The effects of environmental health risks on housing values and minorities

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BAD AIR DAYS

Refinery long viewed as city's biggest polluter

By Frank Kummer
STAFF WRITER

LAST week's fiery explosion at the Philadelphia Energy Solutions refinery drew Philadelphians' attention to the size and scale of the 1,400-acre complex, the largest on the eastern seaboard.

But those who live near it have long worried about what the PES plant releases into the air, and many wonder if high rates of asthma and other health issues are linked to the facility. Friday's fire only heightened those fears.

"Why does it take a series of explosions for this to come out?" asked Mollie Michel of the nonprofit Moms Clean Air Force, who lives in South Philadelphia with her husband and two daughters.

City reports show the refinery, which processes 335,000 barrels of crude oil a day, was already Philadelphia's biggest single air polluter even before last week's fire sent plumes of black smoke skyward.

In a 2017 "Powering Our Future" report, the Office of Sustainability noted, "For nearly all particulate pollutants, the single-largest source of local air pollution is the Philadelphia Energy Solutions refinery."

Federal data paint a similar picture. The U.S. Environmental Protection Agency's Toxics Release Inventory (TRI) tracks toxic chemicals that may pose a health threat to and requires certain industrial facilities to report how much of each chemical is used, combusted, disposed of, or released. According to TRI data, the refinery is by far the biggest releaser of chemicals into the air in Philadelphia.

A PES spokesperson had no comment.

On the day of the explosions, smoke pours into the Philly air from the refinery. JESSICA GRIFFIN / Staff Photographer

Philadelphia officials, charged with monitoring the air quality at the site, have acknowledged the facility poses a challenge.

The Office of Sustainability report noted that Philadelphia is the 12th most polluted city in U.S. by particulate pollution, a mix of solid and liquid particles that get into the air. It said the refinery "accounts for more than 50 percent of local emissions for each of those pollutants."

Particulate matter, also referred to as particle pollution, when inhaled can cause serious health problems. Some particles, such as dust, dirt, or soot, are visible to the human eye. Others are not. Smaller particles pose the biggest health risk. They are also the biggest cause of haze in the United States.

The report also found that the refinery is the single largest contributor of emissions, including carbon dioxide.

"While not a particulate pollutant, carbon dioxide (the primary contributor to global climate change) is also emitted at the local level. Again, the PES refinery is the single-largest source of carbon emissions citywide," the report stated.

Overall, motor vehicle emissions are the largest collective source of pollution in the city, officials said.

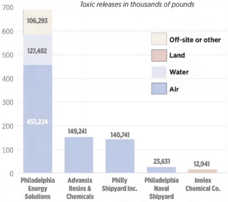
The city health department said Friday after the fire was brought under control that the air quality around the facility was not an immediate health threat. The department's Air Management Services has permanent monitors throughout the city that it uses for air quality checks. The closest monitor to the refinery is at 24th and Ritner Streets.

Additionally, James Garrow, a department spokesperson, said monitor readings from Saturday and Sunday detected no hydrogen sulfide, carbon monoxide or hydrocarbons. The department also looked at an air monitor in Camden and did not detect levels of concern there.

The highest levels of particulate matter occurred Friday at 7 a.m. as the fire was raging. But the readings did not reach a level of concern, officials said.

Top 5 Philadelphia Toxic Emitters

EPA data show that the Philadelphia Energy Solutions refinery is the facility that releases or disposes of the highest amount of toxic chemicals in the city.



SOURCE: Environmental Protection Agency Staff Graphic

However, Air Management Services, which also issues violations for air pollutants, has repeatedly flagged the refinery for its emissions in the recent past. It found the refinery had "High Priority Violations" of the Clean Air Act in nine of the last 12 quarters.

Garrow said High Priority Violations of the Clean Air Act "are those which warrant additional scrutiny to ensure local state and

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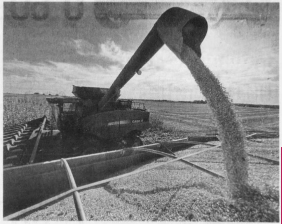


REGISTER FILE PHOTO

In addition to selling corn, farmers could sell the plant remnants, called stover, to ethanol plants to be burned in the production of the fuel. But that idea could lose merit if the Environmental Protection Agency considers the emissions to be a greenhouse gas.

EMISSIONS

FROM PAGE 1D

Act because of other pollutants such as nitrogen oxide that they emit.

What the greenhouse-gas regulations will do is sweep the rest of the state's plants under the Clean Air Act, and require them to start filing reports on emissions and paying fees on their pollutants as well, said Marnie Stein of the DNR's Air Quality Bureau.

The fees would likely average $5,600 to $11,200 a year, she said.

"Those fees could be quite costly for some ethanol plants," said Geoff Cooper, who follows regulatory issues for the Renewable Fuels Association, a Washington trade group.

No one questions that fermenting corn or burning biomass for electricity puts carbon dioxide into the atmosphere.

But most greenhouse gas calculations, including those of the United Nations' climate panel, don't include such emissions, known as biogenic, because they come from biological sources.

The reason: The carbon released from corn or biomass will eventually be returned to earth as crops and other biomass sources are replanted. Plants take carbon dioxide out of the air as they grow.

Coal, on the other hand, is dug from the earth and never replaced, so its carbon is lost into the atmosphere when the coal is burned.

In a bit of irony, some analysts believe the rules could actually discourage ethanol plants from cutting their use of fossil fuels.

Here's how: The environmental agency is expected to eventually go beyond demanding paperwork and fees from greenhouse-gas sources and start requiring them to reduce emissions.

An easy way for ethanol producers to do that would be to stop running their plants with coal or natural gas and instead burn corn stalks and other sources of biomass. But that won't work if the agency continues to count emissions from burning biomass as greenhouse gases, said Nathaniel Baer, who follows energy policy for the Iowa Environmental Council.

"If the biomass is considered carbon neutral, then it seems like it would create a viable compliance option down the road for reducing emissions" from ethanol plants, Baer said.

