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Differential Impact of Pollution Prevention and Green Chemistry Activities on Marginalized Communities

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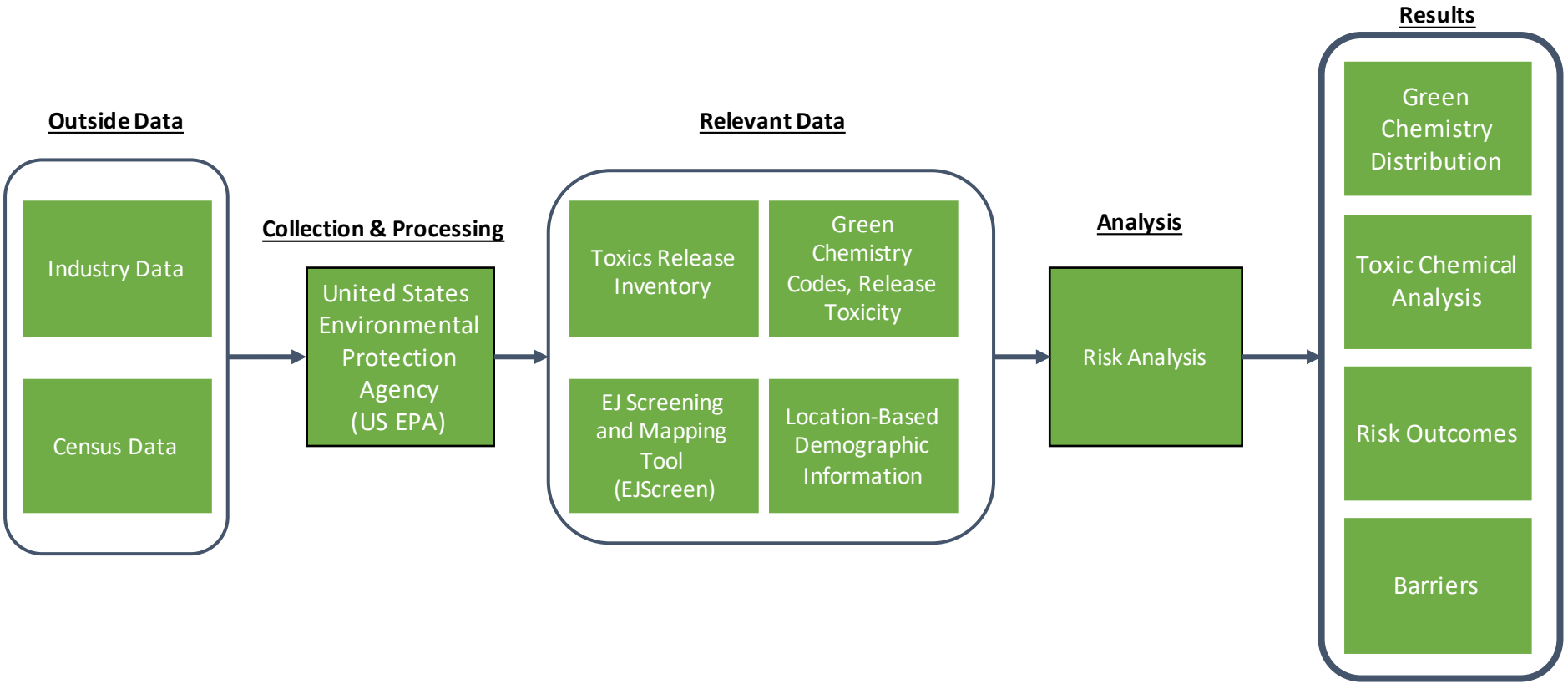
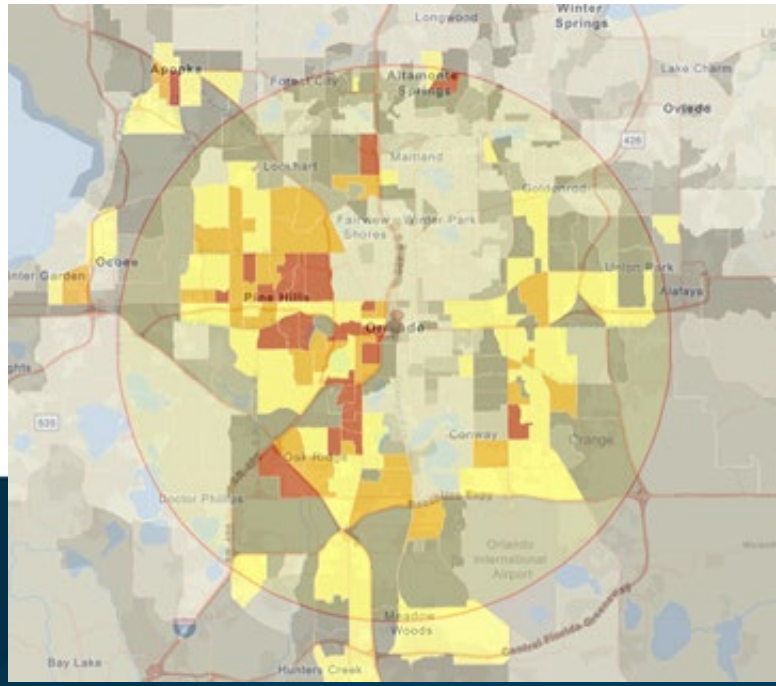

Outside Data
Industry Data
Census Data
Collection & Processing
United States Environmental Protection Agency (US EPA)
Relevant Data
Toxics Release Inventory
Green Chemistry Codes, Release Toxicity
EJ Screening and Mapping Tool (EJScreen)
Location-Based Demographic Information
Analysis
Risk Analysis
Results
Green Chemistry Distribution
Toxic Chemical Analysis
Risk Outcomes
Barriers

Demographic Index & Divisions

- Index based on the average of two demographic indicators:
  - Minority
  - Low-Income
- Analysis at 3 different demographic divisions:
  - Similar population groups
    - Census Block Group - Average 9.4 square mi
    - Census Tract - Average 26.4 square mi
  - Area Groups
    - 10 Mile Radius - 314 square mi



(EJSCREEN, 2022)

Not at Risk vs At Risk

- EJSCREEN User Manual defines marginalized communities as having a demographic index above the 80th percentile

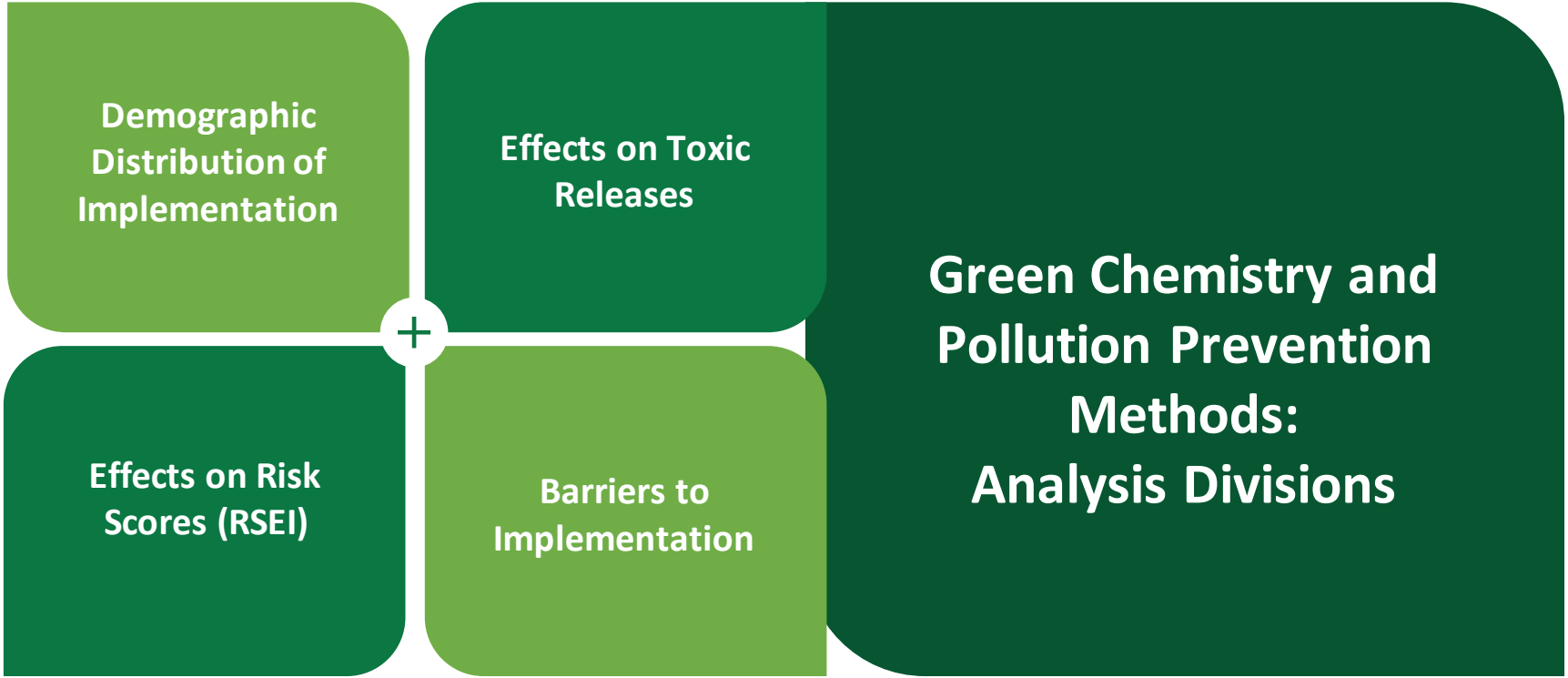
- Meaning, above 57.51% Demographic Index is an At Risk community

