A REVIEW OF VAPOR INTRUSION GUIDANCE BY STATE

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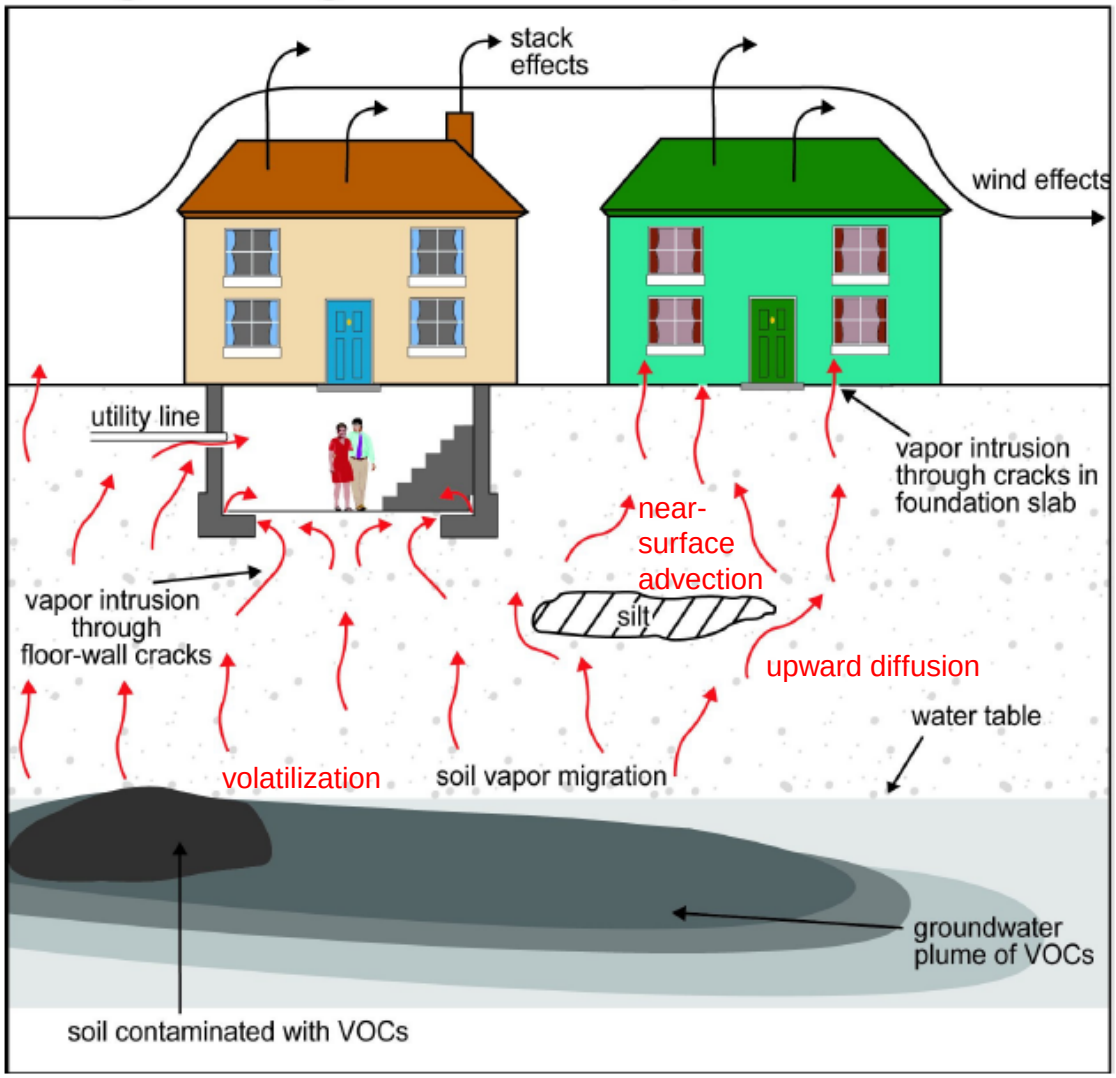
Northeast Waste Management Officials' Association

What is Vapor Intrusion?

- **Vapor Intrusion (VI):** The migration of volatile chemicals from the subsurface into overlying buildings (EPA, draft VI guidance, 2002).
- The **VI Pathway** may pose unacceptable risks of long-term exposure via inhalation of chemicals present in indoor air resulting from VI.
- A **complicating factor** for VI investigations is the common presence of those same volatile chemicals within buildings unrelated to VI ("background levels").



Source: EPA (http://www.epa.gov/oswer/vaporintrusion/basic.html)

A Brief History of Vapor Intrusion

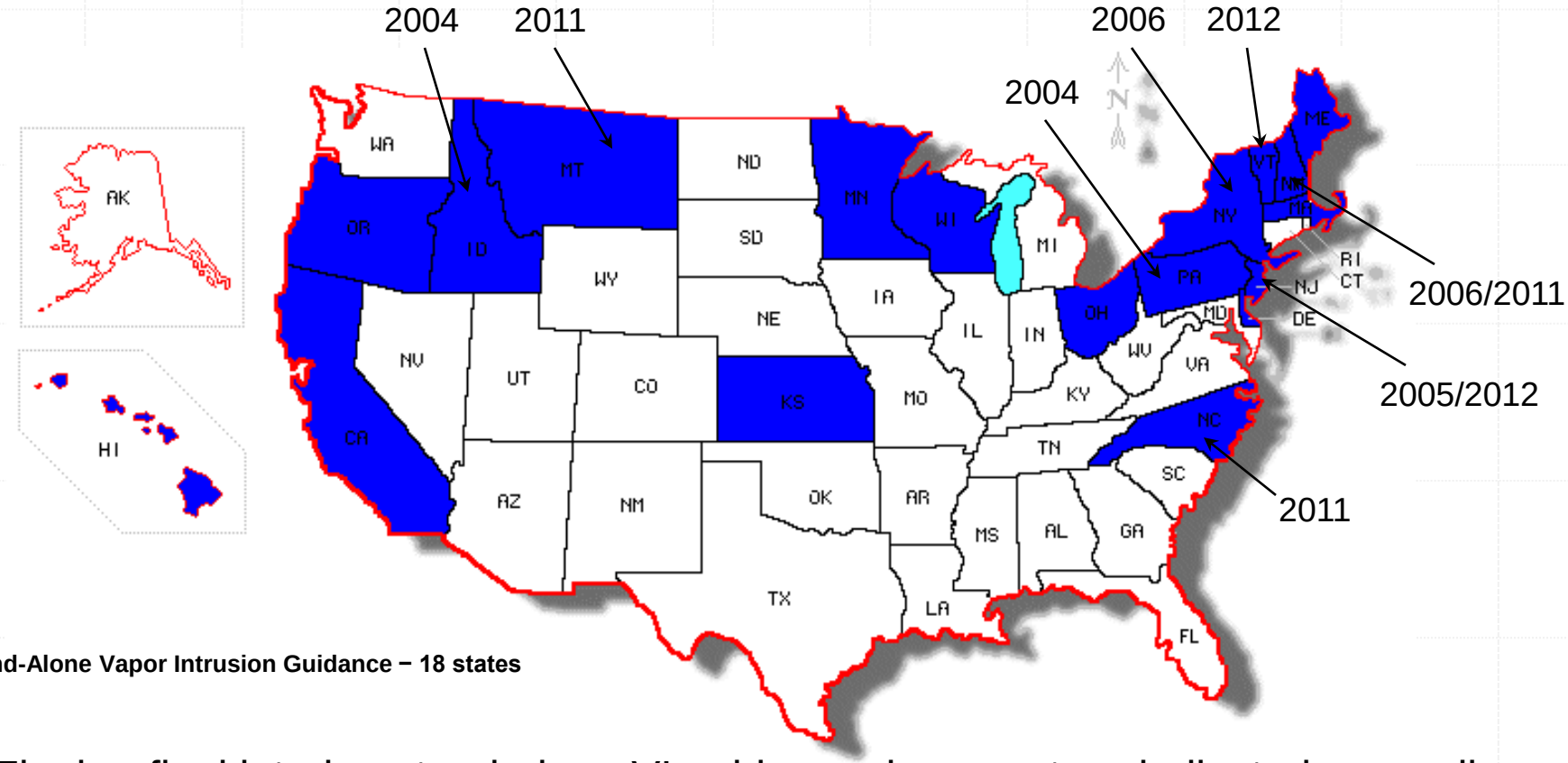
- 1970s – Primary focus on intrusion of fuel vapors into buildings, potential fire/explosion, and acute effects.

