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Excess emissions from industrial facilities: What are they and why should we care about them?

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Introduction

Excess emissions are a specific class of emissions released during periods of startups, shutdowns or malfunctions (SSM) from industrial facilities[1]. For decades, excess emissions have remained outside of the regulatory and enforcement focus of the EPA. In a recently published paper at the Journal of Environmental Science and Technology[2] we analyzed a unique dataset of excess emissions from industrial facilities in Texas. Our findings suggest that these pollution releases occur on a regular basis and are large enough to represent a sizeable share of permitted emissions. Using an Integrated Assessment Model, we estimated that the health impacts of excess emissions are approximately $150 million per year in Texas.

Background

Excess emissions due to SSM that go beyond a facility's permitted levels have been considered violations of the Clean Air Act (CAA) since the law was enacted[1]. While states have always been required to regulate these releases in their State Implementation Plans (SIPs), they have for years regularly granted automatic exemptions to facilities with excess emissions[a]. Even though there have been several court decisions with regards to SSM requirements over the years, a great deal of uncertainty and inconsistency across states exists as to how excess emissions are regulated[3,4]. In 2015 the EPA identified 36 states whose SIPs included language that was inadequate to meet the standards of the CAA with regards to how excess emissions were treated[1,b]. States have begun to revise their SIPs, but the new EPA administration has signaled that it might consider withdrawing the 2015 SIP call[5].

The problematic regulatory landscape of excess emissions described above, is compounded by the fact that few states keep systematic records of excess emissions events and even fewer make that data available to the public in a comprehensive manner. Texas, Louisiana and Oklahoma are the only three states that have developed comprehensive reporting requirements for excess emissions and make the information publicly available. Other states that collect data on excess emissions and make them available to the public do so on a case-by-case basis. For practical purposes, that makes analyzing the information on excess emissions very challenging.

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[a] The EPA defines an automatic exemption as a "generally applicable provision in a SIP that would provide that if certain conditions existed during a period of excess emissions, then those exceedances would not be considered violations of the applicable emissions limitations."[1]

[b] The 2015 EPA SIP call came as a response to a 2011 petition filled by the Sierra Club which argued that many states had provisions in their SIPs that did not follow EPA's guidance on automatic exemptions[10].

Since 2003 the Texas Commission on Environmental Quality (TCEQ), has implemented a 24-hour reporting requirement. Any facility in the state that experiences an excess emissions event (where emissions cross a certain threshold) has 24 hours to report that event to the TCEQ. The facility is then given two weeks to submit a final report that, if necessary, will provided updated/corrected information about the types and amounts of pollutants that were released[c].

Key findings

Studying data from the Texas Emissions Inventory[6] as well as the Air Emissions and Maintenance Events dataset[7] (described above) over the period of 2003-2017 we arrived at the following key findings.

Excess vs. Permitted emissions

The magnitude of excess emissions is sizeable especially when compared to permitted emissions. Across all facilities, excess emissions of Volatile Organic Compounds (VOCs) represented 7.5% of permitted emissions in the time period 2004-2015. The relevant ratio for other criteria pollutants is 2% (sulfur dioxide and carbon monoxide), 1.5% (for particular matter 10 and 2.5), and 0.5% (nitrogen oxides). Among the group of VOCs several pollutants had significantly high ratios of excess over permitted emissions. Examples include N Butane (22%), propylene (20%), ethylene (14%), and benzene (5.5%).

Key industrial sectors

A small number of industrial sectors, emit the vast majority of excess emissions. The top five sectors—Natural Gas Liquids, Refineries, Industrial Organic Chemicals, Electric Services, Crude Oil and Natural Gas—emit upwards of 80% of excess emissions of all industrial sectors in Texas. Moreover, the ratio of excess to permitted emissions for those sectors can be substantial. Figure 1 shows the ratio of excess to permitted emissions of VOCs for the top polluting sectors.

[c] More information on the TCEQ's reporting requirements as well as the way excess emissions are defined by the TCEQ can be found in section 4 of Zirogiannis et al. (2018)[2].