The environmental agency announced this summer that it was taking a second look at the emissions issue and asked for industry and public comment.

In the meantime, the DNR is taking steps to implement the regulations in Iowa and has no choice but to mirror what the environmental agency does, Stein said. If the state tried to exempt the emissions from corn fermentation, as the ethanol industry wants, the agency would under federal law override the state rules, she said.

If the agency reverses itself on ethanol and biomass emissions, the state will follow suit later, she said.

The Renewable Fuels Association wants the state to exempt the emissions now without waiting on the environmental agency, noting that even if the agency doesn't change its rules they could be struck down by the courts.

Not all producers are worried about the regulations.

Green Plains Renewable Energy is experimenting at its Shenandoah plant with reducing its carbon dioxide emissions by using the gas to grow algae that could be used for fuel or feed. Green Plains hopes to eventually offer the technology to ethanol plants and other companies that want to reduce carbon dioxide emissions, a spokesman said.

How it works

The Environmental Protection Agency's greenhouse gas regulations would sweep all of the ethanol industry into the paperwork and fee requirements of the Clean Air Act because of the way it counts carbon emissions. A plant that produces 100 million gallons of ethanol a year would emit about 325,000 tons of carbon dioxide. The agency will start regulating sources of more than 100,000 tons of greenhouse gases.

Permits in Iowa

Fifteen Iowa ethanol plants already have air pollution permits:

- Archer Daniels Midland, Clinton and Cedar Rapids
- Cargill, Eddyville
- Corn LP, Goldfield
- Big River Resources, West Burlington
- Global Ethanol, Lakota
- Grain Processing Corp., Muscatine
- Golden Grain, Mason City
- Homeland Energy Solutions, Lawler
- Lincolnway Energy, Nevada
- Little Sioux Corn Processors, Marcus
- Penford Products, Cedar Rapids
- Platinum Ethanol, Arthur
- Poet Biorefining, Coon Rapids
- Southwest Iowa Renewable Energy, Council Bluffs

US sues chemical company over cancer risk to mostly minority area

By Michael Phillis and Matthew Daly
ASSOCIATED PRESS

WASHINGTON — Federal officials sued a Louisiana chemical maker on Tuesday, alleging that it presents an unacceptable cancer risk to the nearby majority-Black community and demanding cuts in toxic emissions.

Denka Performance Elastomer LLC makes synthetic rubber, emitting the carcinogen chloroprene and other chemicals in such high concentrations that it poses an unacceptable cancer risk, according to the federal complaint. Children are particularly vulnerable. There is an elementary school a half-mile from the plant.

The former DuPont plant has reduced its emissions over time, but the Justice Department, suing on behalf of the Environmental Protection Agency, said the plant still represents "an imminent and substantial endangerment to public health and welfare," including elevated cancer risks.

"The company has not moved far enough or fast enough to reduce emissions or ensure the safety of the surrounding community," EPA Administrator Michael Regan said in a statement.

Denka, a Japanese company that bought the rubber-making plant in 2015, did not immediately respond to messages seeking comment. A company spokesperson said in September that advocates described a crisis that "simply does not exist."

Denka's facility makes neoprene, a flexible, synthetic rubber used to produce common goods such as wetsuits, laptop sleeves, orthopedic braces and automotive belts and hoses. Chloroprene is a liquid raw material used to produce neoprene and is emitted into the air from various areas at the facility.

FILE PHOTO | ASSOCIATED PRESS

Angelo Bernard with his grandchildren, who visited him for the weekend at his home in Reserve, La near the Denka Performance Elastomer Plant.

Associate Attorney General Vanita Gupta said every community, no matter its demographics, should be able to breathe clean air and drink clean water. "Our suit aims to stop Denka's dangerous pollution," she said in a statement.

The lawsuit demands that Denka eliminate dangerous emissions of chloroprene. Air monitoring consistently shows long-term chloroprene concentrations in the air near Denka's LaPlace plant as high as 15 times the levels recommended for a 70-year exposure to the chemical, the complaint says.

The complaint is the latest move by the Biden administration that targets pollution in an 85-mile stretch from New Orleans to Baton Rouge officially known as the Mississippi River Chemical Corridor, but more commonly called Cancer Alley. The region contains several hot spots where cancer risks are far above levels deemed acceptable by the EPA. The White House has prioritized environmental enforcement in communities overburdened by long-term pollution.

Regan visited the parish in 2021 during a five-day trip from Mississippi to Texas that highlighted low-income, mostly minority communities adversely affected by industrial pollution. A Toxics Release Inventory prepared by EPA shows that minority groups make up 56 percent of those living near toxic sites such as refineries, landfills and chemical plants. Negative effects include chronic health problems such as asthma, diabetes and hypertension.

Last year, the EPA said it had evidence that Black residents face an increased cancer risk from the chemical plant and that state officials allowed the pollution to remain too high. The agency's letter was part of an investigation under the Civil Rights Act of 1964, which says anyone who receives federal funds cannot discriminate based on race or national origin.

Local activists have long targeted the plant, arguing that nearby air monitoring demonstrates the plant is a danger to St. John the Baptist Parish residents.

The Justice Department, in its complaint, agreed, saying the plant is exposing thousands of people to lifetime cancer risks "multiples of times higher than what is typically considered acceptable."

Mary Hampton, president of Concerned Citizens of St. John the Baptist Parish, said emissions at the plant need to drop quickly.

"It's a positive move in the right direction," she said of the federal lawsuit. "It's been a long time coming."

Beverly Wright, executive director of the Deep South Center for Environmental Justice, said the DOJ's lawsuit helps ensure that Black communities in Louisiana don't have to live with deadly pollution.

Motivation

- Environmental health risks are a critical concern for regulators and drive the design of regulation.
- One of the key challenges in measuring the costs of environmental health risk is that the location choices of firms and households are endogenous.
- These choices lie behind the well-established observation that economically disadvantaged households are disproportionately more exposed to environmental harms
- Companies may intentionally select socioeconomically disadvantaged areas to establish new sites, which implies pre-existing socio-economic disparities
- Households may also choose to live in areas with lower environmental quality, for instance, driven by financial constraints, which widens environmental inequality among households (Kermani and Wong, 2021).