- 1980s – Focus on residential indoor air quality and radon intrusion. Early stages of vapor intrusion/inhalation pathway.

- 1990s – Regulatory focus on chronic VI (e.g., Superfund, certain states). Johnson and Ettinger 1-D Diffusion/Advection Model developed in 1991 to "risk away" VI as a concern.

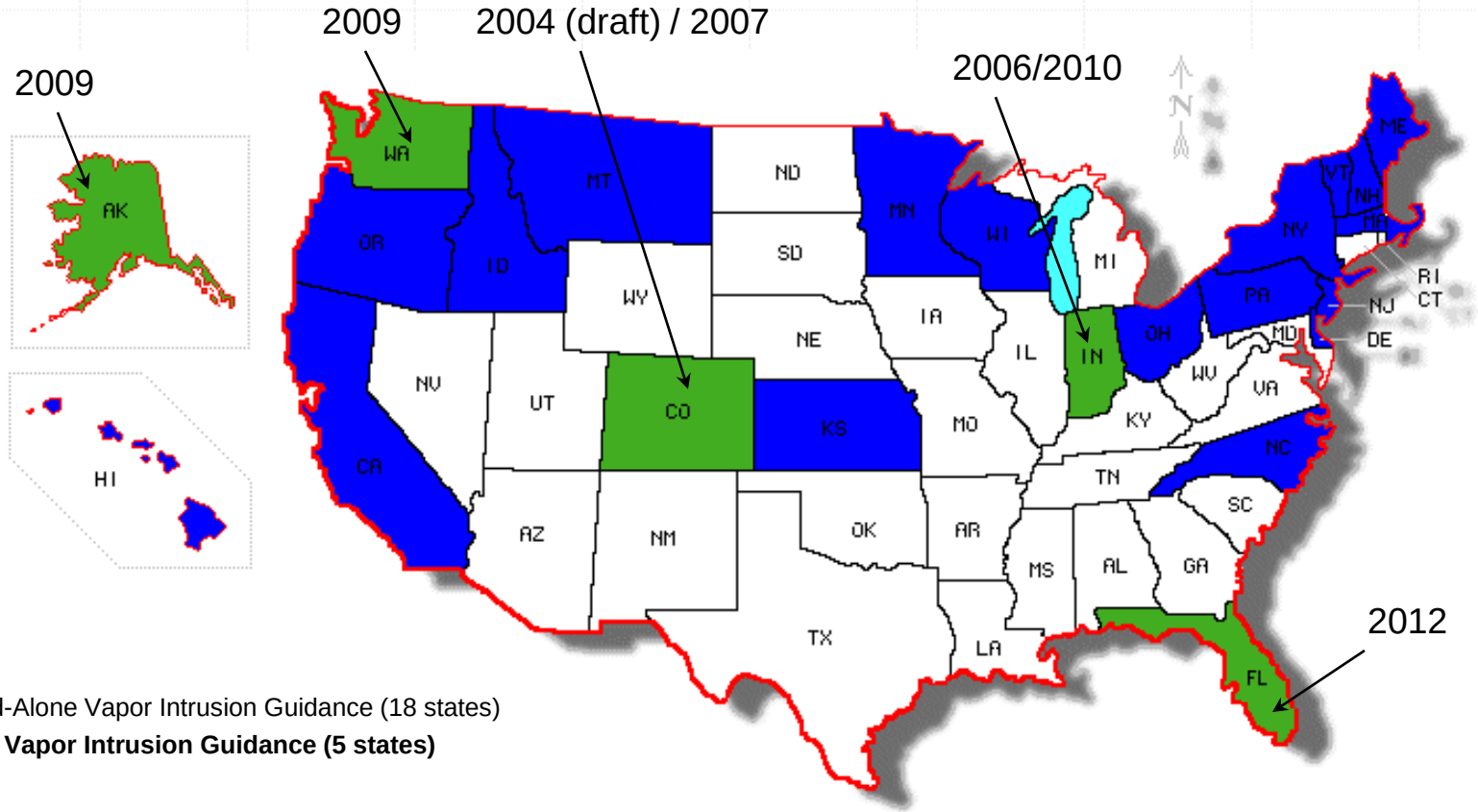
- 2000s – Large scale VI sites (e.g., Endicott, NY; Redfield, Denver, CO). Draft EPA VI Guidance published in 2002. Several states develop their own guidance (e.g., NY, NJ). In 2007, ITRC develops a comprehensive VI guidance document.

