Chesapeake Bay Program
Science. Restoration. Partnership.

Voluntary Phase-Out of Polychlorinated Biphenyls (PCBs) in Current Use in the Chesapeake Bay Watershed

Program Feasibility Study

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Prepared for:

Chesapeake Bay Program

Prepared by:

Eastern Research Group, Inc.

June 2019

Goals

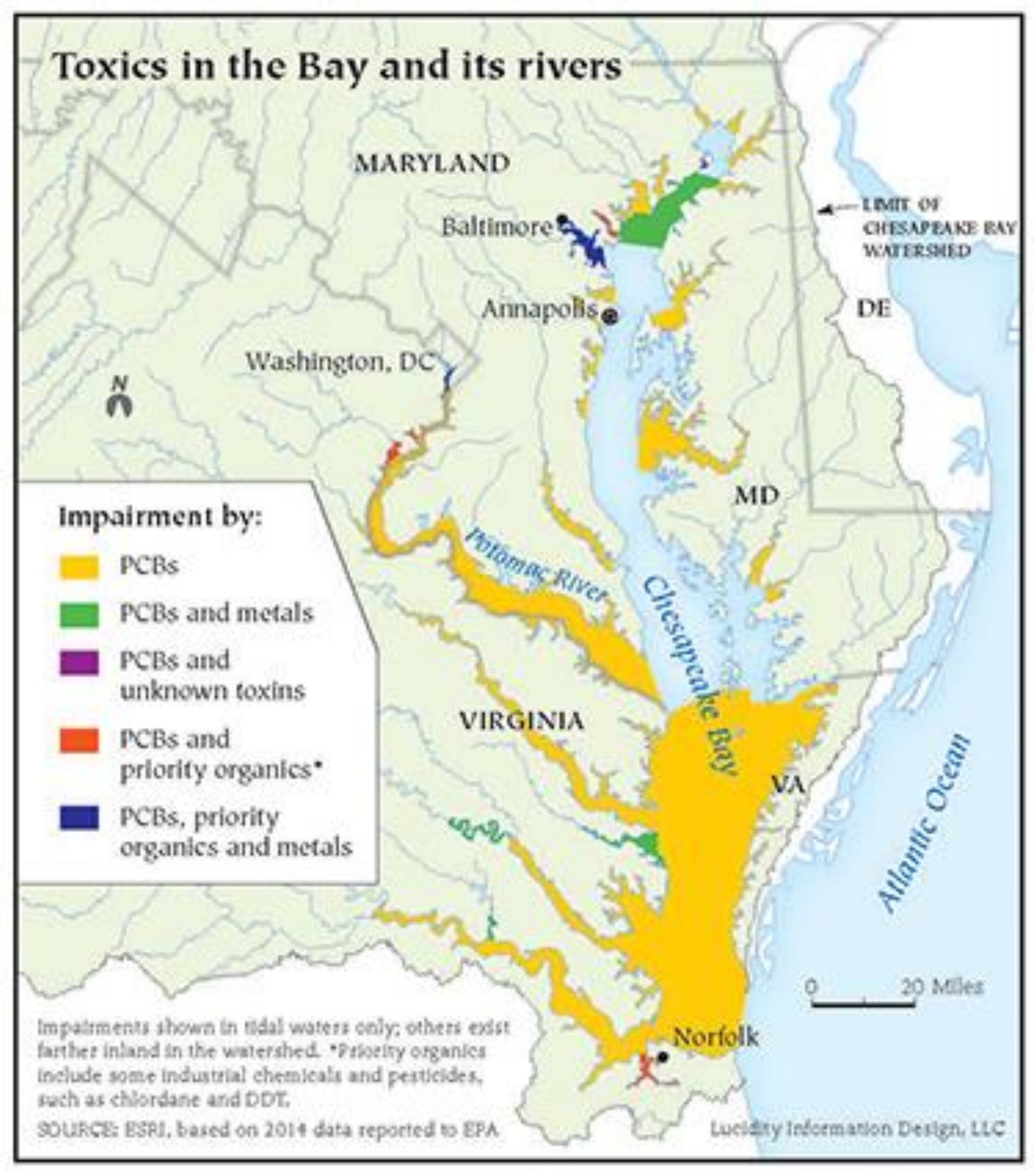
- Identify and quantify (to the extent possible) current and future sources of PCBs in the Chesapeake watershed
- Prioritize sources based on feasibility to address through voluntary initiatives

