Swedish tax on chemicals in certain electronics – a whitepaper on the need for revision

(Lag 2016:1067)

1. Summary

The signatories of this paper strongly suggest to revise the Swedish Tax on chemicals in certain electronics (Lag 2016:1067), because we believe that it does not achieve its original intention of promoting the substitution of critical flame retardants (FRs).

The overall goal of the chemical tax is stated to reduce the supply of hazardous substances in people's home environment and at the same time stimulate companies to select safer alternatives. The current design of the tax is not based on science, it is counterproductive and does not lead to the intended goal.

In contrast to all other policy instruments which aim to reduce or restrict the use of hazardous chemicals, this Swedish tax is based on the chemical-technical properties and not based on the substance intrinsic health and environmental hazardous properties - The simple assumption that additive flame retardants have a worse environmental and health profile than polymeric or reactive flame retardants is wrong.

The current design of the chemical tax may lead to false and regrettable substitution, because well and independently investigated alternatives are taxed whilst known undesirable substances qualify for a minimum tax rate. In addition, there are both good and poor flame retardants that neither contain bromine, chlorine or phosphorus, which are not addressed in the regulation. This creates an incentive for the taxable product manufacturer to select flame retardants that qualify for maximum tax reduction instead of selecting safer alternatives. However, the law could be changed in such a way as to be fair and sensible in promoting the proper substitution towards environmentally safer flame retardants.

2. Pre-amble

On 16-Oct-2018, the Swedish IT and Telecom Industries association, IT & Telekomföretagen, invited a wide range of stakeholders to a "Round Table Discussion" on the Swedish Tax on Chemicals in Certain Electronics, because criticism of the way the law taxes different flame retardants in electronics has been voiced in the past not only by the industry producing flame retardants, white goods and

electronic equipment, but also by environmental organisations, researchers and independent experts. This paper explains the background of the criticism and offers some ideas for a revision. Unless stated otherwise, it represents the common view of the authors who represent a broad range of stakeholders. The group welcomes further comments and suggestions which should be addressed to henrik.edin@itot.se .

The industry groups represented in the round table are not in favour of using taxation for promoting substitution and would rather see the tax law withdrawn altogether. Instead, they endorse international or EU-wide Chemical Regulations like REACH and RoHS, because also the market is global - Sweden represents only ca. 0.5% of the global home electronics market[1]. The proposed revision of the tax law in this White Paper is a compromise and minimum common position of all stakeholder signatories.

Side note: The final regulation text does not mention flame retardants but instead ad-dresses all substances containing bromine, chlorine and phosphorus above 0.1% in the specified product parts. This paper focusses on flame retardants only.

3. Introduction and Background

In April 2017, the Swedish Tax on Chemicals in Certain Electronics entered into force which put a tax on electronic articles and white goods. The tax rate depends on whether and which halogenated (brominated, chlorinated) or phosphorus-based flame retardants are used. The aim of the tax is to promote substitution of "critical" flame retardants by posing an excise tax on them – in addition to the obvious target of raising money for the State. Since taxation is a national legal domain, the law does not need to be aligned within the European Union. There is a general political movement in Sweden to put more taxes on goods than on labour.

4. Basic facts about Lag 2016:1067

The articles covered by the tax are defined by custom's CN code and include dishwashers, freezers, refrigerators, washing machines, tumblers, computers, laptops, tablets, vacuum cleaners, ovens, stoves, toasters, mobile and stationary phones, routers, CD and DVD players, radios, TV sets, computer displays and game consoles. The tax is calculated on the weight of the article, without packaging. The tax rate will be annually adjusted to inflation and as of January 2019 stands at:

- 8 SKR/kg (0.90 USD) for White Goods
- 122 SKR/kg (13 USD) for Electronics
- max. 327 SKR (36 USD) per item

The law entered into force on 1st April 2017, and the tax has been payable from 1st July 2017. The Swedish government tabled a proposal to increase tax rates in early 2019 by 40%. The Government

[1] Germany based Statista estimates the market share in Sweden 2018 between 0.4% and 0.6% for home Electronics (www.statista.com)

estimated tax income was 300 million US Dollars annually. The real number over 12 months was 1.4 billion SKR (ca. 150 million USD, ESV 2018). The tax starts with a default rate of 100% payable. Deductions are possible:

- Deduction of 50% if no additive Chlorinated or Brominated FRs in first circuit board and parts >25 g,
- Deduction of 90% if no additive phosphorus as well as no additive or reactive brominated or chlorinated FRs in circuit board and parts >25 g,
- There is no zero-tax alternative, a minimum tax of 10% has to be paid.

