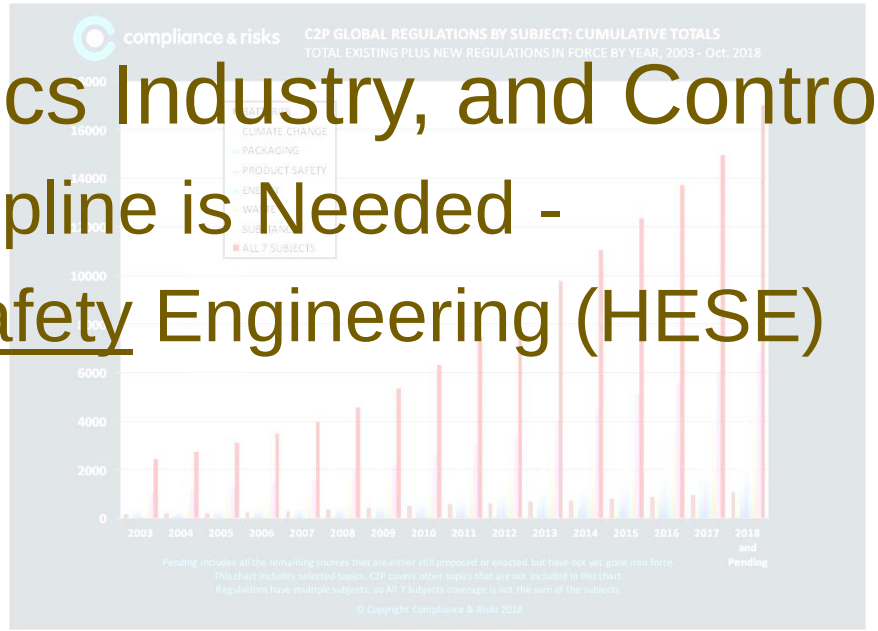
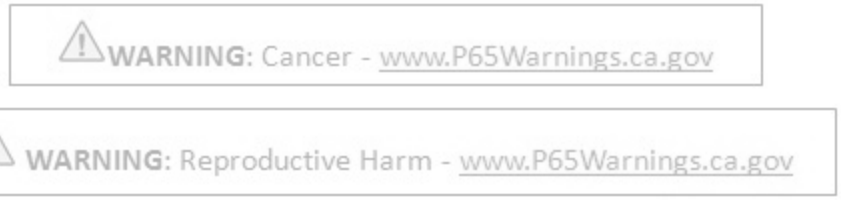
Chemicals, The Electronics Industry, and Control:
Why A New Discipline is Needed -
Health & Environment Safety Engineering (HESE)





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Michael Kirschner
Design Chain Associates, LLC
Compliance & Risks Webinar
12 February 2019

Agenda

- Introduction
- The Problem
- Case Study:
  - Flame Retardants
- The Implications & The Industry's Challenge
- Recommendations

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About DCA

- Manufacturing Consulting firm
  - Focus on Discrete/Fabricated “Article” Manufacturers
  - Based in San Francisco, CA
- Main Focus: Strategies/Tactics for Compliance with Product-focused Environmental Regulation & Customer Requirements
  - Substance Restriction/Disclosure Compliance, Recycling, Green Claims, Energy Use, Conflict Minerals, Carbon/GHG, NGOs/Retailers
  - Worldwide scope
  - A&D, Industrial and Commercial, Consumer, Medical, Apparel, Agriculture, Construction, etc.
- See www.DesignChainAssociates.com

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Mike's Background

- 20 years in manufacturing companies, in product development and quality/reliability roles:

United Technologies

INTERGRAPH

intel

TANDEM

COMPAQ

- 19 years in consultancies

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ENVIRON

- Co-Moderator: ANSI Chemicals Network
- Initial Member of California EPA DTSC Green Ribbon Science Panel: 2009-2013
- Member of American Chemical Society Green Chemistry Institute Advisory Board: 2014-current

