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# The Case against Candle Resistant TVs

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**Proposed amendments to International Electrotechnical Commission (IEC) Standards 60065 and 62368 for candle resistance of television enclosures have no valid fire safety rationale as well as a large potential to cause serious harm to human health and the global environment.**

**We urge TC108 National Committees to vote "NO" on 108/479/CDV and 108/478A/CDV, and additionally comment to remove the mandatory candle flame ignition requirement** in Clause 11 of **IEC 62368-1 Ed 2.0 (108/479/CDV) and Clause 21 of IEC 60065 Ed 8.0 (108/478A/CDV) as well as all related language and references.**

This report contains information about the lack of fire safety benefit of new candle flame requirements for televisions as well as the serious adverse health and environmental impacts of the chemicals that are likely to be used to meet such requirements. It should be read as a supplement to our previous paper, "The Case against Candle Resistant Electronics" available at http://greensciencepolicy.org/sites/default/files/MASTERWhitepaper.pdf.

IEC Standard 62368 Ed 1.0: "Audio/Video, Information and Communication Technology Equipment ¬Safety – Requirements" and IEC 60065-A2 Ed 7.0: "Audio, video and similar electronic apparatus - Safety - Requirements", developed by the International Electrotechnical Commission's (IEC) TC108 included such a candle flame requirement. The standards were voted down in 2008 by a majority of delegates from 31 countries based (in part) on a lack of proven fire safety benefit, as well as health, environmental, recycling, and other concerns. Several other similar proposed standards that included candle flame ignition requirements from the IEC, Underwriters Laboratory (UL), and Canadian Standards Association (CSA), were also voted down in 2008. Nonetheless, a candle flame ignition requirement for television housings in the EU (CENELEC EN 60065) passed in 2009.

During the 2008 votes on 108/276/CDV for IEC 62638 Ed 1.0 and on 108/295/FDIS for IEC 60065-A2 Ed 7. 0, many of the IEC TC108 National Committees submitted comments that the candle flame resistance requirement should not be implemented until current health, environmental, and fire data were evaluated. This paper will show that these external ignition requirements for televisions do not provide a fire safety benefit and have the potential for serious harm to human health and the global environment.

These principal points are discussed in more detail below.

1. Consumer television technology has changed greatly over the past three decades leading to a greatly decreased fire hazard. There is no documented fire hazard from current flat-panel and plasma screen TVs, which have much lower voltages and power levels than past TVs. Furthermore, as current TVs are thin and usually hung on the wall, external ignition sources such as candles are an unlikely source of ignition.
2. A valid current fire safety rationale for the candle resistance of televisions has not been demonstrated. The fire data that is cited is from the 1990s and lacks relevance to current

televisions. Furthermore, accurate comparisons between EU and U.S. TV fire data do not show any difference in the fire death rate.

3. Most fire deaths and most fire injuries result from the inhalation of carbon monoxide, smoke, soot, and other irritant gases. The incorporation of halogenated flame retardants into plastic TV enclosures increases the yield of such toxic gases during combustion, making home fires more toxic and dangerous.
4. The inclusion of a variety of fire retarding chemicals in consumer product housings will make responsible recycling of electronics more expensive and difficult.
5. New ASTM standards in the U.S. and European Committee for Standardization (CEN) standards address the root causes of candle fires and lessen the potential for candle-initiated fires in TV enclosures without introducing harmful chemicals into the environment.
6. Television enclosures and furniture are primary sources of toxic flame retardants found in dust in U.S. homes.
7. These flame retardant chemicals are also found in people, with toddlers and children having the highest levels.
8. Flame retardants in current use have been shown to cause adverse health effects including endocrine disruption, thyroid problems, reduced sperm count, infertility, hyperactivity, and cancer. There is not adequate health and environmental information for the new chemicals that are likely to be used in television housings.
9. The peer-reviewed scientific literature shows that decaBDE, which has been used as the primary fire retardant in TV housings, is found in humans, wild animals, and the environment; causes negative health effects in several species of experimental animals; and converts to more toxic smaller molecules. Although decaBDE is being phased out, the numerous replacements are from the same chemical family and lack adequate information
10. Studies measuring levels of toxic flame retardants find much lower levels in European dust and people, apparently because European countries have not had flammability requirements for electronics housings and furniture in the past. If these standards are implemented, more toxic flame retardant chemicals will to be used in televisions worldwide and end up in people, animals, and the environment.
11. Antimony trioxide (ATO), used at high levels as a synergist in TVs to increase the effectiveness of brominated and chlorinated flame retardants, has been classified as a possible human carcinogen by the IARC (International Agency for Research on Cancer), the European Union, and the U.S. EPA.
12. Many of the brominated chemicals that are likely to be used to flame retard TVs could eventually contaminate sediments in rivers, lakes, and estuaries.
13. Brominated flame retardants are found in increasing levels in ten species of wild animals.
14. The initiative and major support for these amendments comes from chemical manufacturers who profit from the sales of the flame retardant chemicals.

More detailed information of special relevance to the TV candle flame ignition requirement follows.