Table 1 gives an overview of tax rates depending on part type, size and flame retardants used. The law defines flame retardant categories of "additive" and "reactive" and "added in another way". It contains an annex with a list of flame retardants which are assigned to one or the other category. The list of flame retardants in the Annex defines which flame retardants are "additive" and which are "reactive". The list is not conclusive, i.e. if a FR is not listed, the regulation still applies. Are there exemptions? All products sold *in Sweden* to consumers and commercial customers are covered by the tax. Items bought via the internet from abroad or directly imported by cross border shoppers are not covered (!) The Swedish Government calculated that sales of taxable products via the Internet was 0.4%, the real number is minimum 25% and growing [HUI 2018].

Table 1: Tax rate as a function of the flame retardants used and the part weight. PCB = Printed circuit board.

FR used		PCB	Part < 25 g	Part > 25 g	Tax rate
None					10%
Phosphorus	reactive	X	X	X	10%
	additive		X		10%
		X		X	50%
Chlorinated / Brominated	reactive		X		10%
		X		X	50%
	additive		X		10%
		X		X	100%

5. Why the law does not promote proper substitution

Within the framework of "green" taxation, the Swedish Government's intention of the tax law is to 'reduce the presence, distribution and exposure of hazardous flame retardants.' However, the design of the chemical tax does not lead to this declared goal, because the physical-chemical properties of the substances are taxed, not their intrinsic health and environmental properties which is the stand-

ard procedure in chemical legislation like REACH and RoHS (see table 2). The tax law distinguishes between additive and reactive/polymeric flame retardants. Apart from the legal definition and the reference list accompanying the law, the well accepted scientific definitions and related properties are:

Additive flame retardants are small molecules or salts which are physically mixed into the target polymer, usually by a process called extrusion (similar to a meat grinder) for thermoplastics (polymers which can be melted) or mixed with the starting materials which form thermoset materials which cannot be melted anymore, e.g. epoxy and polyester resins, polyurethanes.[2]

Reactive flame retardants are also small molecules, but they react with the polymer (or textile) to be treated and form chemical bonds with the matrix or even become part of the polymer backbone. Once reacted in, these FRs cannot be removed from the matrix anymore and cannot evaporate or leach out, unless the chemical bonds are broken which requires high energy or aggressive chemical conditions.

Table 2: Overview of different policy instruments and their approach to alternatives.

Policy Instrument		Chemical substance restrictions based on				Risk for false substitution
		Inherent substance hazard properties	substance is additive or reactive	Risk assessment i.e. hazard + exposure	if safer alternatives are available	
Legislation	EU REACH	YES	NO	YES	YES	Medium
	EU RoHS	YES	NO	YES	YES	Medium
EU Public Procurement		YES	NO	NO	NO	High
Eco labels	EU EcoFlower	YES	NO	NO	NO	High
	Nordic Swan	YES	NO	NO	NO	Medium
	TCO Certified	YES	NO	NO	YES	Low
Chemical Tax	Sweden	NO	YES	NO	NO	Very High

Polymeric flame retardants (subsumed in the category "reactive" in the tax law) are polymers themselves, i.e. composed of repeating units of small molecules (monomers) which are chemically bound together. These resulting big FR molecules are much less mobile and do not migrate as easily as additive FR or may not migrate at all. Polymers are also not bioavailable, i.e. cannot be taken up by cells and lead to chemical toxic effects (there can be physical toxic effects by dust inhalation). However, polymeric FRs may undergo degradation during processing or recycling, because of heat stress, hydrolysis etc. depending on environmental conditions. Also, polymeric FRs may contain residues of monomers or oligomers (= smaller polymer fragments).