National Percentiles for Demographic Index	
National Percentiles	Percentages
95 - 100 percentile	≥ 80.01
90 - 95 percentile	< 80.01
80 - 90 percentile	< 71.54
70 - 80 percentile	< 57.51
60 - 70 percentile	< 45.72
50 - 60 percentile	< 36.35
Less than 50 percentile	< 29.26

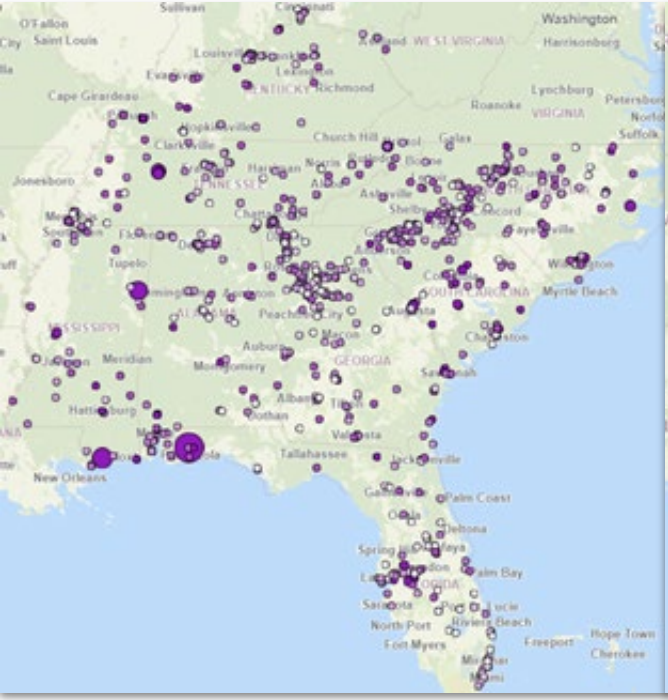
Scope

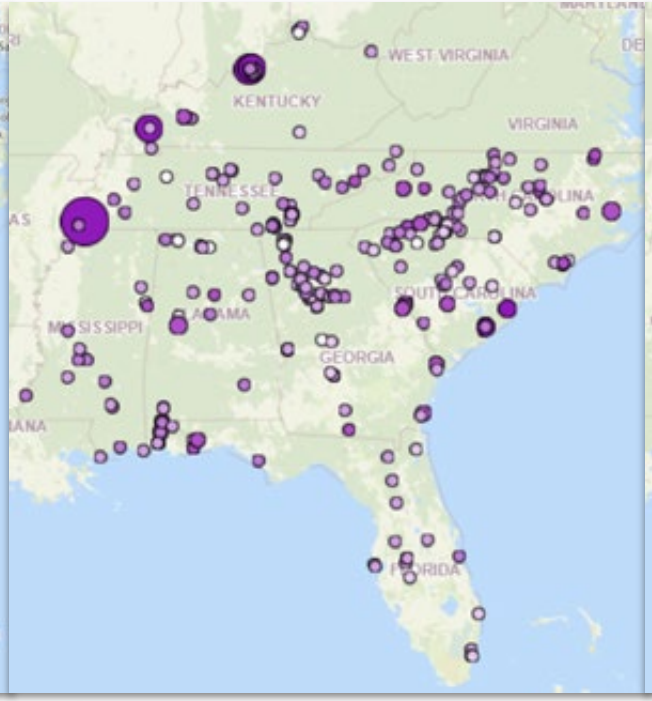
- EPA Region 4
  - 3rd greatest toxic releasing region
  - Multiple areas with high minority populations
  - Prominence of the chemical industry
- North American Industry Classification System (NAICS) Codes
  - Chemical Industry (325)
  - Subsectors of chemical industry
- Air and Water Releases
  - Land releases excluded

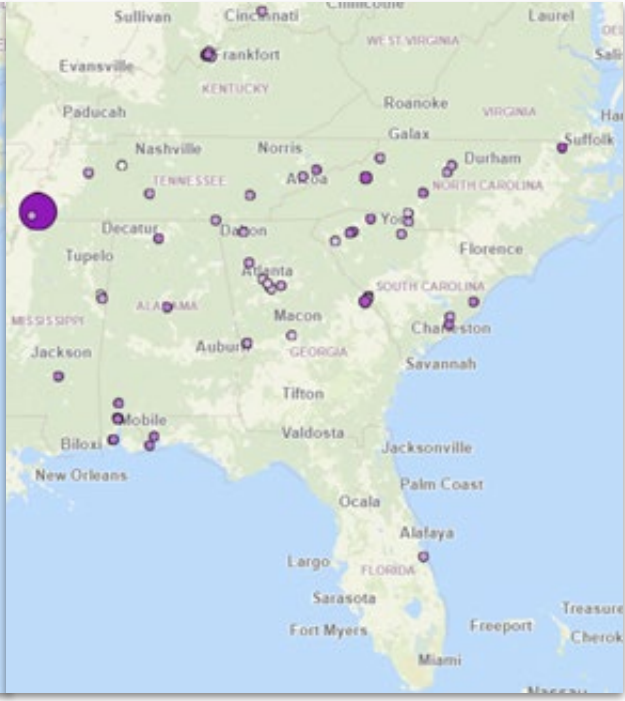
(EPA, 2022)


Demographic Distribution of Implementation
Effects on Toxic Releases
Effects on Risk Scores (RSEI)
Barriers to Implementation
Green Chemistry and Pollution Prevention Methods: Analysis Divisions

Green Chemistry/Pollution Prevention Implementation







All facilities with release reports

Facilities with P2 activities

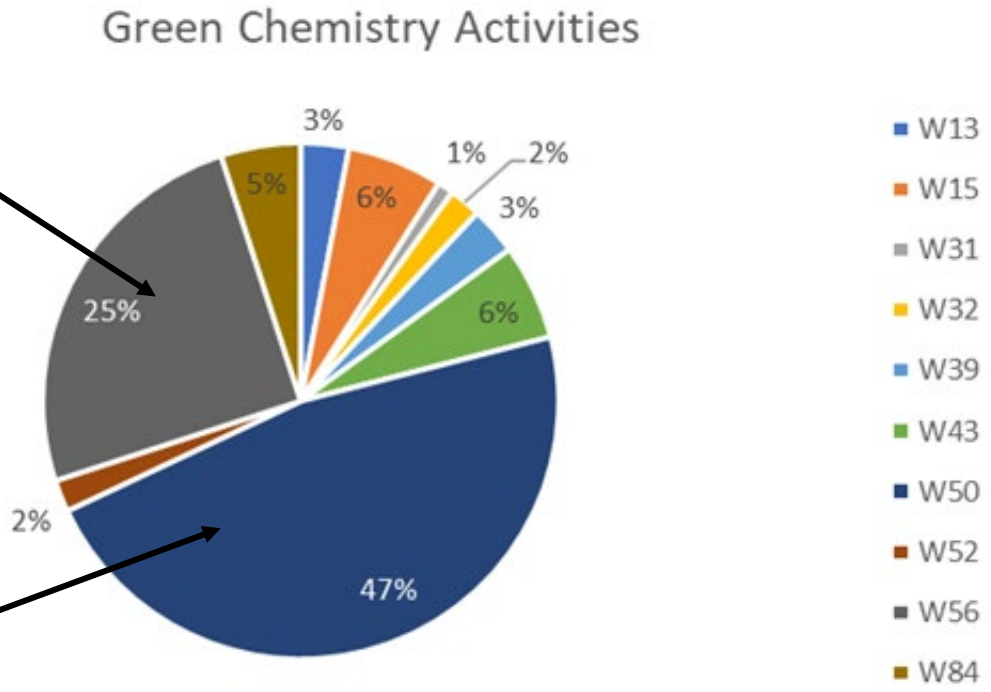
Facilities with GC activities

(TRI Toxics Tracker, 2022)

