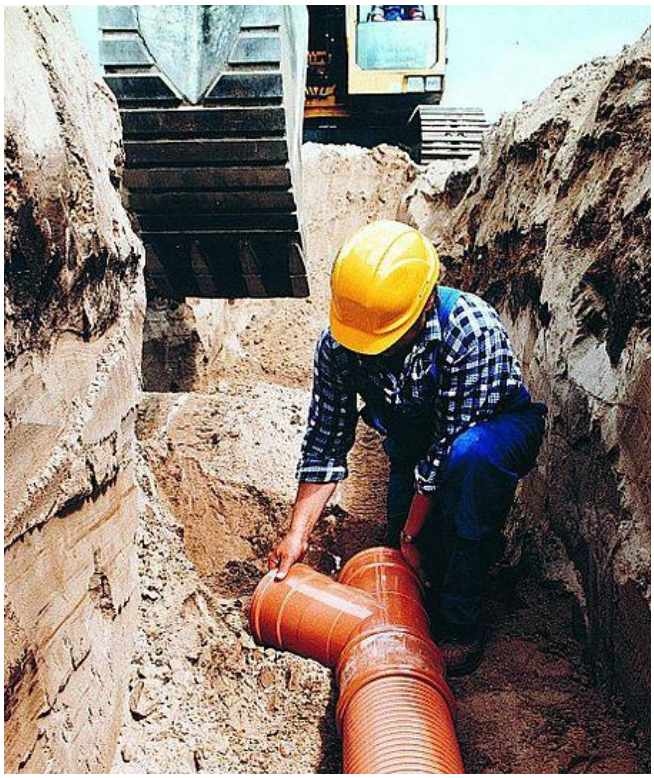
DYNAMIX

Decoupling growth from resource use and environmental impacts

DYNAMIX policy mix evaluation



Reducing PVC and phthalates use in Denmark

European Commission

SEVENTH FRAMEWORK PROGRAMME

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DYNAMIX PROJECT PARTNERS

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1 Resource/Issue

Name of resource targeted (or focus of the case study, if the policy mix is broader than the specific resource(s) we have decided to analyse).

Phthalates and polyvinyl chloride (PVC).

2 Geographical area of policy mix coverage

Country name, and region or city if appropriate (if policy mix is applied regionally or locally)

Denmark.

3 Policy context

3.1 Needs assessment: The environmental problem /resource challenge

What is the environmental problem/concern (consider both quantity and quality), e.g. soil erosion, excessive use of non-renewable or renewable resources and the crossing of environmental thresholds/tipping points for impact, resource scarcity concerns?

Are there any economic or social problems related to the issue and environmental problems – e.g. is there important price volatility, (risk of) unavailability of resources for the economy or society?

Who is the target group affected that have been, are or will be beneficiaries of the policy response?

Phthalates are a group of substances primarily used as plasticisers in PVC, and suspected to be endocrine disrupting substances, i.e. they are liberated during the lifetime of the products and might be the cause of premature puberty in girls and malformation of genitalia in new-born boys. The use of some phthalates in childcare products has been restricted to varying levels in some EU countries, including Denmark, and in the US.

The main problems with PVC are threefold: firstly it is a petroleum-based material and thereby has significant environmental impacts in its manufacture. Secondly, PVC usually contains additives which are harmful to human health and the environment. Thirdly, the disposal of old PVC products when incinerated or landfilled can release substances (such as dioxins) with related negative impacts on human health and the environment. Incineration can also liberate organic compounds containing chlorine to the environment due to incomplete combustion. These compounds are persistent environmental pollutants and have several health effects.

Phthalates are chemical substances (phthalic esters or benzenedycarboxilic acid esters) used to plasticise some polymers, i.e. they make polymers more elastic. The PVC content in plasticisers varies from 15 – 60 %, with averages from 35 – 40 % (European Commission 2000).[1] Di-2-ethylhexyl phthalate (DEHP) is the most commonly used phthalate.

Phthalates do not have an acutely toxic effect, and were therefore traditionally considered to be harmless. A number of different phthalates exist and most of them have different characteristics and impacts on human health. Risk assessment studies led to the classification of some phthalates as toxic for reproduction (Regulation (EC) No 1272/2008):[2]

- DEHP: di-2-ethylhexyl phthalate
- DBP: dibutyl phthalate
- DIBP: diisobuty phthalate
- BBP: benzyl butyl phthalate
- bis(2-methoxyethyl) phthalate
- 1,2-benzenedicarboxylic acid, dipentylester, branched and linear
- n-pentyl-isopentylphthalate
- di-n-pentyl phthalate
- diisopentylphthalate

For a number of phthalates there is no sufficient information for performing a risk assessment. Some phthalates may reduce fertility, and animal experiments have shown that some phthalates can cause cancer.

Polychlorinated dibenzo-p-dioxins (PCDDs) are derivates from “dioxins”, a basic organic heterocyclic compound. PCDDs are highly toxic and bio accumulative compounds are generated by incomplete combustion of substances containing chloride, such as PVC. PCDDs can cause reproductive and developmental problems, damage the immune system, interfere with hormones and also cause cancer (WHO 2010).[3]

Environmental effects of PVC

The main environmental effects of PVC are the bio accumulative substances that PVC-containing products liberate during their lifetime and during incineration. Phthalates liberated during the use phase are potentially harmful for users, especially for children, and PCDDs liberated through incineration are accumulated in the environment and exposed to humans through the food chain.

Some phthalates, such as DEHP, may be broken down in laboratory tests in the presence of oxygen, but not in anaerobic conditions. This means that in practice only a small part of the substance is expected to be degraded in sewage treatment plants. In addition, the biodegradability of phthalates in the natural environment is expected to be lower than in laboratory conditions and in wastewater treatment plants.

DEHP has a high potential to accumulate in aquatic organisms’ systems. The substance is not acutely toxic to the aquatic environment, but it can have long term effects on aquatic life (Danish Environmental Protection Agency 1996).[4]

DBP, BBP, DINP (diisononyl phthalate), DIDP (diisodecyl phthalate) can also accumulate in aquatic organisms. DBP and BBP are very acutely toxic, DEP (diethyl phthalate) is acutely toxic, and DMP (dimethyl phthalate) is harmful to aquatic organisms. On the contrary, DINP and DIDP are not acutely toxic. In summary, DBP, BBP, DINP and DIDP all have long-term effects on aquatic organisms (Danish Environmental Protection Agency 1998).[5]

There is little information on the effects of human exposure. DEHP, for example, can induce liver changes in rats, can have carcinogenic effects after ingestion and can reduce fertility in mice and rats. The effects on humans are unclear and the number of available studies is limited. Some phthalates show teratogenic effects (birth defects) but this generally requires exposure to very high concentrations.