ANSI American National Standards Institute

SAFER CONSUMER PRODUCTS

ACS Green Chemistry Institute®

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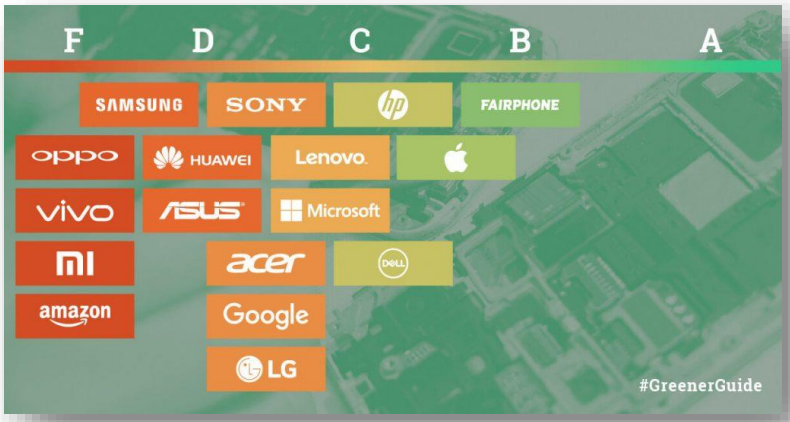
Problem

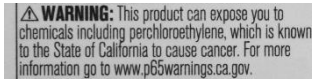
- Historically – and at worst – *chemical toxicity in manufactured articles* has been treated as Somebody Else's Problem
- At best, we are treating chemical environmental and health toxicity as a performance issue

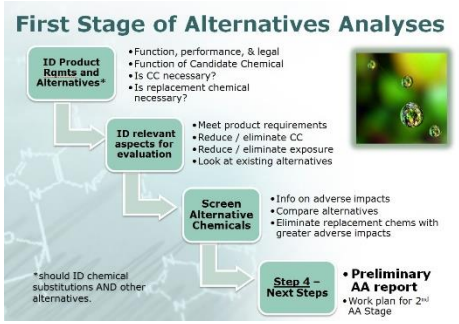


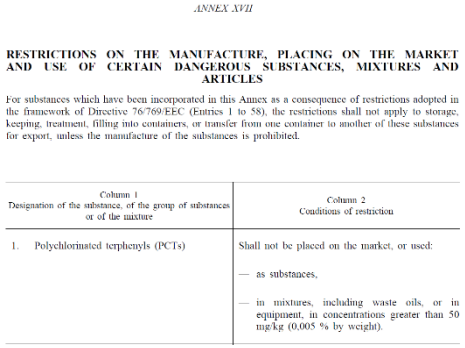
chemsec SIN LIST

Competition Doesn't Sway Governments

- Governments demand that industry address it
  - Industry grudgingly reacts
- Industry does not view it as a sellable parameter like
  - Speed
  - Gigabytes/Second
  - Teraflops
  - Sexiness
  - Etc.





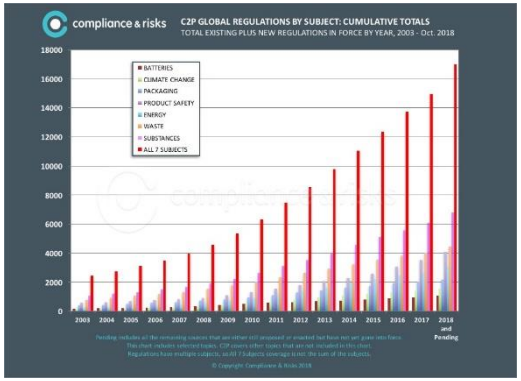


ANNEX XVII

RESTRICTIONS ON THE MANUFACTURE, PLACING ON THE MARKET AND USE OF CERTAIN DANGEROUS SUBSTANCES, MIXTURES AND ARTICLES

For substances which have been incorporated in this Annex as a consequence of restrictions adopted in the framework of Directive 76/769/EEC (Entries 1 to 58), the restrictions shall not apply to storage, keeping, treatment, filling into containers, or transfer from one container to another of these substances for export, unless the manufacture of the substances is prohibited.

Column 1 Designation of the substance, of the group of substances or of the mixture	Column 2 Conditions of restriction
1. Polychlorinated terphenyls (PCTs)	Shall not be placed on the market, or used: — as substances, — in mixtures, including waste oils, or in equipment, in concentrations greater than 50 mg/kg (0,005 % by weight).



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The Result

Industry's reactive approach is … suboptimal

Suboptimal?