**1. Consumer television technology has changed greatly over the past three decades leading to a greatly decreased fire hazard. There is no documented fire hazard from current flat-panel and plasma screen TVs, which have much lower voltages and power levels than past TVs. Furthermore, as current TVs are thin and usually hung on the wall, external ignition sources such as candles are an unlikely source of ignition.**

After the earlier transition from vacuum tube to solid state technology occurred, cathode ray tube (CRT)-based TVs have become nearly extinct, and are being replaced by LCD panel and plasma display based technologies. These new technologies have resulted in:

- Greatly reduced and contained high voltage
- lower power
- shallower products; new TVs cannot function as shelves, nor can materials easily be placed to lean against them
- more capability to wall-mount
- lower weight

Flame retardant chemicals were first added to TV enclosures in the mid-1970s to protect against internally-initiated fires. The likelihood of such fires was far greater with the 15,000V to 25,000V required by CRT technology, generated by a large flyback transformer, and transmitted to the CRT anode by an insulated wire. Air can break down at 10,000V to 20,000V per inch (4,000V to 8,000V per centimeter) based on humidity levels, so these voltages were significant arcing risks, particularly if the transformer, wire, or connection to the CRT failed. Today's technology eliminates this hazard. High voltages are now self-contained in the ballast of fluorescent lamps that backlight the LCD display (these can briefly reach several hundred volts), or within the individual cells of a plasma display (normally around 200V). These voltages are so low that arcing is not a potential hazard.

This new technology eliminates hazards such as internal heat sources like the tube filaments, rectification and plate voltages that could reach as high as several hundred volts, and related high currents that were required in the printed circuit boards to deliver (particularly) filament power. Currently, in the US, TVs are essentially required to have flame-retardant enclosures due to internally initiated ignition threats rather than externally initiated ignitions. The dramatic reduction in and containment of what was extremely high voltage, significant reduction of power requirements, as well as decades of improvement in the technology of other high power circuitry (and the fact that high power is, again, very limited in new technology TVs) suggests that TV manufacturers interested in improving environmental performance of their products, without impacting fire safety, should consider revisiting whether design changes can be made to eliminate the necessity for flame retardants in plastic enclosures.

2. **A valid current fire safety rationale for the candle resistance of current televisions has not been demonstrated.**

Much of the TV fire data cited as a rationale for this requirement is more than ten years old and refers to all TV fires rather than external small open flame ignitions. The majority of TV fires result from internal electrical malfunction; these should not be included in the analysis. Candle fires (or any other external small open flame) account for a small share of appliance housing fires and appliance housings as first items ignited account for a small share of candle fires. [2,3]

It is important to distinguish between overall fire death rates, which are relatively accurate and consistently captured, and death rates from relatively infrequent causes such as TV fires and candle fires. At that level of detail, fire data coding systems and collection methods are likely to vary from country to country and large sampling errors are inevitable. Fire data collected in different studies in Europe is difficult to compare with each other or with the U.S. as can be seen from the large variability between Grand and Wilkie data and Poortere's results as compared in Table 2 below.

In their book published in 2000, Grand and Wilkie found European TV fire incidence and death rates similar to those reported for the US.[4] In contrast, a paper by Poortere, Shonbach, and Simonson reports a significantly higher rate of TV fires and related injuries and deaths.[5] The Poortere *et al.* research was funded by the European Brominated Flame Retardants Industry Panel and was based on a single suburb of Stockholm with an extraordinarily large number of TV fires in the 1990s. Please refer to our previous paper "The Case against Candle Resistant Electronics" pages 13-14 for further discussion of the Poortere *et al.* analysis.

**Table 2** Comparison of reported TV fire data per million TVs.

| | *Per Million TVs* | | |
|---|---|---|---|
| Region (Source) | TV Fires | Fire Deaths | Fire Injuries |
| US (Hall, 2002) | 10 | 0.13 | 0.65 |
| Europe (Grand and Wilkie, 2000) | 12 | 0.07 | 0.91 |
| Europe (Poortere, Shonbach, & Simonson, 2000) | 165 | 1.00 | N/A |

Public relations campaigns, financed by the flame retardant industry, may have contributed to the statistically unproven perception that Europe has a large fire problem that urgently needs to be solved. On the contrary, Western European fire death rates are lower than the U.S., rather than higher. The published comparative national data on Western European fire death rates show death rates per 100,000 for Western Europe ranged from 0.43 (Switzerland) to 2.12 (Finland).[6] The average Western European rate of 1.1 can be compared with a U.S. death rate of 1.6 during the mid-90's.[7]

Proposals for flammability standards for plastic housings around television (TV) and other electronic equipment often cite papers by Simonson and colleagues [8,9,10] showing a large fire-safety benefit from the use of flame retardant chemicals in TV enclosures. The Simonson model in these papers consists of a life-cycle study comparing TV sets with and without flame retardants. The model compares emissions from TV production, flame retardant production, and TV incineration, but does not include health or environmental effects of the chemical flame retardants themselves. For example, the model considers the chemicals emitted when a TV burns, but is limited to carbon dioxide, polycyclic aromatic hydrocarbons, dioxins, and furans. The model does not consider the effects of exposures that are due to the migration of flame retardants, such as decaBDE or HBCD, from the plastic TV enclosures into household dust, humans, animals, water, and the food chain.[11,12] In view of the recent significant increase in knowledge about the health and ecologic effects of flame retardants, the Simonson model would benefit from considering other inputs across the life cycle of the products. These effects would include health effects from exposures occurring during manufacturing and use of the product, as well as toxicity to humans and the environment during and after disposal.