PCBs

- Many industrial and consumer uses prior to 1979 ban
- Insulating fluids in electrical equipment – transformers, capacitors and more
- Plasticizer in paints, plastics and rubber products
- Pigments, dyes and carbonless copy paper

PCB impacts on the Bay

- Water quality impairment throughout the watershed
- Source of most fish consumption advisories
- ~40 TMDLs in place (DC, DE, MD, PA, VA, WV) and additional TMDLs under development



Legacy Sources

- Sites where PCBs or PCB-containing equipment was manufactured, processed, used, stored, repaired, recycled or disposed
  - Utility-related sites
  - Large industrial sites (railroads, steel mills, refineries, chemical plants, scrapyards, marine terminals)
  - Commercial buildings

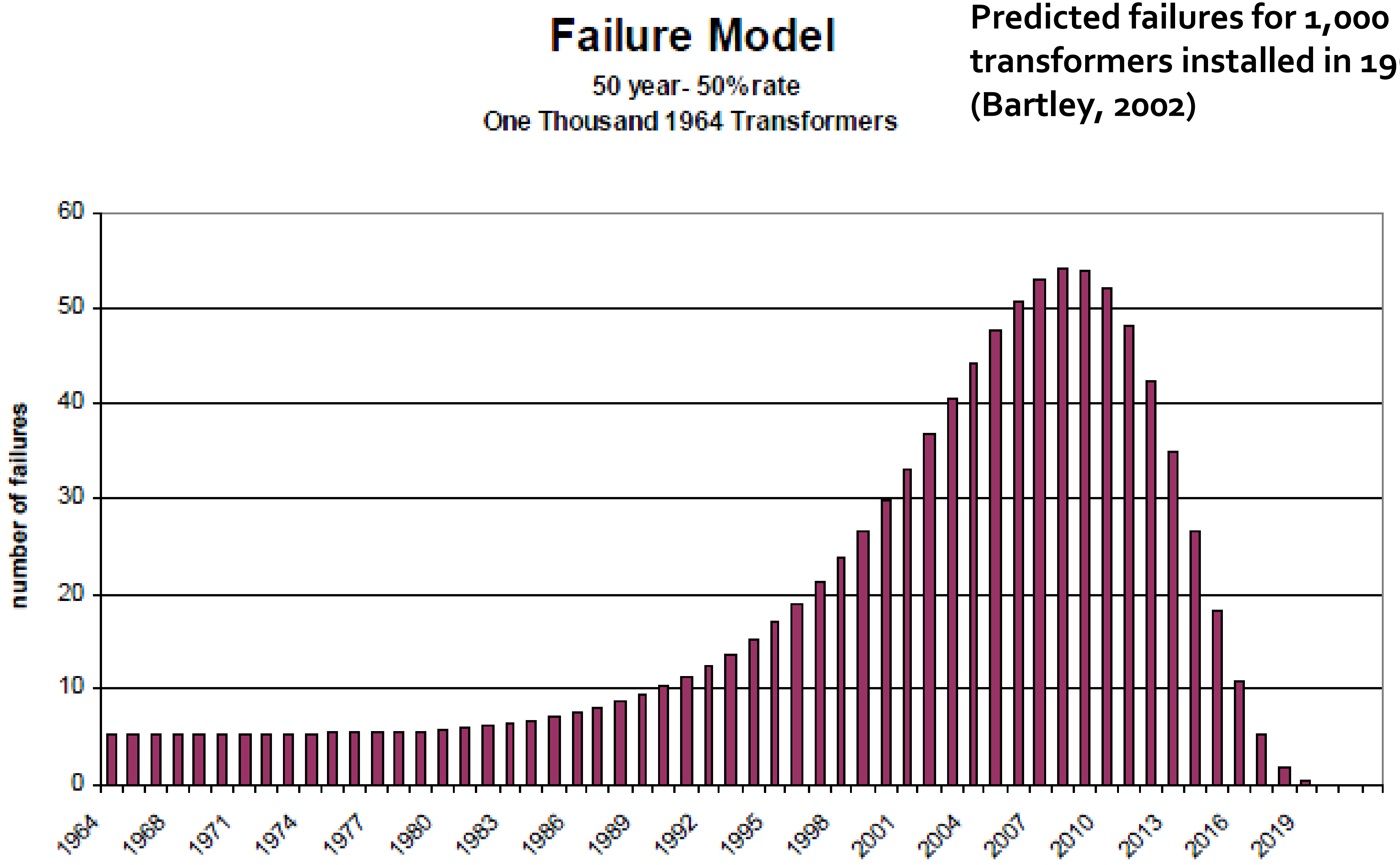
Legacy Sources

- States have identified many non-point sources as well as MS4s, CSOs, and POTWs that receive PCBs from other sources
- Control strategies are challenging

Ongoing Sources – PCB Electrical Equipment

- Electric power generating stations and substations, along transmission and distribution lines, and at customer sites
- Continued, authorized use under “fully enclosed” provisions of TSCA 1979
- Aging equipment – more prone to failure, leakage and spills

Predicted failures for 1,000 transformers installed in 1964 (Bartley, 2002)



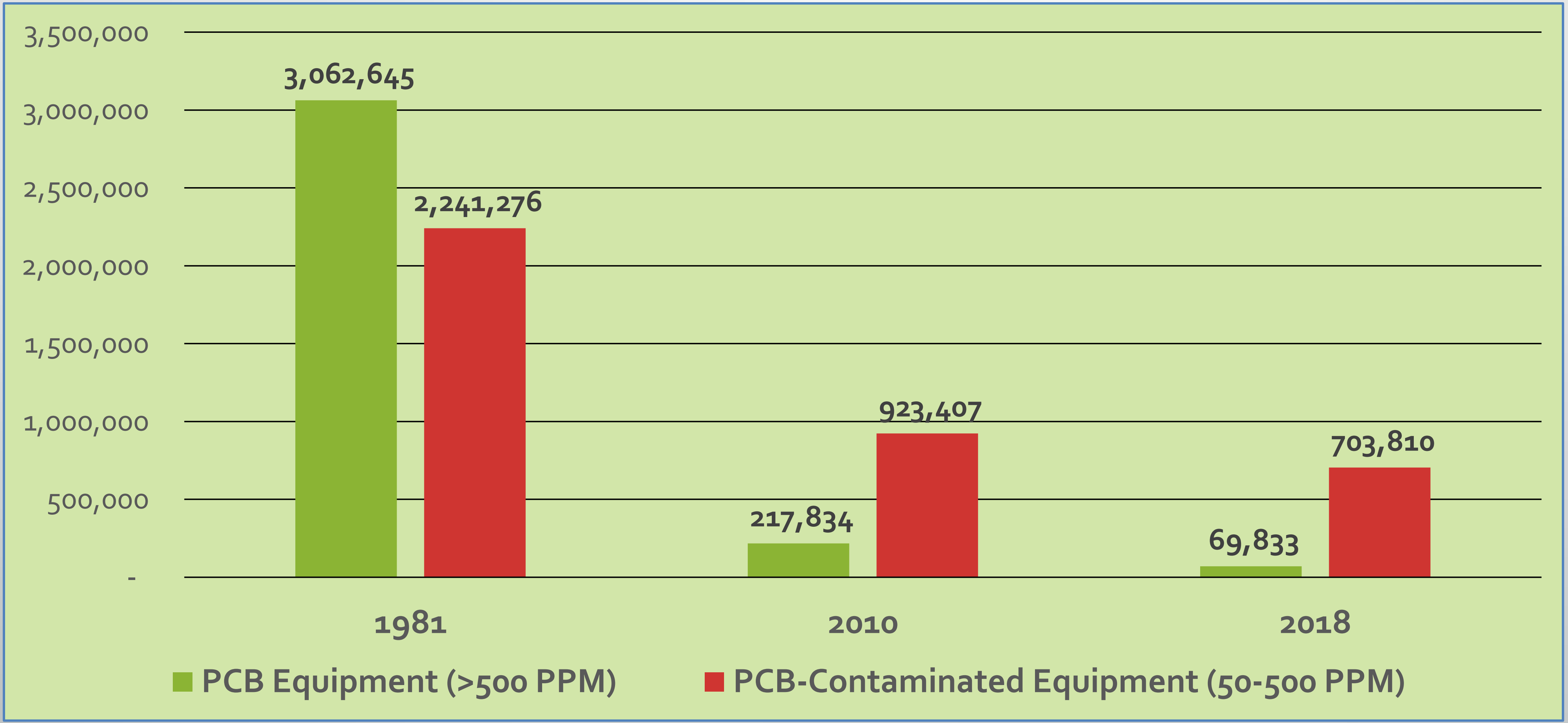
Ongoing Sources – PCB Electrical Equipment