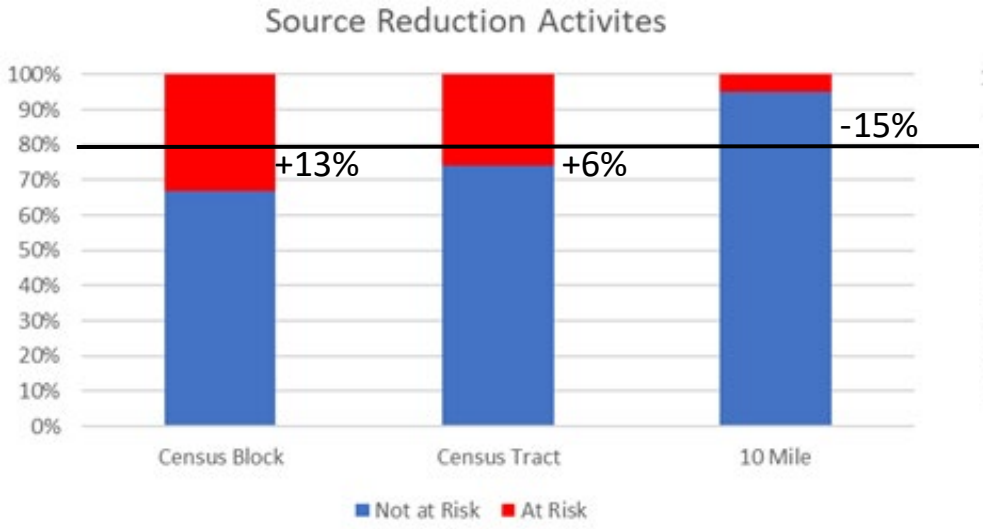
Green Chemistry Implementation by W-Code

W56 - Reduced or eliminated use of organic solvent (Process Modification)

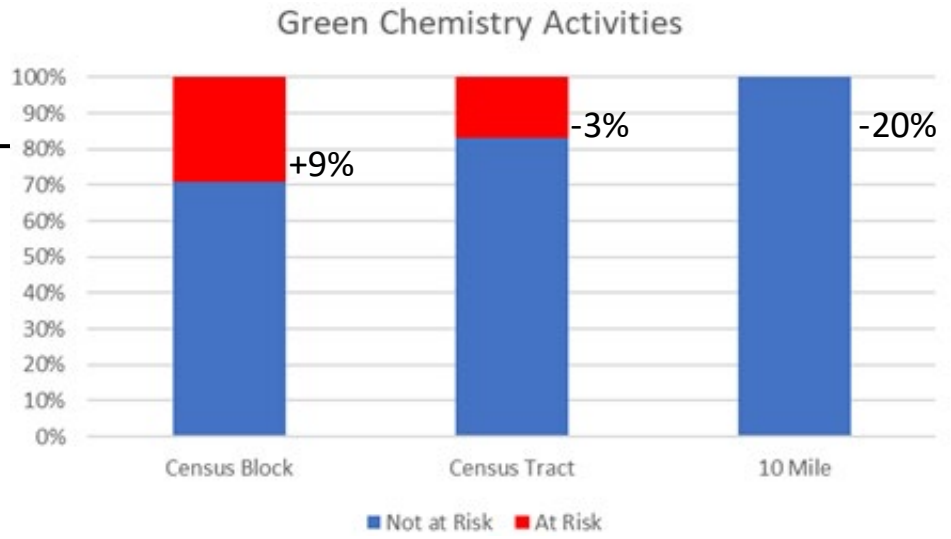
W50 - Optimized Reaction Conditions or Increased Reaction Efficiency



Demographic Distribution of Facilities



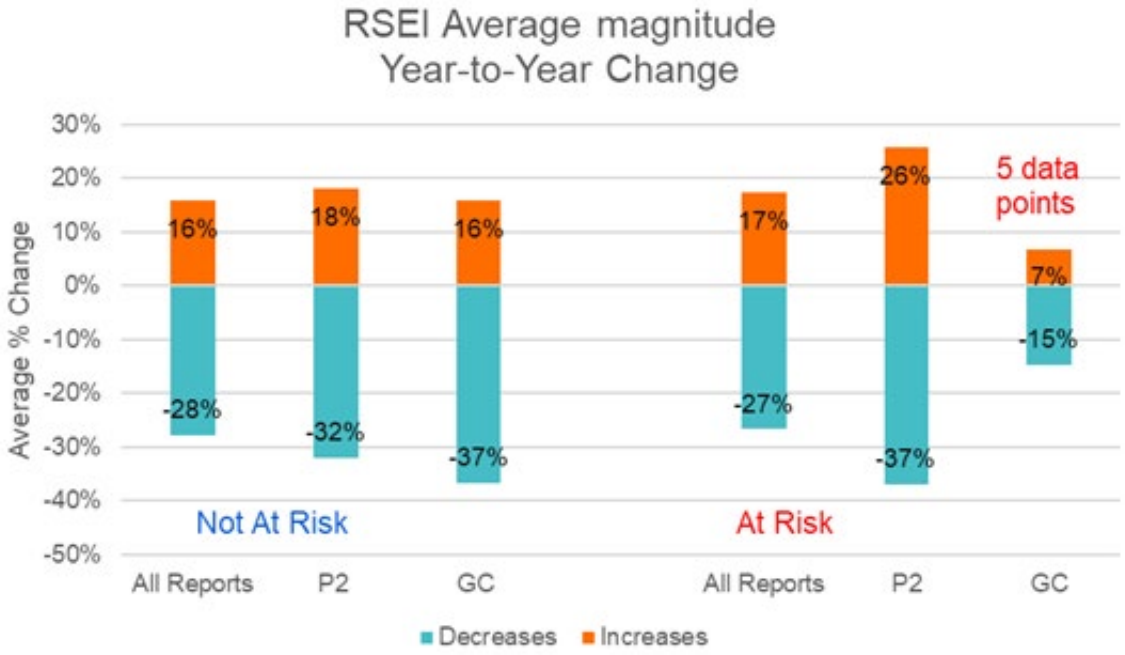
172 Facilities total



24 Facilities total

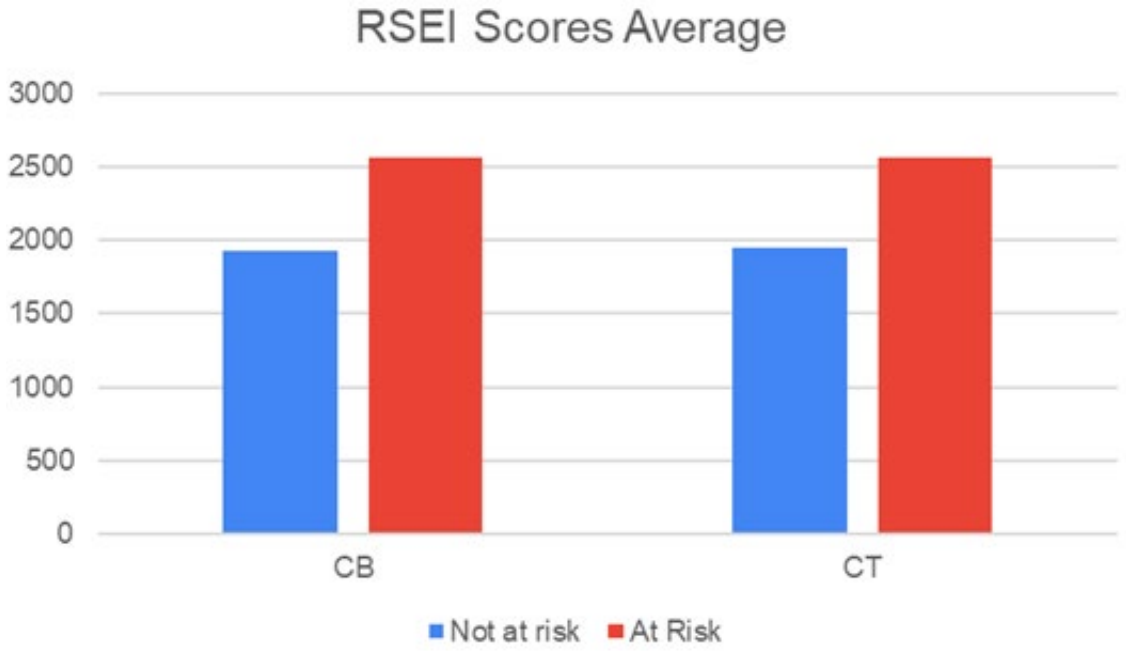
Outcomes: Year-to-Year changes

- With P2 and GC activities have greater reductions of RSEI scores.
- GC in at risk communities has a much smaller impact.