The table below builds on the European Commission's Scientific Committee on Toxicity, Ecotoxicity and the Environment's (CSTEE) assessment on the risks of the different phthalates and presents a summary of the most commonly used phthalates, showing critical effects, zero-effect levels (NOAEL) and the tolerable daily intake.

Table 1: Critical effects, zero-effect levels (NOAEL) and tolerable daily inputs for most commonly used phthalates

Phthalate	Critical effect	NOAEL Mg / kg / day	Tolerable daily Input μ g / kg body weight / day
DINP	Increased liver and kidney weight	15	150
DOP	Microscopic cell changes in the liver	37	370
DEHP	Damage to testicles	3.7	37
DIDP	Increased liver weight	25	250
BBP	Decreased sperm	20	200
DBP	Reduced weight of offspring	52	100

Source: CSTEE. 1998. "Opinion on Phthalate migration from soft PVC toys and child-care articles". 6thCSTEE plenary meeting. Brussels, 27 November 1998.

3.2 Policy context and policy needs

What policy challenge(s) did the problem pose and what policy challenges does it still pose?

What is the policy context related to the policy mix being evaluated? What policies have been put in place to address the issues, what policies are currently in place and which ones are already foreseen for future introduction (e.g. to address past, existing and future objectives)?

What sort of policy response did (and does) the problem call for?

Since phthalates are released from products made of PVC, any policies in this area need to focus on those products that could represent a risk of harm to people. The lack of epidemiologic studies and the difficulty of extrapolating the results of animal tests to humans led to an adoption of a precautionary principle in Denmark, i.e. restricting the use of some components in view of the risk of possible harm to consumers.

In Denmark as in 1999 the Danish Ministry of Environment proposed the ban of phthalates in childcare products (see Section 6). At that time there were already pieces of national legislation on phthalates in certain areas, such as waste from agricultural activities and food uses (regulated by the Danish Veterinary and Food Administration) and medical devices (regulated by the Danish Health Agency).

In 1999, the Danish Ministry of Environment also published its 'Action plan for reducing and eliminating the use of phthalates in soft plastic' (Danish Ministry of Energy and Environment 1999a).[6], Following this, the European Commission initiated the risk assessment of DEHP, DOP, DINP, DIDP, DBP and BBP, but none of these substances were classified as hazardous to date. In addition, the Danish Ministry of Environment proposed the European Commission to develop a regulation on phthalates, with the aim of avoiding a negative effect

on the competitiveness of Danish manufacturers if a restriction on phthalates was only established in Denmark.

3.3 Historical performance and projections into the future: Insights on decoupling

What has been the trend vs. GDP (or other economic performance metrics, such as sectoral growth) and what type of decoupling has been achieved?

In 1999, the Danish Environmental Protection Agency (EPA) adopted a 'Strategy for the PVC area'. At that time the consumption of PVC in Denmark was about 84,000 to 89,000 tonnes per year. The main sector in which PVC was used was the building sector. The table below shows the distribution of PVC consumption in Denmark in 1998.

Table 2: Danish PVC consumption,1998

Sector	Quantities (tonnes) consumed per year
Building products	45,000 to 50,000
Packaging products	4,000
Other products (e.g. office supplies, medical supplies, clothing, blinds, furniture and awnings)	35,000

Source: Danish Ministry of Energy and Environment. 1999b. Strategy for PVC area. Status Report and Future Initiatives. June 1999

No official statistics on the consumption of PVC in Denmark were found when delivering this case study evaluation, hence we use extrapolated EU figures for plastics. The consumption of PVC in Europe has increased significantly since 1960, from less than 1 million tonnes (mt) per year in 1960 to around 6 mt per year in 2004 (PE Europe, 2004).[7] The total amount of plastics consumed in the EU in 2011 was around 47 mts, 11 % of which was PVC (i.e. 5 mts) (Plastics Europe 2012).[8] Plastics consumption in Denmark in 2011 was equal to around 1 % of the total plastics consumption in Europe. Based on these figures, it could be estimated that the consumption of PVC in Denmark in 2011 was around 50,000 tonnes.

A report by COWI (COWI 2003)[9] estimated the consumption of PVC in Denmark in 1995, 2000 and 2001 at 92.7 thousand tonnes (kt), 91.2 kt and 73.5 kt respectively. The same study reported phthalates consumption in Denmark of 11 kt, 10.35 kt and 10.39 kt respectively.

This would mean a reduction of around 44 - 58 % in Danish PVC consumption from 1998 – 2011. Although figures for GDP are not provided here, given this continued to rise throughout the same time period, this means that absolute decoupling of PVC consumption from GDP was achieved.

In 1992, the annual Danish consumption of phthalates amounted to approximately 10,000 tonnes, of which around 90 % was used in flexible PVC. It is estimated that consumption increased from 1992 to 1995, when the consumption of soft PVC was of around 11,000 tonnes (Danish Ministry of Energy and Environment 1999a).[10] In 1999, the Danish 'Strategy for the PVC area' set a policy target to reduce the use of 17 phthalates by 50 % by 2010. No evaluation on this objective was found at the time of writing. The latest evaluation available of

this policy dates from 2003 (Miljoministeriet 2003).[11] At that time, the consumption of phthalates in Denmark was estimated to have fallen by 15 % compared to 1995.

Table 3: Danish PVC and phthalates consumption (kt), 1992-2001

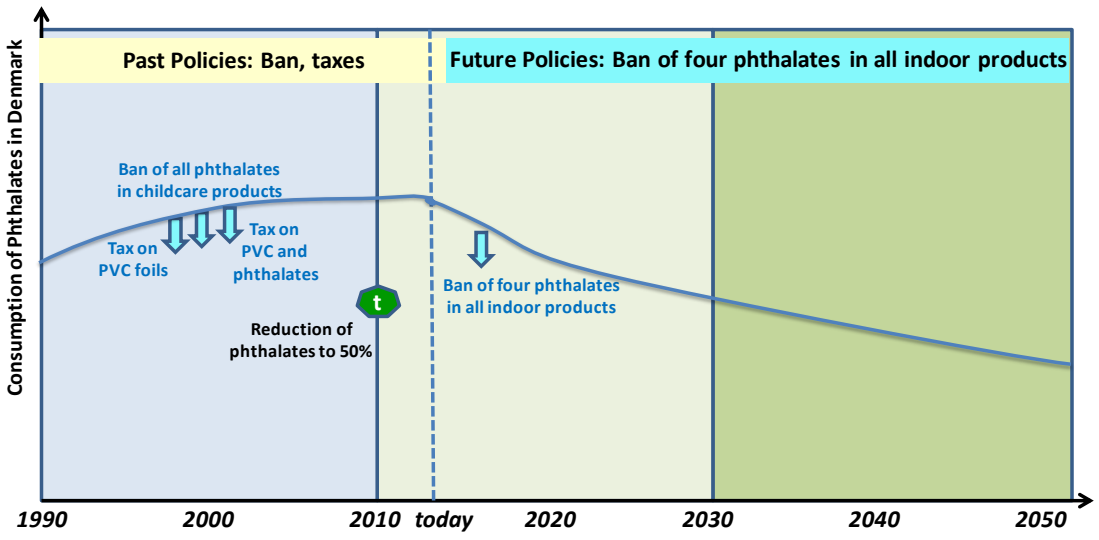
	1992	1995	1998		1999	2000	2001	2011	
			Min	Max				Min	Max
	kt	kt	kt	kt	kt	Kt	kt	kt	kt
PVC		**92.7**	**84.0**	**89.0**		**91.2**	**73.5**	*51.7*	
Rigid PVC		**59.3**	*58.8*	*62.3*		**54.1**	**35.5**	*36.2*	
Flexible PVC		**33.3**	*25.2*	*26.7*		**37.1**	**37.8**	*15.5*	
Phthalates in flexible PVC	*9.0*	*9.9*	*7.6*	*10.7*	*11.1*			*4.7*	*6.2*
Total Phthalates	**10.0**	**11.0**	*8.4*	*11.9*	*12.3*	**10.4**	**10.4**	*5.2*	*6.9*
Bold: Original data *Italics: Calculated*									