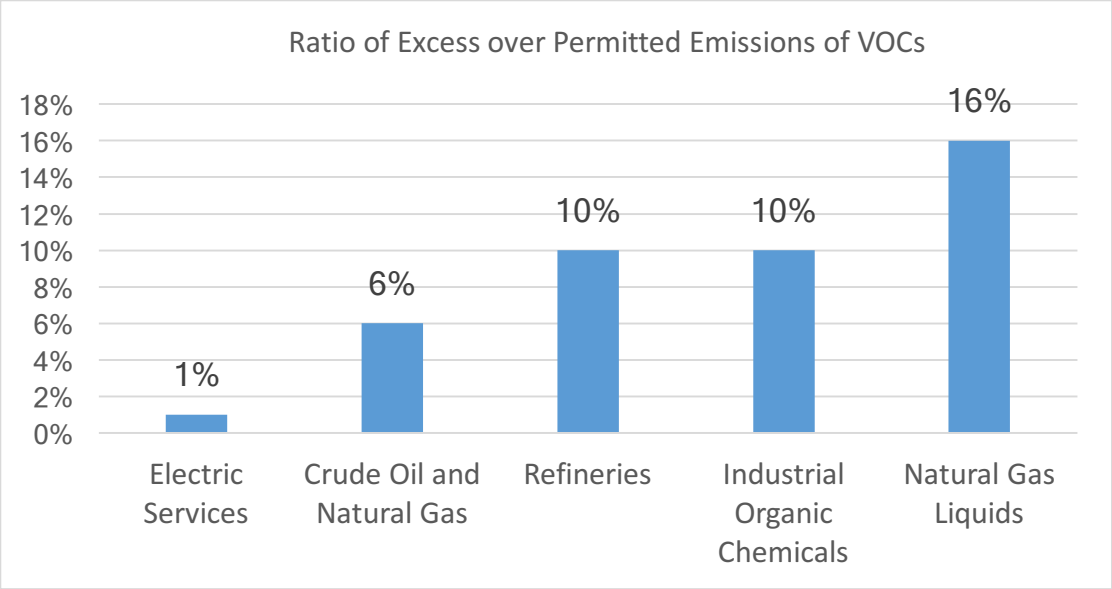

Figure 1: Ratio of excess over permitted emissions of VOCs for top polluting sectors. Reprinted with permission from Zirogiannis, N., Hollingsworth, A.J., and Konisky, D.M. (2018). Understanding Excess Emissions from Industrial Facilities: Evidence from Texas. Environmental Science and Technology (DOI: 10.1021/acs.est.7b04887). Copyright (2018) American Chemical Society. https://pubs.acs.org/doi/10.1021/acs.est.7b04887

Episodic or routine

When Hurricane Harvey hit Texas in August 2017, dozens of facilities had to shut down (and then later start up after the storm passed) their operations to minimize damages from extreme weather. In the process they released approximately 2,000 tons of excess emissions. While one would expect that excess emissions are more frequent during extreme weather events, such as floods or hurricanes, our analysis showed that they are in fact a routine part of industrial operations. We found that only 10% of all excess emissions events can be attributed to force majeure weather (like lightning, flash floods, fires and hurricanes).

Distribution of emissions

Excess emissions releases are highly skewed. While thousands of excess emissions events occur every year in Texas, the median event (that is, the excess emission event in the 50th percentile of the distribution) releases less than one ton of a given pollutant. The top 5% of excess emissions events release the vast majority of pollutants across the most polluting industrial sectors. Further evidence of this skewed pattern can be found within the top polluting sectors. For example, the 6 most polluting refineries in Texas are responsible for 77% of all carbon monoxide excess emissions from all refineries operating in the state[d].

Health effects

Using an Integrated Assessment model[8,9], we find that excess emissions are responsible for $150 million in health damages annually in Texas. This estimate pertains only to premature mortality attributed to

[d] More information on the pattern and frequency of criteria pollutant excess emissions across key industrial sectors is provided in the Appendix of Zirogiannis et al. (2018)[2].

secondary particulate matter emissions (formed from sulfur dioxide and nitrogen oxide emissions). Given that this estimate included only mortality (and not morbidity), it can be considered a lower bound of health effects. As can be seen in Figure 2, excess emissions from refineries are responsible for a significant share of those health effects.