- When a substance is restricted, manufacturers replace it based primarily on these factors
  - Functional equivalence
  - Cost
  - Availability

- Toxicity – the rationale for the restriction – is generally not a primary, or often even a secondary, consideration

- Result: The *technical requirement* is addressed but the *problem* is not, or it is poorly addressed

Case Study: Flame Retardants are used in Plastics

To Meet Flammability Safety goals defined in product safety standards, for example IEC (or UL) 62368-1

(IEC/UL 62368-1 covers IT/Video/Audio; other standards cover other categories of electronics)

- IEC: International Electrotechnical Commission – international standards body
- UL: Underwriters Lab – US-focused standards

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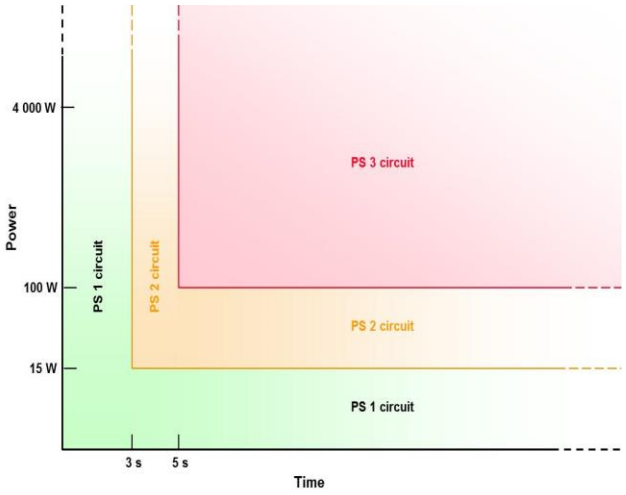
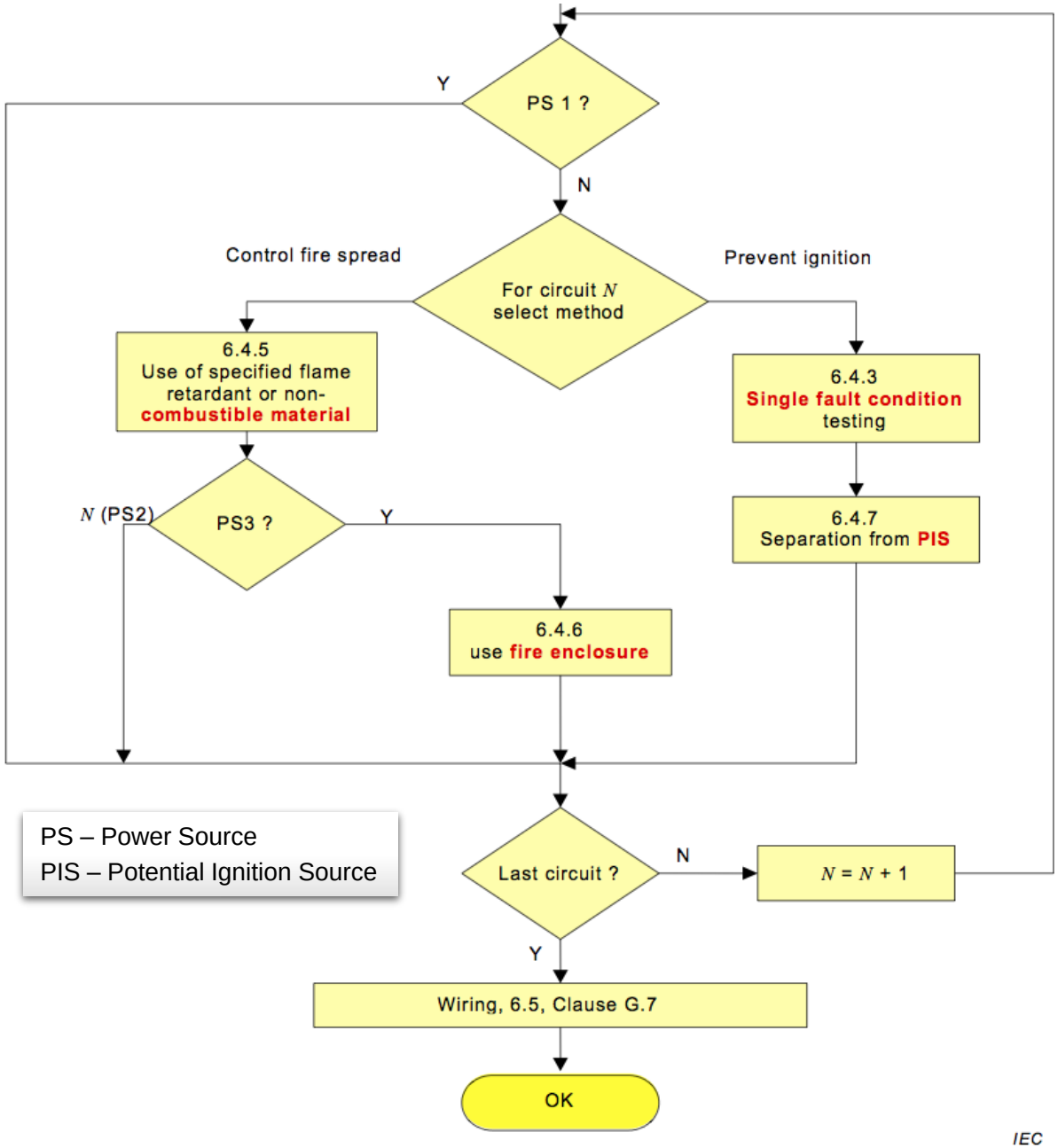
IEC 62368-1 Clause 6