This paper

- We estimate the environmental costs through changes in house prices in a short-time window around the first time that plants report emitting carcinogenic chemicals.
  - → Adopt a "donut" approach: Compare property values for those that are within a 3-mile ring of the plant ("treated") to those properties that are in a ring between three and five miles from the same plant ("control").
  - → Environmental health risks are higher closer to the plant, but the economic benefits accrue to all households within the five miles area.
  - → Repeated sales approach: Focus on properties with multiple transactions before and after the reporting event. It allows us to control for unobserved time-invariant property characteristics.
  - → Control further for local economic conditions using fixed effects.
  - → Focus on plants already operating and exploit the timing of when they exceed the minimum reporting thresholds (event).
- Evidence on the economic effects of the plant through employment and sales.
- Evidence on housing transactions by minorities.

Preview of results

1. On average, houses close to plants that newly report emitting carcinogens transact at prices 6% – 12% lower than before the event, and relative to properties that are further away.
2. But using a repeated sales approach that allows us to control for unobserved property characteristics, we estimate significantly smaller changes, ranging between −1.4% and −1.7%.
    a. We do not find a commensurate change in listing prices (discounts) and the time these properties are on the market, implying that asking prices are reduced in response to the event.
3. Heterogeneity: The drop in house price is entirely driven by properties in the above median group experiencing a decline of around −3% after the event relative to those in the below median group.
4. Economic benefits: Newly reporting plants experience a 2 percent increase in employment.
5. Document granular changes in neighbourhood composition with a greater fraction of minority buyers and sellers transacting in the close proximity of these plants (but larger fraction of buyers than sellers).

Related Literature

- Literature that uses changes in house prices to estimate the willingness-to-pay for households and benefits from local environmental quality improvements (Rosen 1974, Chay and Greenstone 2005, Greenstone and Gallagher 2008, Bayer, Keohane, and Timmins 2009, Currie et al. 2015, Ito and Zhang 2020).
- Literature on agglomeration argues for spillovers and their propagation through firm networks to the local economy in the form of input sharing, labor market pooling, and knowledge externalities (Giroud et al. 2021, Bloom et al. 2019, Neumark and Simpson 2015, Enrico 2011, Greenstone, Hornbeck, and Moretti 2010).
- Our contributions: identification, pre-existing plants that report carcinogenic emissions for the first time, heterogeneity and mechanisms of adjustment.

INSTITUTIONAL BACKGROUND AND DATA

Event

- Firms that satisfy several criteria must report their emissions to the EPA under the Toxics Release Inventory (TRI) Program.
  - → the number of employees (at least 10);
  - → the industry sector where the facility operates (some NAICS codes are covered);
  - → the manufacture, production, or use of TRI-listed chemicals;
  - → the plant exceeds at least one of the thresholds for a chemical or a chemical category.
- Identify treated plants as those with *new* flags for the emission of harmful pollutants classified as such under the Clean Air Act and as a carcinogen by the Occupational Safety and Health Administration (OSHA).
- Plants that already satisfied these criteria in the year of 2000 (the starting year of the data) are excluded.
  - → We do not know whether this is the first year in which they did so.

Data I

- **Corelogic Deed and Tax Records**: Covers the near-universe of US residential housing transactions between 2000 and 2020. Focus on single-family residence, condominiums, duplexes, and apartments. Residential transactions
- **Toxics Release Inventory**: Plants report emissions of several chemicals to the EPA through the TRI program. We identify the first year a carcinogenic chemical is reported to the EPA from the TRI data. Additionally, we use the reported latitude and longitude of each plant to merge with the property transactions data and calculate the distance between each residential property and plant using Vincenty 1975's formula. Plant locations
- **National Establishment Time Series**: Captures economic activity of plants and includes information on employment and sales.

Data II

- **Air Quality Monitoring**: The AQS data are collected by a network of over 10,000 monitoring stations located throughout the United States and measuring various pollutants, including ozone, particulate matter, carbon monoxide, nitrogen oxides, sulfur dioxide, and lead. We focus on hazardous air pollutants (HAP) and extract readings from all air monitoring stations that are within a five-mile radius of the plant.
- **RSEI Geographic Microdata**: A summary score capturing the relative size of chemical releases taking into account its toxicity and how it affects the population that are potentially exposed. Highly granular (810m $\times$ 810m grid cells) with disaggregated air and water results and linked source-receptor information.
- **Multiple Listing Services (MLS)**: Comes from Corelogic which records a snapshot of homes listed for sale on multiple listing services (MLS) from several publicly available web sites and records the address, MLS identifier, and list price.

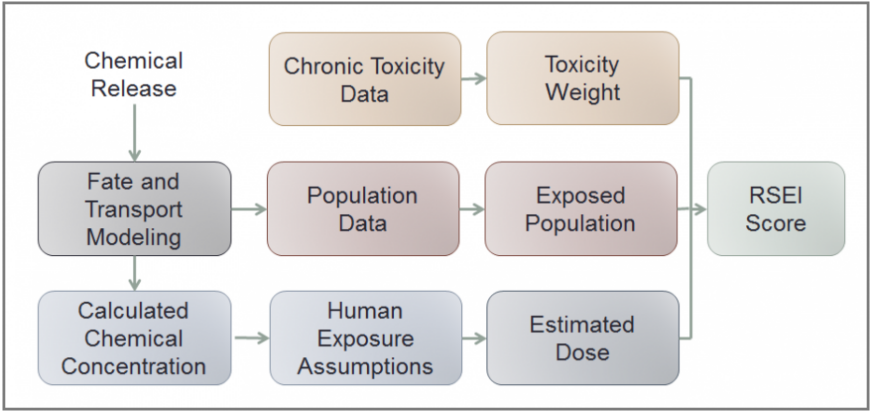
EMPIRICAL STRATEGY

Empirical strategy

1. "Donut" approach: Compare property values for those that are within a 3-mile ring of the plant ("treated") to those properties that are in a ring between three and five miles from the same plant ("control").
   → Need to define the ring size
2. Differences in unobserved property characteristics
   → Focus on repeated sales of the same property Comparison of sale prices
3. Further controlling for effects on property values arising from local economic activity
   → Fixed effects:
   (i) Sale-year × county fixed effects, Or
   (ii) Plant × sale-year fixed effects.
4. Location decisions of firms and households are endogenous
   → Focus on plants that operated prior to the announcement