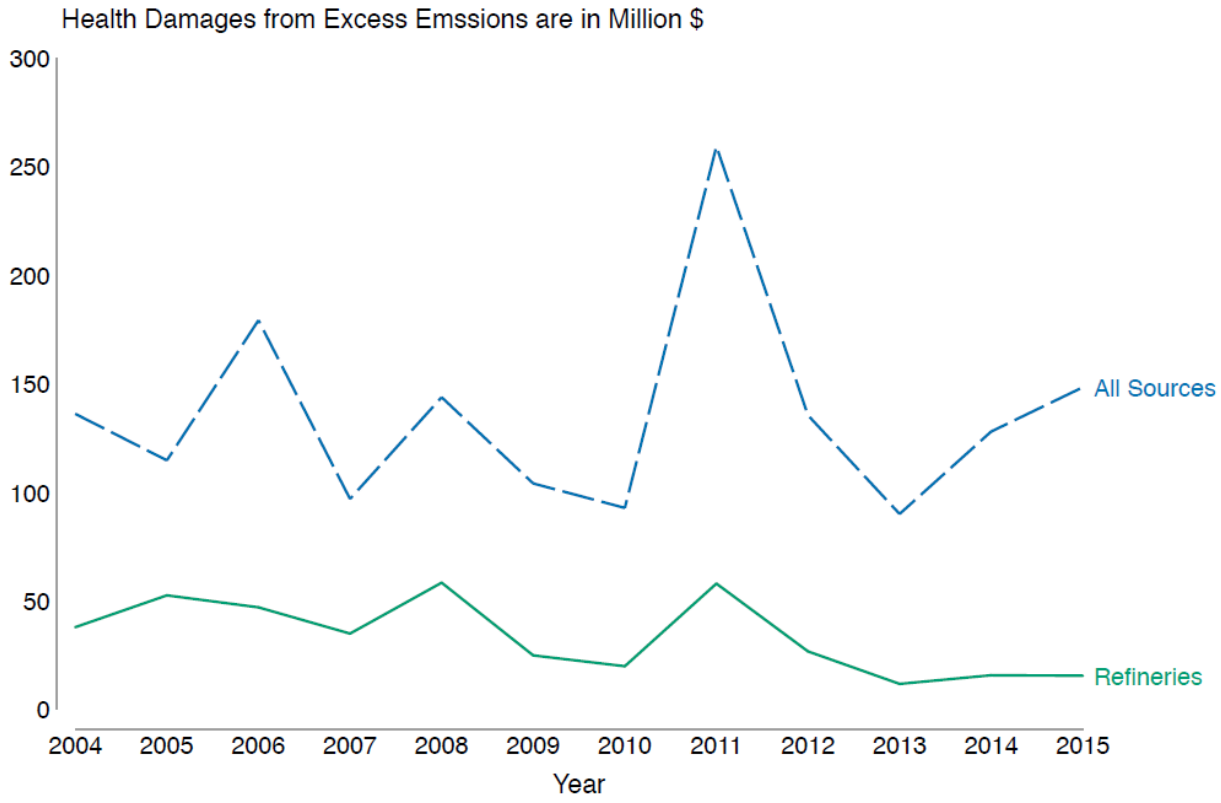

Figure 2: Health damages from excess emissions by year in Texas.

Conclusion

Excess emissions represent an under-regulated and under-studied class of emissions. Using data from the TCEQ, our research finds that excess emissions represent a substantial share of permitted emissions and that a relatively small number of facilities in a few industrial sectors are responsible for a sizeable share of excess emissions. While Texas has detailed reporting requirements for excess emissions and maintains a thoroughly documented dataset, the same is not true for other states. Given their magnitude and substantial health impacts it is imperative that other states begin systematically tracking excess emissions and making the data available to the public. This is particularly important given the current uncertainty around EPA's ultimate position on how excess emissions should be regulated.

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