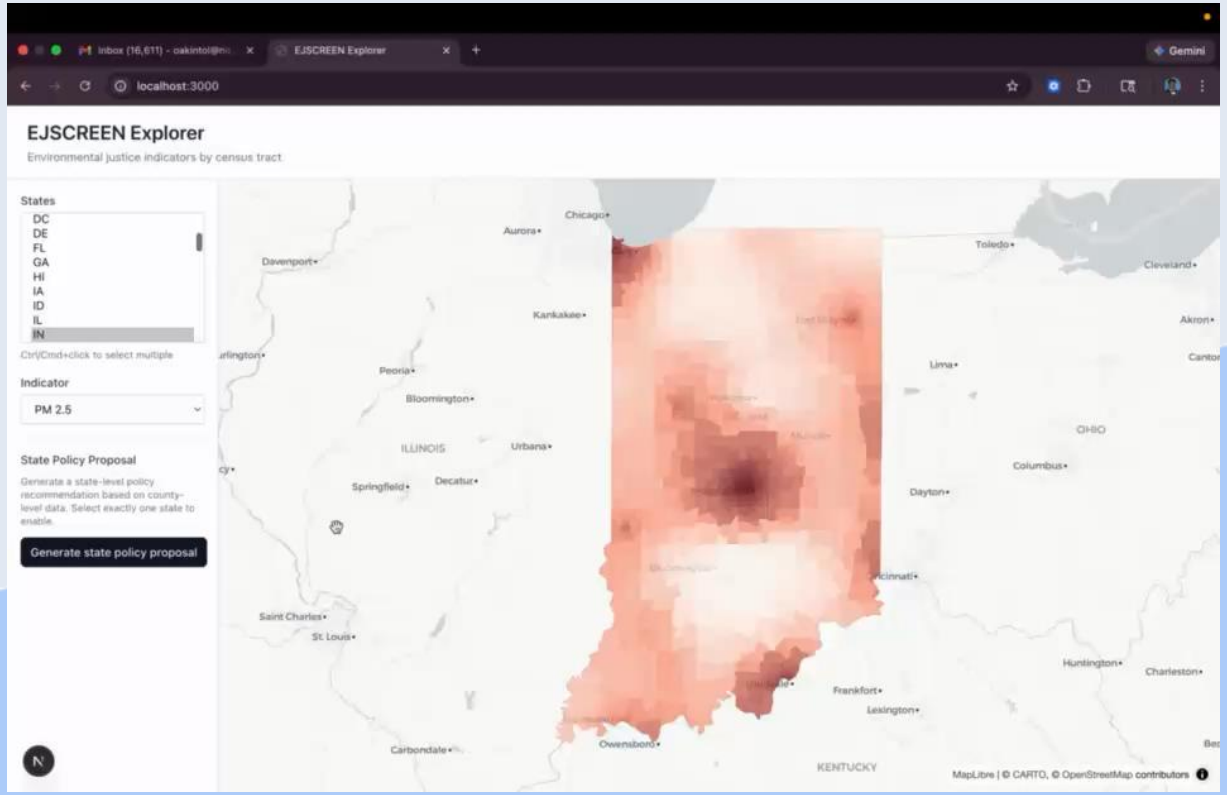
AI generated policy output trained on **NCSL policies**

Achieving **health equity** despite **a decrease in funding**

Our Research Question:

Can we create an AI system that (1) determines which environmental factors are most responsible for adverse health outcomes on the census-tract level, and then (2) create a policy proposal with the goal of mitigating those adverse health outcomes?

Our Model at Work

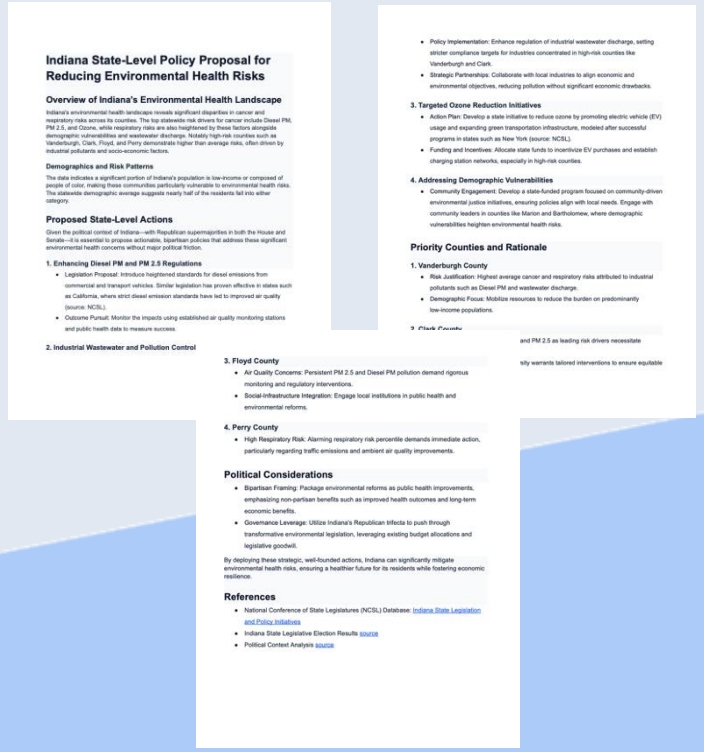


Technical Aspects

Used **EJ Screen and ATSDR datasets** to create **a gradient-boosted tree model** that **regresses cancer and respiratory health risk** on various environmental factors