**Table 3** Annual estimated TV fires per million TVs in the U.S. and Europe that breach the TV enclosure

| **Estimate** | **TV fires/million** | **Ignition Source** |
|---|---|---|
| Europe - Simonson[a] | 165 | 100 internal, 65 external[13] |
| U.S. – Simonson[b] | 13 | Internal, external[14] |
| Europe – DTI[c] | 18.2 | 12.2 internal, 6 external[9] |

[a] Based on 8 reported TV fires in a Stockholm suburb in 1994; [b] NFPA National 1990-1994 data based on fire department surveys and fire incident data from the U.S. Fire Administration; [c] UK Department of Trade and Industry (DTI) 1996 report based on fire brigade data and a review of fire statistics across Europe

As detailed in Table 3, the Simonson model also uses dissimilar data sources for comparing the annual fire rates in TV enclosures without flame retardants (Europe) and to those with flame retardants (U.S.). For Europe, the model input extrapolates from eight TV fire incidents during 1994 in one suburb of Stockholm, Sweden to an estimate of 165 TV fires per million TVs annually across all of Europe.[8,9] The 1994 in-depth review used a broad definition of a TV fire, which included very small fires. A detailed critique of extrapolating from such a small, unrepresentative sample to fire data for all of Europe has been previously published.[15]

Annual U.S. TV fire data as reported by the NFPA was based on fire-department surveys and fire-incident data from the U.S. Fire Administration from across the country.[16] The data were normalized to 13 TV fires per million TV sets, from both internal and external ignition.[8] The Simonson model then assumed that only a fraction of the U.S. TV fires reported by the NFPA were due to internal ignition and restricted further analysis to only the internal ignition fires (reducing the number of annual U.S. fires from 13 TV fires per million TVs to 5 TV fires per million TVs).[9, 10] In contrast, the model does not restrict European TV fires to internal ignition fires. The dissimilar data sources are based on different definitions and sizes of TV fires, potentially leading to an unrealistically high estimate for European television fires and a correspondingly low one for the U.S.

By comparison, a U.K. Department of Trade and Industry (DTI) review of fire brigade data from across Europe found 12.2 European TV fires per million TVs by internal ignition plus 6 TV fires per million TVs by external ignition.[17] The Simonson estimate, based on data from one Stockholm suburb, gives results an order of magnitude higher than European fire brigade data, which are more representative and comparable to the U.S. data reported by the NFPA (Table 3).

The DTI review suggests a similar rate of TV fire incidents in Europe, where flame retardant chemicals have not been used, as that in the U.S., where TV enclosures contain decaBDE and other flame retardants.

The end-of-life emissions calculations in the Simonson model also used different inputs and methodologies for the U.S. and Europe. The model assumes that all disassembled TV enclosures will be incinerated, which overestimates the extent of incineration of European TVs. The non-treated plastics in European TVs can be reused repeatedly without degradation and account for 87% of recycled electronics plastics.[18] Plastic enclosures manufactured with flame retardants (U.S. TVs) are not recommended for recycling, as combining flame-retardant-containing recycled plastics with new product in manufacturing can result in dioxin and furan concentrations in the plastic enclosures above legal limits.[19] The model underestimates incineration emissions by assuming that 100% of incinerated plastic enclosures are used for energy recovery. In Europe and the U.S., only a small percentage of plastic waste (31% in Europe, 14% in the U.S.) is incinerated with energy recovery.[20] Also not accounted for in the model are the emissions from uncontrolled incineration, such as landfill fires or open pit burning of plastic waste after disassembly. Such unregulated incineration of TVs treated with flame retardants emits toxic brominated dioxins and furans into the environment.

Conducting life-cycle analyses to evaluate the benefits and risks of adding flame retardants to plastic enclosures can provide useful information to policy makers. As described above, however, the Simonson analysis would benefit from incorporating public health and environmental impacts of commonly used flame retardant chemicals as well as using comparable data sources for the model inputs and end-of-life pollution related to disposal.

3. **Most fire deaths and most fire injuries result from the inhalation carbon monoxide, smoke, soot, and other irritant gases.** [21] **The incorporation of halogenated flame retardants into materials increases the yield of such toxic gases during combustion.** [22,23]

Halogenated flame retardants act by replacing the most reactive hydrogen (H•) and hydroxyl (H•) free radicals in a flame with more stable chlorine (Cl•) or bromine (Br•)·free radicals. The OH• radical, however, is required for the conversion of carbon monoxide to carbon dioxide.

$$CO + OH\cdot \rightarrow CO2 + H\cdot$$

In the presence of brominated or chlorinated flame retardants, this reaction is prevented, resulting in more carbon monoxide (CO).[24] Thus, the same flame retardant action that reduces heat release is also responsible for much higher yields of CO. In addition, the flame-quenching action of Br• and Cl• radicals prevents the oxidation of other like hydrocarbons and aldehydes to carbon dioxide (CO2) and water, and significantly increases the smoke yield. Increased CO, incapacitating irritants, and smoke hinder an escape from the fire.