- Utilities are under no obligation to locate, remove, or monitor PCB equipment
- Doing so is labor- and resource-intensive
- Many have policies to remove/replace or refill as equipment is inspected or brought in for repair
- Some have declared they have completed phase outs of PCB equipment
- How much remains?

Ongoing Sources – PCB Electrical Equipment

- April 2010 - EPA proposal to reassess continued use authorization (75 FR 66; page 17645)
- Inventory model needed for economic analysis
  - Starting point: prior utility industry reports on PCB equipment populations in 1981 and 1989
  - ERG built model to extrapolate population, factoring in annual removal and failure rates

PCB Electrical Equipment Population



Ongoing Sources – PCB Electrical Equipment

- Equipment population apportioned to Chesapeake Bay watershed, after adjustment for population and density

Type of Equipment	U.S.	Chesapeake
PCB equipment (>500 ppm)	69,833	1,425 – 3,935
PCB-Contaminated Equipment (50-500 ppm)	703,810	14,901 – 39,662
TOTAL	**773,643**	**16,326 – 43,597**

Estimated quantity of PCBs in Chesapeake Bay equipment: 176.2 – 445.2 lbs

Ongoing Sources – PCB Electrical Equipment

- Utilities within the watershed can be identified using data from EIA
  - Plant name, location, fuel source, capacity, operator name
- Transmission and distribution entities can also be identified from EIA
- Non-utility owners – large industrial energy users
  - Often legacy sites now
  - Includes some Federal facilities

Ongoing Sources – PCB Electrical Equipment

Federal Owner	City	State	Number of PCB Transformers
Capitol Power Plant (Architect of the Capitol)	Washington	DC	8
National Gallery of Art (Smithsonian Institution)	Washington	DC	1
National Railroad Passenger Corp. (AMTRAK)	Washington	DC	8
U.S. Army Corp of Engineers CENAB	Baltimore	MD	12
U.S. Army Garrison, Aberdeen Proving Ground	Aberdeen Proving Ground	MD	2
U.S. Department of the Army	Carlisle	PA	2
Federal Aviation Administration, Chesapeake Bay	Leesburg	VA	12
Fort Myer Military Community	Arlington	VA	6

Source: U.S. EPA. "Most Recent" EPA Regulated PCB Transformer Data.