[2] In principle, these FR molecules can be released from the surface of the treated material, depending very much on the polymer and environmental conditions like temperature and humidity or presence of solvents or surface-active substances like detergents. Both evaporation into (indoor) air and, if there is contact with water, dissolution (called leaching) can be of relevance. In most practical cases, only a very thin surface layer of the polymer can release its flame retardants to the environment and only a tiny fraction of the flame retardants contained in the material is affected.

Intrinsic Hazards

The Swedish tax law is based on the assumption that all additive FRs pose a higher risk to consumers or the environment than reactive / polymeric FRs, which is not the case. There are proven examples of additive FRs with third party assessments showing their good environmental and health profile. Simply because an additive FR *may* migrate, it does not mean it poses a risk. If it is of low hazard, then it will not be a risk, even if there are typical exposures. Whilst the approach of additive = bad and reactive/polymeric = good makes for simple implementation of the regulation, it does not do justice to the many good additive FRs on the market and the efforts of progressive and responsible producers to document their environmental and health properties. This finding is supported by an assessment of 10 reactive and 48 additive FRs (ToxServices 2018): "In conclusion, ToxServices' hazard assessment of reactive phosphorus FRs and additive phosphorus FRs indicates that many chemicals in both types of phosphorus FRs are less hazardous and are relatively safe for use in EE products."

Migration

For decades, the scientific community has studied indoor air quality to identify which substances are released from human activities as well as building materials and electrical and electronic products, in offices as well as residential areas with the purpose to understand if these pose a risk to human health and the environment.[3] A large number of research studies exist from which the following conclusions can be made (Cacho 2013, JEITA 2014, Willem 2010, Kemmlein 2003):

- In most cases, new products have been tested in 1m^3 test chambers in accordance with the ENV 13419-1 standard.
- A large number of chemical substances have been identified in the emission studies, anything from 10-70; none of the studies have shown significant emission differences between additive and reactive flame retardants.
- The emission is higher from products at raised temperature, like power supplies and cathode ray tube (CRT) displays.

[3] There may be the assumption that because of their smaller molecular size, additive flame retardants have a high propensity to be released from the polymer, either by contact with water or to the air. For both cases the mobility of the molecules or ions in the polymer is important as well their "attachment" to the polymer, in technical terms these are expressed as the coefficient of diffusion and the equilibrium distribution constant. For the leaching of FRs into aqueous (water) phases, it was found that this depends very much on the polymer tested and that in general, the amounts that leach out are very small, because of the limited water solubility and mobility of FRs as shown by Brandsma et al. (2014, with ample further references) within the European Commission funded ENFIRO project (ENFIRO 2014): "*Particle size, pH [acidity], porosity (adding synergist), surface structure, impact strength and strength of break are determining factors in the leaching behaviour of the FRs. Many of these parameters are related to the polymer type, which is the main parameter determining leaching behaviour. Differences in leaching behaviour between HFFRs [halogen free flame retardants] and BFRs [brominated flame retardants] have been observed for the polymers polyamide (PA), polybutylene terephthalate (PBT) and epoxy resins (EPR). These polymers showed also the highest leaching properties. Almost no FRs leached from high impact polystyrene (HIPS)/polyphenylene ether (PPE/HIPS) and polycarbonate/acrylonitrile butadiene styrene (PC/ABS polymers). Therefore, no differences between HFFRs and BFRs were observed.*" For example, the percentages of Diethylphosphinate FRs leached range from 0.02% from PBT to 0.3% from PA.

- The maximum substance concentration levels are very low, in the range from picogram (10^{-12}) to microgram/m3 (10^{-6}).
- For most of the detected substances, these drop over time to extremely low levels. Concentrations of some organophosphates seem to be stable over time, however, still at very low levels.
- Compared to legally binding workplace concentration limits, so called threshold limit values (TLVs), which are in the 10^{-3} range, the measured concentrations are far below these, in the majority of cases there is a safety factor of at least 1 000.
- Substance emissions in chamber testing of new products show very low concentrations, which rapidly drop over time. The detected levels are very low and pose no risk to the user.