Fire effluents from the combustion of materials containing halogenated flame retardants will be more toxic for three reasons:

1. The effluents will contain more carbon monoxide.

2. The effluents will contain powerful irritant acid gases (hydrogen chloride or hydrogen bromide).

3. The effluents will contain a cocktail of respiratory irritants comprising unburned and partially burned hydrocarbons, resulting from stopping the burning process midway.

In addition, as discussed, combustion of organo-halogen compounds leads to the formation of brominated and chlorinated dioxins and furans.

When flame retardants are present, the reduced risk from increased time to ignition and reduced heat release rate during a fire should be balanced against the increased hazard from CO, irritant gases, and particulates like soot or smoke particles.

4. **In addition, the inclusion of a variety of flame retarding chemicals in consumer product housings will make responsible recycling of electronics more expensive and difficult. Brominated and chlorinated flame retardants form highly toxic dioxins and furans during the controlled and uncontrolled combustion that is still the unfortunate end-of-life fate for much of the world's electronics.** See Appendix I for a detailed rebuttal with references to industry claims to the contrary.

5. **Regarding candle flame ignition of TVs, new ASTM and European Committee for Standardization (CEN) standards for candle design address the root causes of candle fires and substantially reduce the potential for candle-initiated fires in TV housings.** Candles can no longer be placed on many of the new TVs; they are now very shallow and can no longer function as a shelf to put candles and other items on. Also, consumers have an increased awareness of the risks of placing open flames near electronics. Manufacturers are producing candles with a maximum wick length and warning labels, without combustible decorative materials, that will self extinguish without incident when they have burned down, and that are designed to not tip over.

6. **Televisions and furniture are the primary sources of the brominated flame retardants in U.S. house dust.** Joe Allen, as part of a group led by Tom Webster at the Boston University School of Public Health, published a peer-reviewed paper in *Environmental Science & Technology* on April 30, 2008 demonstrating that the **bromine levels in TVs can be related to decabromodiphenyl ether (decaBDE) levels in dust in homes.**[25] The association was stronger for homes with more residents, suggesting an effect of usage of the TVs. TV usage could impact dust concentration by elevating the temperature of the plastic and increasing the rate at which the decaBDE migrates from the TV into the dust. For the main living area, a relation was found between an approximation for television usage and the level of decaBDE in dust. Allen's scientific study was reported in recent news accounts with titles such as "Harmful chemical wafts off your TV."[26]

7. **The flame retardant chemicals from consumer products end up in people, with children [27]having the highest levels.** Pounds of flame retardant chemicals can be found in a typical home or office. The chemicals continuously migrate out of furniture into dust[28] and are ingested by humans[29].U.S. citizens harbor levels of flame retardant chemicals that are much higher (between 7.1 and 35 times) than those of Europeans.[30] The reason for this can be linked to the fact that furniture manufactured for sale in California must comply with TB117 (a small open flame standard for foam) and TV manufacturers add flame retardants to TV enclosures to achieve compliance with UL-94 V0 flammability requirements for the US market. Flame retardants were not required in TV housings in Europe prior to 2011 and are still not required furniture in Europe.

   Webster's group published the first research to definitively link pentaBDE concentrations in house dust with concentrations in the people living in those homes.[31] PentaBDE levels in house dust were also associated with levels in breast milk of nursing mothers. Children take in approximately 7 times more pentaPBDE each day than adults.[32] Toddlers have pentaBDE levels three times higher than their mothers—at a time when their rapidly developing brains and reproductive organs are the most vulnerable.

8. **When studied, many flame retardant have been shown to cause adverse health effects including endocrine disruption, thyroid problems, reduced sperm count, infertility, hyperactivity, and cancer. There is not adequate health and environmental information for the chemicals that currently are likely to be used in television housings.**

   In animal studies, brominated flame-retardants such as penta and decaBDE have been reported to cause thyroid disease, reproductive and developmental problems, and cancer**.** Neurological impacts include decreased memory and learning, behavioral disorders, and hyperactivity.[33,34] In humans, pentaBDE exposure is associated with thyroid hormone changes,[35] lowered IQ[36] ,and neurological impairments.[37]

According to an American Public Health Association Consensus Resolution,[38] virtually all organochlorides that have been studied exhibit one or more serious toxic effects, including endocrine dysfunction, developmental impairment, birth defects, reproductive dysfunction, immunosuppressant effects, and cancer, often at extremely low doses.

**9.** The primary flame retardant chemical currently being used in TVs is decaBDE. Although the bromine industry states that hundreds of studies show decaBDE does not pose a significant environmental or human health risk, a survey of the literature yields a contrary result. **Most of the peer-reviewed scientific literature on decaBDE demonstrates accumulation of the flame retardant chemical in humans, wild animals, and the environment; negative health effects in experimental animals and humans; and debromination resulting in conversion of decaBDE into more toxic smaller molecules.**

Although decaBDE is being phased out, the numerous replacements are from the same family and lack adequate information. According to EFRA[39] there are a series of brominated replacements.

In ABS:

a. Tetrabromobisphenol-A (TBBPA),
b. Tris(tribromophenoxy)triazine (TTBPT),
c. Brominated Epoxy oligomers/polymers with or without end capping (BEOs, BEs and MBEOs), and
d. Ethane bis(pentabromophenyl) (EBP) or Brominated Carbonate Oligomers (BCOs), in combination with metal oxide synergists, are the most common flame retardant additives for the manufacture of enclosures.