Source: Own compilation

Based on industry figures, of the total current EU PVC consumption, 70 % is rigid PVC (PE Europe, 2004).[12] If no alternative to phthalates as plasticisers in PVC is used, flexible PVC contains around 35 – 40 % of phthalates (European Commission 2000).[13] Extrapolating this data to the Danish case would mean that Danish consumption of phthalates in 2011 was a maximum of around 4,500 - 6,000 tonnes, if phthalates were used as plasticisers for all flexible PVC. Although not based on scientifically robust data, it could be that Danish consumption of phthalates almost halved between 1999 and 2011, as GDP continued to rise in the same time period. Therefore, absolute decoupling could be seen to have occurred.

No economic information on the affected sectors was found at the time of writing.

Figure 1: Danish phthalates and PVC policy mix and instrument estimated performance, 1990-2050



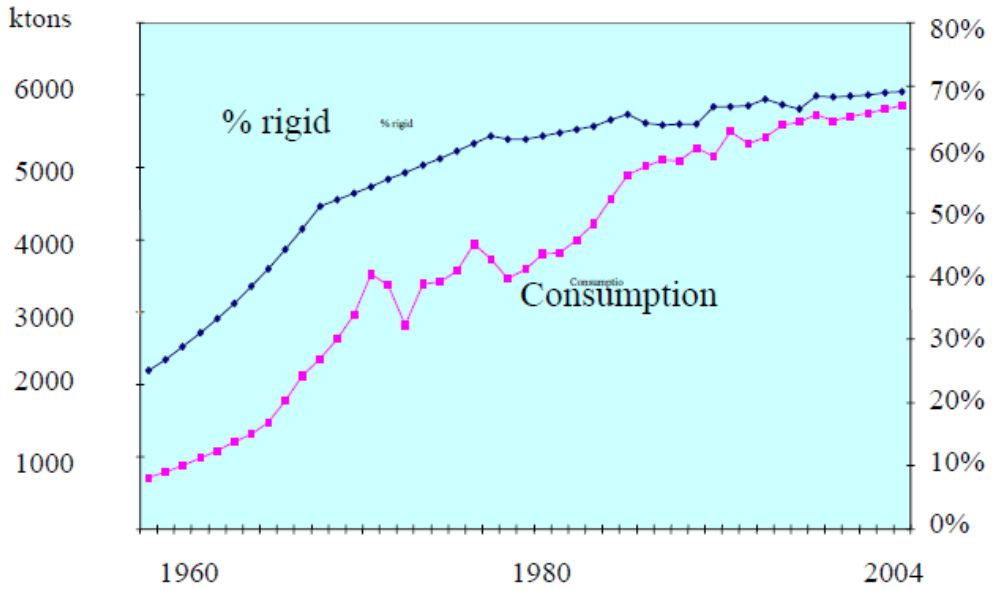
Source: Own compilation

4 Drivers affecting change: resource use/ environmental issues

What are the drivers affecting resource use (driving demand for the resource and leading to resource overuse) or other environmental impacts?

Phthalates are chemical substances mostly used as additives in polymers, mainly PVC. The use of PVC in Europe has increased in the last decades (PE Europe 2004)[14] (see Figure 2), mainly due to its relatively low price, recyclability and ease of processing and versatility.

Figure 2: Western European consumption of PVC and proportion in rigid applications, 1960-2004



Source: PE Europe. 2004. Life Cycle Assessment of PVC and of principal competing materials. Commissioned by the European Commission

Although the biggest share of PVC consumed in Western Europe is for rigid applications, the use of phthalates is closely linked to the use of PVC, as phthalates are mainly used as plasticisers in polymers. Therefore, it can be said that the consumption of phthalates has increased together with the use of PVC in Western Europe.

The drivers for the increased use of phthalates are the same as for PVC. In addition, the use of flexible PVC in food containers (e.g. plastic films and trays) may have increased in recent years due to changes in diets and consumer behaviour (e.g. take-away food, individual portions, etc.).

With regards to childcare products, their use is driven by social and demographic conditions. While demographic changes (e.g. lower birth rate) may lead to a reduction in the consumption of toys and other childcare products, societal changes such as increase in income per family and consumerism drive higher consumption of these kinds of products with a reduced lifetime.

5 Situation/trend prior to introduction of policy mix

Information on the baseline situation before the policy mix was introduced.

As shown in section 3.3, the consumption of PVC in Denmark was estimated to increase in the years preceding the publication of the 'Strategy for the PVC area', reaching from 84,000 to 89,000 tonnes of PVC used per year in 1998 for construction products, packaging products and others products (e.g. office supplies, medical supplies, clothing, blinds, furniture and awnings).

The total consumption of phthalates in Denmark increased from 10,000 tonnes in 1992 to 11,000 tonnes in 1995 and around 13,000 tonnes in 2011 (see section 3.3). All of the phthalates consumed were imported.

One of the problems with PVC was in the end-of-life management of the large quantities of building products primarily made of flexible PVC that were not recycled and ended up in waste incineration. Therefore, total PVC waste in Denmark was expected to increase in the years following the adoption of the Danish 'Strategy for the PVC area' in 1999 (Danish Ministry of Energy and Environment 1999b).[15]

6 Description of policy mix

This section presents the main policy mix that will be the focus of this ex-post assessment.

Lifecycle focus (point of application of the policy mix):	Production
Sector covered:	Manufacturing of indoor products made of PVC, particularly childcare products
Scale of application of policy mix:	National
Implementing body:	Danish Ministry of Environment
Objective of policy mix:	To reduce the consumption of phthalates by 50 % until 2010. The restriction of use of phthalates is stricter than the EU legislation on the same area.