Defining the donut size

1. Cancer risk measured using the RSEI cancer score



Source: EPA

Defining the donut size

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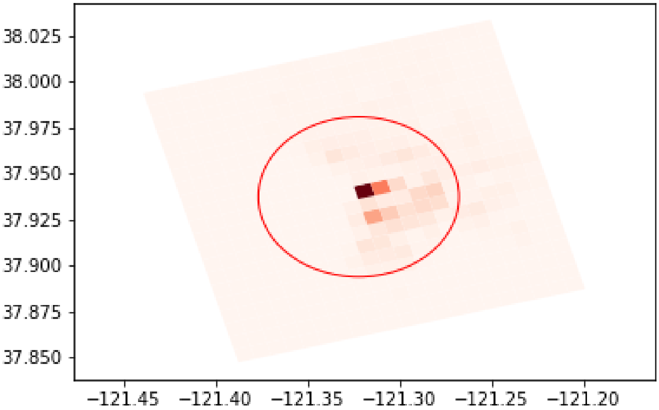
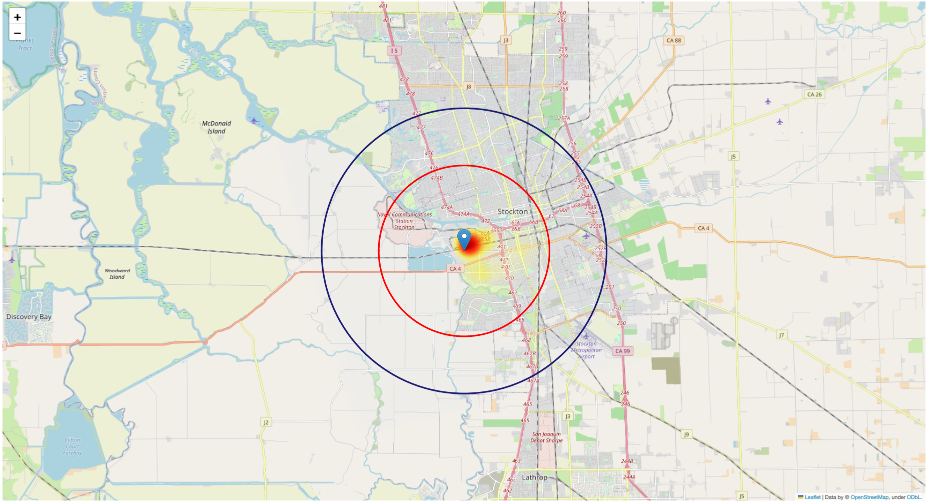


Defining the donut size

1. Cancer risk measured using the RSEI cancer score



RESULTS

Changes in house prices around first year of reporting

Empirical specification, all transactions

$$\log(\text{Sale amount})_{ijct} = \alpha + \beta_{Post} \times \text{Post}_{it} + \beta_{\text{Post} \times \text{Distance}} \times \text{Post}_{it} \times \mathbb{1}_{ij}^{Distance_{ij} < X miles} + \gamma_j + \gamma_{ct} + \epsilon_{ijct},$$

- $Post_{it}$, is an indicator variable taking a value of one if property i is sold in the year t after the event year and zero otherwise.
- $\mathbb{1}_{ij}^{\text{Distance}_{ij} < X \text{miles}}$ to take a value of one if property i is within X miles from a plant j, with $X = 3, 2, 1.5, 1.25, 1$ in the regressions, and zero for properties between 3 and 5 miles of the same plant.
- γ_j controls for time-invariant plant characteristics and
- γ_{ct} controls for the time-varying macroeconomic conditions in the county where the property is located.

Changes in house prices around first year of reporting

All transactions

Dependent variable:	Log(sale amount)				
Treatment (Distance in miles)	3	2	1.5	1.25	1
	(1)	(2)	(3)	(4)	(5)
Post	0.022***	0.019***	0.015***	0.011***	0.008**
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Post $\times$ $\mathbb{1}^{\text{Distance}<X\text{miles}}$	-0.063***	-0.085***	-0.101***	-0.111***	-0.124***
	(0.005)	(0.007)	(0.008)	(0.008)	(0.009)
Plant fixed effects	Yes	Yes	Yes	Yes	Yes
Year $\times$ county fixed effects	Yes	Yes	Yes	Yes	Yes
R^2	0.43	0.43	0.43	0.43	0.43
Observations	7,542,012	5,744,154	4,998,638	4,688,460	4,424,724

Coefficients by State Coefficients by Event year

Changes in house prices around first year of reporting

Empirical specification, repeated transactions

$$\log(\text{Sale amount})_{ijct} = \alpha + \beta_{Post} \times \text{Post}_{it} + \beta_{\text{Post} \times \text{Distance}} \times \text{Post}_{it} \times \mathbb{1}_{ij}^{Distance_{ij} < X miles} + \gamma_i + \gamma_{ct} + \epsilon_{ijct},$$

- *Post*$_{it}$, is an indicator variable taking a value of one if property i is sold in the year t after the event year and zero otherwise.
- $\mathbb{1}_{ij}^{\text{Distance}_{ij} < X \text{miles}}$ to take a value of one if property i is within X miles from a plant j, with $X = 3$ in the baseline regressions, and zero for properties between 3 and 5 miles of the same plant.
- γ_i controls for time-invariant property characteristics and
- γ_{ct} controls for the time-varying macroeconomic conditions in the county where the property is located.

