chemsec
INTERNATIONAL CHEMICAL SECRETARIAT

# Look Ahead

## How to Spot Future Profits in the World of Chemicals

# Introduction

I used to be a stock trader in the 90s. It was an exciting time trading on the floor, writing orders on paper and shouting buys and sells to brokers. And my time on the stock market not only gave me valuable working experience, it also taught me how the industry works and what drives it forward: the constant need to look ahead and search for new opportunities to invest in, hunting for promising figures, stories and companies. Even to this day I still have this sense of excitement when I come across a promising investment opportunity – like a hound sniffing a scent.

In 2011 I picked up one my strongest "scents": the wish of many of the world's largest retailers to remove Bisphenol A in cash receipts, which emerged after scientific studies reported the health effects of touching these cash receipts, or thermal paper, which is the technical term. Back then I wanted to invest in a company that could offer a safer alternative to Bisphenol A in thermal paper, but unfortunately I got lost in the research. Ever since then, however, I've kept my eyes open for new information that could help me understand if it is as good an investment as I envisaged.

This report is a result of my personal conviction that chemical substitution can offer substantial investment opportunities. All over the globe there is emerging legislation that targets hazardous chemicals in products. Couple that with the increasing demand by consumers for chemical transparency and you have a very promising landscape for markets that are shifting towards safer alternatives and new solutions.

But chemical substitution does not just offer opportunities for the investment community to make lots of money – investors can also play a large role in contributing to the elimination of hazardous chemicals from products. Shareholders wield powerful opinions over corporate decisions – power that can be used to make money as well as demand transitions to sustainable and safe products at the same time.

*Sonja Haider*
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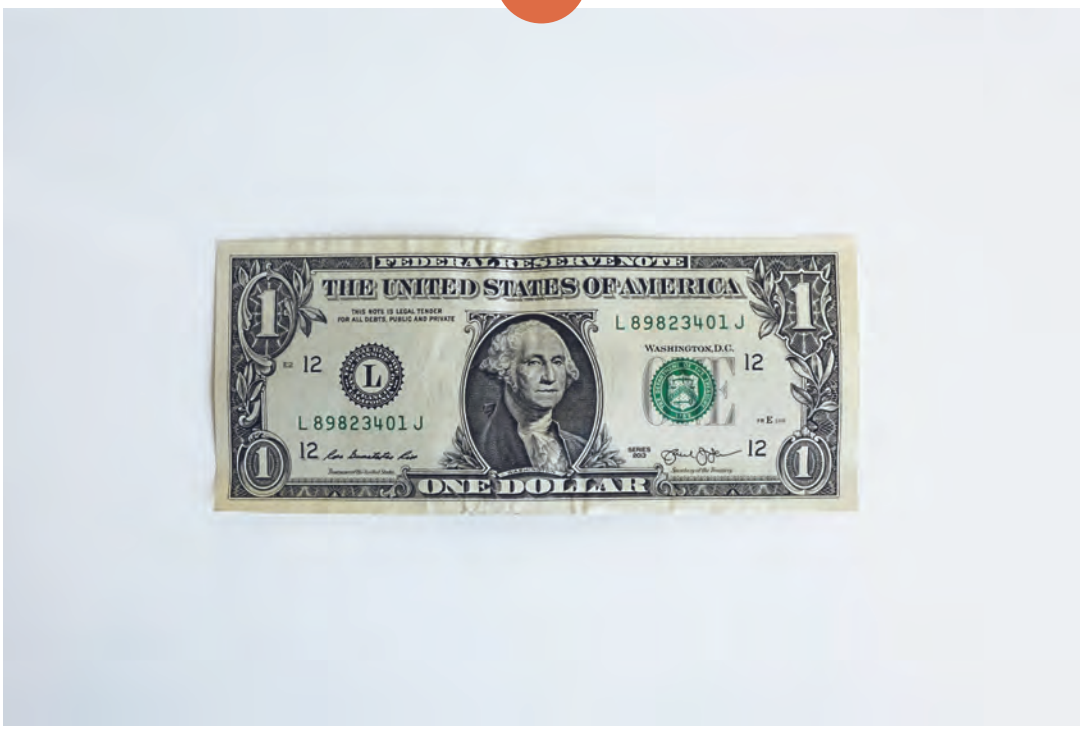
# What is chemical substitution and why is it an investment opportunity?