Denmark was one of the first countries to adopt a policy restricting the use of some phthalates in childcare products. Since 1996, the Danish EPA issued a number of guidelines for Green Public Procurement, some of which included recommendations on how to avoid PVC.

In 1988, the Danish EPA launched an 'Action Plan on the reduction of PVC' with the aim of reducing the health and environmental harms of the use and disposal of PVC products. In 1991, this strategy led to an agreement between the Danish Government and the Danish industry on the use of PVC with the objectives of reducing incineration of PVC, increasing recycling and limiting the use of additives in PVC, such as lead and chlorinated paraffin. On 1st of January 1999, the Danish Ministry of Environment introduced a tax of 12 DKK/kg on all PVC foils for food stuffs. On 1st April 1999, it banned the sale, use or import of all phthalates

for childcare products, if the product contains more than 0.05 % in weight of phthalates and is intended for children up to 3 years old.

In June 1999, the Ministry published an 'Action Plan for reducing and eliminating the use of phthalates in soft plastic'. This Action Plan included several policy actions:

- Danish and international regulation
- Requirements for phthalates in standardisation
- Tax model for phthalates in selected product groups
- Subsidies for the development of substitutes
- Green Public Procurement
- Ecolabelling

Also in June 1999, it adopted a 'Strategy for the PVC area'**Error! Bookmark not defined.** (Danish Ministry of Energy and Environment 1999b)[16], including a tax of 2 DKK/kg PVC on all PVC products, with the exception of construction goods and a tax on phthalates of 7 DKK/kg, which entered into force on 1st July 2000.

The Danish Ministry of Environment also established the objective of reducing the consumption of 17 phthalates by 50 % by 2010.

In 2009, the Danish Government prohibited all phthalates, defined as esters of o-phthalic acid, in concentrations above 0.05 % (Danish Statutory Order No. 855)[17]. Furthermore, in 2012 it announced plans to introduce a national ban on the four phthalates DEHP, DBP, DIBP and BBP in concentrations above 0.1 % in products for indoor use and products that can come into direct contact with the skin or mucous membranes (Danish Statutory Order no. 1113)[18]. However, bans of widely used products or substances has been proven to be difficult, as in the abandoned ban proposed in 2012 on products for indoor use containing four phthalates (Danish Environment Ministry 2013). ~~The ban would have been applicable from 1 December 2013, however for electrical and electronic equipment covered by the RoHS Directive (Directive 2011/65) is not applicable until 1 December 2014 (Danish EPA, N.d.)[19].~~

Similar but less restricting policies were also adopted in the EU in 1999 and 2005 and later, in 2008, in the US. The EU Commission Decision 1999/815/EC[i] and Directive 2005/84/EC[ii] prohibited placing on the market toys and childcare articles intended to be placed in the mouth by children of less than three years of age and made fully or partly of soft PVC containing more than 0.1 % by weight of one or more of the following phthalates:

- di-isononyl phthalate (DINP)
- di(2-ethylhexyl) phthalate (DEHP)

[i] Commission Decision of 7 December 1999 adopting measures prohibiting the placing on the market of toys and childcare articles intended to be placed in the mouth by children under three years of age made of soft PVC containing one or more of the substances di-iso-nonyl phthalate (DINP), di(2-ethylhexyl) phthalate (DEHP), dibutyl phthalate (DBP), di-iso-decyl phthalate (DIDP), di-n-octyl phthalate (DNOP), and butylbenzyl phthalate (BBP), OJ L 315, 9.12.1999, p. 46-49

[ii] Directive 2005/84/EC of the European Parliament and of the Council of 14 December 2005 amending for the 22nd time Council Directive 76/769/EEC on the approximation of the laws, regulations and administrative provisions of the Member States relating to restrictions on the marketing and use of certain dangerous substances and preparations (phthalates in toys and childcare articles), OJ L 344, 27.12.2005, p. 40-43

- di-n-octyl phthalate (DNOP)
- di-iso-decyl phthalate (DIDP)
- butyl benzyl phthalate (BBP)
- dibutyl phthalate (DBP)

This policy, based on the precautionary principle, was widely contested by the chemical industry (Callapez 2006).[20] Furthermore, the slight differences between the Danish and EU regulations led to confusion in manufacturers and consumers.

Finally, in 2012, the Danish Ministry of Environment submitted a proposal to the European Commission to ban imports and sales of products containing DEHP, DBP, DIBP or BBP. This ban has not been approved at the time of writing, but if it is put into force in the future, it will be the first time that a ban is based on the cumulative effect of various substances and various sources.

6a. Supplementary context questions including elements pertinent to paradigm discussions in DYNAMIX

Timeline for the different phases of the policy cycle (i.e. rationale and objective-setting; appraisal; implementation and monitoring).

Description of the government in power during each of the three following policy phases: rationale and objective-setting; appraisal; and implementation and monitoring.

Does the mix contain policies that are unusual or not typical of the country/ies or regional/local administration that implemented it?

Names of resource efficiency concepts, terms, models, ranking/classification systems, accounting methods etc. used or relied upon in each of the three phases of the policy cycle: rationale and objective-setting; appraisal; and implementation and monitoring, and how they were used (e.g.: 'waste hierarchy' – used in objective-setting to link policy objectives to more desirable uses for waste).

The 'Strategy for the PVC area' and the 'Action plan for reducing and eliminating the use of phthalates in soft plastic' were published in 1999 by the Ministry of Environment, led by Svend Auken from the centre-left Social Democrats party from 25 January 1993 until 27 November 2001. From 2001 to 2004 and from 2007 to 2011, the Ministry of Environment was led by the centre-right Venstre Party and between 2004 and 2007 by the centre-right Conservative People's Party. In 2011, Ida Auken from the Socialists People's Party (centre-left to left-wing) took the lead of the Ministry, and in 2012 proposed the ban of four phthalates for all indoor products with which people come into direct contact.

Table 4: List of Prime Minister's parties and Minister of Environment's parties in Denmark since the publication of the 'Strategy for the PVC area' and the 'Action Plan for reducing and eliminating the use of phthalates in soft plastic'

Year	Policy milestone	Prime minister's party and political bias	Minister of environment's party and political bias

1999	Publication of 'Strategy for the PVC area' and the 'Action Plan for reducing and eliminating the use of phthalates in soft plastic' Tax on all PVC foils for food stuff Ban on the sale, use or import of all phthalates for childcare products intended for children up to 3 years old, if the product contains more than 0.05 % in weight of phthalates	Social Democrats party (centre-left)	Social Democrats party (centre-left)
2001-2004	-	Venstre (centre-right)	Venstre (centre-right)
2004-2007	-	Venstre (centre-right)	Conservative People's Party (centre-right)
2007-2011	-	Venstre (centre-right)	Venstre (centre-right)
2001-	National ban of four phthalates in concentrations above 0.1 % in all indoor products in contact with people Proposal to the European Commission to ban imports and sales of products containing four phthalates	Social Democrats party (centre left)	Socialists People's Party (centre-left to left-wing)

Source: Own compilation

6b. Instruments and orientation of policy mix

Instruments in the mix and whether one type of tool (i.e. regulatory, economic, information) is dominant.