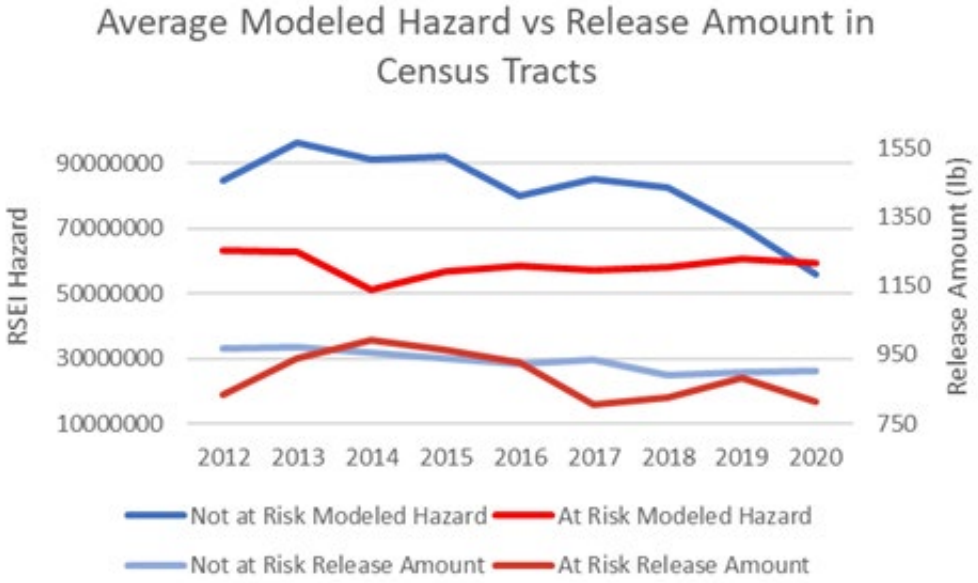
Average RSEI Score

- At risk communities have a higher per report RSEI score
- RSEI score includes affected population



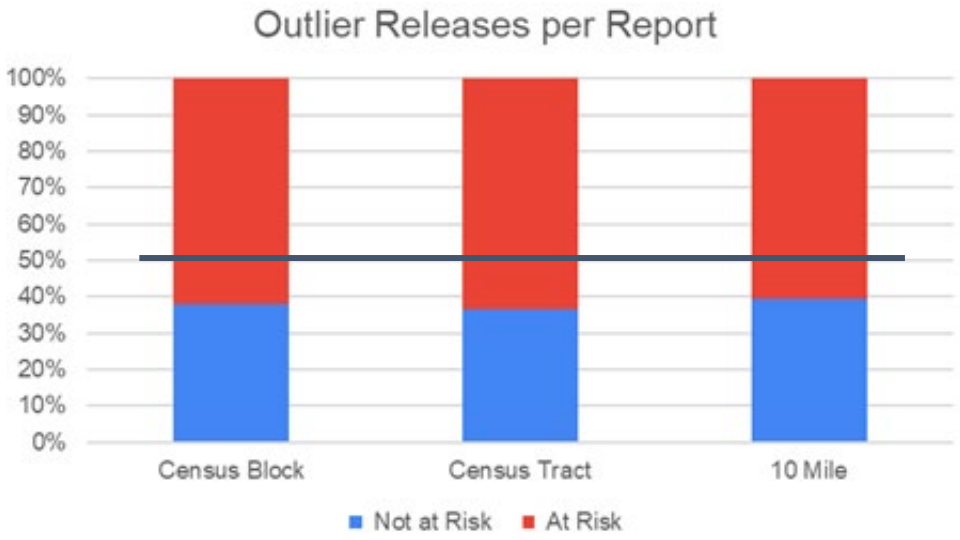
Modeled Hazard vs Release Amount

- Average Modeled Hazard decreases across Not at Risk communities
- Average Release Amount stays constant in both Not at Risk and At Risk communities



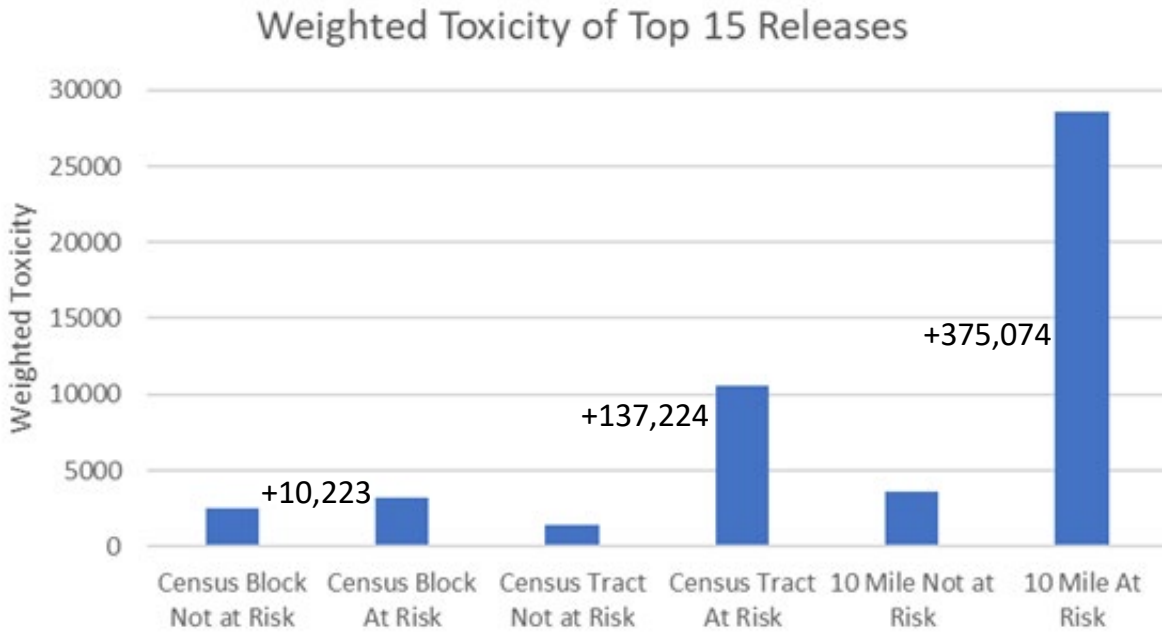
Outliers - Toxic Releases

- Outliers report releases greater than 7,171 pounds
- Average releases were greater in At Risk communities than Not at Risk Communities



Weighted Toxicity

- Weighted Toxicity removes influence of release amount
- Top releases in At Risk communities release more toxic chemicals



Barriers (B) to Pollution Prevention (P2)

B1 - Insufficient capital to install new source reduction equipment or implement new source reduction activities/initiatives

B2 - Require technical information on pollution prevention techniques applicable to specific production processes

B3 - Concern that product quality may decline as a result of source reduction

B4 - Source reduction activities were implemented but were unsuccessful

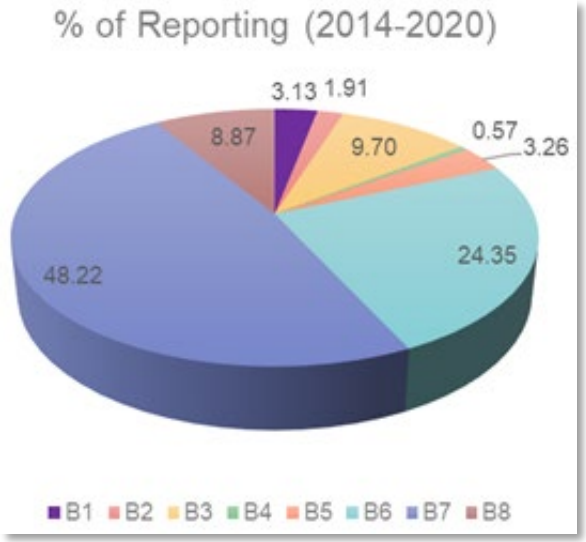
B5 - Specific regulatory/permit burdens

B6 - Pollution prevention previously implemented; additional reduction does not appear technically or economically feasible

B7 - No known substitutes or alternative technologies

B8 - Reduction does not appear to be technically feasible

B99 - Other Barriers



Cost/Regulatory

B1 - ***Insufficient capital*** to install new source reduction equipment or implement new source reduction activities/initiatives

B5 - Specific ***regulatory/permit burdens***

B6 - Pollution prevention previously implemented; ***additional reduction does not appear*** technically or ***economically feasible***