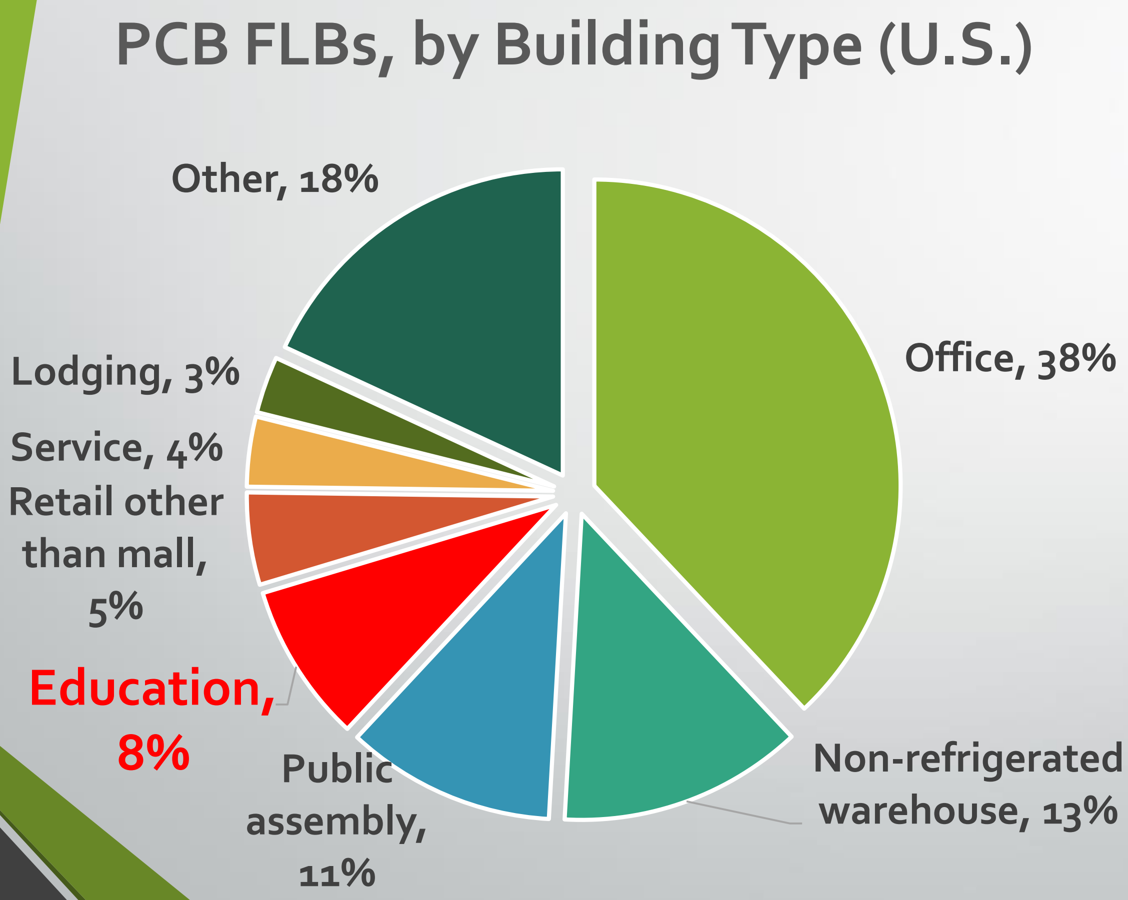
Ongoing Sources – Fluorescent Lamp Ballasts

- PCBs used as insulators for capacitors in FLBs
    - Pre-1979, first generation T-12 type
- Remaining PCB FLBs are well beyond expected service life, but may still be found
    - NYC 2010 – 767 school buildings, $1B to remove
- Failures and leaks are a health, environmental and economic concern

A typical pre-1979 PCB-containing fluorescent light ballast (FLB)

A typical Non-PCB containing fluorescent light ballast. The ballast has a "No PCBs" marking on the top of the ballast and the text "electronic ballast". Only magnetic fluorescent light ballasts contained PCBs.

Ongoing Sources – Fluorescent Lamp Ballasts



	Buildings	PCB FLBs
U.S. total (2012)	1.7 million	1.0 billion
U.S. schools (2012)	117,000	87.8 million
Chesapeake Bay state schools (2018)	**805-897**	**604,000 – 673,000**

Quantity of PCBs in FLBs – Chesapeake Bay state schools

- **13,288 – 34,942 lbs**

Source: ERG estimates

Ongoing sources – paints and pigments

- PCBs in paints and pigments banned after 1979
- Air sampling in Chicago raised concerns about continued presence (Hu & Hornbuckle, 2009)
- Paints tested contained PCB-11, not a legacy contaminant
  - Azo and phthalocyanine pigments, associated with yellow and green colors
- Hypothesis: PCBs were inadvertently created during pigment manufacturing (iPCBs)

Ongoing sources – paints and pigments

- Spokane, WA tested traffic marking paint (yellow) and found PCBs in all samples
  - PCB-11 accounted for between 7 and 98 percent of all PCBs
- Similar PCBs found in wastewater from paper recycling mill (deinking process)
- Rough, conservative estimate of quantity of PCBs in paints: 1,265 pounds
  - Color Pigment Manufacturers Association: 1,000 – 2,000 pounds
- Assuming use is proportional to area and population, quantity of PCBs in traffic marking paint used in the Chesapeake Bay watershed is **70.55 lbs**