The chemical industry is central to the world's economy, as chemicals are used in many stages of the production of physical products: clothes, electronics, cars, plastics and so on. Most of the several hundred thousand well-known chemicals that are currently in use are harmless, but some of them are not. In production processes the term chemical substitution represents the act of replacing a hazardous chemical with a safer alternative. This can be achieved either by swapping the unwanted chemical with a safer substance, or by re-designing the product or changing the process altogether and thus making the initial substance obsolete. Regardless of its type, the aim of substitution is to make a positive difference for health and safety.

There are several drivers behind a business decision to engage in substitution. Obviously legislation is one of the strongest. Due to restrictions and bans, companies have to innovate to provide safer replacements. But before legislation kicks in, this need can often be foreseen by paying attention to other drivers, such as new scientific findings or campaigns by environmental NGOs. This is exactly why most large corporations with a stake in the chemical industry keep a close eye on these drivers. When legislation hits, you want to be well prepared, since substitution is not something done overnight. Investors are wise to pay attention to these very same drivers, as they potentially are signs of looming investment opportunities.

Safer materials can create a global demand – even when the commodity it replaces is not regulated in all regions. For example, many progressive multinational corporations often apply the strictest legislation in all of their markets. This means that a ban on a chemical in Europe often means an effective global ban for those companies.

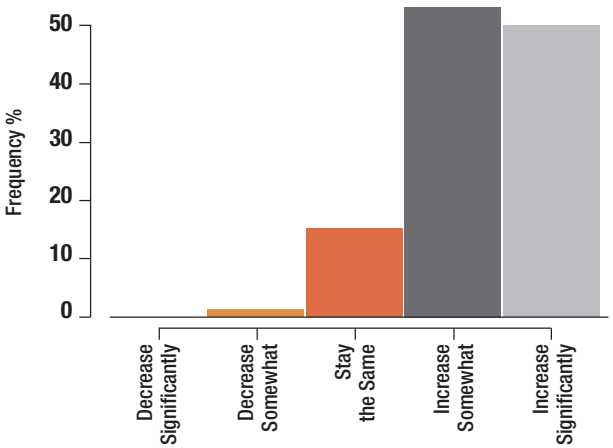
In recent years there has been a huge surge in safer chemicals as legislation has become stricter. The market growth opportunities for safer chemistry




are therefore very positive. In an OECD study [1], 87% of industry chemists predicted that sustainable chemistry offerings will increase during the next 10 to 20 years; 42% predicted a significant increase (see image to the right).

In the 2014 ICIS survey on sustainable chemistry[2], producers said that "80% of their customers are showing the same or higher interest in sustainable chemicals than just one year ago". ICIS believed, "that denotes a sizable fraction that will aggressively move forward, and which is likely to use their purchasing power both to 'nudge' chemical producers to faster action and/or to look for the suppliers that can satisfy them".

*Views of Respondents on Change in Turnover for Green/ Sustainable Product Lines Over the Next 10-20 Years.[1]*



# The thermal paper market – History, growth, companies and the future

How can investors identify market opportunities and invest in promising substances, processes and materials? To identify the drivers for substitution we use the example of the chemical Bisphenol A (BPA) in thermal paper, as it provides an informative case story. But in order to fully grasp why this makes for a good example, we need to take a closer look at the thermal paper industry and get an understanding of how it works.

## HISTORY

Thermal paper based on chemical dyes was invented by NCR using printers with a thermal print head from Texas Instruments, introduced to the market in 1965.

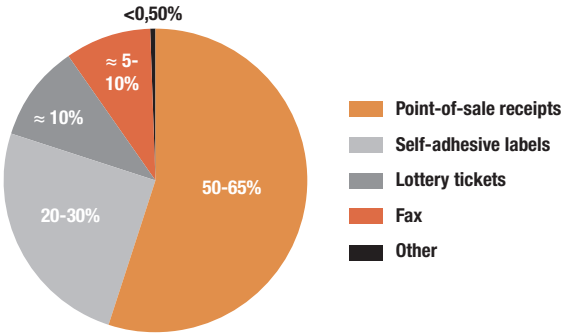
In 1980 the boom in fax paper led to a large-scale investment in thermal paper manufacturing capacity. This was followed by a significant overcapacity when the fax boom ended in the early 1990s. The result was fragmentation and poor profitability in the sector, forcing European producers to look beyond their borders to sell surplus production. Instead of consolidation, the industry embarked on a strategy of improving performance. The early problems of paper that faded and curled over time could be solved, and new coatings prevented the paper from turning black after exposure to heat, moisture or chemicals.