In virgin HIPS, the most widely used flame retardant additives for the manufacture of electronic cabinets and enclosures are:

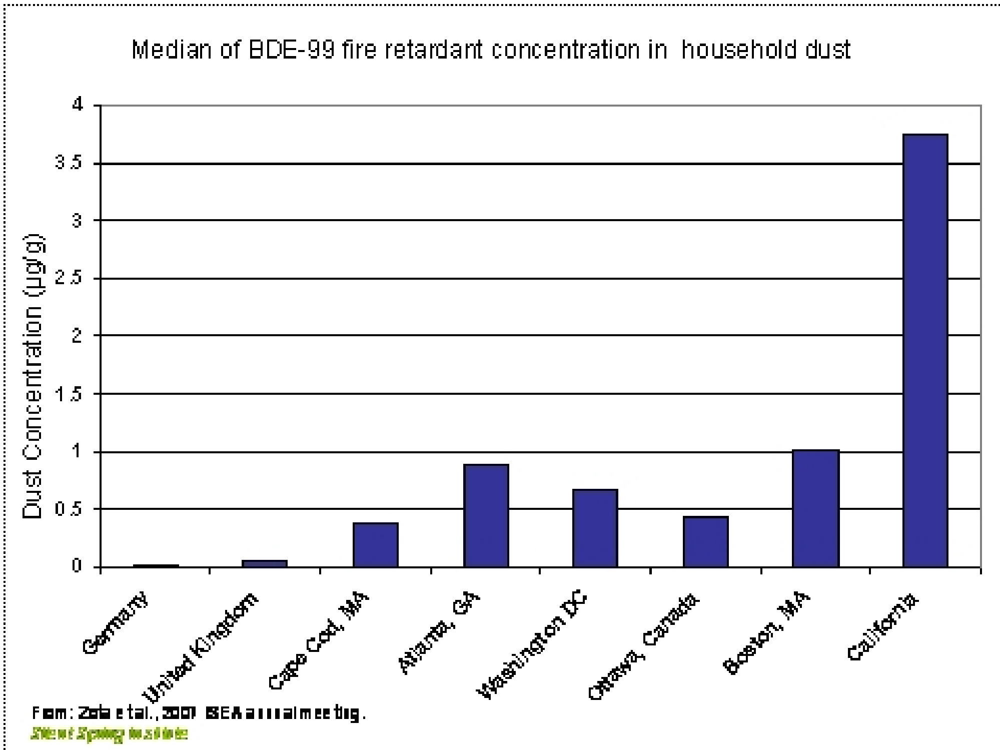
- Ethane bis(pentabromophenyl) (EBP),
- Tris(tribromophenoxy)triazine (TTBPT) and
- Ethylene bis(tetrabromophthalimide) (EBTBP) in combination with metal oxide synergists (typically antimony oxide).

The flame retardant chemical industry has a history of not providing adequate toxicological information in advance of the sale of its products. Polybrominated biphenyls (PBBs), polychlorinated biphenyls (PCBs), Tris, Halon, asbestos, and PBDEs are all flame retardant materials which have turned out to have serious long-term negative effects on our health and/or environment. These effects were documented only following extensive use. In many cases, their use resulted in expensive and often unsuccessful clean-up projects as discussed in Section 12 below.

**10. If these requirements are implemented, more flame retardant chemicals are likely to be used in televisions worldwide and more will find their way into people and animals**. Many dozens of peer reviewed scientific papers demonstrate that chemical flame retardants that could be used to meet such requirements migrate out of consumer products into dust, humans, and animals. For example, the state of California has a unique flammability standard for furniture which results in the use of more retardants in furniture than are used in other states and Europe. California household dust has higher levels of flame retardant chemicals than other states, which in turn have much higher levels than Europe as can be seen in Figure 1 below.

Please note that health information can only be obtained after chemicals have been used for a significant period of time. The most information currently available is for pentaBDEs which has been used in a variety of consumer products since the 1980s. Although banned in the EU and several states in the US, pentaBDE continues to migrate from products in consumers' home. Similar studies are currently being conducted on decaBDE levels in dust and people.

**Figure 1**. Comparison of the flame retardant chemical BDE-99 in dust samples from two locations in Europe and six locations in the US.[40]