Changes in house prices around first year of reporting

Properties with repeated transactions

Dependent variable:	Log(sale amount)				
Treatment (Distance in miles)	3	2	1.5	1.25	1
	(1)	(2)	(3)	(4)	(5)
Post	0.009	0.007	0.009	0.009	0.007
	(0.009)	(0.009)	(0.009)	(0.010)	(0.009)
Post $\times$ $\mathbb{1}^{\text{Distance}<X\text{miles}}$	-0.014***	-0.015**	-0.016**	-0.017*	-0.016*
	(0.005)	(0.006)	(0.008)	(0.009)	(0.010)
Property fixed effects	Yes	Yes	Yes	Yes	Yes
Year $\times$ county fixed effects	Yes	Yes	Yes	Yes	Yes
R^2	0.86	0.86	0.86	0.86	0.86
Observations	1,085,693	829,738	724,260	680,180	642,095

Dependent variable · Measurement error · Time horizon · Control for local conditions

Other margins of adjustment

Discounts in listing price

Dependent variable:	Discount in percentage points				
Treatment (Distance in miles)	3	2	1.5	1.25	1
	(1)	(2)	(3)	(4)	(5)
Post	-0.000	-0.000	-0.000	0.001	0.000
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
Post $\times$ $\mathbb{1}^{\text{Distance}<X\text{miles}}$	-0.002	-0.000	-0.001	0.001	-0.002
	(0.001)	(0.003)	(0.003)	(0.002)	(0.003)
Property fixed effects	Yes	Yes	Yes	Yes	Yes
Year $\times$ county fixed effects	Yes	Yes	Yes	Yes	Yes
R^2	0.75	0.76	0.76	0.76	0.76
Observations	465,375	332,638	287,976	271,773	258,744

Other margins of adjustment

Time on the market

Dependent variable:	Time on the market in days				
Treatment (Distance in miles)	3 (1)	2 (2)	1.5 (3)	1.25 (4)	1 (5)
Post	-0.669 (0.741)	-1.249 (0.805)	-0.971 (0.771)	-0.993 (0.801)	-1.035 (0.753)
Post $\times$ $\mathbb{1}^{\text{Distance}<X\text{miles}}$	-1.153 (0.889)	-2.244* (1.360)	-2.681 (2.349)	-2.531 (2.090)	-3.202 (2.637)
Property fixed effects	Yes	Yes	Yes	Yes	Yes
Year $\times$ county fixed effects	Yes	Yes	Yes	Yes	Yes
R^2	0.62	0.64	0.65	0.66	0.66
Observations	465,249	332,533	287,885	271,692	258,679

HETEROGENEITY BY HOUSE PRICE

Heterogeneity in treatment effects by sale amount

Repeated transactions, properties values split by above median based on house price distribution prior to the event

Treatment (Distance in miles)	3	2	1.5	1.25	1
Below median					
Control	0.0105***	0.0114**	0.0123***	0.0125***	0.0123**
	(0.0039)	(0.0044)	(0.0047)	(0.0048)	(0.0049)
Treated	0.0044	0.0036	0.0061	0.0092	0.0097
	(0.0058)	(0.0078)	(0.0096)	(0.0097)	(0.0101)
Above median					
Control	-0.0289***	-0.0282***	-0.0277***	-0.0279***	-0.0282***
	(0.0044)	(0.0047)	(0.0048)	(0.005)	(0.0051)
Treated	-0.0356***	-0.0361***	-0.0396***	-0.0441***	-0.0518***
	(0.0059)	(0.0082)	(0.0098)	(0.0091)	(0.0113)
Property fixed effects	Yes	Yes	Yes	Yes	Yes
Year $\times$ county fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	530,099	403,715	350,721	329,143	310,633

Heterogeneity in treatment effects by sale amount

Repeated transactions, properties values split by above median based on house price distribution prior to the event

Treatment (Distance in miles)	3	2	1.5	1.25	1
Difference: Treated minus Control					
Below median	-0.0062	-0.0078	-0.0062	-0.0033	-0.0026
	(0.0058)	(0.0073)	(0.0091)	(0.0091)	(0.0093)
Above median	-0.0067	-0.0079	-0.0119	-0.0162**	-0.0237**
	(0.0057)	(0.0076)	(0.0092)	(0.008)	(0.0102)
Property fixed effects	Yes	Yes	Yes	Yes	Yes
Year × county fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	530,099	403,715	350,721	329,143	310,633

Economic activity

Plant-level employment and sales

Dependent variable:	Log (employment)	Log (sales)
	(1)	(2)
Post	0.019**	0.014
	(0.009)	(0.010)
Plant fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
R^2	0.97	0.97
Observations	30,162	29,633

HOUSING TRANSACTIONS BY MINORITIES

Identifying minorities

- Use first and last names of buyers and sellers from the deeds data
- Prediction algorithm proposed by Laohaprapanon, Sood, and Naji 2022:
  - → Exploits the US census data, the Florida voting registration data, and the Wikipedia data.
  - → Predicts ethnicity based on first and last name or just the last name.
  - → Categorizes names between Non-Hispanic Whites, Non-Hispanic Blacks, Asians, and Hispanics, with their respective probabilities.
- For the classification, we use the last names of all sellers and buyers who are individuals. In our sample, for buyers (sellers), we can predict race and ethnicity for 79% (60.2%) of all transactions.
- We focus on Hispanics and Non-Hispanics for which the accuracy of the algorithm is better.
  - → Dummy equal to one for Hispanic home buyer or home seller.