For each instrument, what is its aim? What requirements does it place on relevant players (for example, phasing out a certain substance, meeting minimum recycling targets, etc.)? What reporting requirements exist?

The 'Action plan for reducing and eliminating the use of phthalates in soft plastic' included several policy options: regulation (e.g. limited emissions or bans), standardisation, funding for research and development, ecolabelling, Green Public Procurement and taxes on selected product groups.

The Action Plan covers all uses of phthalates in soft plastics. It addresses individual product groups and examines the ways in which a variety of measures can contribute to reduce consumption of phthalates.

Some of the above listed policy tools already existed before the adoption of the Action Plan, such as guidelines for Green Public Procurement, ecolabelling schemes or the ban of phthalates in toys and childcare products.

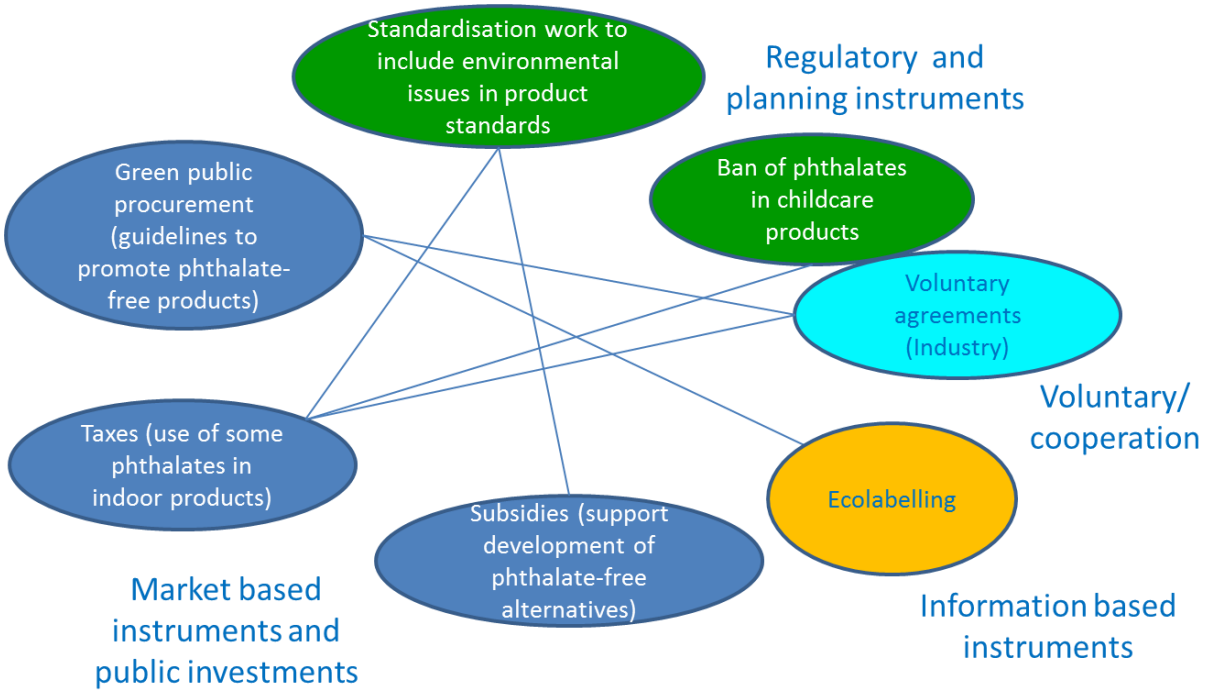
Bans and taxes form the main policy instruments within the policy mix for the restriction of use of phthalates in Denmark. Since their entry into force these two instruments directly affected manufacturers and were expected to have a direct influence on consumption of phthalates in

Denmark. Both bans and taxes aim to convince manufacturers to substitute phthalates with other products. Complementary instruments have also been introduced to help to develop and spread alternatives in the market, such as funding for research and development, green public procurement and voluntary agreements.

Source: Own compilation based on Danish Ministry of Energy and Environment. 1999a. "Action plan for reducing and eliminating the use of phthalates in soft plastic". June 1999

~~Figure 3~~ presents the main policy instruments and how they mutually support each other in the achievement of policy objectives.

Figure 3: Danish phthalate and PVC policy mix instruments and their relationships



Source: Own compilation

Bans

In 1999, the Danish Government banned the sale, use or import of all phthalates for childcare products intended for children up to 3 years old, if the product contains more than 0.05 % in weight of phthalates.

The aim of this ban was to protect children from the exposure to phthalates liberated from PVC in products when chewing on them, as some phthalates may have carcinogenic effects or be toxic for reproduction.

Furthermore, in 2012, the Danish Government proposed a ban in Denmark on all products intended for indoor use containing DEHP, DBP, DIBP or BBP. ~~This ban has not been approved at the time of writing.~~ The objective of this ban wa~~i~~s to protect all citizens from direct exposure through direct contact with household products containing phthalates but it was

abandoned due to it being applied to widely used products (Danish Environment Ministry 2013).

Taxes

The Danish 'Action plan for reducing and eliminating the use of phthalates in soft plastic' introduced a tax model covering 65 % of the phthalates used in Denmark.

This tax model was prepared by the Tax Ministry, in collaboration with the Environmental Protection Agency, and applies to both phthalates used in Danish production and phthalates which are imported in finished products in a number of selected product groups.

The product groups covered include floor and wall coverings, tarpaulins, rainwear, workwear, roof and membrane film, gloves, garden hoses, water hoses, food hoses, power cables, some office supplies, industrial hoses and self-adhesive foils. Initially, the possibility of taxing the entire consumption of phthalates in soft PVC was also assessed, but it was considered beyond possibility because of administrative reasons. A number of products contain soft PVC in unknown quantities and the quantification of the PVC contained in all products would involve high administrative costs. Furthermore, the tax was limited to groups for which a positive effect on reducing PVC was expected. Products that contain only small quantities of soft PVC were not subject to a charge.

The tax was set at the same level for all phthalates in order to simplify the calculation and administration of the tax.

The aim of this tax is to discourage the use of phthalates and promote the adoption of alternatives that do not create harm to users. The charge contributes to the reduction of soft PVC in products and provides incentives for the use of other plasticisers than phthalates. It was estimated that producers would rarely reduce the quantity of phthalates in products as a reaction to the tax, but would rather use alternative materials so that the PVC and/or phthalates in the products are substituted completely. It was expected that a tax on the content of phthalates in the selected groups could ultimately reduce phthalate consumption by approximately 30 % within the selected groups, compared to the phthalate consumption when the tax was introduced.