States with Final VI Guidance (as of July 2012)



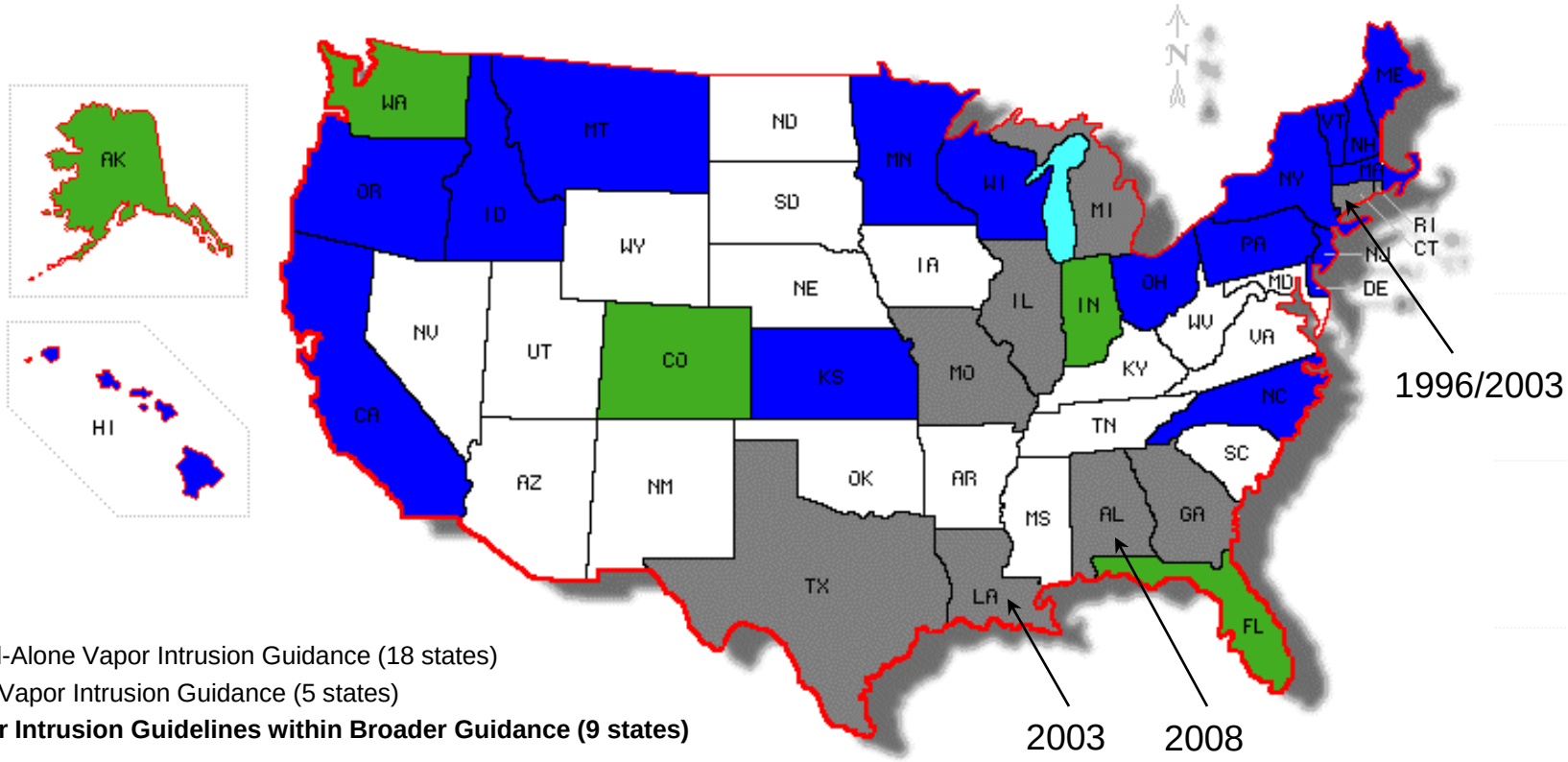
- Final or final interim, stand-alone VI guidance document or dedicated appendix
- Significant VI focus in the northeastern states (industrial legacy, climate, property value)
- Most final guidance documents published after 2006
- In the past year, several states have updated existing final guidance documents (e.g., NJ, NH, CA)
- Recently released: NC, MT, VT

States with Draft VI Guidance (as of July 2012)



- Indiana: Draft VI guidance from 2006 with supplement in 2010
- Colorado: 2004 draft VI guidance (Col. Dpt. of Public Health and Environment)
  2007 petroleum VI guidance (Col. Dpt. of Labor and Employment)
- Florida: 2012 petroleum VI guidance (internal draft avail. from Fla. DEP)

States with VI Guidelines within Broader Guidance Document (as of July 2012)