Lack of Knowledge/Technical Ingenuity

B2 - ***Require technical information*** on pollution prevention techniques applicable to specific production processes

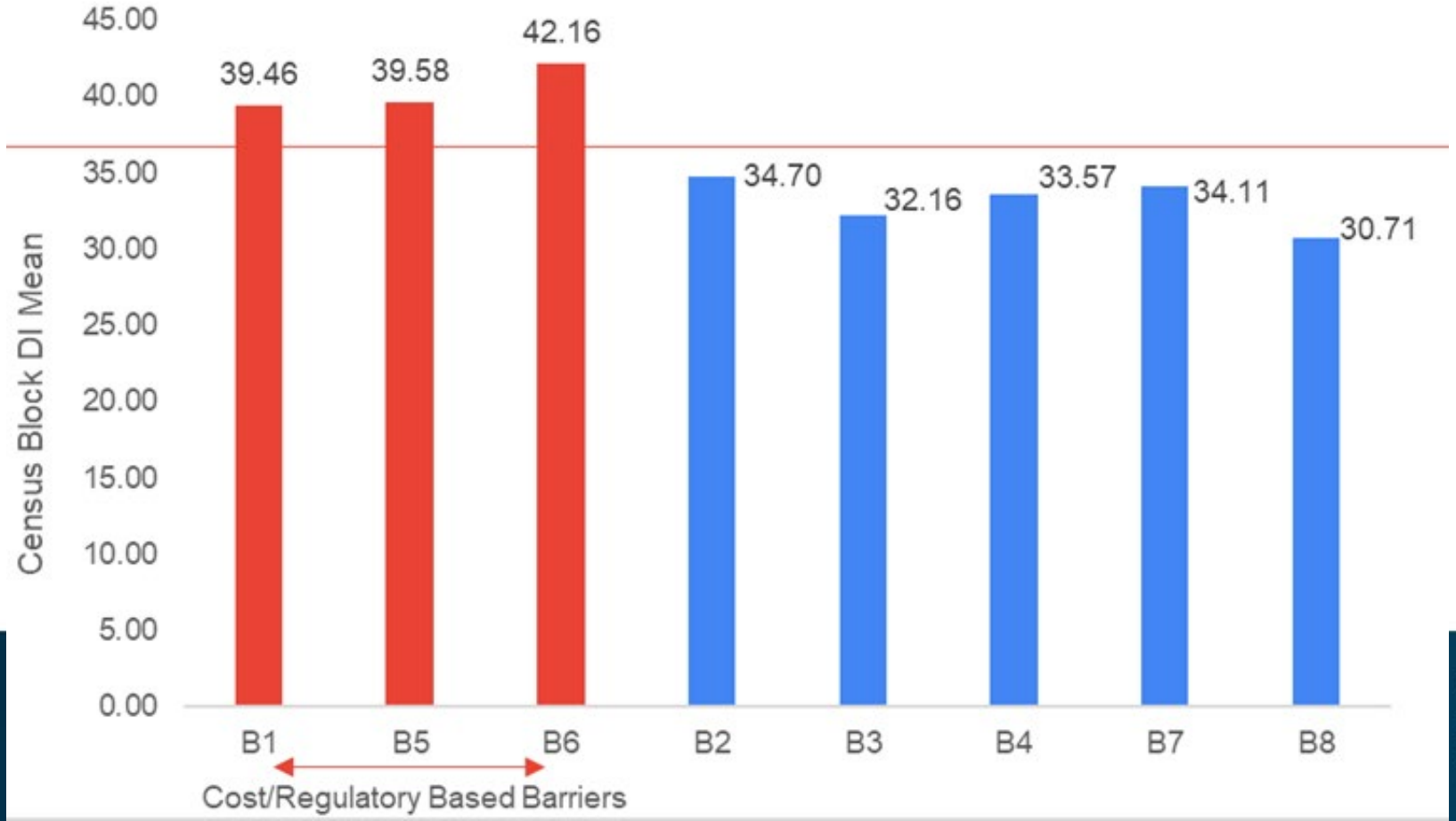
B3 - Concern that ***product quality may decline*** as a result of source reduction

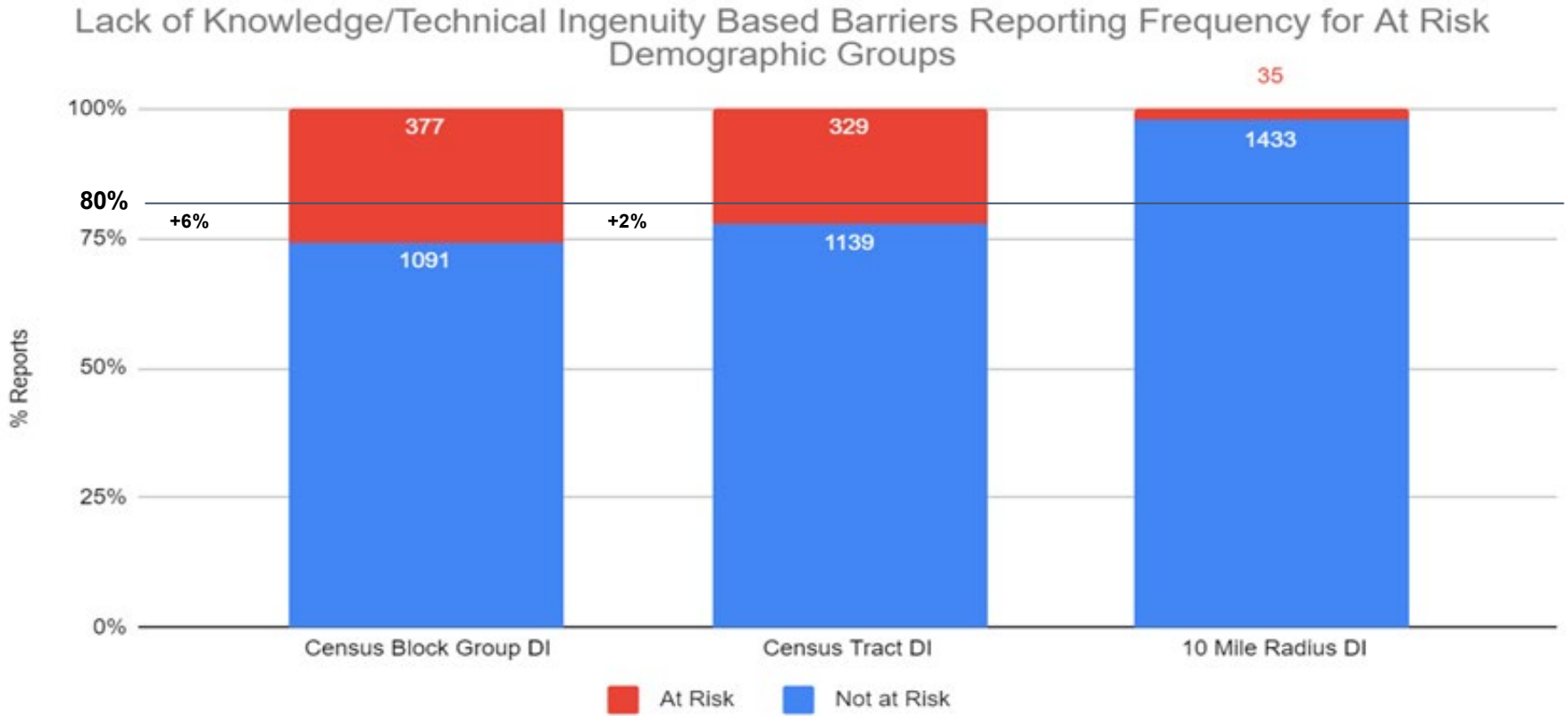
B4 - ***Source reduction*** activities were implemented but were ***unsuccessful***

