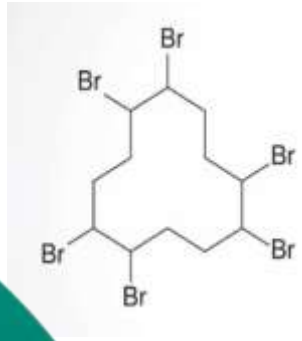
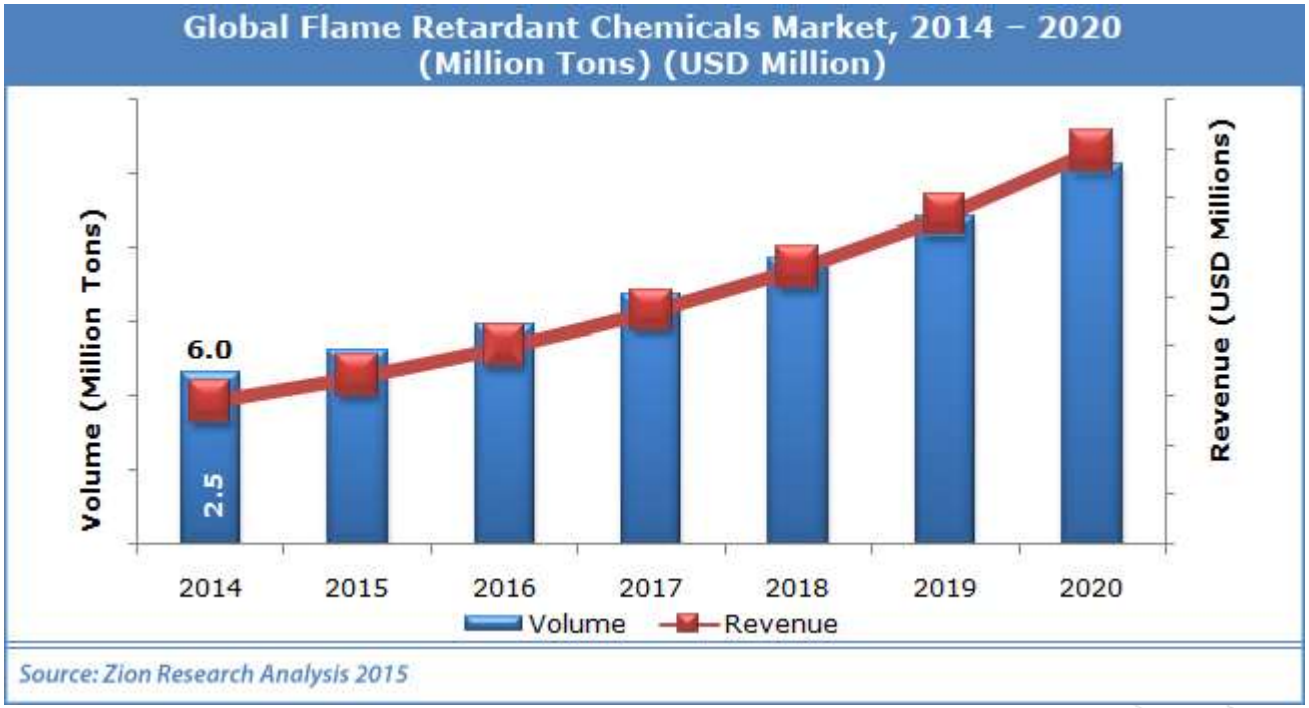
Ministry of Environment and Food of Denmark
Environmental Protection Agency



Brominated flame retardants (BFRs)