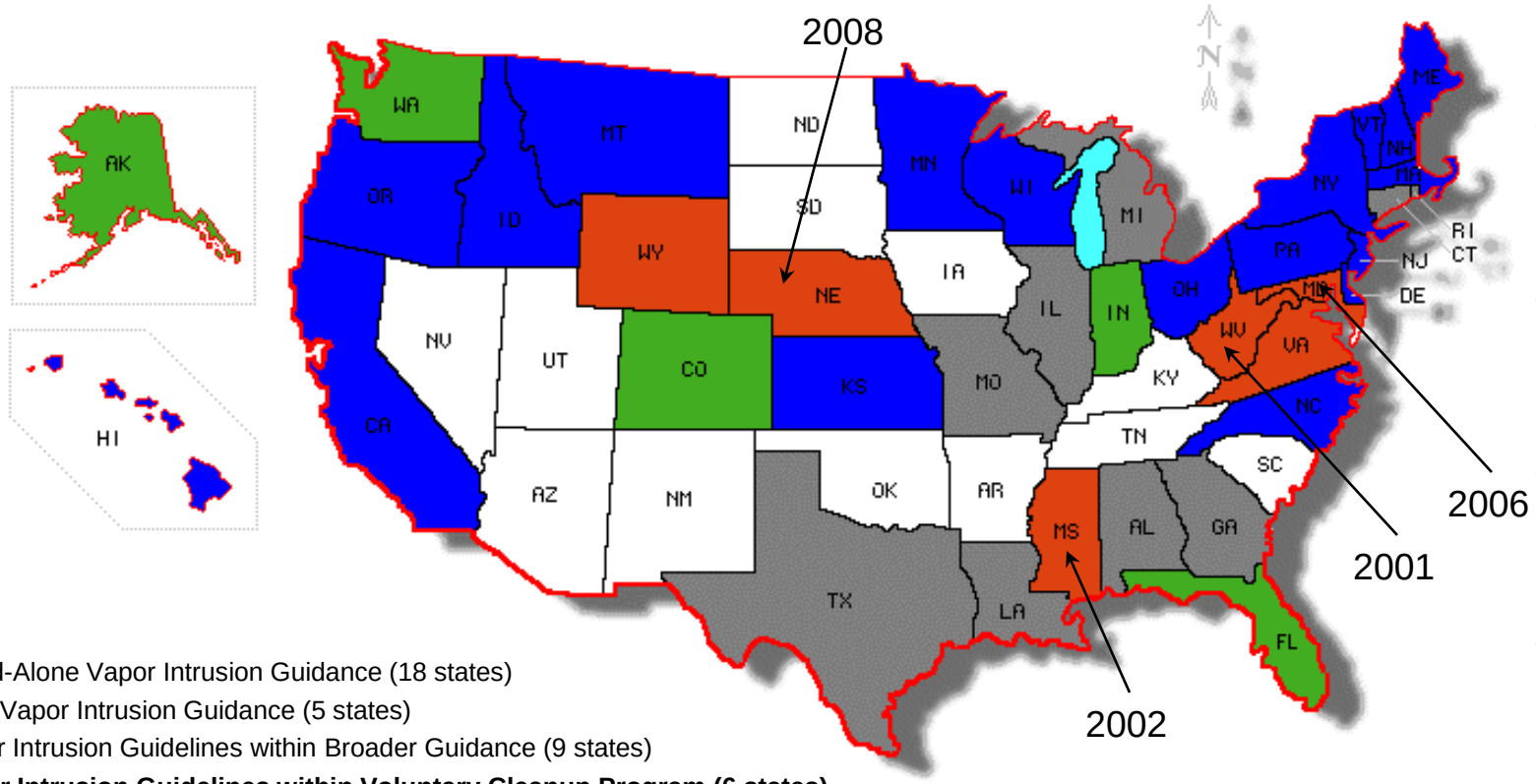


- Stand-Alone Vapor Intrusion Guidance (18 states)
- Draft Vapor Intrusion Guidance (5 states)
- **Vapor Intrusion Guidelines within Broader Guidance (9 states)**

Varying degrees of detail on VI within comprehensive investigation/remediation guidance:

- Vapor inhalation pathway mentioned in risk-based guidance documents (AL, GA, LA, MO)
- IL has an ongoing initiative to further integrate VI pathway in existing program ("TACO")
- Volatilization criteria provided for groundwater, soil and/or soil gas (CT, IL, MI, MO, TX)

States with VI Guidelines within Voluntary Cleanup Program Document (as of July 2012)



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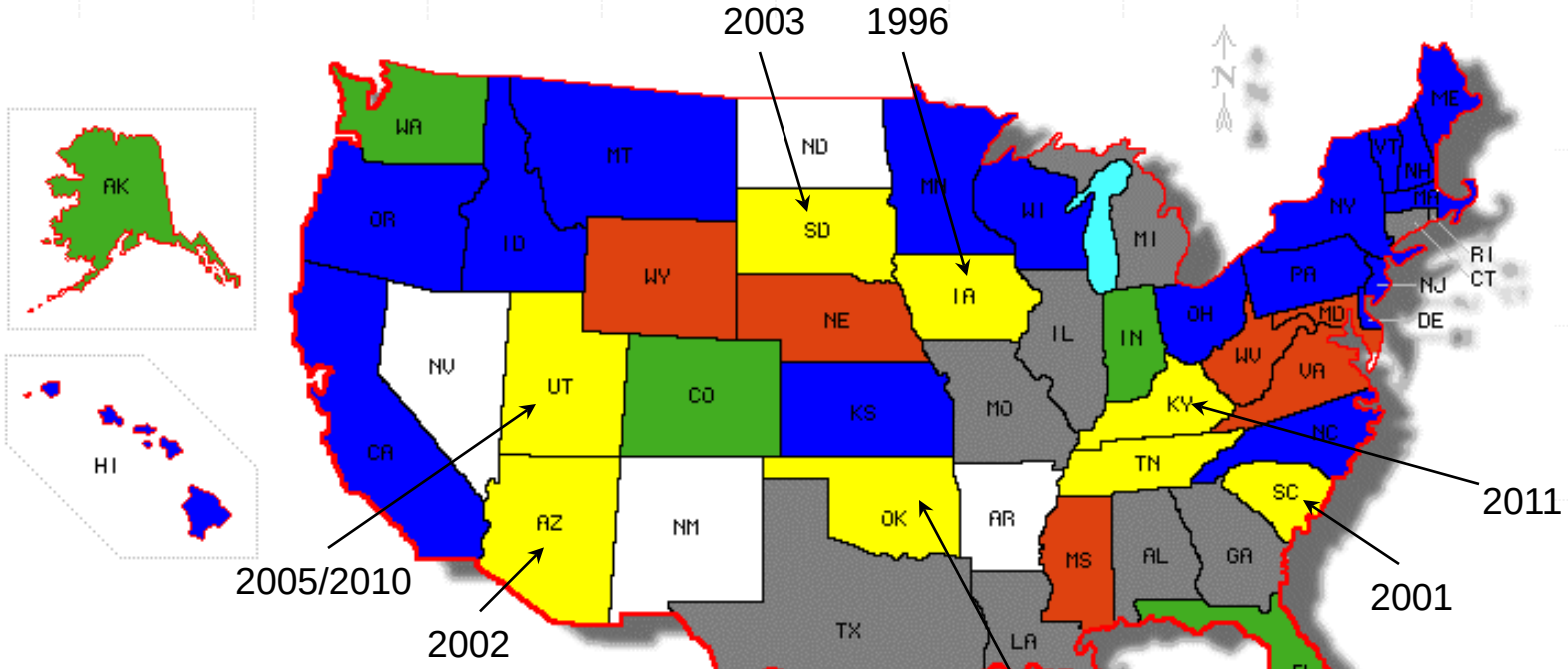
- **Vapor Intrusion Guidelines within Voluntary Cleanup Program (6 states)**

Again, states provide varying degrees of detail:

- VA provides soil gas screening criteria and refers to EPA 2002 and ITRC 2007 guidance
- MD and WY provide factsheets and refers to EPA 2002 draft guidance
- MS and WV mention the volatile compound inhalation pathway
- NE in the process of revising VCP to further incorporate VI pathway

States with VI Guidelines within UST Cleanup Program Document (as of July 2012)



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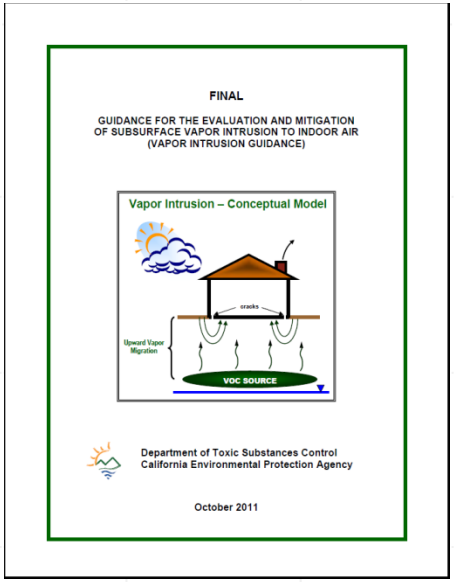
- **Vapor Intrusion Guidelines within UST Cleanup Program (8 states)**