Maryland reports it has switched to "PCB-free" waterborne paints for traffic marking

Ongoing sources – caulks and sealants

- PCBs used as plasticizer in caulks and sealants prior to 1979
- Deterioration can lead to cracking/flaking and deposition to soil
- Caulks/sealants have also been implicated in elevated indoor air PCB concentrations (e.g., Malibu, CA and Lexington, MA schools)
- EPA has not acted on caulks/sealants other than
  - Providing guidance for demolition/renovation
  - Reinterpreting regulations to allow disposal of remediation waste as a bulk waste (Rudzinski, 2012)

Ongoing sources – caulks and sealants

- State of Washington has outlined an approach to estimating the quantity of PCB caulks and sealants remaining in place and released each year
  - County-level records of masonry construction 1945-1980
  - Total square footage of such buildings
  - Assume caulk/sealant application at 55 g/m3 (Diamond et al., 2010)
  - Assumed percent of caulk/sealant containing PCBs and PCB concentration (Kohler et al., 2005)
  - Assume 9 percent gross loss over 50 years (Robson et al., 2010)

Estimated Quantities of PCBs from Sources Within the Chesapeake Bay Watershed

Source		Range of Estimates	Estimated Quantity of PCBs
Electrical Equipment			
	PCB Equipment	1,425 – 9,665 units	176.2 – 445.1 lbs
	PCB-Contaminated Equipment (50-500 PPM)	14,901 – 97,407 units	
Fluorescent Lamp Ballasts (FLBs)			
Buildings	Schools	805 – 978 buildings	
	Other Buildings	10,889 – 12,134 buildings	
	Total	11,695 – 13,031 buildings	
FLBs	Schools	0.60 – 0.67 million FLBs	14,842 - 31,434 lbs
	Other Buildings	6.36 – 7.09 million FLBs	156,375 - 331,193 lbs
	Total	6.97 – 7.77 million FLBs	171,216 – 362,628 lbs
PCB-Contaminated Paint			
	Applied annually	0.51 grams per square mile	70.55 lbs (annual)
Caulks and Sealants		Not estimated	
Legacy Sources/Sites		Not estimated	

Source: ERG estimates.

Existing Voluntary Initiatives Focused on PCBs

- Minnesota PCB Transformer Partnership (2004)
  - MPCA worked with several smaller utilities to identify, target, and replace PCB-contaminated transformers close to Lake Superior Basin
  - Three utilities owning 15,000 transformers identified 548 as suspected PCB transformers, and removed 452 of them (82%)
  - MPCA initially planned testing to confirm PCBs, but cost was high
  - Utilities agreed to remove most suspected transformers without testing

Existing Voluntary Initiatives Focused on PCBs

- State of Washington PCB Chemical Action Plan (2015)
  - Identified and quantified, where possible, PCB releases to air, water and land
  - Priority focus for action was on electrical equipment, FLBs, caulk, and paints/pigments
- Action Items and Cost Estimates
  - Identify PCB FLBs in schools and other public buildings and encourage replacement ($137k)
  - Assess schools to determine extent of PCBs in building materials ($364k)
  - Develop/promote BMPs to contain PCB building materials ($272k)
  - Survey utilities to determine PCB equipment population ($45k)
  - Identify/promote processes that do not inadvertently produce PCBs ($700k)

Existing Voluntary Initiatives Focused on PCBs

- Great Lakes Binational Strategy for PCB Risk Management (2017)
  - Releases from remaining in-service equipment
  - Releases from PCB-containing sealants, paints, finishes, building materials
  - Accidental releases from PCB storage and disposal facilities
  - Emissions from combustion or incineration of materials containing PCBs
  - Inadvertent by-product generation (incineration or dye/pigment manufacturing)
  - Legacy sites

Existing Voluntary Initiatives Focused on PCBs

- Spokane River Regional Toxics Task Force
  - Goal: bring Spokane River into compliance with WQS for PCBs
  - Characterizes the Spokane River area where the efforts are concentrated
  - Defines the key sources and their magnitudes on the Spokane River
  - Outlines the possible actions and recommended actions to be taken to mitigate PCB contaminants
  - Describes future work to be conducted over a five-year period