Technical improvements in thermal printers to reduce energy consumption and make them faster, quieter and more reliable have also helped to regain market shares. Not to forget the reductions in price. No ink or toner are needed, as in other printers, and therefore additional costs and maintenance are avoided.

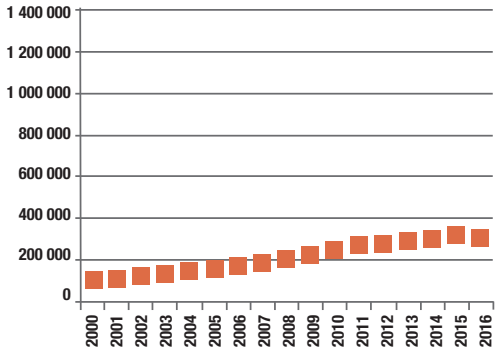
Thermal paper became attractive for a wide range of end products, including point-of-sales receipts, travel documents, medical and financial services, even game cards.

The result has been an overall growth in the market for thermal paper, and market swings like the drop in thermal fax paper have been more than compensated.


Flat White
COFFEE BAR
Yard 8
8/7/2014




*Thermal paper use in Europe 2005/2006 (source: EU Risk Assessment, 2008).*




*Thermal paper market in Europe in million tons.*

The market is still growing today, mainly because of the growth in global retail commerce, which includes for example labelling boxes for online-ordered goods – especially around Christmas. The increased use of bank cards instead of cash has also contributed to the growth. Cash receipts are getting longer and longer, and often include advertisements, legal obligations or coupons. Home Depot, for example, uses the bottom four inches of receipts to ask customers to take an online survey in return for a chance to win a $5,000 gift card. The retailer receives 500,000 responses each month.[3]

## GROWTH

The worldwide market for thermal paper in 2006 was estimated to be 845,000 tons, valued at $1.5 – 1.6 bn, rising to 1.3 million tons in 2012. Another source, Grandview Research, estimates the size of the global thermal paper market at 1.2 million tons in 2015[4].

The long-term growth rate for thermal paper has been 10% per annum. In developing countries, growth rates have been above average, such as China at 15%.

The Danish Environment Protection Agency states a growth figure of 60% between 2000 and 2006 in Europe, with a volume increase from 105,000 tons to 168,000 tons. The European Thermal Paper Association, ETPA, confirmed a growth rate of up to 10% per year over the past ten years and reported European thermal paper production at 300,000 tons in 2016.

## COMPANIES

The market for thermal paper manufacturing is oligopolistic; it is dominated by a handful of large, diversified businesses selling globally. They usually produce a wide range of paper products in addition to thermal paper. Paper manufacturers rarely sell to end consumers, but supply "convertors" with jumbo paper roles for them to cut into commonly used smaller sizes for various applications. Our list contains only paper manufacturers, no convertors.

Two multinationals stand out from these paper producers:

NCR, the initial inventor of thermal paper, is primarily an electronics company, selling hardware and software, but still sells thermal paper, e.g. labels and tags. Ricoh is known for its cameras and office equipment, and also has a division for thermal paper.