Other considerations:

1. So far, the tax does not reach its desired economic benefit, the costs are higher than the income is. For the public sector as a whole, the result varies between a positive income of 53 million USD and a negative burden for the tax payers up to 56 million USD which results in a negative average of -1.7 million USD (HUI 2018).
2. Only flame retardants containing bromine, chlorine and phosphorus are taxed regardless of hazardous properties of other FRs based on e.g. nitrogen, aluminium, antimony, magnesium, boron or zinc.
3. Everything is taxed (min 10%) regardless of which FRs specifically are used or any use of FRs at all.
4. There is no possibility to monitor and check the right tax reductions as standardized test methods are missing for almost all the substances in the appendix to the legislation, which creates legal uncertainty – and cheaters may benefit.
5. Many errors have been identified in the current appendix to the legislation.[4]

6. What are alternative options for a revision of the law?

The authors of this paper suggest to base taxation of FRs not on additive vs. reactive/polymeric nature of the FRs, but rather on their environmental and health profile including the likelihood of migration and exposure. Going beyond the current scope of the law, the amended tax regulation could even include additional FRs which are not based on chlorine, bromine or phosphorus. With respect to environmental and health profiles, the assessment of FRs needs to be based on an agreed assessment scheme for chemical hazard assessment (CHA). The scheme should be publicly accessible, producing reports that are publicly accessible and including a process for verifying results and resolving technical conflicts. There are several CHA schemes currently publicly accessible. They include e.g.

[4] Some of the identified mistakes include 1) incorrect CAS numbers; 2) 9 out of the 10 listed reactive phosphorous compounds should be additive; 3) substances that, depending on the application, can be both additive and reactive; 4) more than 20 substances have been banned for many years (via RoHS and PoPs).

the US Environmental Production Agency Design for the Environment Program Alternatives Assessment Criteria for Hazard Evaluation (US-EPA 2011), the Cradle to Cradle Material Health Assessment Methodology (Cradle 2019), and the GreenScreen® methodology (CleanProduction 2018). ChemSec provides in its MarketPlace a repository of proven substitutes for critical chemicals. In case of doubts on the potential for migration in various material matrices, industry would have to provide appropriate evidence.

For most flame retardants, sufficient health and environmental data are available and for the most part well documented in REACH dossiers so that a thorough assessment of their hazard and environmental properties is readily possible. These CHA schemes are increasingly used globally and are being integrated into certification programs currently specified by businesses and governments around the world. For example GreenScreen has been used for a number of years by e.g. Apple, HP and TCO Development, and just recently been adopted in the US EPEAT ecolabel to promote sustainable procurement decisions for personal computers, displays and servers.

TCO Development eco labelled IT products use flame retardants accepted under TCO Certified. Even though 9 FRs on the "TCO Certified Accepted Substance List" are GreenScreen Benchmark 2 and 6 FRs are even Benchmark 3 (the second-best benchmark, the top benchmark 4 is hardly achieved by any chemical), use of these FRs is taxed at high rates under the current Tax Law.

However, GreenScreen® as a proprietary and US-based scheme is not the only established methodology for the assessment of chemical alternatives. The Organisation for Economic Cooperation and Development (OECD, 2018) has compiled an overview of resources in their Substitution and Alternatives Assessment Toolbox (SAAT) including a tool selector, an overview of frameworks and guides, case studies, regulations and restrictions. In addition to GreenScreen® the toolbox lists several alternatives assessments tool, amongst them KemI PRIO from the Swedish Chemicals Agency (KEMI 2018). This tool also uses a hazard-based approach which characterises the substances at the two levels of prioritisation, phase-out substances and risk reduction substances. The KEMI website says 'when selecting to use a certain chemical, the risk is what should be determined for the assessment. The risk contains two factors, the inherent properties of the chemical, the hazard, and how the chemical is used, the potential for exposure.' For the evaluation of flame retardants within the context of the Swedish Tax law, there needs to be some agreement on suitable assessment schemes, preferably by an expert group.