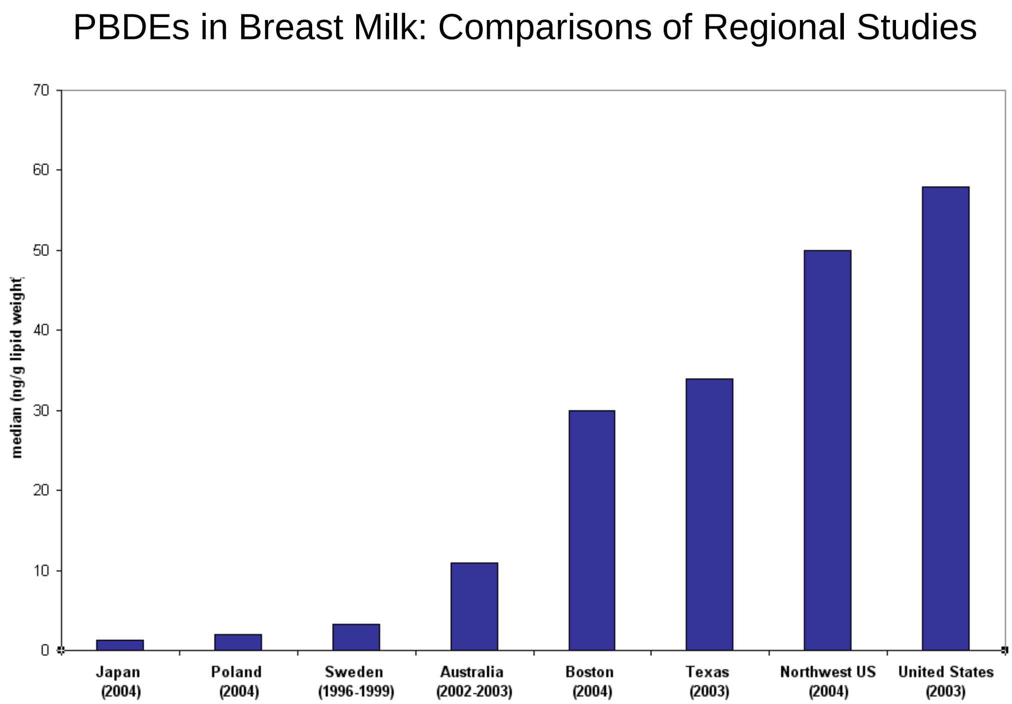



The US has a much higher level of toxic pentaBDE congeners such as BDE-99 in dust, breast milk and body fluids than does Europe. In the US, median human pentaBDE levels in breast milk range from 30 to 58 nanograms PBDE per g lipid weight which can be compared to levels of 1.3 in Japan, 2.0 in Poland, and 3.2 in Sweden in similar studies as shown in Table 1 and Figure 2.[41]

**Table 1**. Recent studies of PBDE levels in human breast milk

| **Study (US)** | Year collected | Population | Number of subjects | Median ng/g lipid weight | Range ng/g lipid weight |
|---|---|---|---|---|---|
| Schecter et al | (2003) | Texas | 47 | 34 | (6.2- 419) |
| Lunder, Sharp | (2003) | US | 20 | 58 | (9.5 to 1,078) |
| She et al | (2004) | NW US | 40 | 50 | (6 to 321) |
| Wu et al | (2004) | Boston | 40 | 30 | (4.3 to 264) |
| **(Outside US)** | | | | | |
| Eslami et al | (2004) | Japan | 105 | 1.3 | (0.01-23.0) |
| Jaraczewska et al | (2004) | Poland | 22 | 2.0 | (0.8-8.4) |
| Lind et al | (1996-99) | Sweden | 93 | 3.2 | (0.9-28.2) |

**Figure 2.** A comparison of the sum of PBDE congeners in breast milk from regions around the world shows higher levels in the United States compared to Europe and Japan.[42] Regions, from the left, are Japan, Poland, Sweden, Australia, Boston, Texas, Northwest U.S, and the U.S.




**Chemically similar flame retardants are likely to be used if Clause 21 is implemented, and could similarly end up in dust, human and animal bodies and breast milk.**

11. **Antimony trioxide (ATO), which is used at a high level in electronic applications to increase the effectiveness of brominated and chlorinated flame retardants, has been classified as a possible human carcinogen by the IARC (International Agency for Research on Cancer), the European Union and the U.S. EPA**. Brominated and chlorinated flame retardants are usually mixed with up to 50 percent ATO when used in TV housings. The ATO could pose an additional threat to worker and consumer health.

12. **Once the brominated flame retardants (BFRs), such as those listed above in Section 9 that could be used to fire retard TVs, go out into the world, we cannot call them back. BFRs are being identified as emerging contaminants in sediments in rivers, lakes, and estuaries. They are likely to possess many of the same properties as polychlorinated biphenyl compounds (PCBs) and could eventually cause similar environmental problems.[43]**