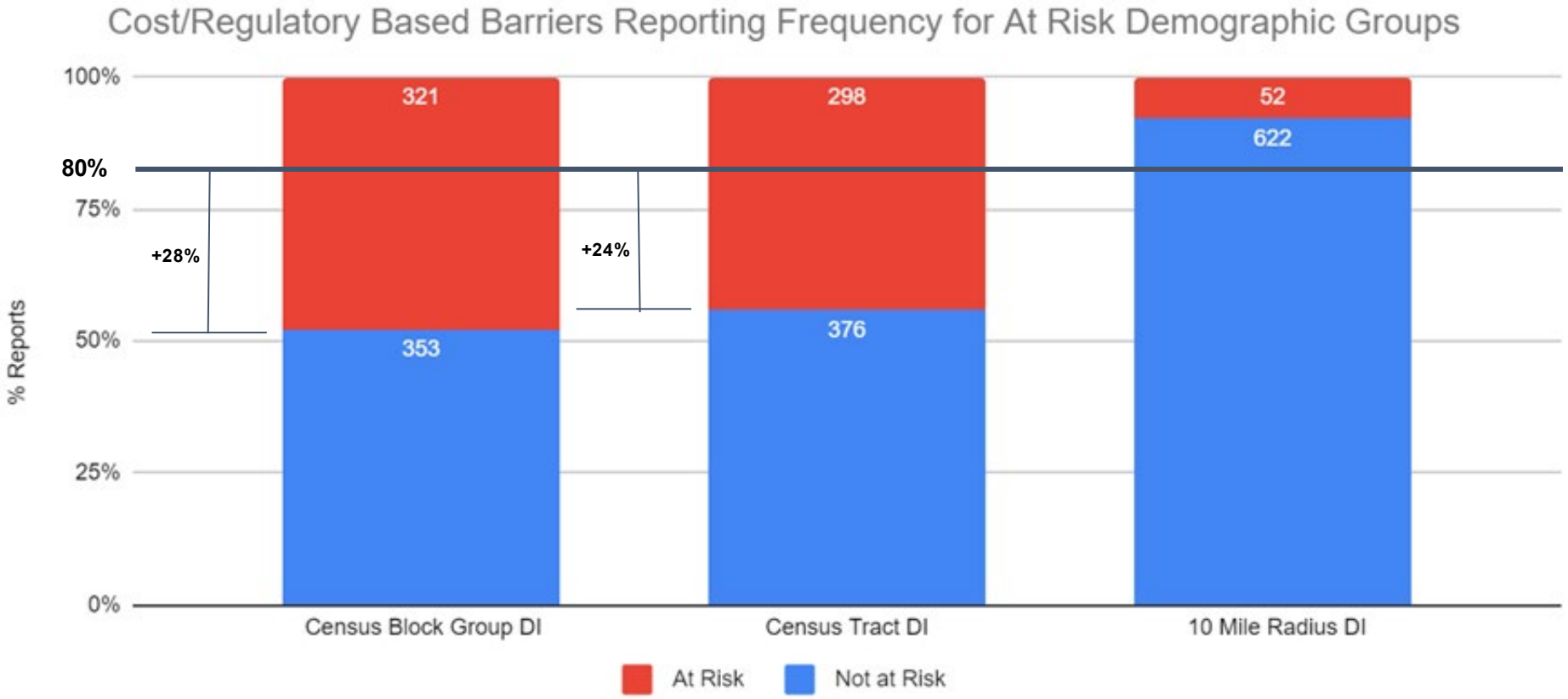
B7 - ***No known substitutes*** or alternative technologies

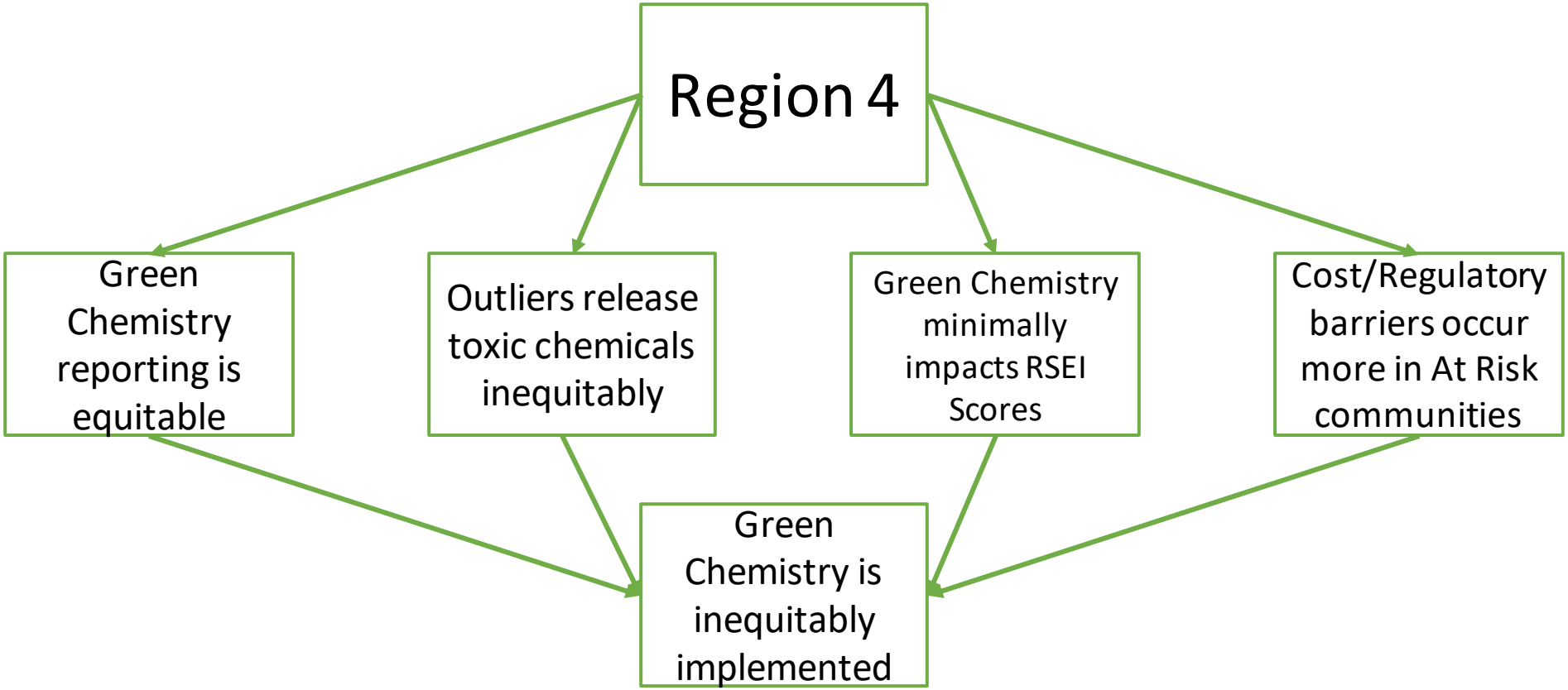
B8 - Reduction does not appear to be ***technically feasible***

Reported Barrier Demographic Index Averages




Lack of Knowledge/Technical Ingenuity Based Barriers Reporting Frequency for At Risk Demographic Groups
100%
80%
75%
50%
25%
0%
% Reports
377
1091
329
1139
35
1433
+6%
+2%
Census Block Group DI
Census Tract DI
10 Mile Radius DI
At Risk
Not at Risk


Cost/Regulatory Based Barriers Reporting Frequency for At Risk Demographic Groups
100%
80%
75%
50%
25%
0%
% Reports
321
353
298
376
52
622
+28%
+24%
Census Block Group DI
Census Tract DI
10 Mile Radius DI
At Risk
Not at Risk


Region 4
Green Chemistry reporting is equitable
Outliers release toxic chemicals inequitably
Green Chemistry minimally impacts RSEI Scores
Cost/Regulatory barriers occur more in At Risk communities
Green Chemistry is inequitably implemented

Limitations

With TRI data:	With Demographic data:
• Releases are related to productivity. • Accidents and unexpected events. • Green chemistry practices reported are not widespread.	• Census Blocks and Tracts are irregular. • Nearby populations can be excluded due to block boundaries. • At Risk grouping only considers the two dimensions.

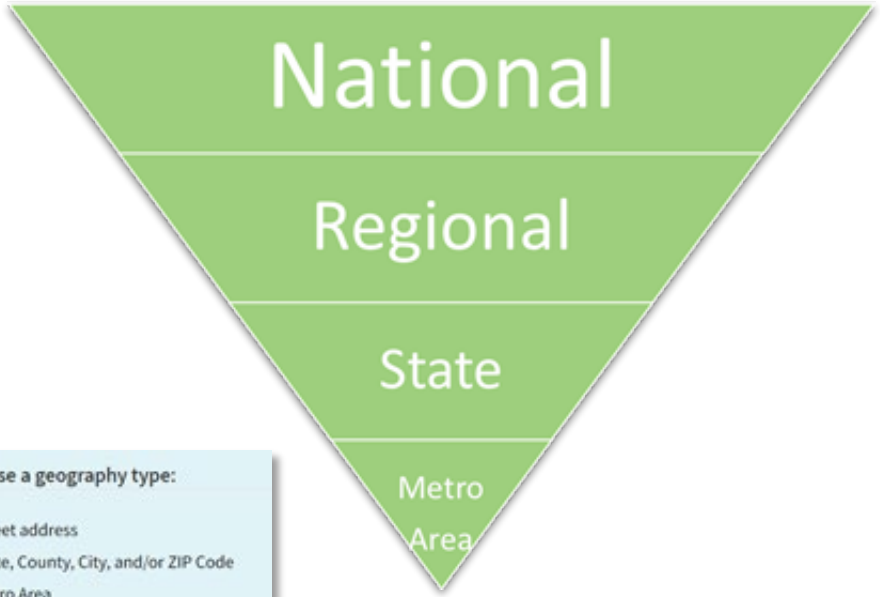
Expanded Applications of the Method

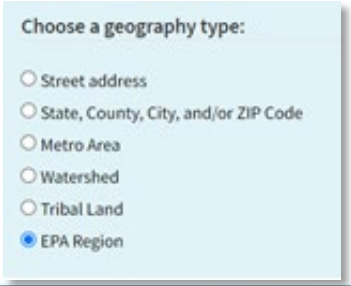
Reproducible

- Individual Companies
- Subsectors
- Chemical Specific
- Other Nations

Scalable

- TRI geography filters





(TRI Toxics Tracker 2022)

