

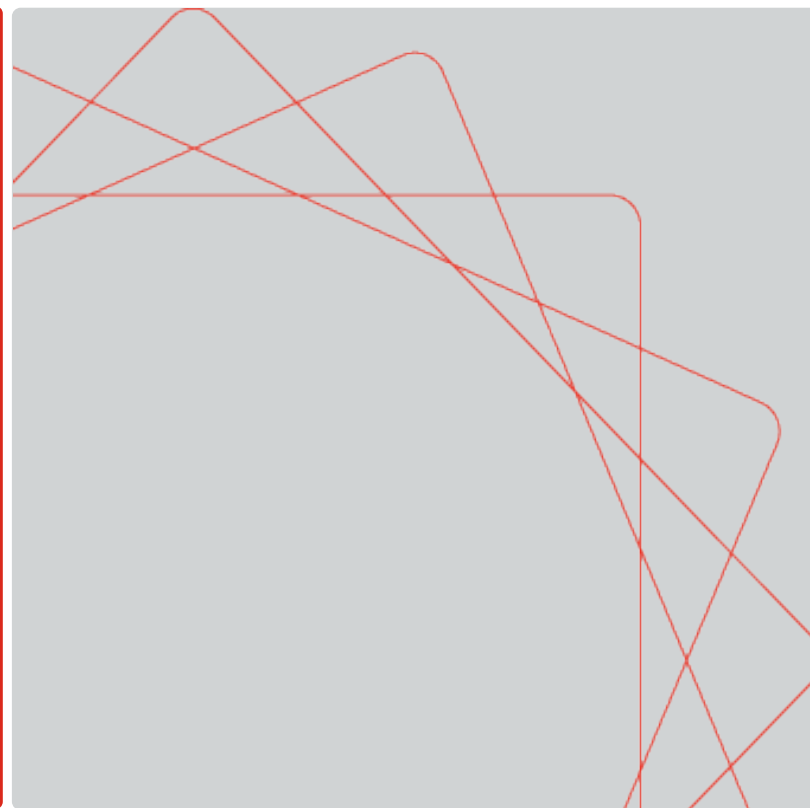


The Cumulative Impact of Source Reduction on U.S. Toxic Releases

Evidence from a Differences-in-
Differences Analysis

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Background

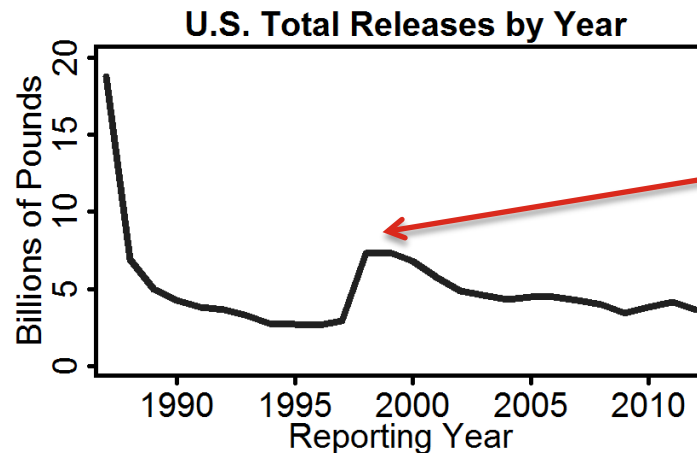


- Source reduction is a proactive approach for managing toxic releases from industrial facilities.
 - Definition: reducing the volume or toxicity of waste at the source by changing the material-generating process.
 - Examples: redesigning a product to use fewer materials; substituting a safer chemical for a more toxic one; preventing spills and leaks.
- Why do source reduction?
 - Inexpensive compared to end-of-pipe controls (such as scrubbers).
 - Voluntary approach, so attractive to both government and industry.
- Sounds great...but how effective is it?

Motivation



- Between 1991 and 2012, the 56,000 facilities that reported to the TRI program carried out 370,000 source reduction projects.
- Over the same time period, annual aggregate U.S. toxic releases declined significantly.



(The increase in releases in 1998 is due to an expansion of TRI reporting requirements to new industries.)

- Research question: What role did source reduction play in this large decrease in U.S. toxic releases?

Research Overview



- Goal: To understand how source reduction affects facilities' releases of toxic chemicals. Two questions:
 - 1) How do the average facility's TRI releases change when it implements a source reduction project?
 - 2) How has source reduction affected U.S. aggregate TRI releases over the last 20 years?