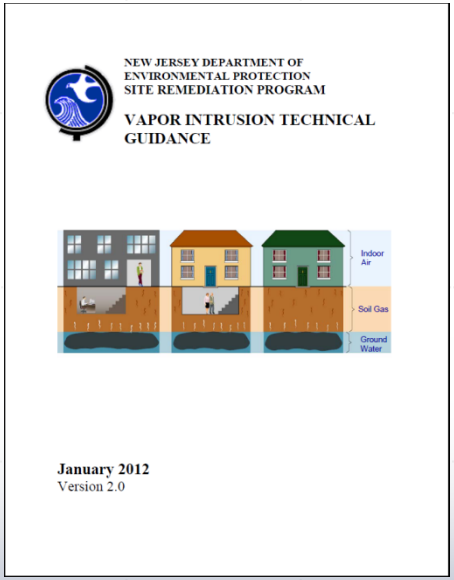
- Generally, state UST cleanup guidance documents outline a tiered approach and the need to assess the vapor inhalation pathway (typically as part of Tier 2)
- Some states provide volatilization criteria for soil, soil gas, and/or groundwater for BTEX, naphthalene, and/or MTBE (e.g., IA, SD, TN)

Typical Approach Found in VI Guidance

- Use of a multi-step or tiered approach (consistent with EPA 2002 draft guidance)
- Rely on multiple lines of evidence approach, incl.
  - groundwater, soil, soil gas, subslab vapor, indoor air data
  - outdoor air data, flux data, tracer data (e.g., radon)
  - NAPL presence, spatial/temporal variability of data
  - soil properties
  - differential pressure data; building characteristics; preferential pathways; background sources

1. Conduct preliminary screening and assess VI potential (is VI pathway potentially complete?)
2. Address imminent hazards
3. Develop CSM and sampling work plan
4. Conduct subslab vapor sampling and compare to screening/target levels (use of attenuation factor)
5. Conduct expanded investigation (indoor air)
6. Remediate or mitigate (engineering controls)
7. Long-term monitoring and termination