The current appendix should be deleted and replaced by a simplified appendix containing preferred flame retardants, flame retardants of high concern, and flame retardants with existing hazard data gaps. This would greatly simplify surveillance and control. To create a real incentive for industry to move to safer flame retardants, a zero-tax alternative is proposed. Currently the elimination of brominated and chlorinated flame retardants qualifies for a 50% tax reduction. If in addition, only documented safer flame retardants were used, there should be no tax for these products. If these changes were adopted, leading companies would be rewarded, and the objective of the Swedish Government to protect human health and the environment will be met. A fee for the recycling of all

E&E articles is already charged under the WEEE legislation, therefore, the 10% tax as a catch-all for the societal impact of E&E equipment does not make sense.

Current chemical tax

Tax	Flame Retardant (FR)
100%	Additive brominated FRs and/or Additive chlorinated FRs
50%	(Reactive brominated FRs and/or reactive chlorinated FRs) or additive phosphorus based FRs
10%	(Reactive phosphorus FRs) or (FRs not based on bromine, chlorine or phosphorus) or (no FRs)

Suggested chemical tax

Tax	Flame Retardant (FR)
100%	Brominated FRs and/or Chlorinated FRs and/or Other FRs with not-acceptable environmental and health profile
50%	FRs with acceptable environmental and health profile
0%	FRs with best-in-class environmental and health profile

Figure 1: One scenario for a revised tax scheme based on new flame-retardant categories.

7. Proposed next steps

The authors suggest starting a review of the tax law immediately with the involvement of all relevant stakeholders. KEMI or the Swedish Environmental Protection Agency should be tasked with checking the current tax implementation and its effectiveness. Furthermore, we suggest that a chemical expert group is established with representatives from KEMI, Chemsec, TCO Development, and the new Swedish Centre for Chemical Substitution and industry. The responsibility of the expert group is to review potential FR assessment schemes and propose a pragmatic way of setting up a new FR substance annex. Since the substance list would be dynamic, it would need at least annual revision. Any rulings by the Swedish National Board of Advanced Tax Rulings should of course also be included in the revision.

8. Conclusion

The current Swedish tax law discourages the use of safer substances and leads to regrettable substitutions, as certain known safer substances are taxed, while some documented more hazardous alternatives are not taxed. The authors propose a revision in order to base the taxation levels on true environmental impact of the flame retardants and create an incentive for industry for proper substitution.

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11. Signatories

The following individuals and organisations endorse this White Paper:

IT&Telekomföretagen

PINFA – Phosphorus, Inorganic and Nitrogen Flame Retardants Association

TCO Development

Stefan Posner, Rise

Hans Wendschlag, Senior consultant

12. Annex

Table 3: Overview of responses to the proposed increase of the Chemical Tax (interpretation by White Paper authors). Original submissions can be found found here.

	Has position on tax	Against the tax in general	Against tax increase	Chemical classification should be revised	Questioning the positive impact of tax	Product scope should be revised
BFS, Industry Organization for large kitchen appliances	●	●	●		●	●
ESV, Ekonomistyrningsverket, the Swedish National Finance Management Authority						
APPLIA, the industry organization for home appliances	●	●	●	●		●
IKEM, the Swedish Chemical Industry Association	●	●	●		●	
INREGO, one of the largest IT refurbishment / reuse companies	●	●	●			●
IT&Telekomföretagen	●	●	●	●	●	
KEMI, the Swedish Chemical Authority	●				●	
Kommerskollegium, National Board of Trade Sweden	●	(prefer REACH)				
KI, Konjunkturinstitutet, National Institute of Economic Research	●	●	●			
Konkurrensverket, Swedish Competition Authority						
Naturskyddsföreningen, Swedish Society of Nature Conservation (NGO)	●					●
Näringslivets Regelnämnd, Board of Swedish Industry and Commerce for Better Regulation	●		●		●	
Regelrådet, the Swedish Better Regulation Council	●	●	●		●	
Skatteverket, the Swedish Tax Authority	●					
Svensk Elektronik, Swedish Electronics Trade Association	●	●	●		●	●
Svensk Handel, Swedish Consumer Trade	●	●	●		●	●
Svensk Näringsliv, Swedish Confederation of Enterprises	●	●	●		●	
Teknikföretagen, The association of Swedish Engineering Industries	●	●	●		●	
ChemSec	●			●	●	
Electrolux	●	●	●	●		