- Data: Taken from the TRI reporting program.
 - 1987-2012: Toxic releases, by facility, chemical, and year
 - 1991-2012: Number of source reduction projects, by facility, chemical, and year

Research Overview



- Methodology: “Differences-in-differences” approach (common in economics literature)
 - Estimates how toxic releases at each facility-chemical changed in the year before and after implementing a source reduction project.
 - Controls for other facility- and industry-level factors (e.g., changes in production, economic conditions, pollution regulations).
- Main findings (still preliminary!):
 - The average source reduction project results in a 13 percent decrease in facility-level TRI releases (of targeted chemicals).
 - Between 1991 and 2012, source reduction may have reduced cumulative U.S. TRI releases by as much as 26 billion pounds.

Presentation Outline



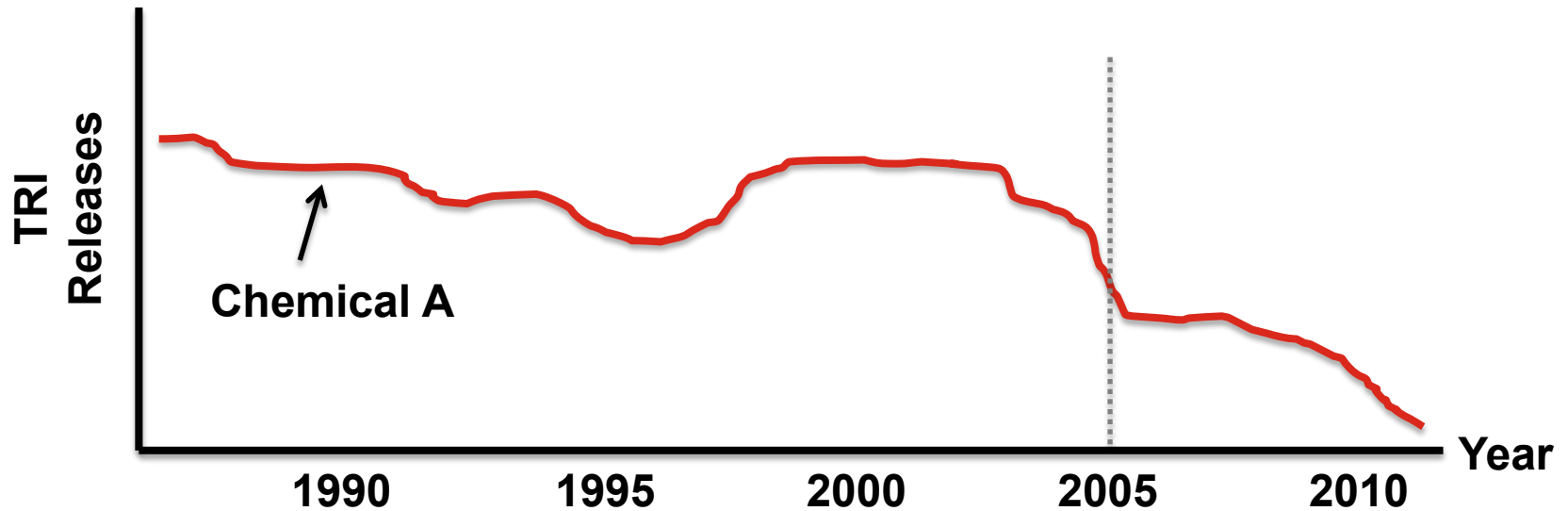
- **Methodology**
- **Results**
- **Discussion**