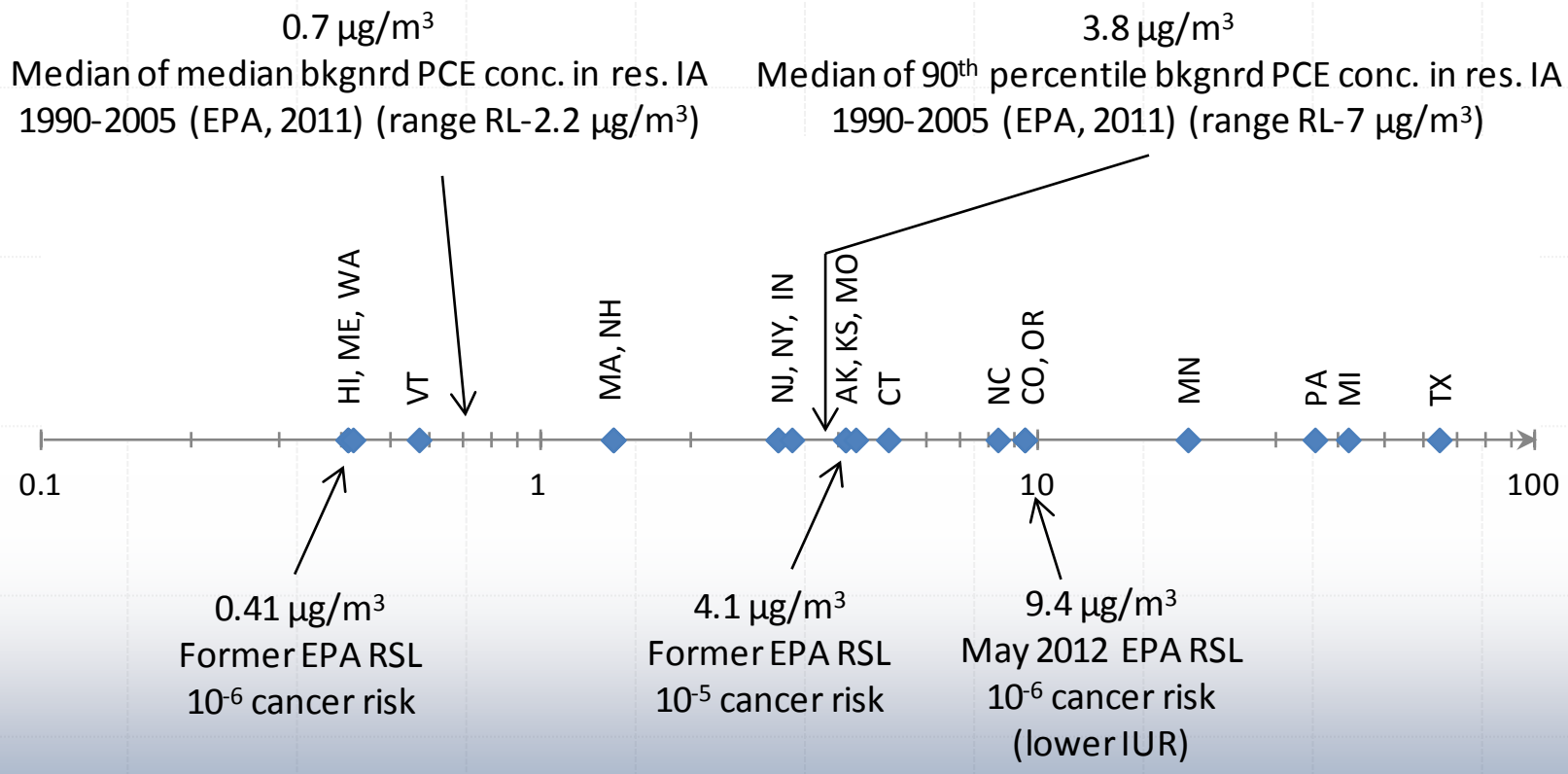




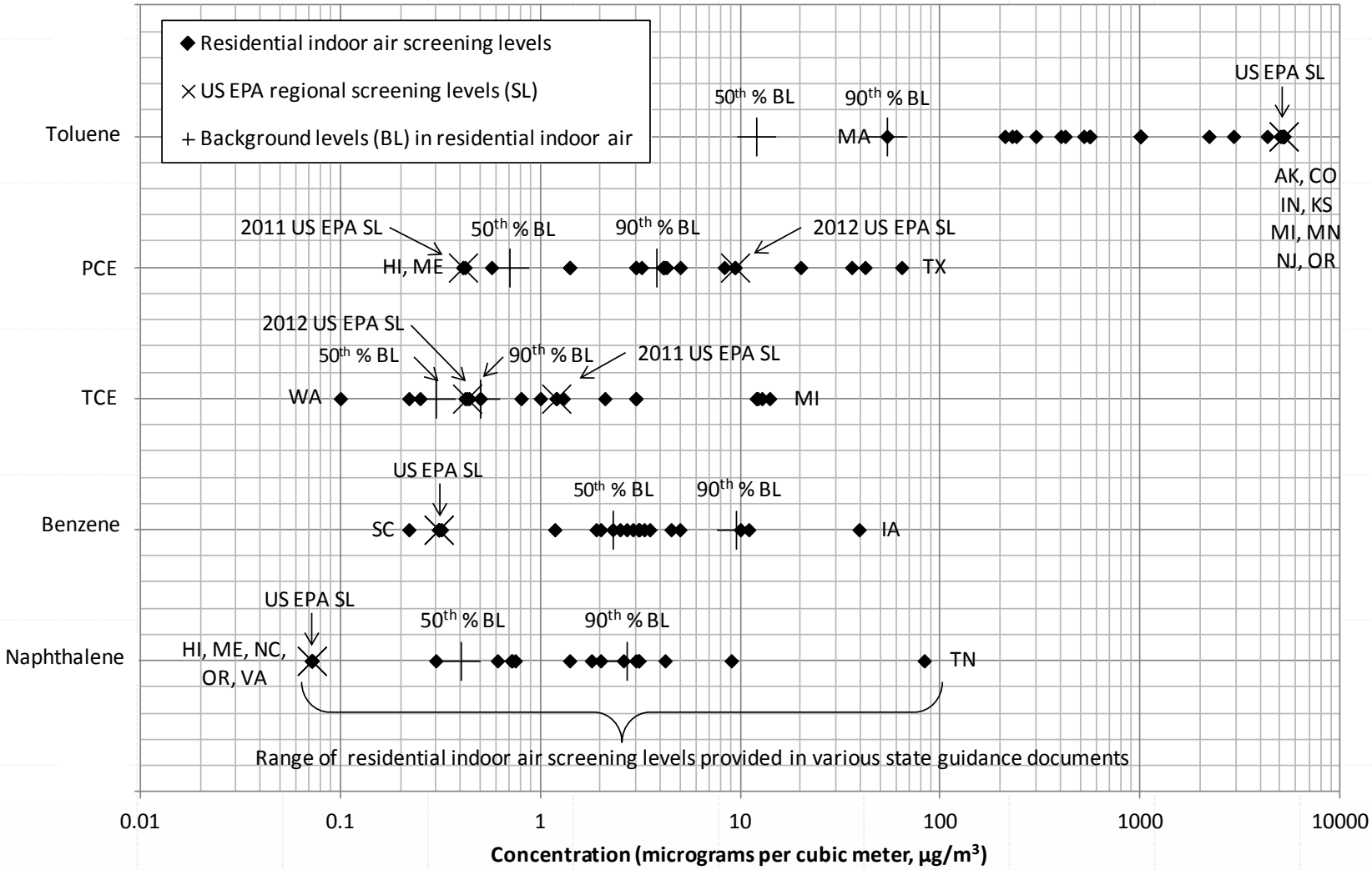
Indoor Air Screening Levels Vary Broadly Between States

- Typically health-based criteria (10^{-5} or 10^{-6} cancer risk and HI = 1 or 0.2)
- Sometimes based on background level studies (e.g., MA, CT, PA, VT)
- Occasionally based on TO-15 reporting limits (e.g., NH)
- Example for tetrachloroethene (PCE). Range of screening values spans two orders of magnitude with several states relying on former EPA RSL

PCE Reference/Screening Values in Residential Indoor Air (µg/m³)



Indoor Air Screening Levels (continued)

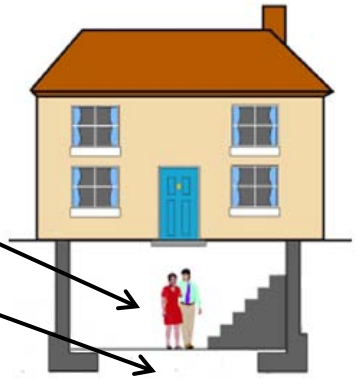


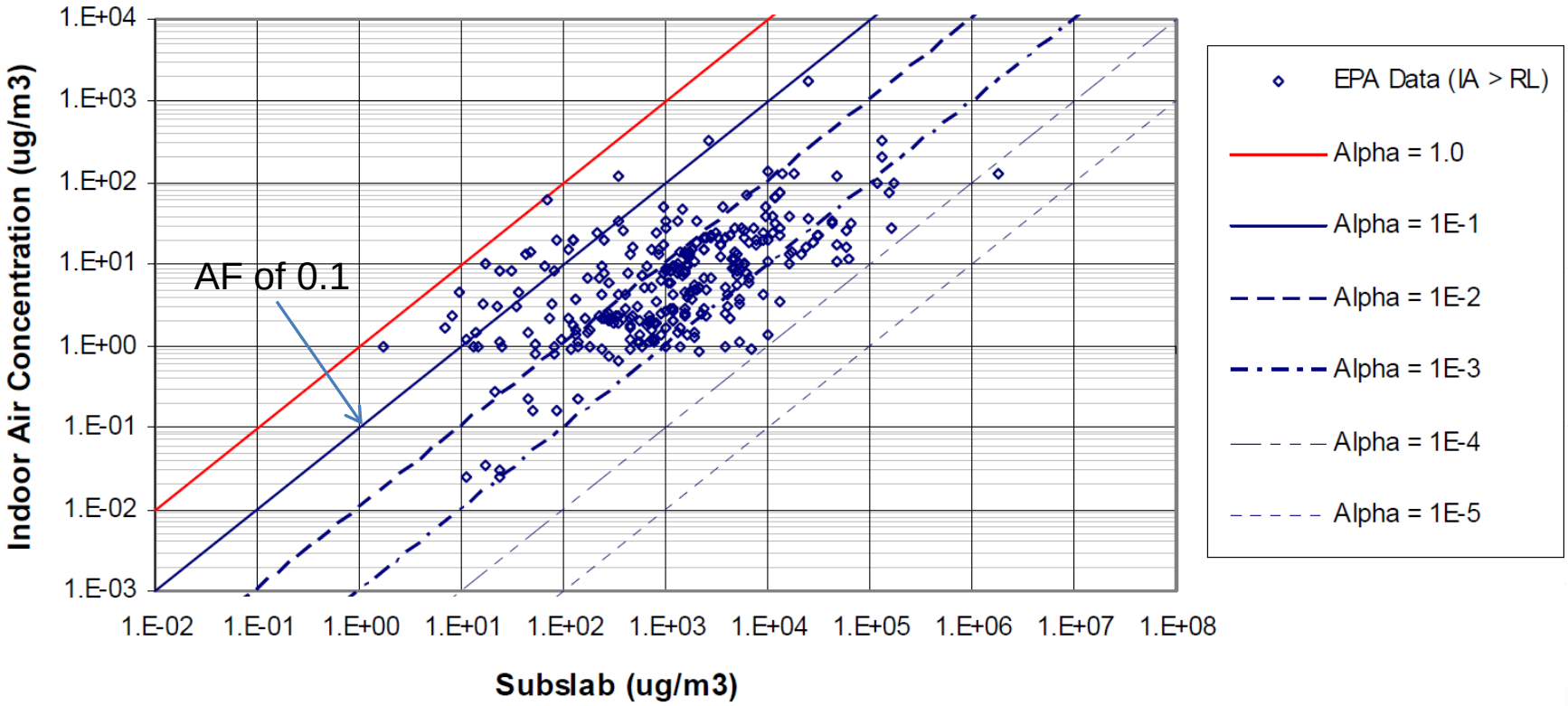
- Range of two orders of magnitude (different risk levels, non risk-based SL, NC/C)
- TCE less common in background than PCE although certain SL are below background
- Most SL for benzene and naphthalene within or below background