| COMPANY | COUNTRY | SALES | PRODUCTION/ YEAR (TONS) | STAFF | OWNER |
|---|---|---|---|---|---|
| **Koehler Paper** | DE | €712 m | 500,000 | 1,800 | Privately owned |
| **Mitsubishi HITec Paper**<br>**www.mitsubishi-paper.com/papers/** | DE | €277 m | 185,000 | 710 | Mitsubishi Paper Holding GmbH: 81.6%, Mitsubishi Corporation: 18.4% |
| **Mitsubishi Paper Mills**<br>**www.mpm.co.jp** | JP | $1,919 m | | 3,697 | ISIN: JP3901200000 |
| **Jujo Thermal (Nippon Paper Industries)**<br>**www.jujothermal.com** | FI | €100 m | | 200 | Nippon Paper Group<br>ISIN: JP3721600009 |
| **Appvion**<br>**www.appvion.com** | US | $690 m | | 1,400 | 100% employee-owned |
| **Kanzan**<br>**www.kanzan.de/en/** | DE | €100 m | 60,000 | 315 | 95% owned by OJI Holdings<br>ISIN: JP3174410005 |
| **Ricoh (Thermal paper division)**<br>**ricoh-thermal.com/en/** | JP | ¥2,209 bn | | 109,361 | ISIN: JP3973400009 |
| **Nashua**<br>**www.nashua.com** | US | | | | Conveo Inc<br>ISIN: US15670S4021 |
| **NCR**<br>**www.ncr.com** | US | $6,370 m | | 30,200 | ISIN: US62886E1082 |
| **Hansol Paper**<br>**www.hansolpaper.co.kr** | SCA | KRW1,349 bn | | 1,000 | ISIN: KR7004150009 |
| **Torraspapel**<br>**www.lecta.com/en/torraspapel** | ES | | | | Part of Lecta, a private company controlled by CVC Capital Partners |
| **Sihl**<br>**www.sihl.com**<br>**Only coating of paper, no paper production** | DE | €140 m | | 500 | Privately owned |
| **Siam Paper Public**<br>**www.siampaper.co.th** | TH | | 141,600 | | |
| **Gold HuaSheng Paper**<br>**www.goldhs.com.cn** | CN | | | 3,000 | Asia Pulp and Paper |
| **Henan JiangHE Paper**<br>**www.jianghe-paper.com** | CN | | 493,000 | | Privately owned |
| **Thermal Solutions International**<br>**www.thermalsolutionsinternational.com** | US | | | | |

### PRICES FOR THERMAL PAPER:

Prices are often not publicly available or vary considerably depending on demand, current production capacity, available stocks, the client relationship and other factors.

An educated guess, based on several interviews, is that the price for jumbo rolls containing BPA is between 6 and 7 euro cents/$m^2$ and the alternatives covered in this report cost about double.

## PROFITABILITY

As the thermal paper market is fiercely competitive and has tight margins, profitability depends on the cost of raw materials and a high degree of automation to achieve economies of scale in production. Clients such as large retailers are also very price-sensitive concerning paper, which is seen as a necessity, but not a high-profile consumer product.

## THE PAPERLESS DIGITAL FUTURE?

Like the decreases in sales in the past due to the phase-out of fax machines, other technical innovations are on the way that will impact the market significantly. Your smart phone will be the future file for your receipts – through mobile payment, paperless transactions, e-invoices, apps or receipts sent to you by email or other services. It therefore seems likely that thermal paper for point-of-sale (POS) applications is on the decline. As reported by the Danish Environmental Protection Agency in 2013, mobile banking and payment is a fast-growing area, and the number of users globally is expected to double to one billion by the end of 2015 from almost 500 million at the end of 2012. These numbers correspond to an estimated global mobile payment volume reaching one trillion USD by the end of 2015, from 200 billion USD in 2012.

In the transport sector, smart cards can be topped up and used for payments (Oyster Card in London, OV-chipkaart in Netherlands, etc.) or tickets can be bought via apps. Ticket-less times are ahead of us.

But regardless of this envisaged paperless digital future, a market increase is expected as the future creates new demand. As more and more goods are ordered online and subsequently delivered, there has been an increase in labelling production in recent years, with high peaks around Christmas. The increased use of handheld computers to issue receipts in restaurants or by your postman or craftsman have also spiked demand for thermal paper.

Recent technical developments have meant that thermal paper can now be bought with a guaranteed ‘non-fade’ lifetime of up to 25 years. This durability has increased the range of uses for thermal paper to include guarantees, proof of purchase, legal documents, expense reports, tax records and medical records. Many types of tickets, especially travel tickets for public commuter traffic, are prone to counterfeiting. The thermal paper manufacturers have responded with products that contain a range of security options, including watermarks in the paper, colour inlays, UV-fluorescent fibres and UV-fluorescent security features under the topcoat. So as these innovations show, there is potential for growth and adaptability in the industry.

# Bisphenol A – What is it and why is it used in thermal paper?

The chemical BPA has gained notoriety in recent decades because it is harmful for reproduction and an endocrine disruptor. Endocrine disruption means that it interferes with hormonal communication between cells, and since hormones play a vital role in many processes, including organ development, mood and reproduction, endocrine-disrupting chemicals can have profound effects on our health. Examples of health effects associated with BPA are obesity, heart disease, breast and prostate cancer, diabetes, fertility problems, birth defects, and effects on brain development and behaviour.[5] The effects on reproduction and the increased cancer risks led to a ban on BPA in baby bottles (Canada 2008; EU 2011; China 2011; Turkey 2011; US 2012). The resulting press coverage brought the chemical to the attention of the mainstream media.