Methodology



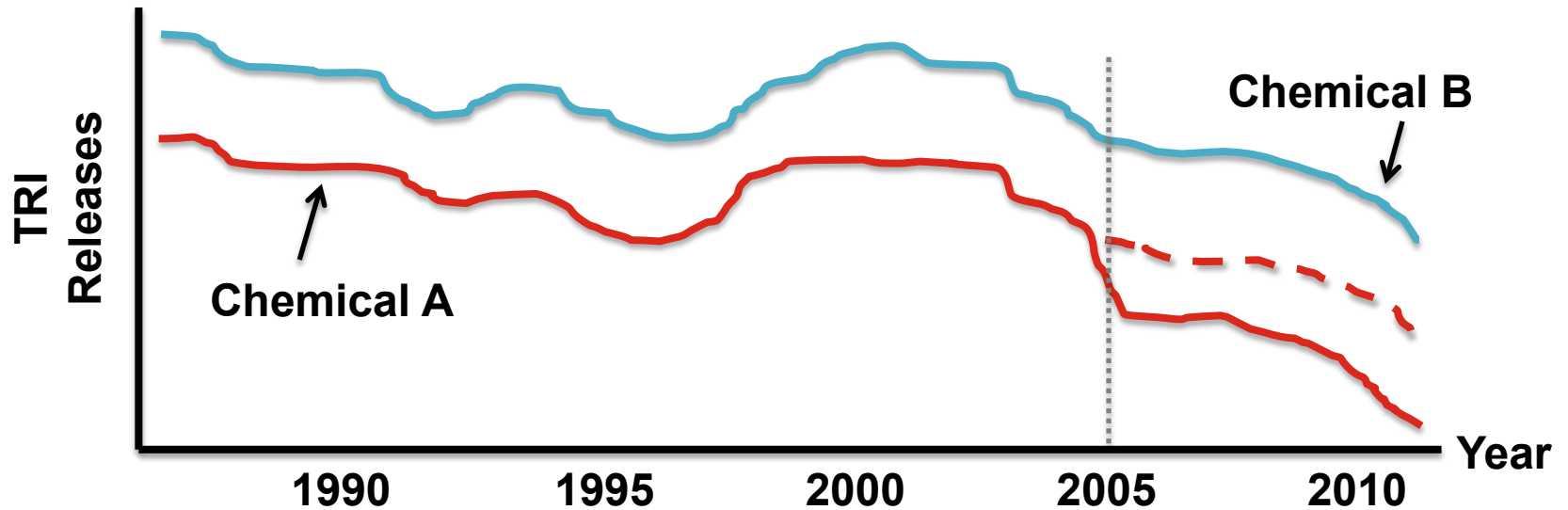
Methodology

Differences-in-Differences Approach



- Suppose that a facility implements a source reduction project that reduces its releases of a particular chemical in 2005.
 - We want to measure how the project affected its releases.
 - **Problem:** We don't know how releases would have changed anyway if the facility hadn't implemented the project.