Changes in fraction of Hispanic home buyers

All transactions

	Panel A: Buyers				
Dependent variable:	$\mathbb{1}$(Hispanic)				
Treatment (Distance in miles)	3	2	1.5	1.25	1
	(1)	(2)	(3)	(4)	(5)
Post	-0.005***	-0.005***	-0.004**	-0.003*	-0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Post $\times$ $\mathbb{1}^{\text{Distance}<X\,\text{miles}}$	0.012***	0.016***	0.018***	0.019***	0.022***
	(0.002)	(0.003)	(0.003)	(0.003)	(0.004)
Plant fixed effects	Yes	Yes	Yes	Yes	Yes
Year$\times$ county fixed effects	Yes	Yes	Yes	Yes	Yes
R^2	0.14	0.14	0.14	0.14	0.13
Observations	6,177,760	4,701,805	4,088,040	3,832,287	3,615,276

Hispanic buyers: Alternative definition

Changes in fraction of Hispanic home sellers

All transactions

Panel B: Sellers					
Dependent variable:	$\mathbb{1}$(Hispanic)				
Treatment (Distance in miles)	3	2	1.5	1.25	1
	(1)	(2)	(3)	(4)	(5)
Post	-0.005***	-0.005***	-0.004***	-0.004***	-0.003**
	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
Post $\times$ $\mathbb{1}^{\text{Distance}<X\text{miles}}$	0.010***	0.014***	0.016***	0.018***	0.019***
	(0.002)	(0.003)	(0.003)	(0.004)	(0.005)
Plant fixed effects	Yes	Yes	Yes	Yes	Yes
Year $\times$ county fixed effects	Yes	Yes	Yes	Yes	Yes
R^2	0.13	0.13	0.13	0.12	0.12
Observations	4,795,888	3,640,031	3,158,636	2,959,388	2,788,211

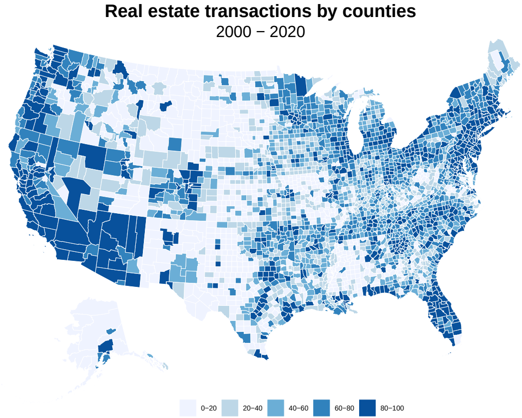
Hispanic sellers: Alternative definition

Conclusion

- We estimate the effects of environmental health risks using granular data on housing transactions.
- Our methodology allows us to control for local economic activity effects (donut approach, saturate the model with fixed effects).
- We find an overall negative effect on housing values of between -1.4% and -1.7%.
- Significant heterogeneity with more expensive properties experiencing a relative decline of around -3%. In contrast, less expensive ones benefit from an increase in value (in the control group).
- Our results suggest that the willingness of households to pay to avoid such plants is offset by an increase in industrial activity with greater benefits for those who purchase lower-priced houses in the area.

THANK YOU!

Number of real estate transactions by county



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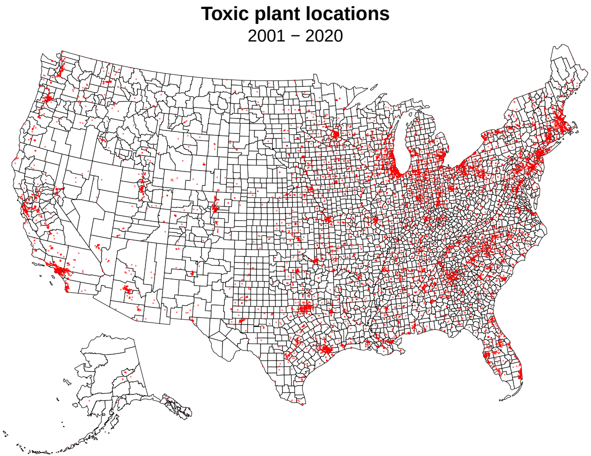
Location of the reporting plants



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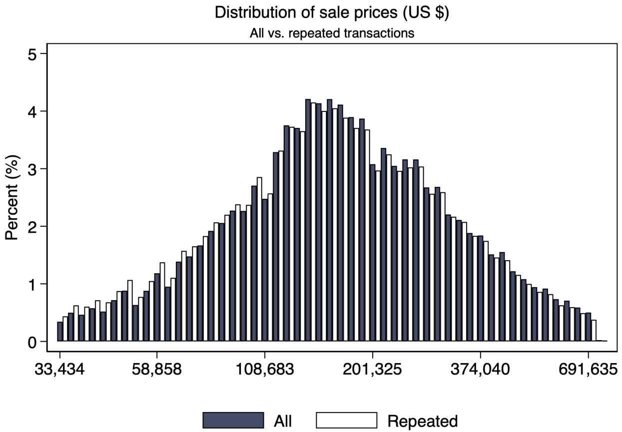
Empirical distribution of sale prices

All transactions vs. repeated transaction



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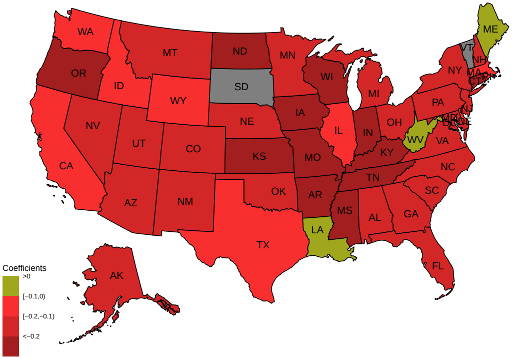
Coefficients by state

All transactions with plant fixed effects



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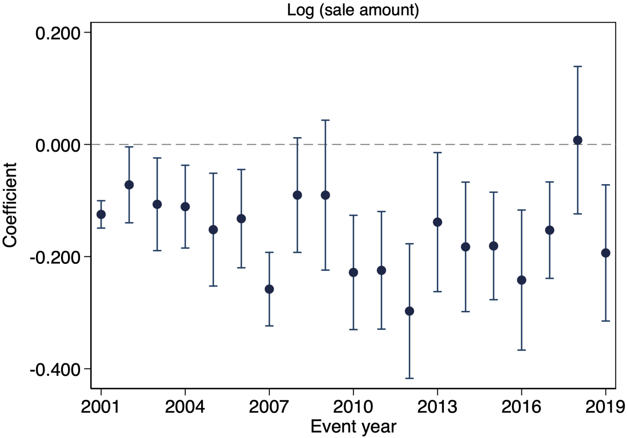
Coefficients by event year