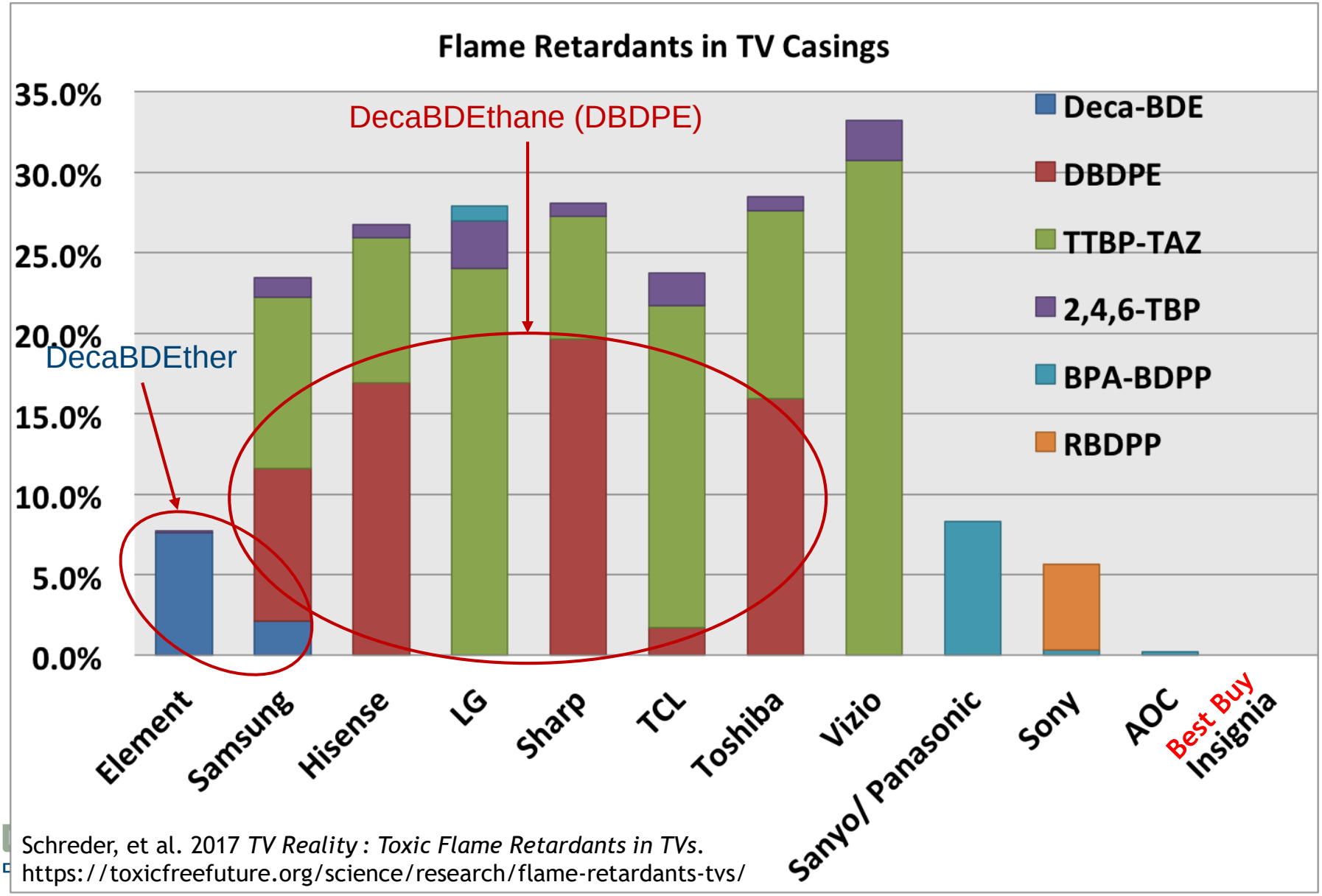
When is a fire enclosure necessary?