Differences-in-Differences Approach

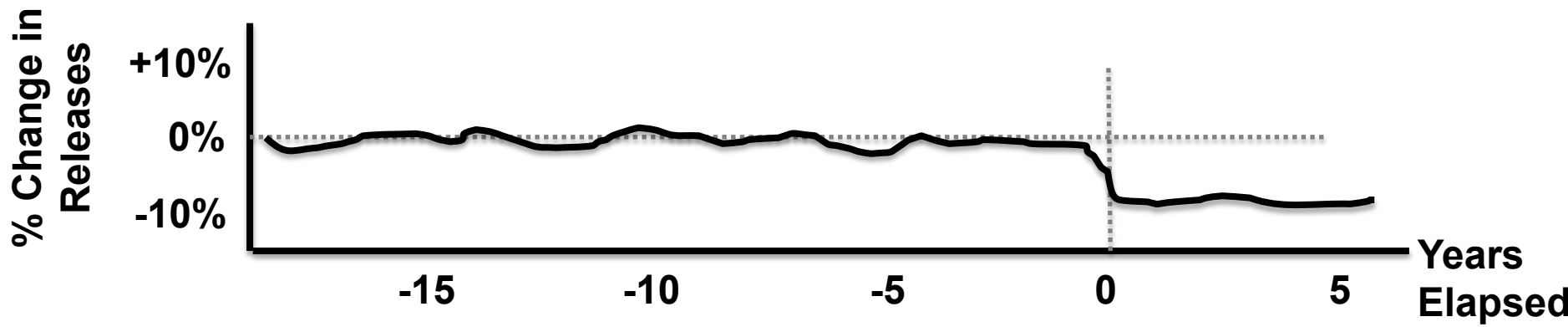
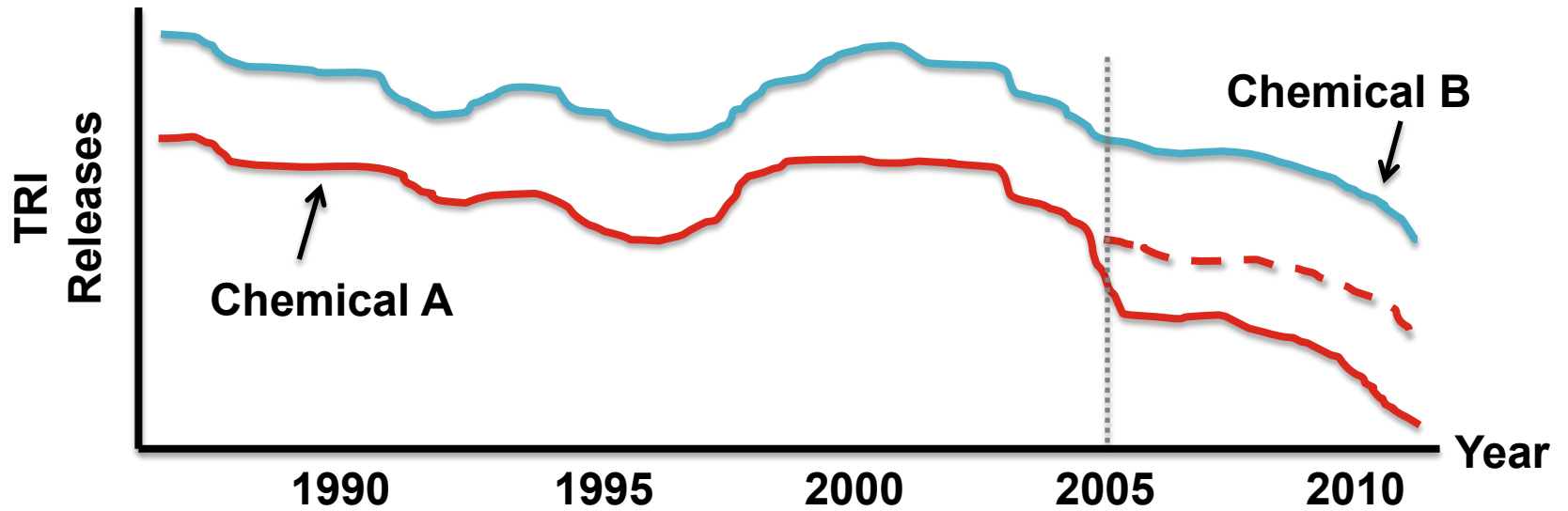


Solution:

- 1) Compare the trend in releases of the affected chemical against the trends in releases of unaffected chemicals from the same facility.
- 2) The difference in the changes in releases is due to source reduction.

(Note that we drop facilities that only report one type of chemical.)