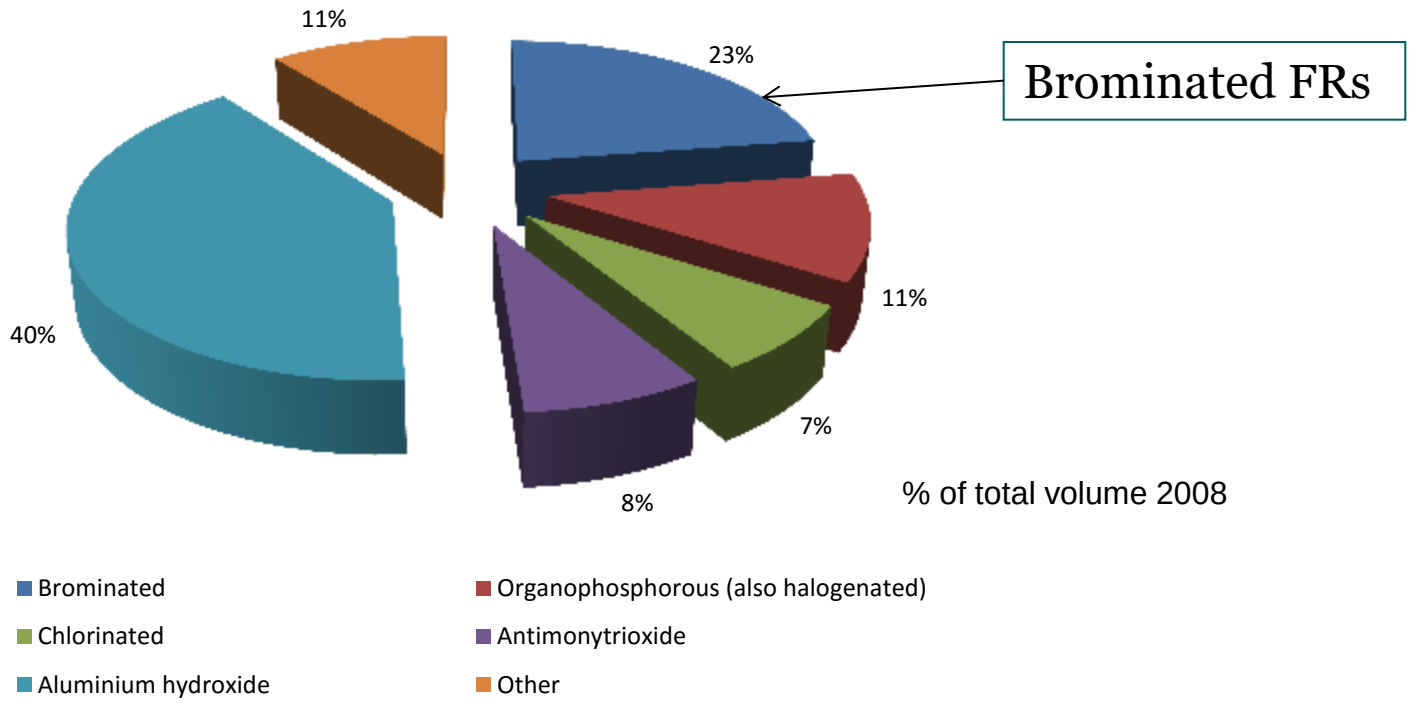
Jesper Gruvmark, Danish EPA

Flame retardants - annual growth

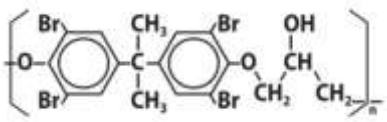


http://www.marketresearchstore.com/news/global-flame-retardant-chemicals-market-set-for-rapid-123

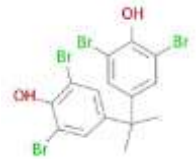
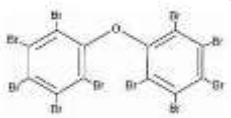
Global consumption flame retardants



Data from Norwegian Environment Agency:
http://www.miljodirektoratet.no/no/Publikasjoner/Publikasjoner/2011/Mai/Assessment_of_the_consumption_of_HBCDD_in_EPS_and_XPS_in_conjunction_with_national_fire_requirements/