Ran **Shapley Additive explanations transformation** to make model more interpretable

Sample Output: “Indiana State-Level Policy Proposal”



Indiana State-Level Policy Proposal for Reducing Environmental Health Risks

Overview of Indiana's Environmental Health Landscape

Indiana's environmental health landscape reveals significant disparities in cancer and respiratory risks across its counties. The top statewide risk drivers for cancer include Diesel PM, PM 2.5, and Ozone, while respiratory risks are also heightened by these factors alongside demographic vulnerabilities and wastewater discharge. Notably high-risk counties such as Vanderburgh, Clark, Floyd, and Perry demonstrate higher than average risks, often driven by industrial pollutants and socio-economic factors.

Demographics and Risk Patterns

The data indicates a significant portion of Indiana's population is low-income or composed of people of color, making these communities particularly vulnerable to environmental health risks. The statewide demographic average suggests nearly half of the residents fall into either category.

Proposed State-Level Actions

Given the political context of Indiana—with Republican supermajorities in both the House and Senate—it is essential to propose actionable, bipartisan policies that address these significant environmental health concerns without major political friction.

1. Enhancing Diesel PM and PM 2.5 Regulations

- Legislation Proposal: Introduce heightened standards for diesel emissions from commercial and transport vehicles. Similar legislation has proven effective in states such as California, where strict diesel emission standards have led to improved air quality (source: NCSL).
- Outcome Pursuit: Monitor the impacts using established air quality monitoring stations and public health data to measure success.

2. Industrial Wastewater and Pollution Control

- Policy Implementation: Enhance regulation of industrial wastewater discharge, setting stricter compliance targets for industries concentrated in high-risk counties like Vanderburgh and Clark.
- Strategic Partnerships: Collaborate with local industries to align economic and environmental objectives, reducing pollution without significant economic drawbacks.

3. Targeted Ozone Reduction Initiatives

- Action Plan: Develop a state initiative to reduce ozone by promoting electric vehicle (EV) usage and expanding green transportation infrastructure, modeled after successful programs in states such as New York (source: NCSL).
- Funding and Incentives: Allocate state funds to incentivize EV purchases and establish charging station networks, especially in high-risk counties.

4. Addressing Demographic Vulnerabilities

- Community Engagement: Develop a state-funded program focused on community-driven environmental justice initiatives, ensuring policies align with local needs. Engage with community leaders in counties like Marion and Bartholomew, where demographic vulnerabilities heighten environmental health risks.

Priority Counties and Rationale

1. Vanderburgh County

- Risk Justification: Highest average cancer and respiratory risks attributed to industrial pollutants such as Diesel PM and wastewater discharge.
- Demographic Focus: Mobilize resources to reduce the burden on predominantly low-income populations.

2. Clark County

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3. Floyd County

- Air Quality Concerns: Persistent PM 2.5 and Diesel PM pollution demand rigorous monitoring and regulatory interventions.
- Social-Infrastructure Integration: Engage local institutions in public health and environmental reforms.

4. Perry County

- High Respiratory Risk: Alarming respiratory risk percentile demands immediate action, particularly regarding traffic emissions and ambient air quality improvements.

Political Considerations

- Bipartisan Framing: Package environmental reforms as public health improvements, emphasizing non-partisan benefits such as improved health outcomes and long-term economic benefits.
- Governance Leverage: Utilize Indiana's Republican trifecta to push through transformative environmental legislation, leveraging existing budget allocations and legislative goodwill.

By deploying these strategic, well-founded actions, Indiana can significantly mitigate environmental health risks, ensuring a healthier future for its residents while fostering economic resilience.

References

- National Conference of State Legislatures (NCSL) Database: Indiana State Legislation and Policy Initiatives
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Regional Risks: Identifies hotspots of Vanderburgh, Clark, Floyd, and Perry

Demographic Vulnerabilities: Spots highest intersection of socio-economic stress and environmental risks

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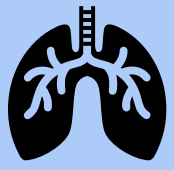