Attenuation Factors

The ratio of indoor air to subslab vapor concentration

$$AF = \frac{C_{\text{indoor air}}}{C_{\text{subslab vapor}}}$$

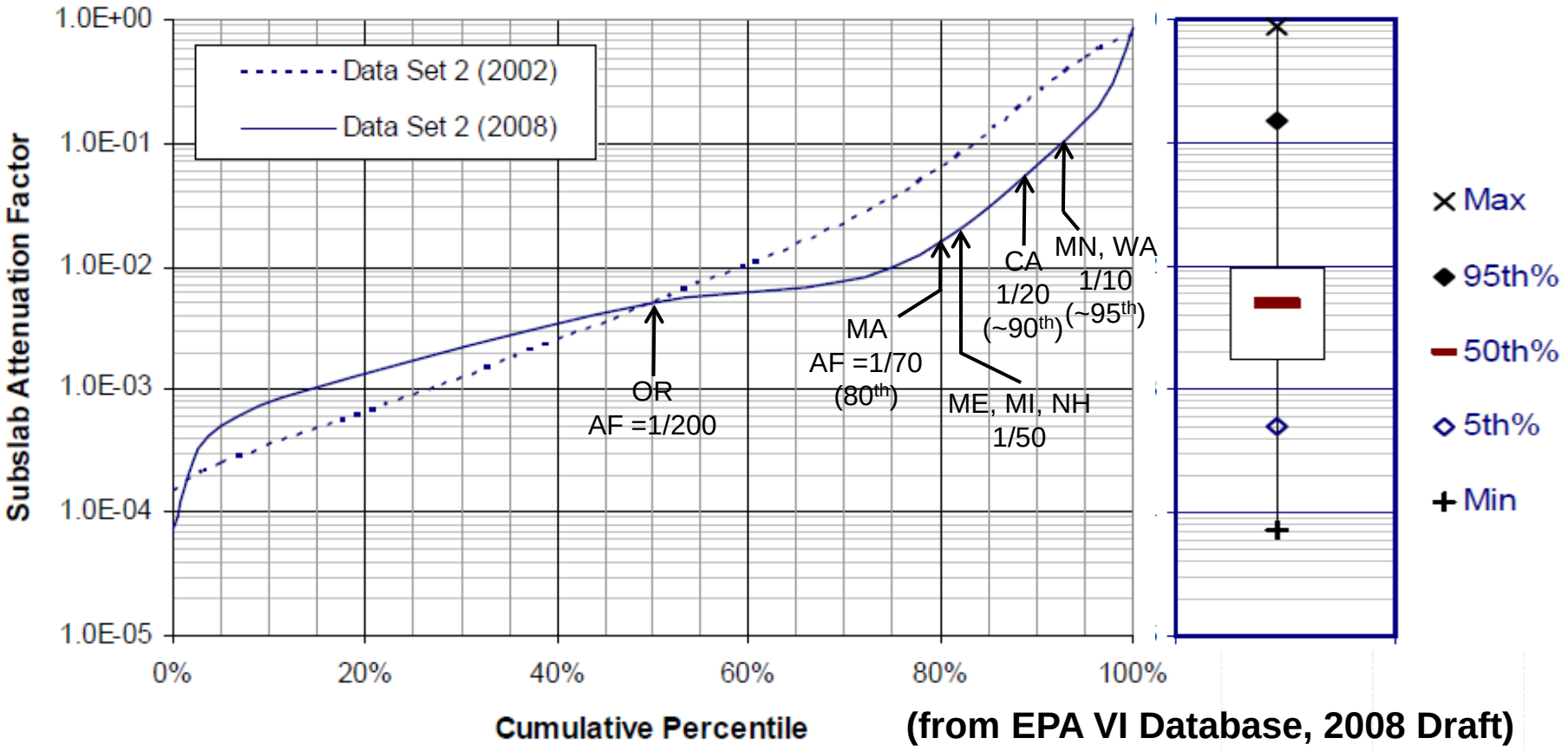




311 paired subslab vapor-to-indoor air data points from 13 sites (after **EPA VI Database, Draft 2008**, Final March 2012)