International regulation

Denmark is a small market and therefore the policies limited to its internal market would imply competitive disadvantages for Danish companies and consumers, rather than changing the practices of main manufacturers. Subsequently, it was considered necessary to have a shelter of international support under the bans and restrictions on the use of phthalates. Thus, in 2011 the Danish Government proposed to the European Commission to create common rules that prohibit some uses of phthalates (Danish Environmental Protection Agency 2011)[21] (e.g. DEHP, BBP, DBP and DIBP in articles intended for indoor use and articles that may come into direct contact with the skin or mucous membranes in a concentration greater than 0.1 % by weight of any plasticised material).The European Chemicals Agency opened a consultation period and submitted the results to the European Commission, which would take the decision whether to include new restrictions in Annex XVII of REACH Regulation. At the time of writing this decision had not yet been taken.

Voluntary agreements

In 1999, the Danish government proposed a voluntary agreement in the textile industry to phase out phthalates in PVC for textile printings within 3 years. The government planned to fund activities for informing importers, retailers and advertisers on alternatives and possibilities of eliminating the use of phthalates in textiles. In addition, the Danish government proposed to launch consumer information campaigns on the use of phthalates in textile printings and possible alternatives.

The textile market in Denmark is complex and includes a number of players, with a considerable share of imports through international supply chains. This means that an international regulation such as a specific ban or tax for the textile sector would give disproportionate administrative costs and would need a complex market surveillance structure. It was therefore seen as most appropriate to phase out the use of phthalates in textile products by international initiatives and voluntary agreements.

Support research and development

In addition to regulatory instruments, within the 'Action Plan for reducing and eliminating the use of phthalates in soft plastic' the Danish Government included the compromise of putting efforts on developing environmentally suitable alternatives to phthalates. These propositions covered standardisation work that aimed to promote the possibility of replacing phthalates with alternatives and a subsidy on cleaner products, which would prioritise funding to develop substitutes for PVC and phthalates.

Previously to the Action Plan, a number of development projects were supported by a fund called "Cleaner Technology", which was discontinued and substituted by the new grant scheme called "Program for Cleaner Products", which ran from 1998 to 2003. The new subsidy scheme was based amongst others on the former Cleaner Technology scheme and aimed to strengthen the development and sale of cleaner products. The scheme was administrated by the Environmental Council for Cleaner Products, a former public agency part of the Danish Ministry of Environment (European Topic Centre on Sustainable Consumption and Production 2010).[22] No information on the amount of funding allocated has been found at the time of writing.

Green Public Procurement (GPP)

The 'Action plan for reducing and eliminating the use of phthalates in soft plastic' recommended all public purchasers of medical products the prioritisation of phthalate-free alternatives. Danish public administrations already had some experience on PVC-free public procurement and it was seen that PVC containing phthalates were almost phased out in some hospitals due to these GPP practices.

The objectives of the PVC-free public procurement were twofold. Firstly, it aimed to drive manufacturers to develop alternatives to phthalates and assess whether there are enough feasible alternatives in the market. In this case a full or partial ban of phthalates could be envisaged. Secondly, it aimed to encourage the rest of society to also use PVC-free products.

Between 1997 and 1999 the Ministry of Environment created 33 environmental guidelines with recommendations for public procurers on how to integrate environmental considerations into public procurement. The environmental guidelines that affect the product groups within the scope of the 'Action plan for reducing and eliminating the use of phthalates in soft plastic'

were revised to include recommendations to encourage the substitution of phthalates and / or soft PVC.

Ecolabelling

The Danish Ministry of Environment committed to work to ensure that both the EU Ecolabel and the Nordic Swan ecolabelling schemes include the absence of phthalates within their environmental criteria for product certification, such as textiles, indoor paints, varnishes, floors and furniture office equipment.

The objective of the Danish Ministry of Environment with regards to this work is to update and develop harmonised criteria in the ecolabels regarding phthalates and to avoid any possible gaps or incoherencies.

Table 5: List of instruments and product groups affected by the 'Action plan for reducing and eliminating the use of phthalates in soft plastic'

Product Groups	Emissions to be limited	Standardisation	Substitution possibilities should be explored	Ecolabelling	Guidance for GPP	Other tools
Cars	X (At the car wash)		X		X	
Floor and wall coverings		X (Building Materials)		X (Swan)		Tax
Toys		X			X (for importers)	Ban
Furniture / vinyl				X (Swan)	X	Tax
Tarpaulins	X (In production)		X			Tax
Medical equipment	X (In production)	X (Medical Devices)	X		X	
Rain work wear					X	Tax
Posts lid			X			
Profiles		X (Building Materials)		X (As part of the furniture)		
Membrane film		X (Building Materials)				Tax
Gloves					X	Tax
Garden products	X (In production)					Tax

Product Groups	Emissions to be limited	Standardisation	Substitution possibilities should be explored	Ecolabelling	Guidance for GPP	Other tools
Boots / Waders			X		X	
Textiles with PVC prints				X (EU Ecolabel and the Swan label)	X	
Foodstuff hoses						Tax
Power cables	X (In production)	X (Building Materials)		X (cables in ecolabelled machines)	X	Tax
Others in medical devices						Taxes on certain products
Office Supplies				X (Swan)	X	Taxes on certain products
Industrial hoses	X (In production)					Tax
Self-adhesive film						Tax
Other products						Taxes on certain products

Source: Own compilation based on Danish Ministry of Energy and Environment. 1999a. “Action plan for reducing and eliminating the use of phthalates in soft plastic”. June 1999

6c. Evolution of policy mix

Evolution of the policy mix throughout its existence –details of the introduction of the first policy tool(s), then all subsequent relevant tools, and related revisions/reforms (e.g. progressive increases in rates applied through economic tools, broader extension of regulation requirements, etc.).

In October 1988, the Minister for the Environment launched an ‘Action Plan on the reduction of PVC’ aiming for the reduction of PVC. In 1991, this strategy led to an agreement between the government and the industry on the use of PVC. The government and the PVC related industry agreed to identify problems associated with the use of PVC in order to help establishing objectives for action and defining a strategy dealing with these problems later on.

Since the agreement, some positive results were achieved, such as the restriction of the use of heavy meats and the reduced use of PVC packaging (but other issues, including the financing of the collection system for PVC construction products, the incineration of PVC

building products, the increasing consumption of PVC products and the increased PVC waste generation, were not solved). Furthermore, the problems related to phthalates were not covered in the agreement as there was no scientific evidence on the possible negative effects of phthalates on the environment or human health at that time.

Since 1996, the Danish Ministry of Environment issued a number of guidance documents which aim to help public administrations to include criteria for avoiding products that contain PVC in public procurement.