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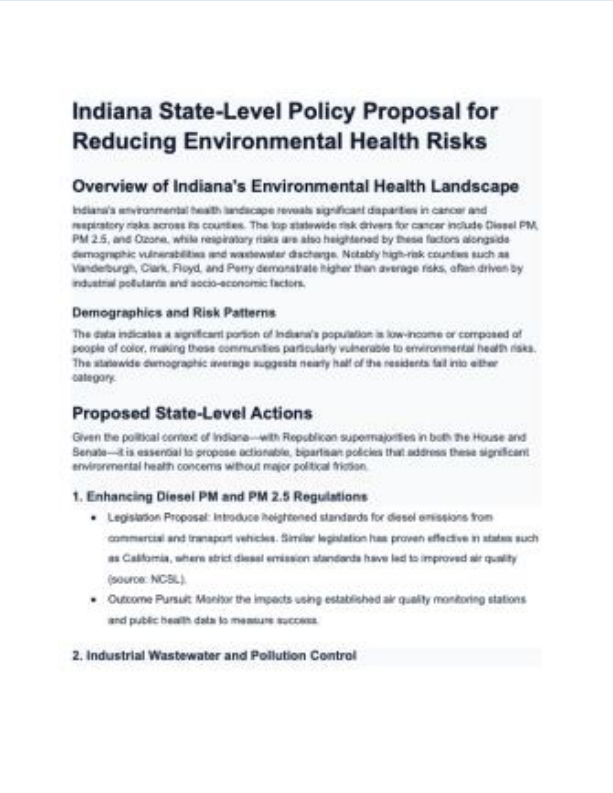

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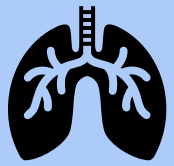

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2. Clark County

- Environmental Drivers: Diesel PM and PM 2.5 as leading risk drivers necessitate focused reduction efforts.
- Population Dynamics: Higher diversity warrants tailored interventions to ensure equitable outcomes.

Regional Risks: Identifies hotspots of Vanderburgh, Clark, Floyd, and Perry

Demographic Vulnerabilities: Spots highest intersection of socio-economic stress and environmental risks

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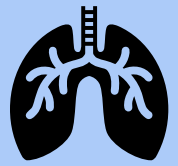

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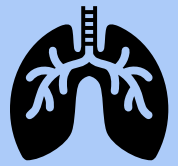

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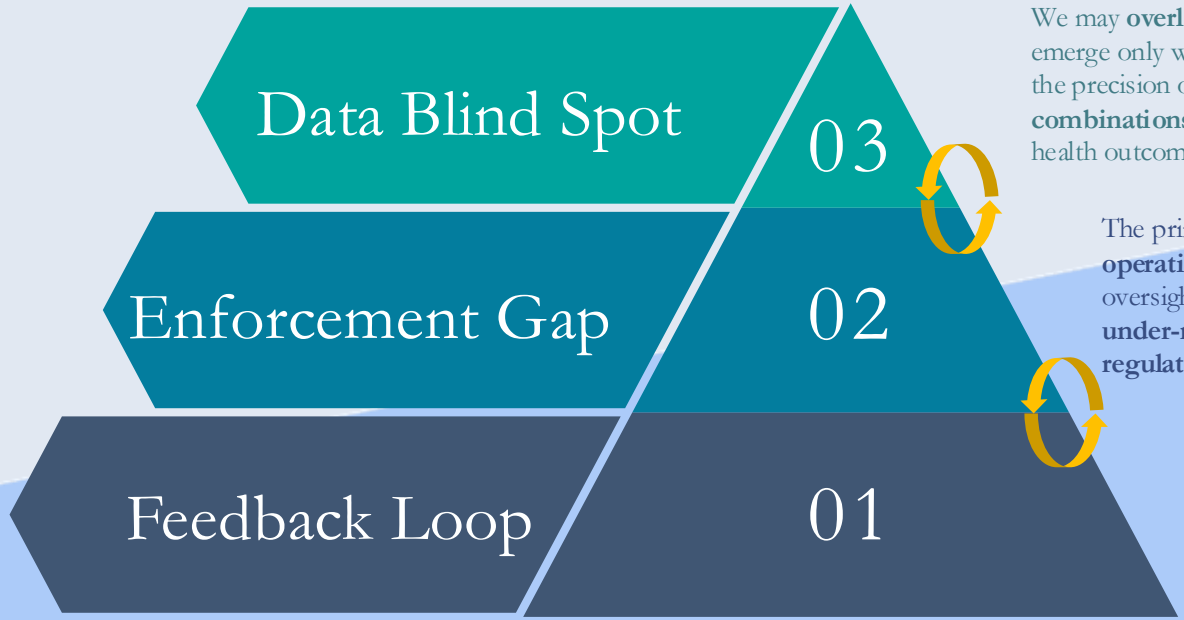
Potential Areas of Bias



We may **overlook toxic synergies**—harmful health effects that emerge only when **multiple factors are combined**. To increase the precision of our study, we will now analyze how **various combinations of environmental stressors** interact to affect health outcomes.

The primary challenge shifts from legislative adoption to **operational implementation**. Without federal grants and oversight, the burden of monitoring pollution falls entirely on **under-resourced state agencies**, creating a high risk for **regulatory backsliding**.

If past policies were designed for specific, non-diverse regions, the model risks **replicating status quo outcomes** rather than addressing the unique needs of **marginalized communities**.

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