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  - Steve DeVito

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  - Dr. Joel Tickner, University of Massachusetts Lowell Center for Sustainable Production
  - Dr. Lauren Heine, ChemForward

"Injustice anywhere is a threat to justice everywhere."
- Dr. Martin Luther King

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Backup Slides

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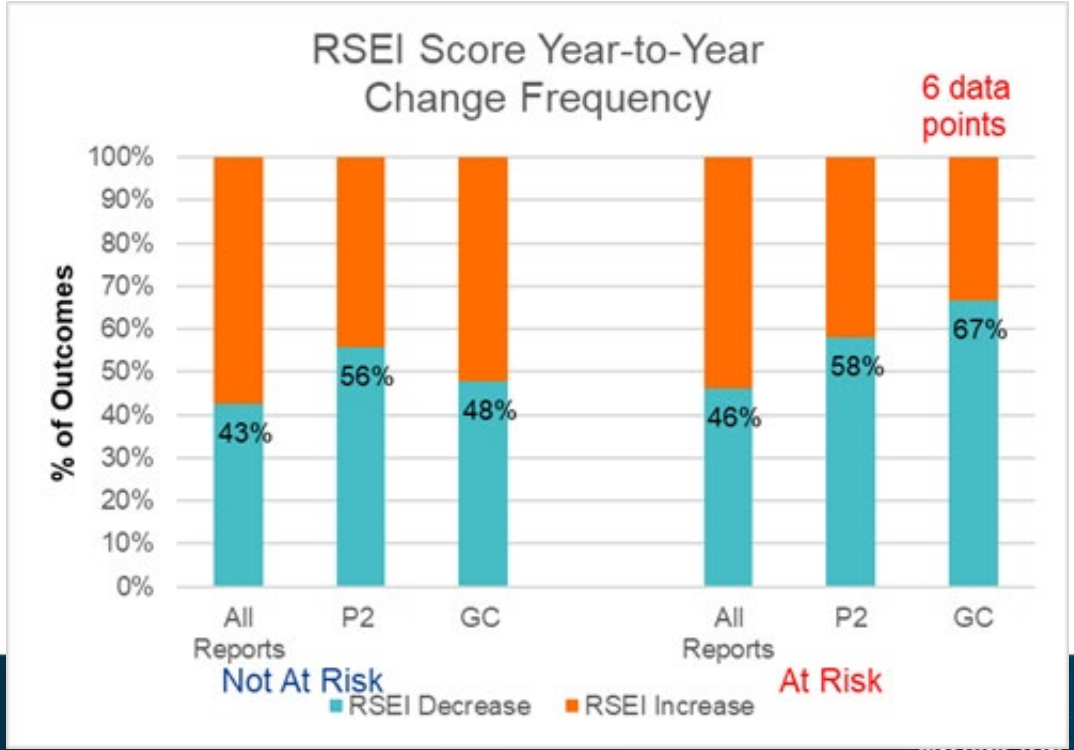
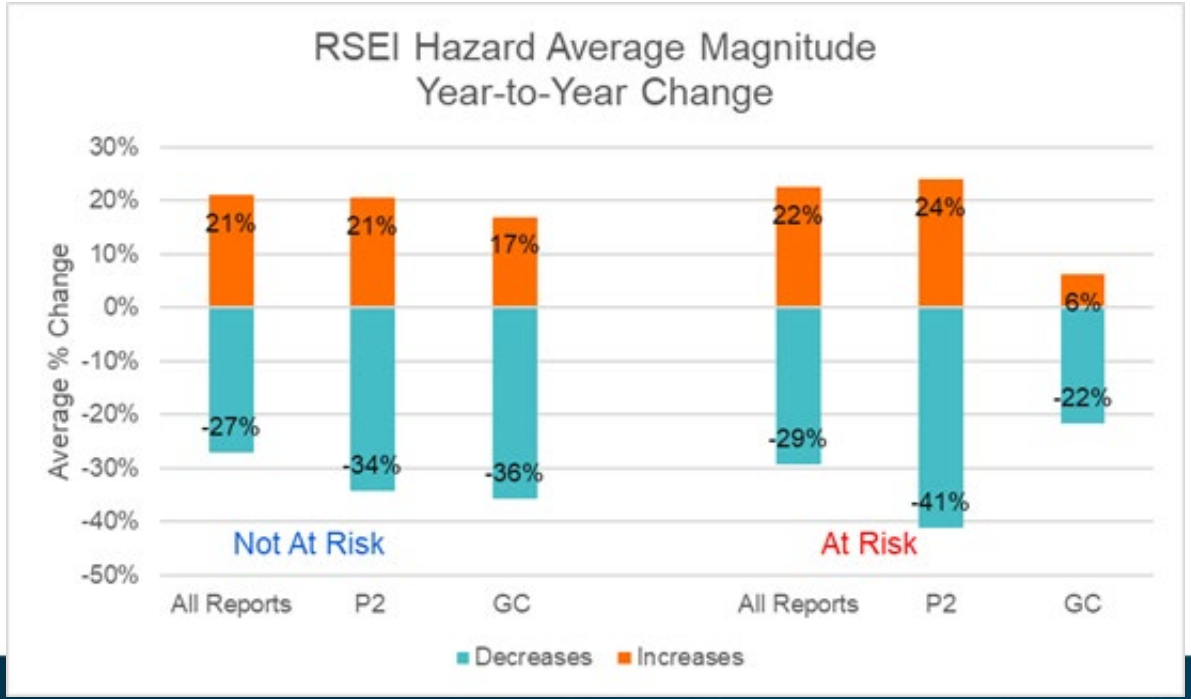
Outcomes: Frequency

- There is a greater frequency of Chemicals increasing in RSEI score.
- P2 and GC activities improve the occurrence of decreasing RSEI score.

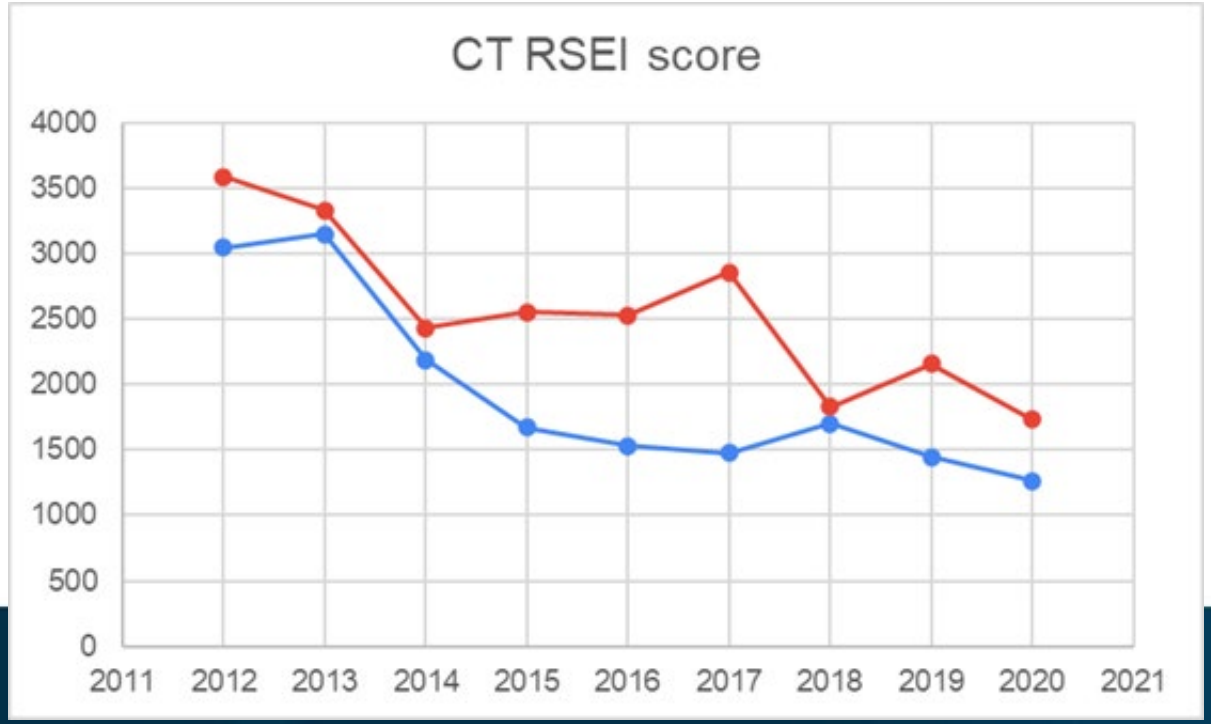


Outcomes: Year-to-Year changes (Hazard)

- With P2 and GC activities have greater reductions of RSEI scores.
- GC in at risk communities has a much smaller impact.