**Bisphenol A is used in:**

- Polycarbonate plastic
  - Bottles
  - Sports equipment
  - Medical and dental devices
  - CDs and DVDs
  - Household electronics
  - Spectacle lenses
- Epoxy resins for
  - Coatings for cans (food, beverages)
  - Lining of water pipes
- Thermal paper as a colour developer

BPA breaks down quickly, but the sheer volume of the chemical and its widespread use in all sorts of everyday products lead to the exposure of almost every one of us. BPA can be found in humans all over the world as well as in our environment.

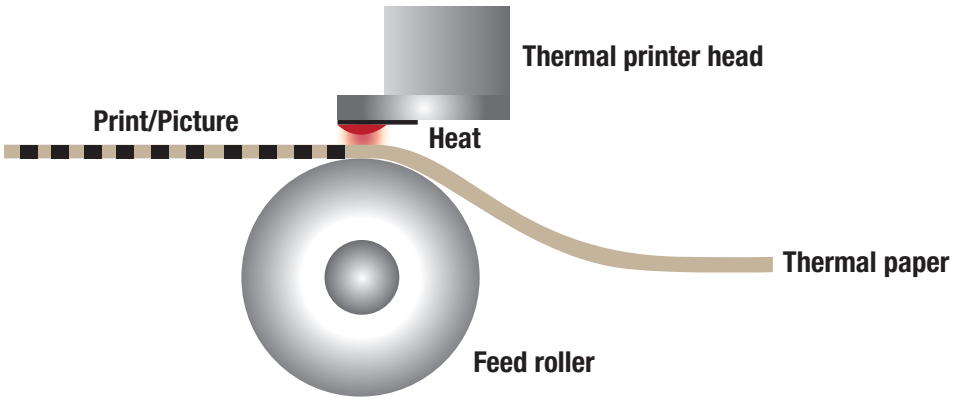
Humans are exposed to BPA through different routes. One is through BPA-contaminated food or drinks, which allow BPA to be absorbed through the digestive system. BPA can also enter the body through the skin, which is the case with thermal paper. As BPA is not chemically bound in the paper, it easily rubs off. Exposure through skin from thermal paper is a significant source of exposure. From the skin, BPA then migrates into the blood stream.[6]

## WHY IS BPA USED IN THERMAL PAPER AND HOW COMMON IS IT?

Thermal paper gets its name because it is used in printing devices with a heated print head, which allows the words and images to appear. To make the characters appear, the paper has a reactive coating made with binders, dyes and developers, such as BPA. The chemical plays a major role in thermal paper production. BPA is effective, available and affordable (Mendum, Stoler et al. 2011) and therefore widely used as a developer in thermal paper.

*”Receipts are the single largest source of exposure to BPA for humans”*

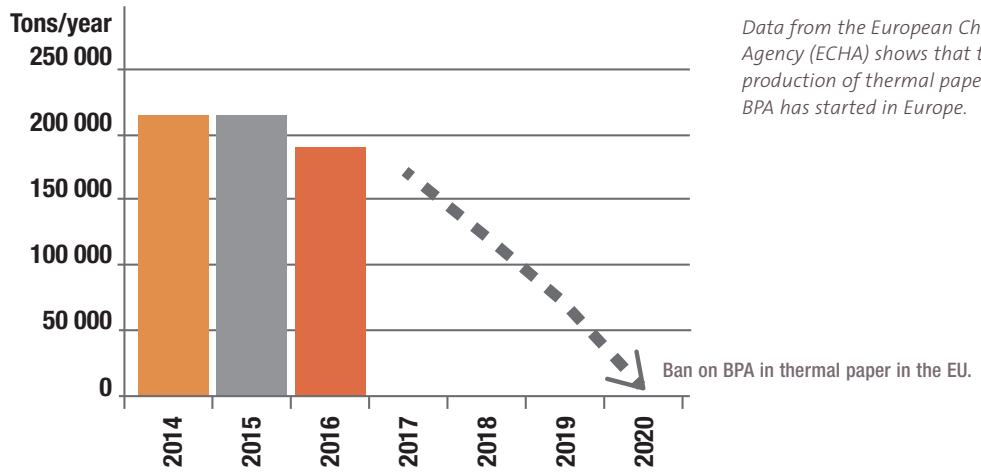
Receipts are the single largest source of exposure to BPA for humans, which means that even if thermal paper production is only responsible for a small part of the total usage of BPA, it is still a large part of the problem.