Flowchart from IEC TR62368-2

Flame Retardants Used in TV Enclosures Sold in the US



Schreder, et al. 2017 *TV Reality : Toxic Flame Retardants in TVs*.
https://toxicfreefuture.org/science/research/flame-retardants-tvs/

Flame Retardants Used in US TV Enclosures

Proposed for Restriction in Canada!

Restricted or Declarable in EU, California, Illinois, Minnesota, New Jersey, New York, Washington, etc.!!

Chemical Name	Acronym	CAS #	Type
Decabromodiphenyl ether	Deca-BDE	1163-19-5	brominated
Decabromodiphenyl ethane	DBDPE	84852-53-9	brominated
1,3,5-Triazine, 2,4,6-tris(2,4,6-tribromophenoxy)	TTBP-TAZ	25713-60-4	brominated
Octabromotrimethylphenylindane	OBIND	1084889-51-9	brominated
2,4,6-tribromophenol	2,4,6-TBP	118-79-6	brominated
Resorcinol diphosphate	RBDPP	125997-21-9	phosphate
Bisphenol A bis-(diphenylphosphate)	BPA-BDPP	5945-33-5	phosphate

Schreder, et al. 2017 *TV Reality : Toxic Flame Retardants in TVs*.
https://toxicfreefuture.org/science/research/flame-retardants-tvs/

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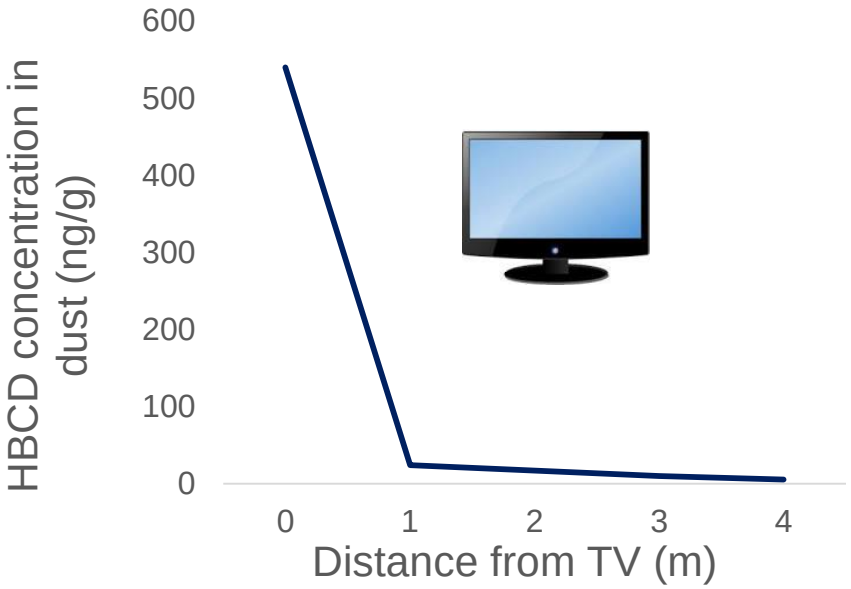
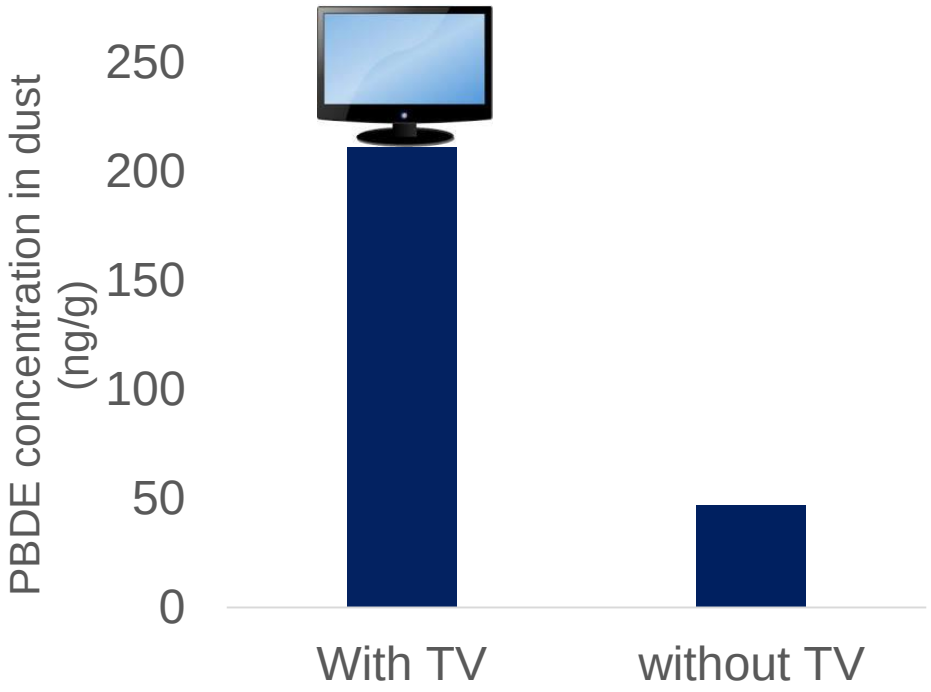
OrganoHalogen Flame Retardants Migrate from Electronics into Dust