Existing Voluntary Initiatives Focused on PCBs

- Spokane River Regional Toxics Task Force (cont.)
  - A Task Force workshop identified 45 Control Actions considered potentially applicable to address PCBs in the Spokane River and assessed them in terms of costs and effectiveness
  - Existing Controls
    - Wastewater treatment
    - Remediate known contaminated sites
    - Stormwater controls
    - Low impact development ordinance
    - Street sweeping
    - Purchasing standards
  - Improved Controls
    - Support of green chemistry alternatives
    - PCB product testing
    - Waste disposal assistance
    - Regulatory rulemaking
    - Compliance with PCB regulations
    - Emerging end-of-pipe stormwater technologies
  - New Controls
    - Identification of sites of concern for contaminated groundwater
    - Building demolition and renovation control

Criteria for Evaluating Potential Voluntary Program Participants

PCB Source	*Criteria for Voluntary Program Consideration*			
	Contribution to PCB Problem	**Ability to Identify Participants**	**Participants' Ability to Address Problem**	**Participant Leverage**
Legacy contamination	High	Responsible parties may be unknown or difficult to identify. Nonpoint source identification is challenging.	Cost of remediation is high.	Identified sources may already be under regulatory scrutiny (e.g., TMDL PMPs).
Electrical equipment	Moderate	Moderate	Equipment is old and a liability. Will need replacement soon. Newer equipment is more efficient.	Utilities have high public visibility. Federal facilities may or may not feel obligation to participate.
FLBs	High	Diverse mix of building types and owners. Schools may make the most logical target because they are readily identified.	Equipment is old and a liability. Will need replacement soon. Newer equipment is much more efficient. Incentives may be available.	Health risks compound concern about PCBs. Parental and community pressure has driven action elsewhere.
Traffic and road marking paint/pigments	Low	State and local transportation departments can be readily identified and approached.	Replacement products will require evaluation. Procurement specifications may need to be revised.	Public agencies are visible and may feel public pressure to engage.

Source: ERG.

Options for PCB Voluntary Initiatives

- Legacy sources
  - Hundreds/thousands of sources, many already subject to regulatory action
  - Unclear how much additional voluntary action could be prompted
- Electrical equipment owners
  - Voluntary efforts have been successful elsewhere (MN)
  - Owners can be identified and targeted fairly easily (utilities, federal facilities)
  - Strong business case for replacement
  - Tie into industry sustainability campaign (EEI, 2019)

Options for PCB Voluntary Initiatives

- FLBs in buildings
  - Focus on schools makes sense from a logistical, cost, and risk standpoint
  - Strong business and wellness case for replacement
- Public agency procurement of outdoor paint
  - PCB-free paint specifications may be available from MD or other states
  - Suppliers have demonstrated ability to meet PCB-free paint requirements

Voluntary Partnership Structure

- Partners
  - Sign partnership agreement and commit to undertaking a discrete set of activities.
  - Conduct outreach campaigns to educate public
  - Implement best practices
  - Submit annual report on activities
  - Apply for award / recognition

- CBP
  - Develop outreach campaign tools and materials
  - Recruit partners
  - Provide technical assistance via webinars, online tools, partner forums
  - Establish recognition/awards program
  - Compile annual accomplishments report; highlight partner stories and results

PCB Voluntary Program

Moderate LOE Option

Program Component	Year 1 LOE (hours)	Year 2 LOE (hours)
Program design	800	100
Program infrastructure	1,200	2,500
Marketing, education, outreach	750	2,000
Technical assistance, partner support	200	850
Awards and recognition	750	1,500
Data analysis and program evaluation	50	750
TOTAL	**3,750**	**7,700**

PCB Voluntary Program
Low LOE Option

Program Component	Year 1 LOE (hours)	Year 2 LOE (hours)
Program design	800	100
Program infrastructure	1,000	1,000
Marketing, education, outreach	500	2,000
Technical assistance, partner support	150	500
Data analysis and program evaluation	75	500
TOTAL	**2,525**	**4,100**

Questions?

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