# Drivers of substitution

To catch investment opportunities that arise in the chemical and materials sector it is necessary to understand the mindset of the supply chain, as well as the mindsets of authorities and end-consumers. Innovation of safer alternatives is driven by certain factors, and in the case of BPA in thermal paper many of them have appeared in a short period of time:

- **SCIENTIFIC KNOWLEDGE:** BPA has long been known for its hazardous properties.
- **MEDIA ATTENTION:** Its prevalence in very "sensitive" products, such as baby bottles, has created lot of critical media attention for BPA.
- **CHANGE IN DEMAND:** BPA is used in the vulnerable retail sector where companies want to avoid any kind of scandal. Many global retailers have either started to look for alternatives or implemented them already.
- **CHANGE IN SUPPLY OFFER:** Resilient, flexible and innovative companies are willing to try to develop safer alternatives and gain market opportunities.
- **REGULATORY ACTION AROUND THE GLOBE:** Regulations like the EU's chemical legislation REACH have a process for identifying and regulating substances of concern. Many countries and regions have followed suit.




*Data from the European Chemicals Agency (ECHA) shows that the decline of production of thermal paper containing BPA has started in Europe.*

## 1. SCIENTIFIC KNOWLEDGE

In 2010, a trio of scientific studies[7] were the starting point for an exemplary substitution story in the years to come.

- Biedermann, et al. evaluated the daily intake of cashiers, who touch cash receipts repeatedly.
- Vom Saal, et al.[8] used monkeys and mice to conclude that the total daily human exposure to BPA is via multiple routes and is much higher than previously assumed.
- The Environmental Working Group[9] tested receipt paper from US-based retail stores and gave the opinion that "a significant portion of the public may also be exposed to BPA by handling receipts". "The Missouri scientists found that the total mass of BPA on a receipt is 250 to 1,000 times greater than the amount of BPA typically found in a can of food or a can of baby formula, or that which leaches from a BPA-based plastic baby bottle into its contents."

## 2. MEDIA ATTENTION

Media attention brought the scientific findings into the mainstream and suddenly retailers and transport companies found their names associated with negative health effects. The health effects of BPA were not only covered in specialized science journals, but also in more accessible popular science media as well as in regular newspapers and blogs. Nowadays most major media outlets have published a number of articles detailing the health concerns of BPA.

## 3. CHANGE IN DEMAND

Companies in close contact with end consumers are especially vulnerable to scandals. Negative media attention can ruin their reputation and lead to decreasing sales. The quote from Warren Buffet is very valid for this sector: "It takes 20 years to build a reputation and five minutes to ruin it."

Even those who do have a progressive chemical management policy were caught by surprise; the cash receipt paper slipped through their control as it wasn't seen as "a product".

Consequently, when scientific and media reports came to light, some retailers wanted to switch to a safer alternative immediately.

## 4. CHANGE IN SUPPLY OFFER

In October 2010, however, paper suppliers and their association, ETPA, defended the use of BPA: "Bisphenol A is used for a range of applications and ranks as one of the best investigated substances in the world. No studies have ever achieved reproducible results indicating negative impact." This strategy of defending products for as long as possible and ignoring new scientific findings is common practice and was probably intended to calm down customers until alternatives could be developed and offered.

Soon a few companies started to offer phenol-free thermal paper, while others started to market BPA-free or phenol-fee alternatives: Koehler Paper[10], Mitsubishi Paper[11], Appvion[12], Ricoh[13]. Even to end-consumers the change was sometimes obvious, when you were able read at the end of your bill the statement "BPA-free".

## 5. REGULATORY ACTION AROUND THE GLOBE

Legislators began paying attention to this specific use of BPA, which was not well known before. For several years now BPA has been under scrutiny; hundreds of studies giving arguments and counterarguments have been written. It is worth noting that the conclusions often depended on the source of funding. For example, in 2005, Frederick vom Saal[14] from the University of Missouri in Columbia analysed 115 studies and showed that industry-funded studies did not find significant effects of low doses of BPA, while over 90% of public-funded studies reported significant effects.

As stated before, the first phase-out of BPA in thermal paper took place in Japan around the start of the millennium – even before it became a legal requirement. In Taiwan, BPA was banned in thermal papers in 2011. In the USA, some states have voted on bills banning BPA in thermal receipts. Enacted in July 2011, Connecticut Senate Bill 210 prohibits the manufacture, sale or distribution of thermal receipt paper or cash register receipt paper containing BPA. Other states are considering the adoption of the same position.