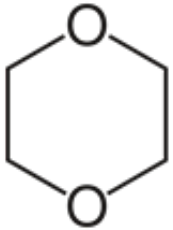


RSEI score trends



Chemicals

- Weighted Toxicity difference of top releasers
  - Average WT Not at Risk: 2,292.7
  - Average WT At Risk: 16,351.9
- Weighted Toxicity = RSEI Hazard Score ÷ Pounds of Toxic Releases
  - Removes the influence of release amounts per report



	Dioxane	Polycyclic Aromatic Compounds
Not at Risk or At Risk communities?	Not at Risk	At Risk
RSEI Hazard	129,420,000	2,748,993,000
Weighted Toxicity	18,000	390,000

Toxic Release Inventory (TRI)

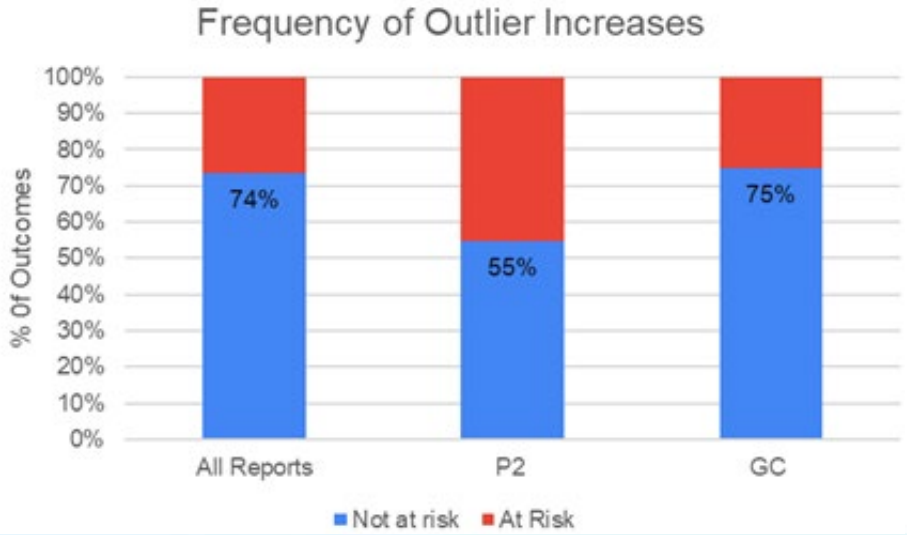
- Section 313 of Emergency Planning and Community Right to Know Act (EPCRA)
- Mandatory reporting of chemical releases
- Tracks industry progress in waste reduction
- Report source reduction activities
- Voluntarily report barriers to pollution prevention

Green Chemistry-Specific W-Codes
W15- Introduce process analysis systems
W43- Substitution of feedstock or reagent
W50- Optimized reaction conditions
W56- Reduce/eliminate organic solvent
W57- Use biotechnology
W84- Developed new chemical product to replace a previous one

Barrier Codes
B1- Insufficient capital
B2- Require specific technical information
B3- Concerned of reduced quality of product
B4- Source reduction activities were implemented but not successful
B5- Regulatory/permit burdens
B6- P2 previously implemented already and not feasible
B7- No known substitutes or alternatives
B8- Reduction does not appear to be technically feasible

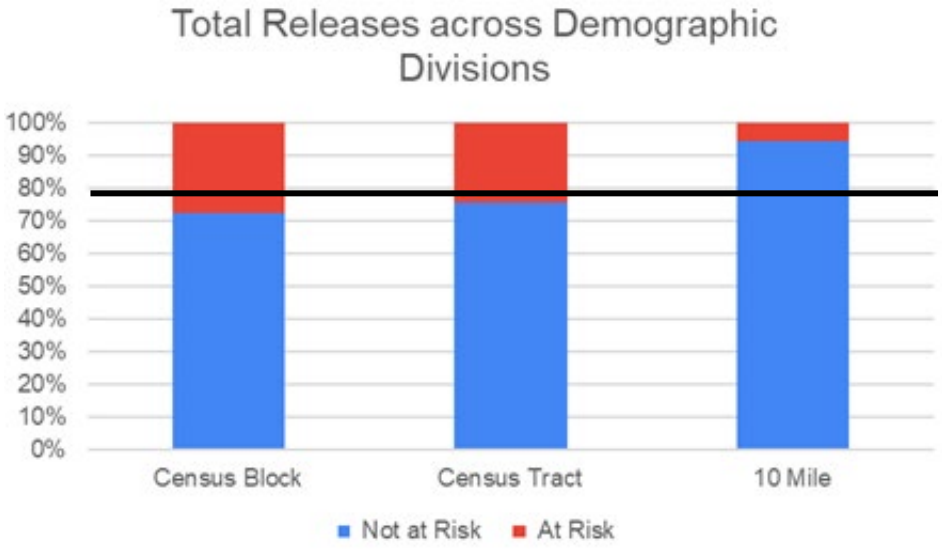
Outliers

Outlier Change magnitude			
	All Reports	P2	GC
Not at risk	168494%	1137%	150%
At Risk	466759%	698%	302%



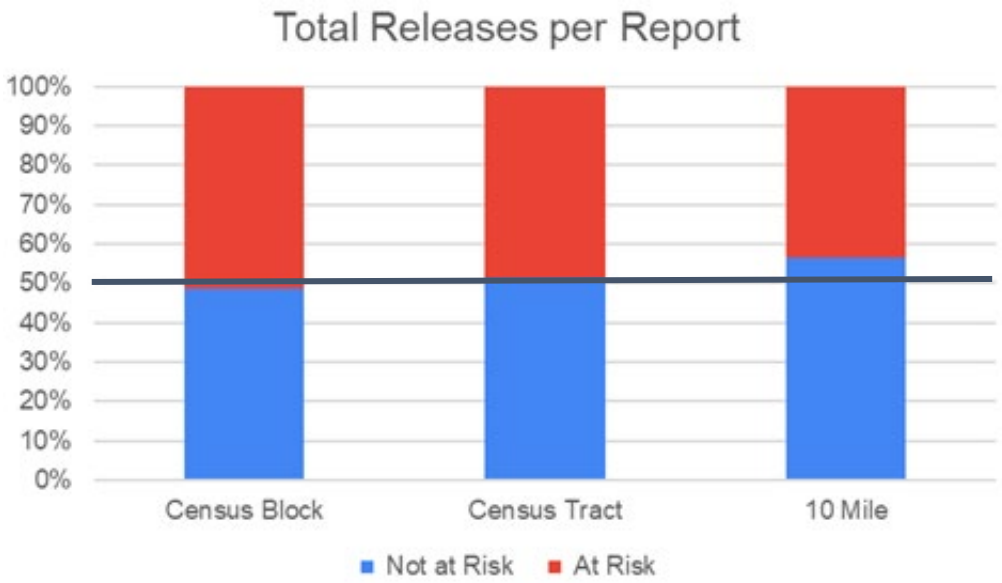
Toxic Releases

- Releases are reported in four categories: total releases, air releases, and water releases
  - Total Releases: 416,779,450.64 pounds
- Land releases not considered
  - Greater risk of exposure for air and water releases
  - Land releases usually moved to off-site disposal



Toxic Releases per Report

- Reporting skewed in favor of areas of lower demographic index values
  - Influence of reporting bias analyzed in calculations
- Release Amount per Report = Total Releases ÷ Total Reports



Outliers

- The same analysis was performed on outlier reports
  - Outlier reports reported more than 7,171 pounds of releases
- Outlier releases show inequitable distribution
  - Demographic divisions show smaller ratio than baseline
  - Outliers in At Risk communities average almost double the amount of releases per report

	Total Releases
Census Block	
Census Tract