All transactions with plant fixed effects



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Robustness to dependent variable function form

Repeated transactions, dependent variable in levels instead of logarithm

Dependent variable:	Sale amount ($)				
Treatment (Distance in miles)	3	2	1.5	1.25	1
	(1)	(2)	(3)	(4)	(5)
Post	1747.970	1313.927	1583.286	1382.705	695.509
	(1906.569)	(2006.493)	(2054.050)	(2082.697)	(2036.329)
Post $\times \mathbb{1}^{\text{Distance}<X\text{miles}}$	-4225.660***	-5771.382***	-6026.167***	-7063.518***	-7245.870***
	(966.320)	(1272.229)	(1650.031)	(1808.607)	(1868.643)
Property fixed effects	Yes	Yes	Yes	Yes	Yes
Year$\times$ county fixed effects	Yes	Yes	Yes	Yes	Yes
R^2	0.87	0.87	0.87	0.87	0.87
Observations	1,085,693	829,738	724,260	680,180	642,095

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Robustness to time measurement error

Repeated transactions, greater than 100 observations

Dependent variable:	Log(sale amount)				
Treatment (Distance in miles)	3	2	1.5	1.25	1
	(1)	(2)	(3)	(4)	(5)
Post	0.010	0.006	0.009	0.009	0.005
	(0.011)	(0.012)	(0.012)	(0.013)	(0.013)
Post $\times \mathbb{1}^{\text{Distance}<X\text{miles}}$	-0.014***	-0.015**	-0.015*	-0.015	-0.013
	(0.005)	(0.006)	(0.008)	(0.010)	(0.010)
Property fixed effects	Yes	Yes	Yes	Yes	Yes
Year× county fixed effects	Yes	Yes	Yes	Yes	Yes
R^2	0.86	0.86	0.86	0.86	0.86
Observations	950,321	717,668	622,391	583,362	549,856

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Robustness to event window

Repeated transactions, expanding the event window size

Dependent variable:	Log(sale amount)									
Event window:	(-2,1)					(-3,1)				
Treatment (Distance in miles)	3	2	1.5	1.25	1	3	2	1.5	1.25	1
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Post	0.014***	0.014***	0.017***	0.016***	0.016***	0.016***	0.015***	0.016***	0.015***	0.016***
	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)
Post $\times$ $\mathbb{1}^{\text{Distance} < X \text{ miles}}$	-0.012***	-0.013**	-0.013**	-0.014**	-0.014*	-0.011***	-0.011**	-0.012**	-0.013**	-0.014*
	(0.004)	(0.005)	(0.006)	(0.007)	(0.008)	(0.004)	(0.005)	(0.006)	(0.007)	(0.007)
Property fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year $\times$ county fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.87	0.86	0.86	0.86	0.86	0.87	0.87	0.87	0.87	0.87
Observations	2,024,515	1,546,964	1,348,404	1,266,398	1,195,207	3,127,197	2,387,778	2,080,655	1,954,800	1,846,326

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Controlling for local economic conditions

Repeated transactions

Dependent variable:	Log(sale amount)				
Treatment (Distance in miles)	3	2	1.5	1.25	1
	(1)	(2)	(3)	(4)	(5)
Post $\times$ $\mathbb{1}^{\text{Distance}<X\text{miles}}$	-0.068***	-0.089***	-0.101***	-0.112***	-0.122***
	(0.006)	(0.008)	(0.009)	(0.010)	(0.012)
Plant$\times$year fixed effects	Yes	Yes	Yes	Yes	Yes
County fixed effects	Yes	Yes	Yes	Yes	Yes
R^2	0.39	0.39	0.39	0.39	0.39
Observations	1,085,203	829,243	723,758	679,667	641,571

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Robustness to number of transactions

Repeated transactions, more than 100 observations

Dependent variable:	Log(sale amount)				
Treatment (Distance in miles)	3	2	1.5	1.25	1
	(1)	(2)	(3)	(4)	(5)
Post	0.005	0.003	0.006	0.006	0.004
	(0.011)	(0.012)	(0.012)	(0.013)	(0.012)
Post $\times$ $\mathbb{1}^{\text{Distance}<X\text{miles}}$	0.105***	0.102***	0.099***	0.096***	0.093***
	(0.007)	(0.009)	(0.010)	(0.011)	(0.011)
Post $\times$ Above $\times$ $\mathbb{1}^{\text{Distance}<X\text{miles}}$	-0.292***	-0.298***	-0.297***	-0.297***	-0.294***
	(0.014)	(0.017)	(0.018)	(0.020)	(0.022)
Property fixed effects	Yes	Yes	Yes	Yes	Yes
Year $\times$ county fixed effects	Yes	Yes	Yes	Yes	Yes
R^2	0.87	0.86	0.86	0.86	0.86
Observations	950,321	717,668	622,391	583,362	549,856

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Robustness to large price changes between consecutive transactions

Repeated transactions, drop 10% of observations by price changes – bottom 5% and top 5%

Dependent variable:	Log(sale amount)				
Treatment (Distance in miles)	3	2	1.5	1.25	1
	(1)	(2)	(3)	(4)	(5)
Post	-0.001	0.001	0.002	0.003	0.003
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Post $\times \mathbb{1}^{\text{Distance}<X\text{miles}}$	0.071***	0.070***	0.068***	0.069***	0.071***
	(0.003)	(0.004)	(0.005)	(0.006)	(0.006)
Post $\times \mathbb{1}^{\text{Distance}<X\text{miles}} \times$ Above	-0.167***	-0.172***	-0.172***	-0.174***	-0.177***
	(0.006)	(0.007)	(0.008)	(0.009)	(0.009)
Property fixed effects	Yes	Yes	Yes	Yes	Yes
Year $\times$ county fixed effects	Yes	Yes	Yes	Yes	Yes
R^2	0.94	0.94	0.94	0.94	0.94
Observations	977,926	745,405	649,851	609,778	575,283