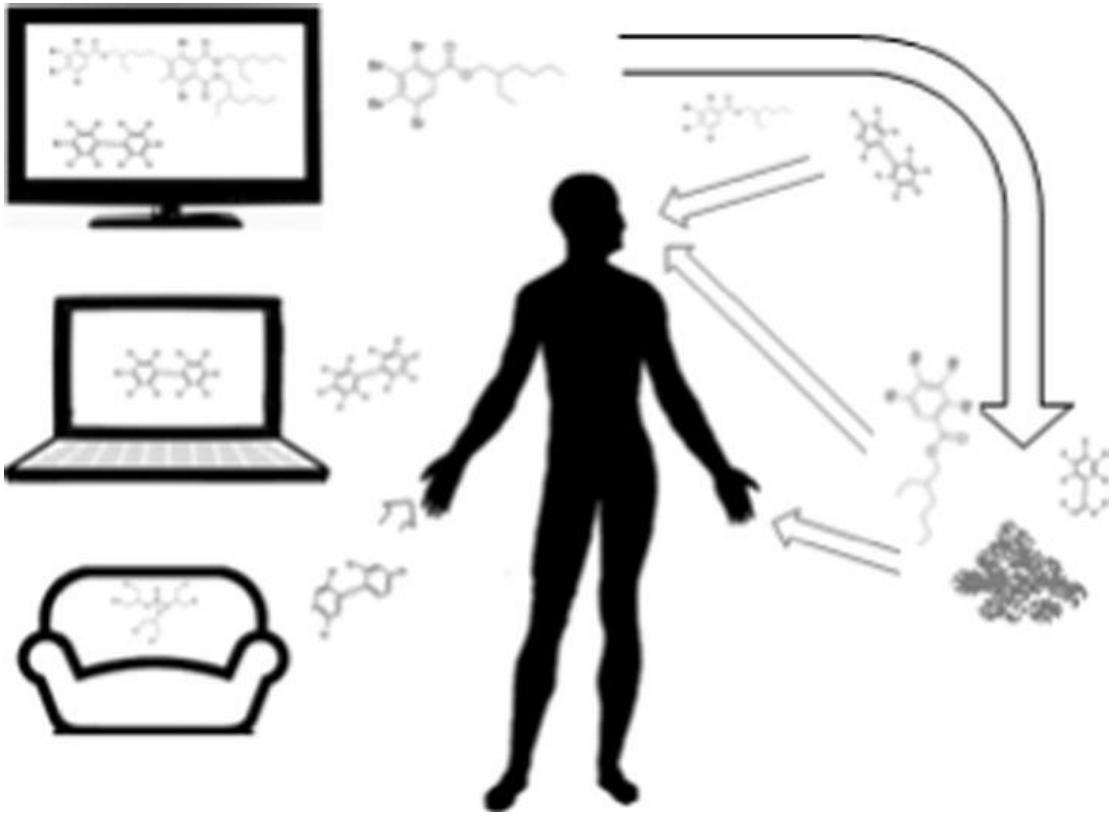
Flame retardants levels in dust are highest within one meter of the television.

Harrad 2008; Harrah 2009; Muehnor 2012

Flame retardants levels in dust are higher when televisions are present.