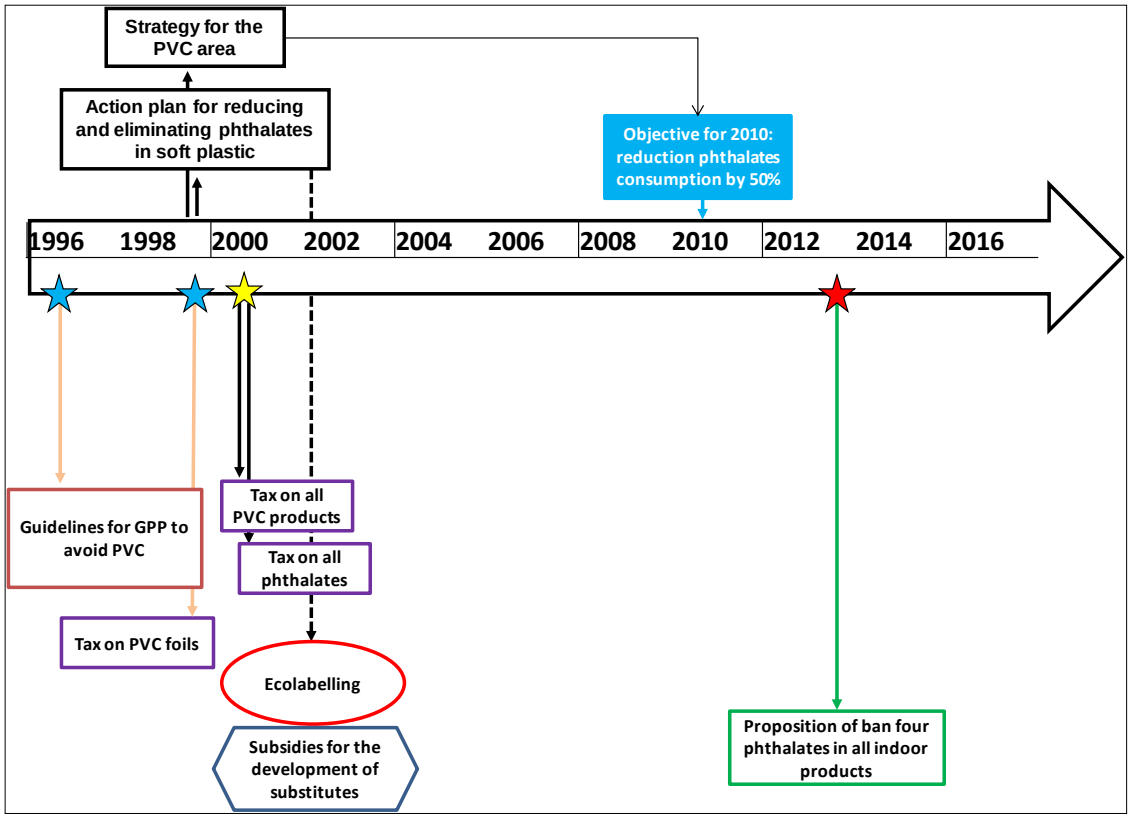
In 1999, the Danish Ministry of Environment adopted the 'Strategy for the PVC area' and the 'Action plan for reducing and eliminating the use of phthalates in soft plastics'. These two strategies combined different policy tools, such as taxes, ecolabelling and subsidies for the development of substitutes. A quantitative objective of reducing the consumption of phthalates by 50 % by 2010 was also established.

The taxes for PVC foils introduced in 1999 were complemented in 2000 with a tax on all PVC products and a tax on all phthalates.

~~In November 2012, the Danish Ministry of Environment approved a ban of four phthalates used in indoor products. This ban will entry into force on 1st December 2013.~~

In addition to the Danish and EU actions to restrict the use of phthalates in PVC, in 2000 the EU PVC manufacturing industry launched its 'Vinyl 2010' programme, a voluntary agreement to minimise the environmental impact of production, promote responsible use of additives and support collection and recycling schemes. The programme was renewed in 2011 for another 10 years, and renamed 'VinylPlus'.

Figure 4: Evolution of the Danish phthalates and PVC policy mix



Source: Own compilation

7 Evaluation of policy mix: effectiveness (environmental sustainability)

Does/did the policy mix result in a positive environmental outcome?

Were its stated objective(s) met? Were the instruments used sufficient to meet the objectives?

Did other, unforeseen/unintended positive outcomes or impacts (environmental, social, economic) result? Did other such negative outcomes or impacts result?

Were these objectives set at a level to meet environmental needs (e.g. avoid crossing environmental thresholds/tipping points or achieve more sustainable levels of resource use/extraction (e.g. maximum sustainable yield (MSY) in fisheries)?

Which sectors/actors were identified as having key impacts/influences on the problem/issue? (e.g. specific industrial/ business sectors, consumers, economy as a whole?) Did any of the instruments specifically target these key sectors/actors? Was there significant take-up/implementation of (voluntary) instruments by these sectors?

Was the policy mix applied to a sector previously not targeted by policies on the issue under question, or in a new area/issue – thereby aiming to stimulate change?

What were the anticipated and actual outcomes, impacts and effects of the policy mix on the behaviour of sectors and actors targeted? (e.g. reductions in emissions from industry, increased recycling rates, increase/decrease in certain product purchases, etc.).

Relationships between the instruments, identifying positive/negative influences on the overall policy mix or on key instruments in the mix, as well as any positive or negative impacts from changes to the mix (introduction or termination of instrument(s), increase or decrease in tax/levy/charge, etc.). Level of 'connectivity' (strong, weak) between each instrument and the primary one(s).

Are there any indicators, monitoring systems, review processes or other monitoring mechanisms in place to track progress?

It is estimated that the use of PVC in Denmark dropped around 40 % to 44 % from 1998 to 2011 (Danish Ministry of Energy and Environment 1999b, PE Europe 2004, Plastics Europe 2012).[23, 24, 25] The consumption of phthalates is estimated to have decreased between 46 % and 59 % from 1999 and 2011 (Danish Ministry of Energy and Environment 1999b, PE Europe 2004, Plastics Europe 2012).[26, 27, 28]

The use of PVC presents a decreasing trend in Denmark, and so does phthalates use. The policy mix thus succeeded regarding the issues of the use of phthalates. As the ban of phthalates does not affect all phthalates compounds, it is possible that the banned substances can be substituted with alternative phthalates after the policy mix was applied.

8 Evaluation of policy mix: efficiency (economic sustainability)

Is/was the policy mix considered cost-effective?

What has been the level of impact on resource use of the policy mix (the effect)?

What have been the costs of implementing the policy mix for target audience (e.g. business, households, etc.)?

What are the costs (financial, human) of implementing the policy mix for the implementing authority – i.e. the administrative/transaction costs?