Consumption brominated FRs

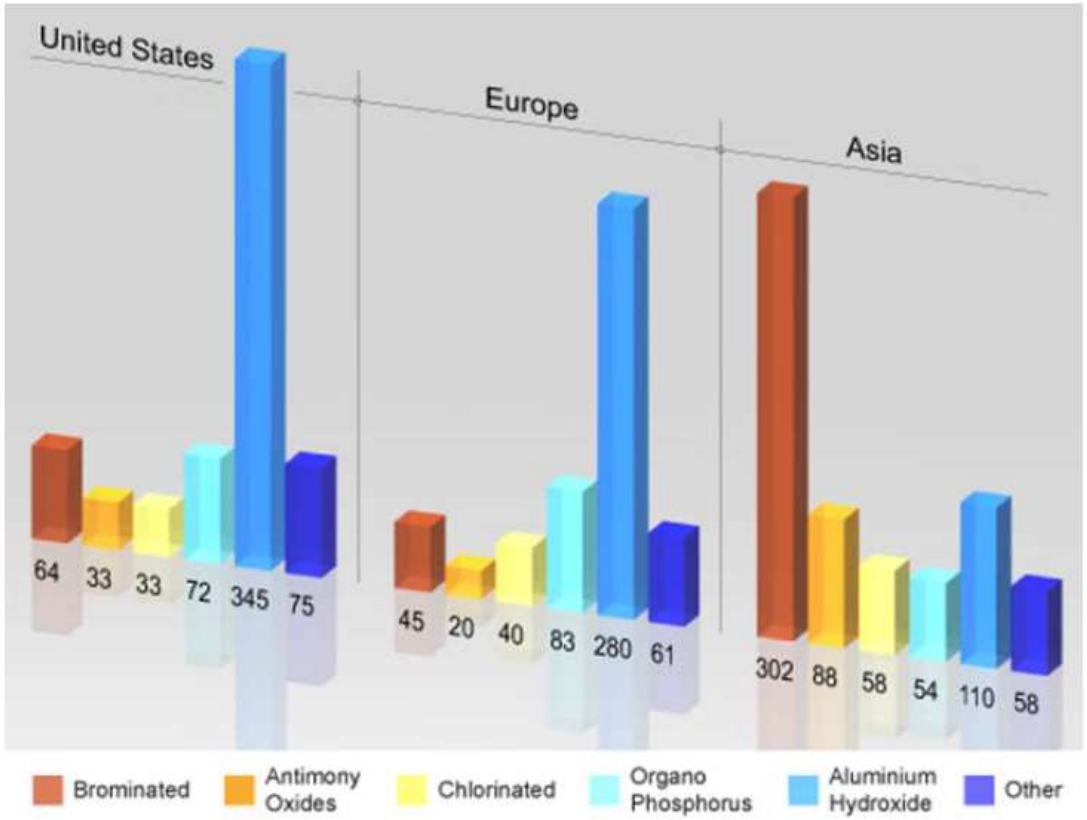
Historical	Global consumption	Trend towards
 TBBPA	~ 40% - printed wiring boards	Weak trend toward non-brominated FR
 DecaBDE, octaBDE	~ 20% - enclosures, various EEE applications	DBDPE, EBTEBPI, TTBP-TAZ, TBBPA derivatives, polymeric BFR
HBCDD	~ 5% - insulation materials	Polymeric BFR
Other, additive (e.g. TTBP-TAZ, BEH-TEBP)	~ 20% - various EEE and automotive applications	No common trend
Other, reactive (e.g. brominated polyols)	~ 15% - insulation materials, various EEE applications	No common trend

FR global consumption by region

LOUS entry: "Certain brominated flame retardants" exemplified with decaBDE, HBCDD and TBBPA.

Survey identifies 69 BFR substances pre-registered or registered under REACH as of June 2013 and/or produced by major manufacturers March 2012 as well as…

… 14 substances described in the literature



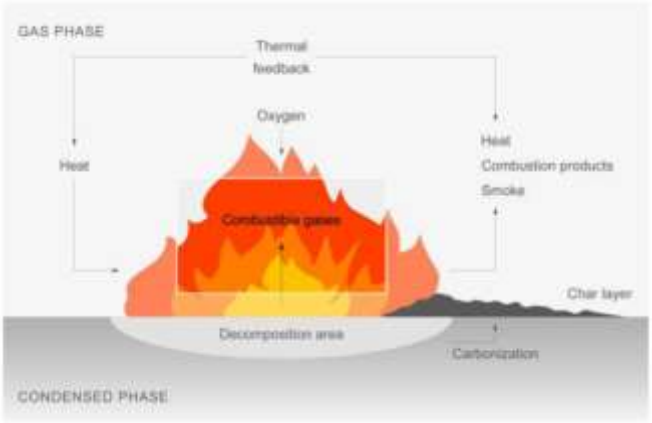
1000 metric tons 2007

Source: Norwegian Environment Agency
http://www.milj___odirektoratet.no/no/Publikasjoner/Publikasjoner/2011/Mai/Assessment_of_the_consumption_of_HBCDD_in_EPS_and_XPS_in_conjunction_with_national_fire_requirements/

Flame retardants – to increase fire safety

Most important uses:

- Building materials
- Electric and electronic equipment
- Transportation (cars, trains, busses, ships)
- Textile, carpets and furniture foam



Source: Clariant.

Use in plastics accounts for approximately 85% of all markeded flame retardants with textile and rubber use accounting for most of the rest.

Sources: Fire Safety Requirements and Alternatives to BFRs – A LOUS follow up project. Environmental project No. 1822, 2016, Danish EPA.
Townsend market study cited on flameretardants-online.com , april 2016.