OHFRs from Electronics are Absorbed by People



Source: Diamond, "Product screening for sources of halogenated flame retardants in Canadian house and office dust," 2016.

PETITION HP 15-1
to the U.S. Consumer Product Safety Commission

…Requesting Rulemaking on Products Containing Organohalogen FRs

Declare as “banned hazardous substances” any:

- Children’s products
- Residential furniture
- Mattresses & mattress pads
- Plastic electronics enclosures

containing additive, non-polymeric organohalogen flame retardants

- 13 supporting statements from scientists and health professionals

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PETITION HP 15-1

to the U.S. Consumer Product Safety Commission

…Requesting Rulemaking on Products Containing C… …gen FRs

GRANTED – 20 September 2017

Declare as "banned hazardous su… …any:

- Children's products
- Residential furni…
- Mattresses & mattress pads
- Plastic electronics enclosures

containing additive, non-polymeric organohalogen flame retardants

- 13 supporting statements from scientists and health professionals

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Sept. 28, 2017

"[T]he Commission recommends that manufacturers of children's products, upholstered furniture sold for use in residences, mattresses (and mattress pads), and **plastic casings surrounding electronics** refrain from intentionally adding non-polymeric, organohalogen flame retardants ("OFRs") to their products."

"Numerous peer-reviewed, published studies show that the vast **majority of consumers** have measurable quantities of OFRs in their blood."

"…the Commission has serious concerns regarding the potential toxicity of OFRs, and the risks of exposure, particularly to vulnerable populations..."

-Federal Register Notice on Additive, Non-Polymeric Organohalogen FRs

https://www.federalregister.gov/d/2017-20733

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The Effect of IEC/UL 62368-1 Clause 6

- Clause 6 of IEC/UL 62368-1 helps safety engineers define design requirements to meet fire (and other) safety goals for IT/Video/Audio equipment
  - As do other standards for other types of Electrical/Electronic Products
- It does not define the “right” approach
  - Or what “right” means!
- It does not specify materials to use ***or*** the use of FRs
  - Or whether/how to assess those materials for environmental/human health/biological safety
- If implemented correctly, the product will pass the *defined* test
  - **But it may not be “safe” in terms of the environment or human health**

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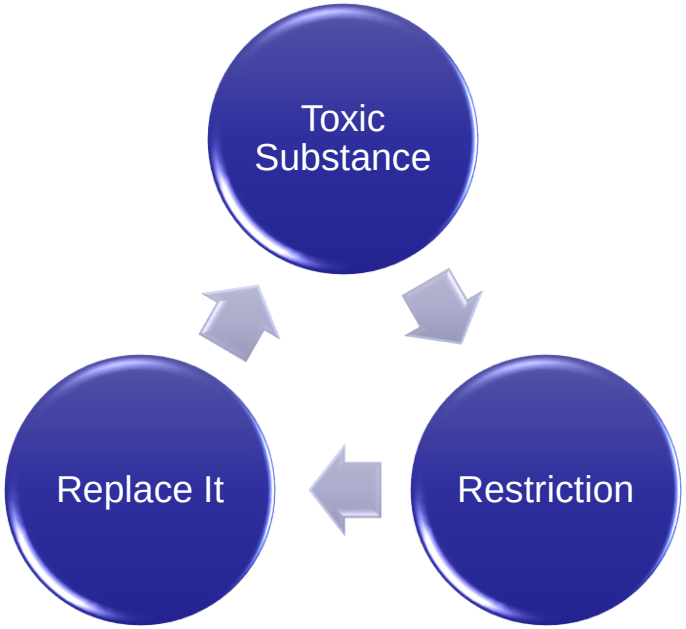

And That Leads to Regulation

Because we end up (unintentionally) designing toxic substances into products

Why Does This Happen?