In the EU, three countries have taken national action against the use of BPA in thermal paper: Belgium, Sweden and France.

France has initiated several European efforts to regulate BPA for all kinds of uses, which have changed the classification of the substance from "reprotoxic suspect" to the more severe "toxic for reproduction", which entered into force in August 2016.

Additionally, France used the European chemical regulation REACH to put forward a restriction proposal for the use of BPA in thermal paper[15]. The proposal has passed through all legislative bodies and in December 2016 it was decided that BPA may not be placed on the European market in thermal paper at a concentration equal to or greater than 0.02% by weight after 2 January 2020.

This applies to all producers and importers, which means that there is a ban on BPA in thermal paper for the European market from 2020 and onwards.

All regulatory activities have concentrated solely on BPA, while all other phenols or other reactive substances used as developers are still legal for use.

Besides legal decisions, there are some more "voluntary" offers available for the industry:

Through its National Competence Centre for Industrial Safety and Environmental Protection (INERIS), France has developed a BPA-free label that has been adopted by a wide range of manufacturers in the EU, for example the German manufacturers Koehler and Mitsubishi, as well as Finnish Jujo Thermal, to show the absence of phenols and bisphenols from their production processes. Large retail groups such as Carrefour, Lidl and Systeme U have also adopted the label.

The related thermal papers are point-of-sales receipts, ATM receipts, parking receipts, self-adhesive labels, boarding passes, queueing tickets etc.

This label should not merely be viewed as consumer information, but rather as a reflection of the commitment by these companies to ban BPA and other bisphenols and phenols that are suspected of being potential endocrine disruptors.

# Alternatives to Bisphenol A

In 2014, the US EPA thoroughly assessed the existing 19 alternatives to BPA in thermal paper using a multi-stakeholder forum that included supply chain companies, technical and green chemistry experts, NGOs as well as international governmental organisations.[16]

The EPA stated in its summary that at this stage there were no obvious safer alternatives to BPA – most alternatives were considered not good enough, since they showed moderate or high toxicity for human health and/or aquatic life. Successful substitution with these alternatives is therefore questionable and can result in the need for additional substitution in the future.

## RECENT INNOVATIONS:

There are a number of companies currently working on different alternatives to BPA. While some of the companies are not stock-listed, they still serve as good examples of how the drivers of substitution can spark innovation, and as indications that the market offering is changing. Below are two examples of alternative providers. We are sure that there will be more to come in the future.

**APPVION** creates a product made without phenols or other controversial chemicals as developers. Instead it's made with vitamin C, which can be seen by the slight yellowish colour of the paper. The reason behind Appvion's innovation is that due to their high toxicity for aquatic life, BPA alternatives would not have been allowed in Wisconsin, which is the US state where they are based.

Appvion's paper is still a niche product that is mainly used by organic food retailers in the US. The main hurdle is the price difference. A conventional jumbo roll of thermal paper costs around €0.06 per square metre before it is sent to converters and cut into smaller rolls. Appvion's paper costs around double that price. Appvion, however, promises several advantages compared with other products: longer print-life and improved resistance to heat, humidity and water.

**KOEHLER PAPER** operates through agents such as Ökobon in German-speaking markets. Koehler's alternative is interesting because it is created using a completely different technique compared to traditional thermal paper. No reactive substance is needed, as the paper itself contains small bubbles of ink that burst and are set free when exposed to the heat of the print head, creating text and figures. In plain speak this is a physical reaction, not a chemical reaction.

As in the case of Appvion, Koehler's alternative is more expensive than traditional thermal paper, slightly more than double the price of conventional BPA thermal paper. Keep in mind, however, that prices are not always as comparable as other criteria. The thickness of the paper plays a role, for example. In addition, Koehler's product has been verified by third-party testing and it complies with the strict rules for food contact material. The paper is currently used by approximately 200 companies in German-speaking countries, mainly in the organic retail sector.