Disadvantages of brominated flame retardants

- Some are POP (Persistant Organic Polutants) and PBT (Persistant Bioackumulating and Toxic) substances
- By time they can release to the environment and be transported long distances, for instance to the Arctic

- Emission from handling and recycling of E-waste
- Evaporation and dust from indoor articles, especially additive BFR's

- Human exposure from food and breast milk
- Some cause birth defects, are suspected endocrine disruptors or carcinogenic
- Cause substantial amount of smoke and toxic fumes in fires

Danish EPA strategy for BFRs

- replacing old strategy from March 2001

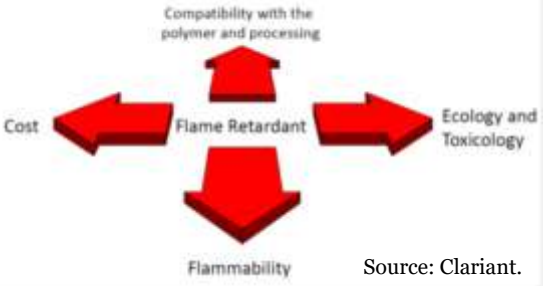
Identified main challenges, projects and results:

A. Datagaps on health and environmental effects for most of the BFRs

- Three identified as possible candidates for substance evaluation under REACH in a published screening project covering nine registered BFR not already regulated or on its way to be
- Denmark is performing a substance evaluation on TBBPA and will also investigate TBBPS and derivates to TBBPA and TBBPS with QSAR models

B. Alternatives assessments

- Report: Fire Safety Requirements and Alternatives to BFRs
- Stakeholder workshop on problematic BFRs in January 2016
- Catalogue of ideas on alternatives (to be published)
- Report: Environmental and health screening profiles of 28 phosphorous FR's



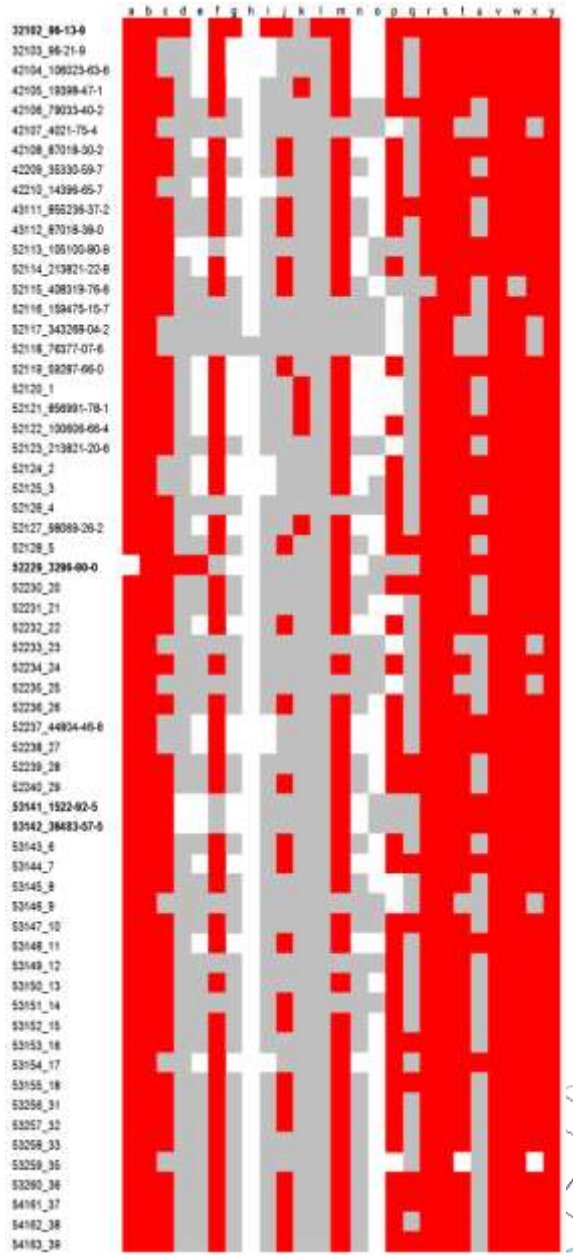
Source: Clariant.

C. Can group regulation replace regulation of substance by substance?

- Category approach for selected brominated flame retardants to be published

Category approach for selected brominated flame retardants

- BFR from LOUS survey and literature grouped by structure in 15 groups
- Group nr. 10 investigated: small brominated alkyl alcohols with three members
- 58 new possible theoretical members added (of those 22 with CAS-number)
- QSAR Toolboox models for mutagenicity and carcinogenicity used on all members
- Result: all 61 members has a carcinogenic potential with possible genotoxic mode of action
- Next step: On the agenda for RoHS revision in 2017?



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