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Robustness to large price changes between consecutive transactions

Repeated transactions, drop 20% of observations by price changes – bottom 10% and top 10%

Dependent variable:	Log(sale amount)				
Treatment (Distance in miles)	3	2	1.5	1.25	1
	(1)	(2)	(3)	(4)	(5)
Post	-0.004	-0.002	-0.001	-0.000	-0.000
	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)
Post $\times$ $\mathbb{1}^{\text{Distance}<X\text{miles}}$	0.055***	0.054***	0.055***	0.055***	0.056***
	(0.003)	(0.003)	(0.004)	(0.004)	(0.005)
Post $\times$ $\mathbb{1}^{\text{Distance}<X\text{miles}}$ $\times$ Above	-0.122***	-0.126***	-0.128***	-0.129***	-0.131***
	(0.004)	(0.005)	(0.006)	(0.006)	(0.007)
Property fixed effects	Yes	Yes	Yes	Yes	Yes
Year $\times$ county fixed effects	Yes	Yes	Yes	Yes	Yes
R^2	0.96	0.96	0.96	0.96	0.96
Observations	882,582	671,732	585,016	548,666	517,483

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Robustness to the definition of above vs. below median

Repeated transactions, above and below median defined within rings

Dependent variable:	Log(sale amount)				
Treatment (Distance in miles)	3	2	1.5	1.25	1
	(1)	(2)	(3)	(4)	(5)
Post	0.004	0.005	0.008	0.008	0.007
	(0.009)	(0.009)	(0.009)	(0.010)	(0.009)
Post $\times \mathbb{1}^{\text{Distance}<X\text{miles}}$	0.115***	0.117***	0.116***	0.112***	0.109***
	(0.007)	(0.009)	(0.009)	(0.010)	(0.011)
Post $\times \mathbb{1}^{\text{Distance}<X\text{miles}} \times$ Above	-0.300***	-0.307***	-0.307***	-0.303***	-0.297***
	(0.013)	(0.015)	(0.016)	(0.017)	(0.018)
Property fixed effects	Yes	Yes	Yes	Yes	Yes
Year $\times$ county fixed effects	Yes	Yes	Yes	Yes	Yes
R^2	0.87	0.86	0.86	0.86	0.86
Observations	1,085,693	829,738	724,260	680,180	642,095

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Robustness to event window

Repeated transactions, expanding the event window size

Dependent variable:	Log(sale amount)									
Event window:	(-2,1)					(-3,1)				
Treatment (Distance in miles)	3	2	1.5	1.25	1	3	2	1.5	1.25	1
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Post	0.012**	0.013**	0.016***	0.015***	0.016***	0.015***	0.015***	0.015***	0.014***	0.015***
	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)
Post $\times \mathbb{1}^{\text{Distance}<X\text{miles}}$	0.093***	0.089***	0.086***	0.083***	0.079***	0.084***	0.081***	0.078***	0.074***	0.070***
	(0.006)	(0.007)	(0.008)	(0.008)	(0.009)	(0.005)	(0.006)	(0.007)	(0.008)	(0.008)
Post $\times \mathbb{1}^{\text{Distance}<X\text{miles}} \times$ Above	-0.248***	-0.252***	-0.252***	-0.252***	-0.247***	-0.219***	-0.222***	-0.222***	-0.220***	-0.216***
	(0.010)	(0.012)	(0.012)	(0.014)	(0.014)	(0.009)	(0.010)	(0.010)	(0.011)	(0.012)
Property fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year × county fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.87	0.87	0.86	0.86	0.86	0.87	0.87	0.87	0.87	0.87
Observations	2,024,515	1,546,964	1,348,404	1,266,398	1,195,207	3,127,192	2,387,778	2,080,655	1,954,800	1,846,326

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Alternative classification of Hispanic buyers

All transactions, predicted probability greater 90%

	Panel A: Buyers				
Dependent variable:	$\mathbb{1}$(Hispanic)				
Treatment (Distance in miles)	3	2	1.5	1.25	1
	(1)	(2)	(3)	(4)	(5)
Post	-0.007***	-0.007***	-0.006***	-0.005**	-0.003*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Post $\times$ $\mathbb{1}^{\text{Distance} < X \text{miles}}$	0.016***	0.021***	0.024***	0.025***	0.028***
	(0.003)	(0.003)	(0.004)	(0.004)	(0.005)
Plant fixed effects	Yes	Yes	Yes	Yes	Yes
Year $\times$ county fixed effects	Yes	Yes	Yes	Yes	Yes
R^2	0.17	0.17	0.17	0.17	0.17
Observations	6,177,760	4,701,805	4,088,040	3,832,287	3,615,276

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Alternative classification of Hispanic sellers

All transactions, predicted probability greater 90%

	Panel B: Sellers				
Dependent variable:	$\mathbb{1}$(Hispanic)				
Treatment (Distance in miles)	3	2	1.5	1.25	1
	(1)	(2)	(3)	(4)	(5)
Post	-0.005***	-0.005***	-0.004***	-0.004***	-0.003**
	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
Post $\times\ \mathbb{1}^{\text{Distance}<X\text{ miles}}$	0.010***	0.014***	0.016***	0.018***	0.019***
	(0.002)	(0.003)	(0.003)	(0.004)	(0.005)
Plant fixed effects	Yes	Yes	Yes	Yes	Yes
Year $\times$ county fixed effects	Yes	Yes	Yes	Yes	Yes
R^2	0.13	0.13	0.13	0.12	0.12
Observations	4,795,888	3,640,031	3,158,636	2,959,388	2,788,211

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