Differences-in-Differences Approach



Results

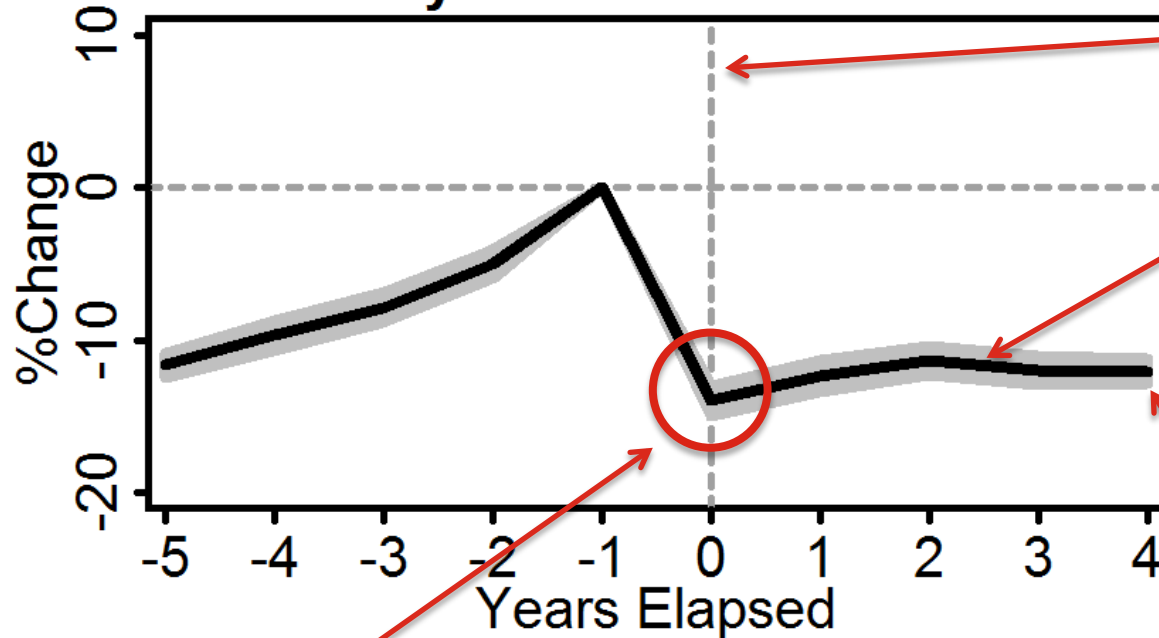


Results

Average Impact on Facility-level Releases



Impact of Source Reduction on Facility-Chemical Total Releases



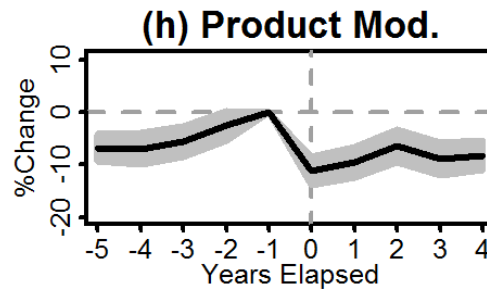
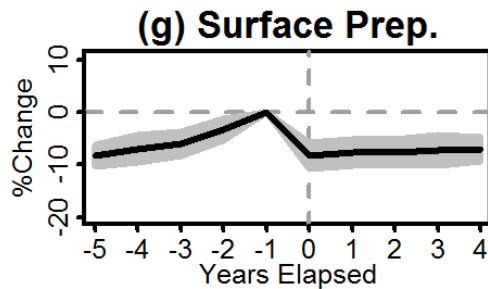
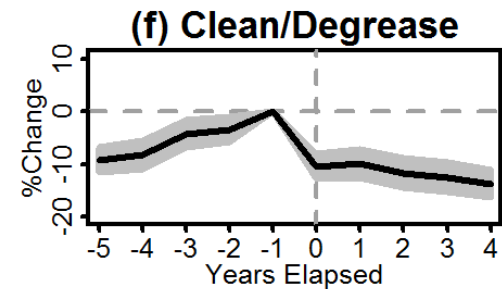
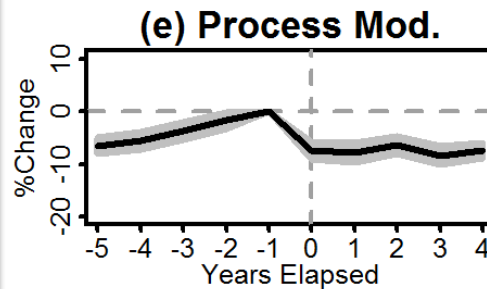
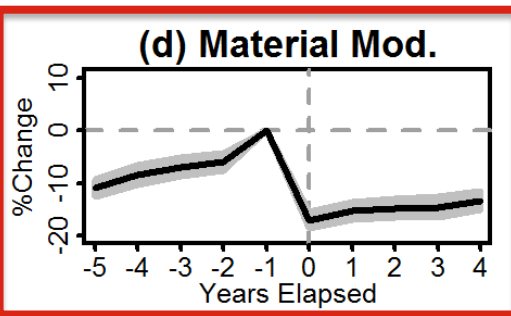
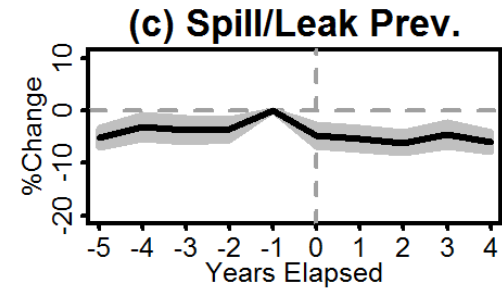
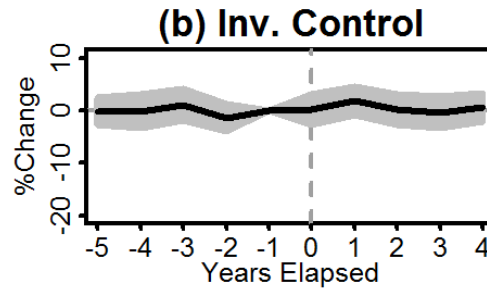
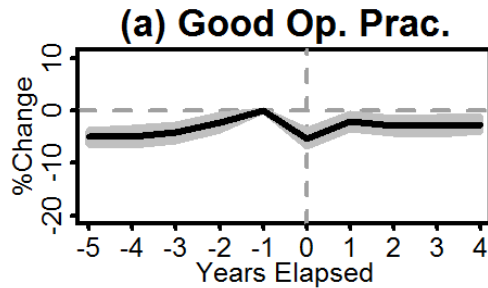
The source reduction project occurs in year 0.