- Chemicals and chemical toxicity are not a typical design constraint: *Product Safety Standards do not address it!*
- Manufacturers define a “Safe Design Space” process
  - Places market, cost, size and other constraints on product design, development & marketing based, in part, on safety standards
  - Adding Heath & Environmental Safety - or any other - Constraints shrinks the “Gray Area” and “Acceptable” spaces

Product Safety vs. Health/Env Safety

- These are not mutually exclusive
  - FR example: meeting flammability safety requirements can have negative human health/environmental safety (HES) impacts
- We are not solving the safety problem: we are displacing it from fire safety to HES
  - Product Safety review and assessment *must* incorporate HES impact assessments; they do not at most manufacturers
  - The HES assessment must go beyond regulatory requirements
    - Regulations lag far behind a chemical's release to the market

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Parallels to Other Customer Expectations

- No overt demand for HES: Consciously or not, customers simply expect
  - "Safe" Products
  - Electromagnetic Interference under control
  - Quality
  - Reliability
  - Cybersecurity => Data Safety
- Problems in some of these areas result in regulation
- Industry response is, in some, to create standards
  - Levels playing field for areas manufacturers prefer not to compete in
    - Note that we don't have product category-specific standards for quality, reliability or cybersecurity goals

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The Industry's Challenge

- To implement a new constraint like this requires chemical and toxicological expertise
  - The electronics industry, like most industries so far downstream of the chemical industry, lacks expertise
- Manufacturers today are simply reacting to environmental/health safety requirements placed on it
  - By regulators
  - By retailers
- Few have the expertise to be proactive

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Nothing will change unless we “get a seat at the table”

- Dramatically expand our knowledge and its availability in this space
- Work with, instead of against, NGOs and governments

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Health & Environmental Safety Engineering

- HESE: A formal product safety discipline, like
  - Thermal, mechanical, electrical, optical, acoustic, etc…
- Focused on **defining** and **meeting** product environmental, biological and human health safety requirements
- Corporate Level:
  - Part of Product Safety Engineering/Engineering Services
  - Built upon existing product compliance/stewardship function
- Industry Level:
  - Membership organization to solidify HESE and create community
  - Standards Development Organization (SDO) to define and develop appropriate standards

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Key Challenges

1. Expertise – sparse, localized
2. ECHA/EU MS Resources – how to compete or stand up to them?
   - Depending on the chemical industry for support is risky, if not foolhardy
3. Long-Term & Readily out-prioritized for funding
4. No Data/No Standard – difficult to make consistent decisions
   - Treading water by being reactive is, therefore, the norm

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Summary/Recommendations

- Health & Environmental Safety must be viewed as a design constraint
  - Product Safety Engineering must work closely with HESE personnel
  - HESE must have a voice in product development and supplier/material selection
- Product Safety Standards define product safety expectations
  - But, aside from acute issues, they do not specify HES expectations
  - Formalizing another safety discipline is the first step toward closing this gap
- Recommendations to manufacturers:
  - Hire the necessary expertise
  - Work together to formalized the Health/Environmental Safety discipline
  - Fund and populate it to properly define scope, requirements and desired output

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Thank You For Your Attention

Michael Kirschner
President
Design Chain Associates, LLC
San Francisco, CA

Mike@DesignChainAssociates.com
415.342.3217

Appendix

<extra slides>

What is an OrganoHalogen?

Organic compound:

- Classically, a molecule that contains carbon

Halogen:

- Periodic Table Group containing
  - **Fluorine**
  - **Chlorine**
  - **Bromine**
  - Iodine
  - Astatine

Organo-Halogen Flame Retardants (OHFRs):

- Chlorine, Bromine, or Fluorine-based
- Inhibit or delay spread of flame

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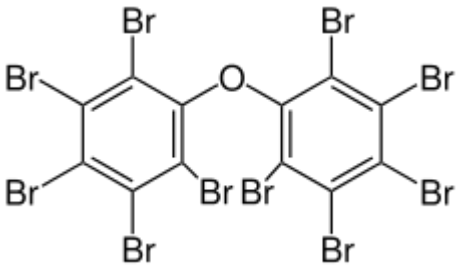
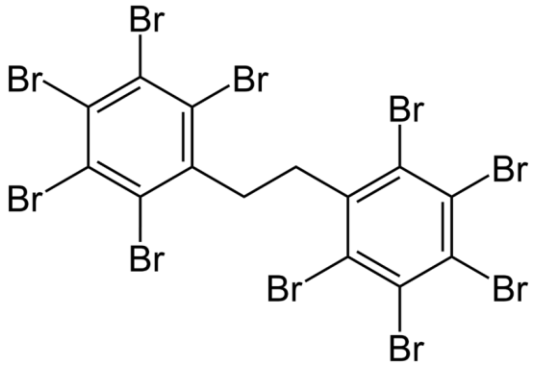


Decabromodiphenyl ether



Decabromodiphenyl ethane

OHFRs are Not Federally Banned Yet!

Only Guidance For Now from CPSC

Regulation is Yet To Come