→ **For most data pairs, AF is less than 0.1**

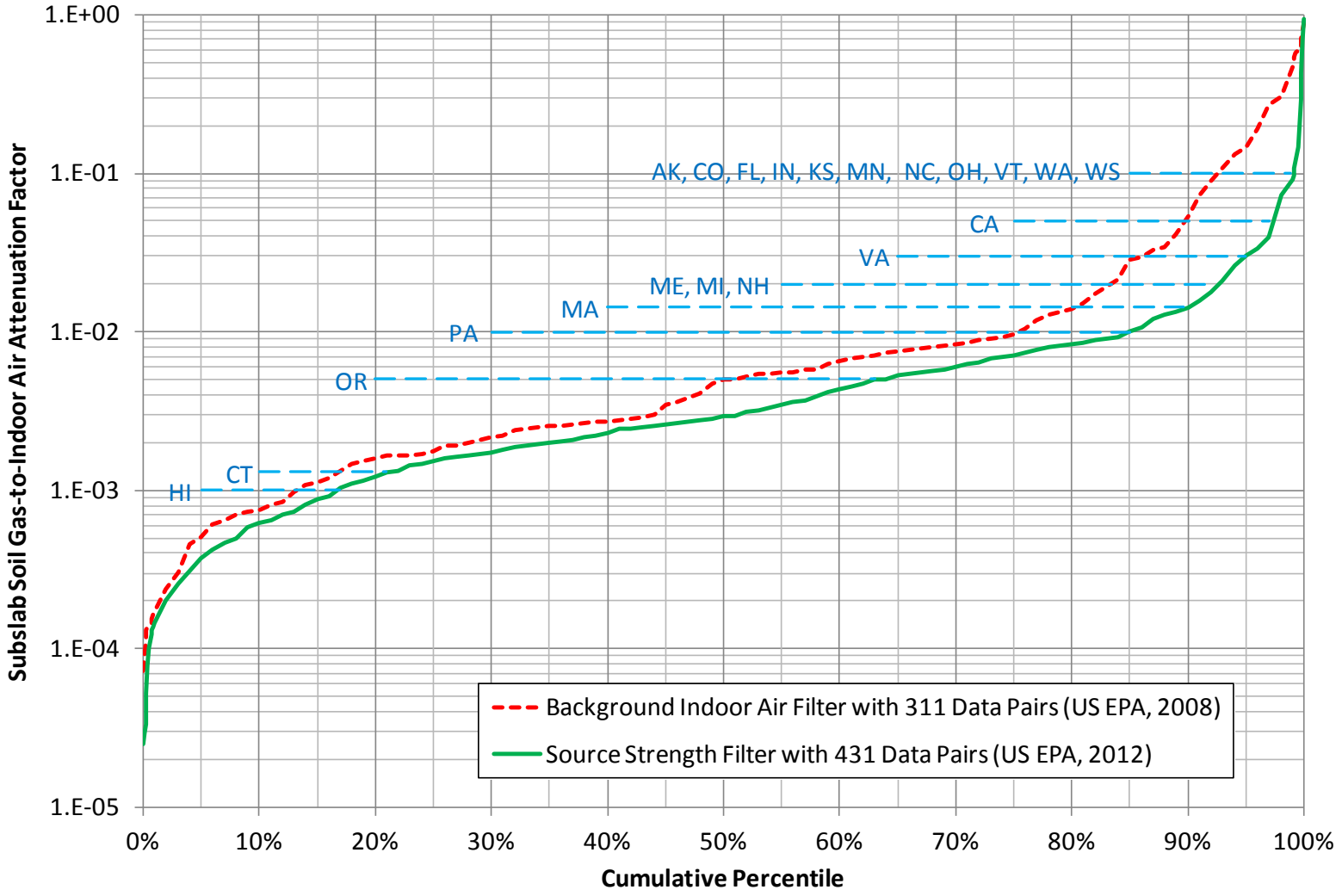
Attenuation Factors (continued)



(from EPA VI Database, 2008 Draft)

- Indoor air concentration predictions using subslab vapor data and assumed AF
- Most states use AF of 0.1 (1/10) based on EPA 2002 draft VI guidance recommendation (AK, CO, IN, KS, NC, OH, VT, WS)
- Several states have relied on results from EPA VI database study (2008 draft) to use less conservative AF

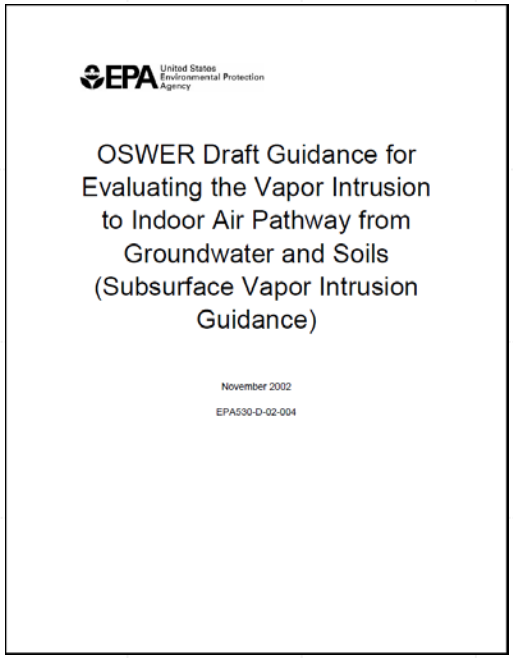
Attenuation Factors — from EPA 2008 to EPA 2012



- 2012 '50x 90th BL source strength' filter replaces 2008 '95th BL IA' filter
- Remaining data pairs show more attenuation than previously derived
- Accordingly, generic AF are more conservative than originally thought

Upcoming this Fall… and in 2013

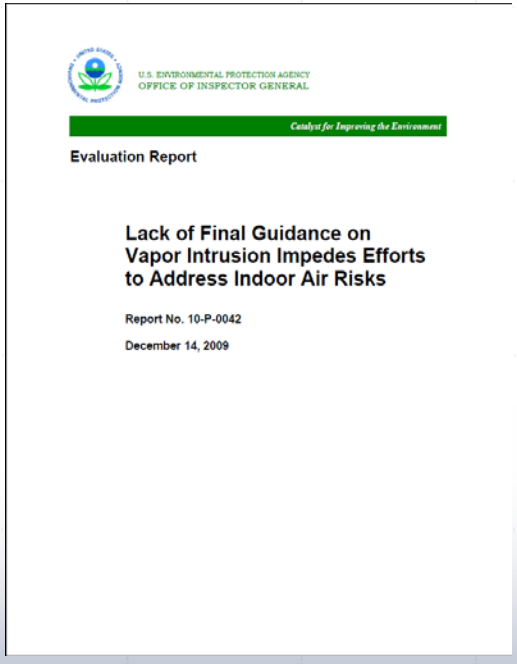
- Final EPA VI guidance due to be released at the end of 2012 ten years after draft was published
- Guidance will likely:
  - Draw from EPA VI database study (EPA, 2008, 2012) (e.g., less conservative subslab to indoor air AF, limitations associated with exterior soil gas data)
  - Rely on EPA background IA study in North American residences (EPA, 2011)
  - Differentiate between VI by chlorinated hydrocarbons and VI by petroleum hydrocarbons ("PVI") (EPA, 2011) (aerobic biodegradation in the vadose zone may result in lower AF)
  - Recommend relying on empirical evidence rather than modeling (e.g., limitations on the use of J&E)
- States are poised to follow suit (if they have not already done so)


EPA United States Environmental Protection Agency

OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance)

November 2002

EPA530-D-02-004


U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF INSPECTOR GENERAL

Catalyst for Improving the Environment

Evaluation Report

Lack of Final Guidance on Vapor Intrusion Impedes Efforts to Address Indoor Air Risks

Report No. 10-P-0042

December 14, 2009

Questions?

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