The solid black line shows how average releases change in the years before and after a source reduction project.

The gray area is a 95% confidence interval.

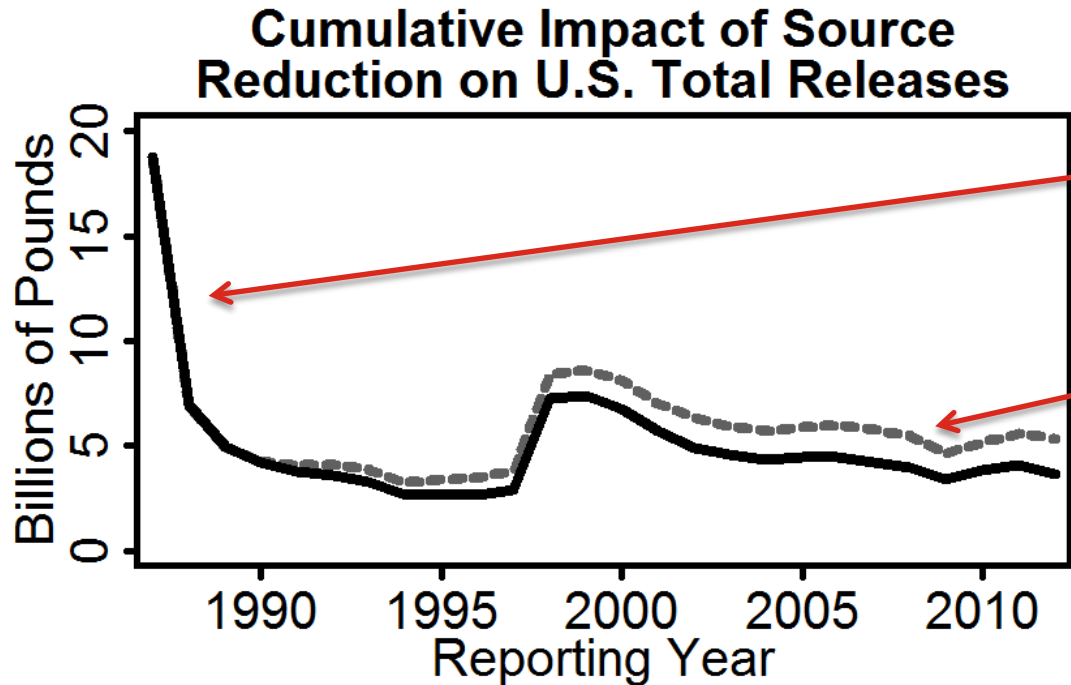
Main result: In the year a facility implements a source reduction project, its releases of targeted chemicals decrease by an average of 13%.

Average Impact on Facility-level Releases, by Type of Project



Raw material modification has the biggest effect on releases.

Cumulative Impact on U.S. Total Releases



The solid black line shows actual total annual TRI releases of all chemicals.

The gray line shows simulated releases, if no source reduction projects had occurred.

- Main result: Between 1991 and 2012, source reduction prevented 26 billion pounds of toxic releases in the United States.
- (Actual cumulative releases were 130 billion pounds over the same period.)

Discussion



Discussion

Uncertainties and Limitations



This analysis has several uncertainties and limitations. For example:

- This is still preliminary research.
- The differences-in-differences approach is reasonable, but not perfect.
 - TRI releases of affected chemicals increase in the years before a source reduction project (compared to unaffected chemicals).
- Because of the TRI reporting thresholds, some facilities might be able to stop reporting after a successful source reduction project.

Conclusions



Two main conclusions:

- The average source reduction project results in a 13 percent decrease in facility-level TRI releases.
- Between 1991 and 2012, source reduction may have reduced aggregate TRI releases by as much as 26 billion pounds.

These estimates are work-in-progress, but they still highlight the potential impacts of source reduction.

Thanks!



Thanks!