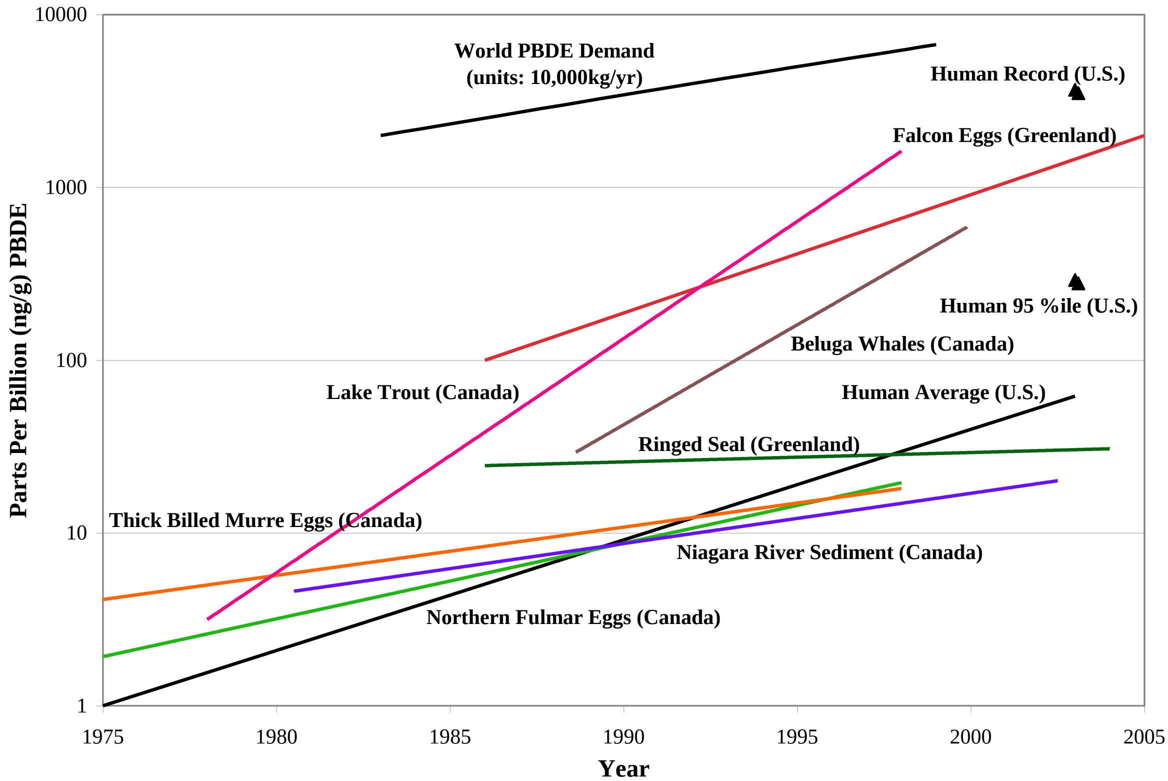
Today, more than thirty years after PCBs were banned from production, we struggle to clean up the legacy from PCB use and disposal. Many other halogenated chemicals are similarly bioaccumulative, toxic, and persistent in the environment. Sediments in rivers, lakes and estuaries often become the final repository for these chemicals, from which the compounds are then transferred through the food web to humans and other animals.

The clean up of contaminated sediments can be challenging and costly. The costs for dredging the Hudson River to try to remove PCB contamination, for example, will be hundreds of millions of dollars, or possibly more. Also, a study of the National Research Council released in 2007 highlighted some of the challenges with sediment dredging such as the difficultly in meeting cleanup goals and dealing with residual material left after dredging. Further, the disposal of toxic dredged sediment is costly and controversial. Hence, we can expend large amounts of effort and money without assurance of success.

**We can learn from the PCB experience that once released into the environment, many halogenated flame retardants eventually could require very challenging and expensive cleanup measures.**

**13.** The rapid increase in amounts of PBDEs in the environment can be seen from the levels in ten species of wild animals as shown in Figure 3. **The increasing body burden of these flame retardant chemicals in wildlife aligns with the increased usage of the chemicals.** Though the magnitude of the body burden varies in different animals, the chart below shows the trend is similarly increasing across the eleven studies included in this survey.[44]

**Figure 3**. Logarithmic graph of the rapid recent increase in PBDE levels in 10 species of wild animal compared with world demand for PBDEs. [11] (Note that the world demand needs to be multiplied by the number on the Y axis.[45] )




14. **The proposed candle flame ignition resistance requirements, while not proven to protect against fires, would lead to a massive infusion of flame retardant chemicals into TVs, as well as substantial profits for the flame retardant chemical manufacturers and flammability testing companies.** Much of the support for the candle ignition requirement comes from the world's three major producers of flame retardant chemicals, based in the US and Israel, and other individuals and organizations associated with the chemical industry.[46, 47, 48, 49]
Including representation from the fire retardant chemical industry in the decision-making process for IEC standards should be balanced by the inclusion of independent environmental and health scientists in the evaluation of the impacts of the clause. Unfortunately, this is not the current situation.

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# Conclusion

**In summary, the arguments for a mandatory candle flame ignition requirement for TVs are based on old data regarding CRT-based TVs and primarily on old internal ignition problems in these TVs. This argument has little bearing on current and future TV technology. Adding**

**chemicals, with the potential for harm to human health and the environment, to televisions to deal with an unsubstantiated present and future fire hazard is not a judicious course of action. Furthermore it is not aligned with larger issues of public health and the environmental goals of increasing recycling and reducing pollution.**

The content and support for "The Case against Candle Resistant Electronics" came from distinguished chemists, biologists, engineers, and physicians from Stanford, University of California at Berkeley and Davis, Carnegie Mellon, and other renowned education institutions. In addition, it has support from numerous health, environmental, consumer, and citizens groups worldwide. Many of the same scientists, physicians, and NGO's are contributing and support this document, "The Case against Candle Resistant TVs."

Without this candle ignition requirement, TV manufacturers will have more flexibility in the future to look at design and material alternatives that could achieve fire safety without potentially toxic chemicals. TV manufacturers might choose to investigate whether they can eventually meet UL 60065 without the use of added flame retardant chemicals in enclosures. Fire retardant chemicals can delay or sometimes stop fires; however they have a high potential health and environment cost. Sprinkler systems can stop fires without polluting or threatening human health. Other effective ways to reduce fire deaths and injuries include increased use of smoke detectors, child-safe lighters, fire safety education, fire-safe cigarettes and candles and design changes in products that avoid need for chemical fire retardants.