Were sufficient resources made available to ensure an effective implementation of the policy-mix?

Was anything foreseen in the policy-mix to address competitiveness concerns (e.g. use of exemptions) or minimise transaction costs (e.g. thresholds below which monitoring wasn't required)?

Did the policy mix involve providing financial support (e.g. subsidies, low interest loans, tax breaks etc.) to key actors (e.g. sector, households, etc.)?

Did the measures generate revenues (e.g. in the case of taxes) and if so, was revenue recycled/re-injected into the economy, and to what levels and activities? Did revenue recycling have positive amplifying effects?

In synthesis - was the policy mix cost-effective?

What elements of the mix were (un)helpful in improving cost-effectiveness?

How was relative/absolute decoupling achieved?

Were resource limits or other thresholds taken into account and how were they addressed?

Although no official evaluation of the policies on PVC and phthalates in Denmark was found at the time of writing, it can be said that the economic impacts of the policy mix would affect manufacturers. As shown in section 06.2, the main policy tools developed within the policy mix are bans and taxes of some phthalates and PVC products. These tools were complemented with green public procurement practices and support to research and development, among others. The extent of the economic impacts of these complementary tools is still not clear. However, the Danish government foresaw an impact on the competitiveness of Danish companies in case a ban of certain phthalates was put forward only in Denmark. For this reason, the Danish government issued a proposal to the European Commission to develop harmonised regulation at EU level. During the process of the preparation of this harmonised EU regulation, the ban was widely contested by the industry. Representatives of the plastics industry argued that the ban would lead to economic impacts on manufacturers, due to a drop of sales and the impossibility of selling the products that are already on the market. These economic impacts would also indirectly affect consumers due to limited choices and increased prices of alternative products (Callapez 2006)**Error! Bookmark not defined.**.[29]

A report from COWI (2010)[30] states that the prices of products made of PVC rose by approximately 50 % after the Danish ban of DEHP was introduced, due to the obligation for manufacturers to make special products without DEHP for the Danish market. The prices

decreased again when the ban was extended to the entire EU, but still were around 10 % to 20 % higher than before the initial ban. This might due to the higher relative prices of the alternatives to phthalates. Some of the alternatives to banned phthalates have similar prices to the substances banned, while others have slightly higher prices or considerably higher prices per weight. The prices of chemical products tend to decrease when production is done at large scale, but the minimum price however is set by the prices of the raw materials.

9 Evaluation of policy mix: welfare (social sustainability)

What social impacts have you found associated with the policy mix? E.g. jobs created, reduced health impacts, distributional impacts etc.

Were social aspects included in an ex-ante impact assessment of the policy mix if one was undertaken? What were these?

Has monitoring of social impacts been included in implementation, to identify actual effects compared to anticipated ones?

Was the policy mix designed to not be socially regressive? What measures were undertaken to ensure this?

Were equity concerns addressed and, in case of re-structuring of the economy/sector, measures in the area of reskilling of the workforce foreseen?

What other public acceptability elements were addressed or considered?

The social impacts of the policy tools have not been studied in any official policy evaluations at the time of writing. However, during the process of the elaboration of a regulation on phthalates at EU level representatives of the industry pointed out some potential risks of a ban on certain types of phthalates. In case of a ban on certain phthalates some existing alternatives would be less studied than phthalates and therefore would be potentially harmful for human health (Callapez 2006).[31]

In addition, the differences in legislation on the use of phthalates as plasticisers in the different Member States would affect the understanding and the confidence of consumers on public policies and safety of the products (Callapez 2006).[32]

However, as the policy mix had the objective of reducing exposure to phthalates, the effects on human health are positive, reducing exposure to these potentially hazardous components. No epidemiologic study has been found on this topic at the time of writing.

10 Overall assessment

What is your overall view on the success(es) or failure(s) of this policy mix?

How did the policy mix enable decoupling?

How could it have been improved to achieve its original objective(s) and to achieve absolute decoupling?

The different policy tools on the use of PVC and phthalates adopted in Denmark had the overall objective of reducing the environmental and health impacts of these products. The principal instruments adopted were bans and taxes on certain types of products and substances, complemented with public funding for research and development, initiatives to promote legislation at EU level, green public procurement and development of ecolabelling criteria.

Even though no official evaluation of the results of the policy has been done at the time of writing, the available statistics on PVC and phthalates consumption in the EU and in Denmark showed that the policy mix has been effective regarding the reduction of PVC consumption, and has met the objective of cutting the consumption of phthalates by 50 % (see section 7).

However, these figures do not allow an in-depth analysis, since no detailed statistics on the consumption of specific phthalates is available at the time of writing.

11 Relevance to the EU and transferability

Denmark was one of the first countries adopting internal regulation regarding phthalates, issued a proposal to the European Commission to develop similar regulation at EU level. The EC adopted Decision 1999/815/EC[iii] and Directive 2005/84/EC[iv] limiting the use of certain phthalates in toys and childcare products.

The content of the EU regulation is less strict than the legislation adopted in Denmark, since it only limits the concentration of phthalates in products and does not ban the substances. Nonetheless, such a proposal at EU level is possible. Furthermore, the EC does not have competencies on Member States' tax regulations, and therefore the policy instruments put forward in Denmark regarding economic taxes for phthalates and PVC products are not likely to be applied at EU level. However, this fact does not prevent other EU Member States from applying similar tax schemes.

In 2012, the Danish Ministry of Environment proposed to the EC a ban of all types of phthalates in all indoor products which are in contact with consumers. This hypothetical scenario of an absolute ban of all types of phthalates at EU level is legally possible. In that case, the objective of reducing the phthalate consumption would be reachable both at EU level and Danish level, provided that valid plasticiser alternatives are developed and available without excessive economic burden to manufacturers or customers.

[iii] Commission Decision of 7 December 1999 adopting measures prohibiting the placing on the market of toys and childcare articles intended to be placed in the mouth by children under three years of age made of soft PVC containing one or more of the substances di-iso-nonyl phthalate (DINP), di(2-ethylhexyl) phthalate (DEHP), dibutyl phthalate (DBP), di-iso-decyl phthalate (DIDP), di-n-octyl phthalate (DNOP), and butylbenzyl phthalate (BBP), OJ L 315, 9.12.1999, p. 46-49

[iv] Directive 2005/84/EC of the European Parliament and of the Council of 14 December 2005 amending for the 22nd time Council Directive 76/769/EEC on the approximation of the laws, regulations and administrative provisions of the Member States relating to restrictions on the marketing and use of certain dangerous substances and preparations (phthalates in toys and childcare articles), OJ L 344, 27.12.2005, p. 40-43

12 Stakeholder contribution

What insights did stakeholders provide?

Interview with Mr Bent Horn Andersen and Mr Lars Fock (Environmental Protection Agency of the Danish Ministry of the Environment) conducted on 1st October 2013.

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