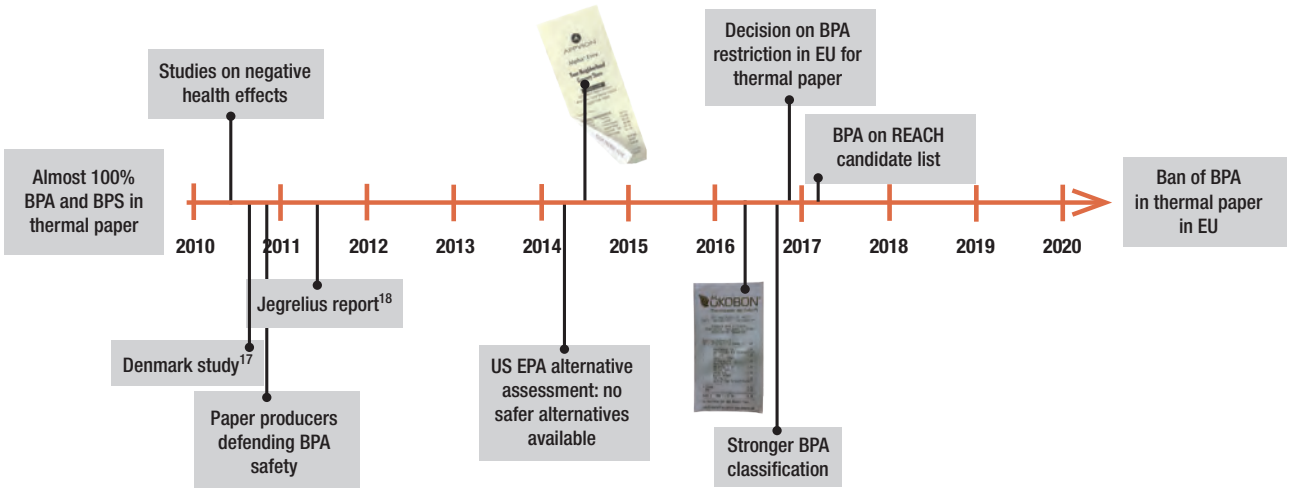
# Analysis

To the trained eye there are numerous drivers that a chemical of concern will most likely be replaced by something else, and thus create a shift in the market. New scientific findings, media attention, public campaigning, new innovations and, the strongest of them all – stricter legislation – are all examples of such drivers. For investors, these drivers are strong hints of an emerging investment opportunity, and especially so if they appear at the same time.

There will be a ban on Bisphenol A in thermal paper on the European market from 2020 and onwards. And as this report has already elaborated on, many multinational corporations apply the strictest regional rules to their products worldwide. Large retailers such as Carrefour, Lidl and Systeme U have already adopted the thermal paper industry's response to the ban – a label that clearly shows if a product is free from BPA. H&M, number 47 in the ranking of global retailers, is currently looking for new thermal paper solutions (see marketplace.chemsec.org). When such giants are set on change, it creates a great demand for safer alternatives.

This example shows the demand for safer alternatives and the opportunities that the transition from hazardous chemicals creates for healthy and environmentally friendly products. Investing in innovative businesses that are solving problems is essential. Allergies, cancer, infertility – just to name a few health issues connected to hazardous chemicals – are widespread. By choosing safer chemicals it is possible to greatly reduce these diseases and make a promising investment at the same time.

## Timeline 2010-2020 – BPA in thermal paper



# Future substitution opportunities

BPA in thermal paper is just one example where different drivers create an investment opportunity by pushing producers towards substitution and the innovation of new materials. There are several more on the horizon, such as:

- **BPA IN FOOD-CONTACT MATERIALS** – banning baby bottles was the first legislative move; more regulation is on the way concerning so-called food-contact materials such as cans and other storage items.
- **PERFLUORINATED SUBSTANCES** – this chemical group makes your clothes water- and stain-repellent. As a result of the Greenpeace detox campaign, bigger brands such as adidas[19] and H&M[20] are moving away and looking for safer alternatives. Some of the worst examples from this group of chemicals are already banned or restricted, such as PFOA and PFOS, and discussion about further regulation is emerging.
- **PRESERVATIVES IN PERSONAL CARE AND HOUSEHOLD PRODUCTS** – the Green Chemical and Commerce Council, together with major multinationals such as Unilever, Beiersdorf and SC Johnson, has just started a competition for safer preservatives[21]. Due to regulatory action, consumer demand and NGO pressure, they are seeking new, effective and safe preservatives.
- **RECYCLABLE PLASTICS** – to avoid plastic pollution in the ocean and increase recycling rates for plastic, brands such as IKEA[22] and Unilever[23] are moving away from certain plastic types towards recyclable plastics.

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