Usually major changes in product regulation are driven by a need to address issues and the solutions are proportional to the problem being addressed. Since there is not evidence of a significant (or even minor) need for protection of televisions from candle ignition, and since the costs and adverse outcomes from this change would be so out of proportion to the problem even using the most conservative data, this major modification to the global electronic safety standards is not justified.

**We urge TC108 National Committees to vote "NO" on the CDVs that include these proposed amendments and additionally comment to remove the mandatory candle flame ignition requirement** in Clause 11 of **IEC 62368-1 Ed 2.0 (108/479/CDV) and Clause 21 of IEC 60065 Ed 8.0 (108/478A/CDV) as well as all related language and references.**

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## Appendix I

**Rebuttals to flame retardant chemical industry statements in italics with regard to recycling in "The Case against Candle Resistant Electronics"**

*"The paper gives reference to the recyclability of flame retarded plastics. In fact, several studies have shown that it is feasible to recycle plastics containing flame retardants."*

Although it is <u>possible</u> to recycle flame retarded plastics, the presence of flame retarding chemicals can be problematic for several reasons, including that the flame retardants can reduce the mechanical properties of the materials, requiring additional treatments and additives to compensate for unpredictable or degraded properties.[50] This problem is more pronounced with phosphorus-based additives.[51] Unpredictable properties of recycled materials reduce the value of the materials in the market, and reduce the economic viability of recycling.

*"The variety of different plastics and the use of a number of different additives is more problematic to the recycling and the economics of recycling [than the use of a single class of chemicals]."*

- We make the identical argument as a reason to not introduce new open flame requirements (p17, number 2). Further fragmenting the market for recycled material by introducing a variety of flame retarding chemicals reduces the financial incentives for recycling.
- Neither increased use of BFRs nor the use of several different additives is desirable with respect to recycling.

*"Large E&E OEMs and resin producers are very pleased by the use of plastics flame retarded among others by BFRs as they can easily recycle them to produce new equipment with a high value; this would not be possible with plastics not using BFRs."*

Most large electronics original equipment manufacturers (OEMs) have made commitments to remove BFRs from product housings and other components, so recycled plastics containing BFRs cannot be used to "produce new equipment with a high value" for these companies because of the requirement to have a maximum concentration level of 1000ppm PBDEs/PBBs under RoHS,[52] or 900ppm Br under certain "halogen free" requirements, or similar voluntary restrictions.

*"Moreover such current practice in Japan saves a lot of energy and eliminates large volumes of electronic waste."*[53]

The development cited is not related to mechanical recycling of plastics. It is a gasification method that can recover metals. Halogenated compounds must still be neutralized. In addition, it is quite new and can hardly be considered "current practice" in Japan.

*"Projects conducted by academic institutes show that recycling operations made under severe and extreme conditions as well as incineration tests made with plastics containing BFRs do not produce noticeable toxic smoke. On the contrary the academic studies indicate very significant reduction of the toxicity of smoke once FRs in general and BFRs in particular are used when compared with the much more toxic smoke produced by the equivalent non FR plastic, or beech wood used as a reference."*

Brominated dioxins and furans (PBDD/Fs) can be formed according to chemical routes similar to their chlorinated PCDD/F analogues in thermal treatment of BFR containing polymers.[54] [55] [56] [57] [58] The immediate human health effect of acute toxicity from a combustion event may be different from the toxicity associated with a chemical's environmental fate, which has been shown to be problematic, especially for BFR containing polymers. [59] [60]

Finally, it should be noted that although the chemical industry and their associates refer to **"The Case against Candle Resistant Electronics,"** as the Greenpeace paper, Greenpeace neither contributed to nor signed on to that paper.

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## Appendix II

**Trade-off Analysis of the Impacts of the IEC TV standard on multiple stakeholders**

A class of graduate and undergraduate students studying "Sustainability in Theory and Practice" in the Department of Civil and Environmental Engineering at Stanford University completed an assignment to read **"The Case against Candle Resistant Electronics,"** and obtain data on the use of FRs in TV housings, fire statistics, and impact of implementing the IEC TV standard on recycling, human and animal health in Europe. Using this data they each performed a trade-off analysis of the impacts of the proposed IEC TV standard in Europe.

A summary of these results will be available and included in subsequent versions of this report.

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[1] With thanks to Michael Kirschner, Dick Luthie, Peter Brigham, Sara Schendler, Elana Fishman, Natalya Blumenfeld, Judy Levin, Ralph Hall, DC Jayasundera, and Nick Enge and Rebecca Schwartz and the other students in Sustainability in Theory and Practice in the Department of Civil and Environmental Engineering at Stanford University, and many others who contributed to the text and/or editing of this report.

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[42] Thanks to Ruthann Rudel, of the Silent Spring Institute, Newton, Massachusetts for the bar graph of the data above.

[43] Thanks to Dick Luthy, Chair of the Department of Civil and Environmental Engineering at Stanford University, who provided the information for this discussion of the environmental remediation of halogenated hydrocarbons.

[44] Thanks to Nick Enge and Rebecca Schwartz, students in the class Sustainability in Theory and Practice, Department of Civil and Environmental Engineering, Stanford University, for summarizing data from references listed below in Figure 3:

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