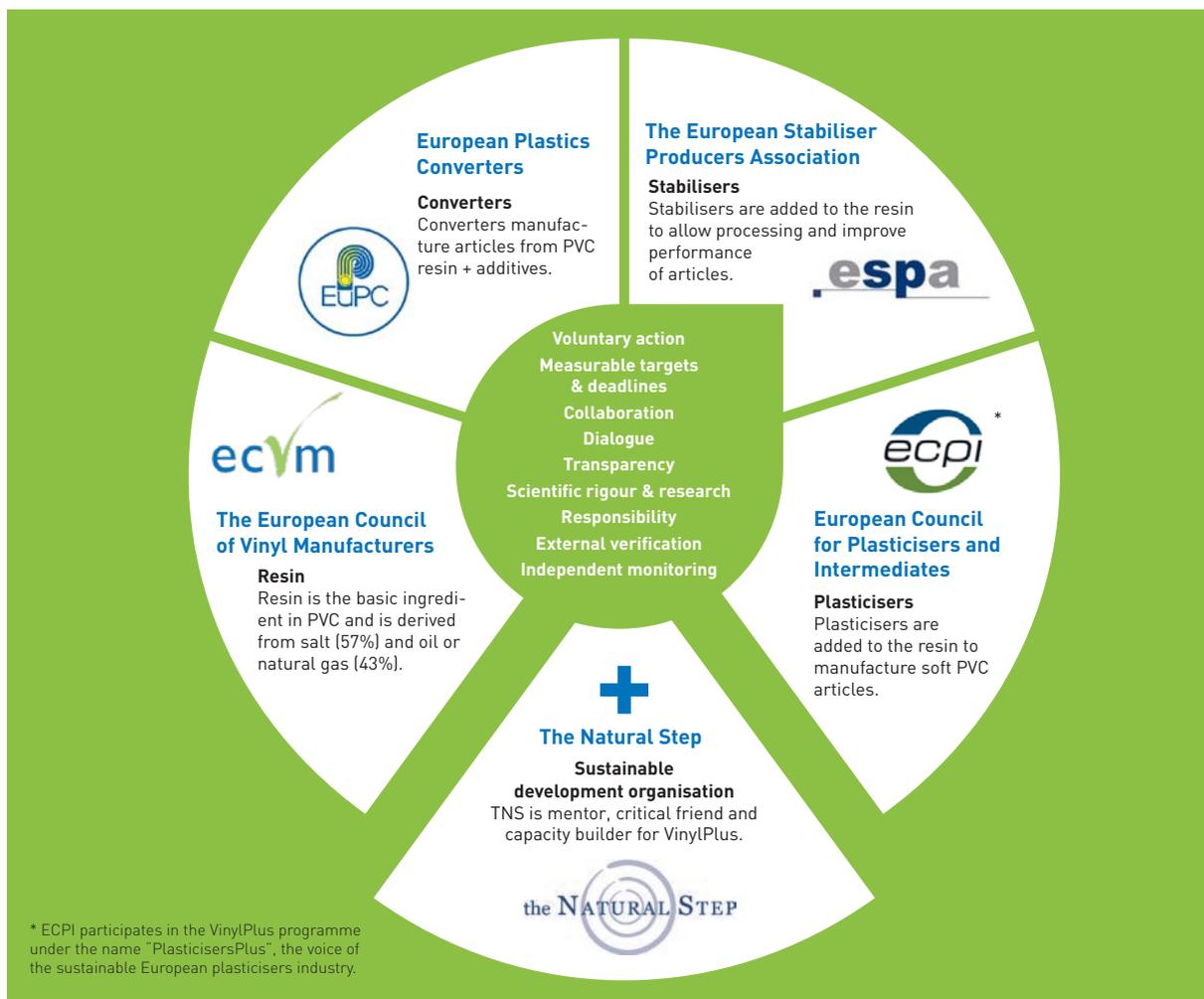




## On the Road to Sustainability: The Ongoing Progress of VinylPlus

*How the European PVC value chain managed to take the journey from being severely criticised to become a role model for how industry can achieve sustainable change.*

By Tobias Johnsen



*VinylPlus is the renewed 10-year sustainability programme for the European PVC industry value chain – from resin manufacturers in one end to converters in the other. The programme was developed in close concert with the sustainable development organisation The Natural Step and has dialogue, transparency and responsibility as some of its working principles.*

PVC, also known as vinyl, is a plastic material found in an ever-expanding array of applications—from construction materials like windows and piping to medical devices such as blood bags and tubing. In this article we will tell the story of how the European PVC industry, through large investments and partnerships, transformed the material from being vilified to play an important role in the battle against climate change and establishing a circular economy. Because most PVC products are durable, fully recyclable, light-weight and have a low carbon footprint, PVC has been recognised as a material for the future. This remarkable journey of the material has only been possible because of the European PVC industry’s voluntary commitments Vinyl 2010 and VinylPlus, whose history will be unfolded in the following pages.

## Vinyl 2010: A New Beginning

Our story begins in March 2000, where a new dawn broke. The whole European PVC industry value chain—resin manufacturers, converters and additive producers as represented by their associations ECVM, ECPI (PlasticisersPlus), ESPA and EuPC—launched the voluntary commitment Vinyl 2010. Rare of its kind, the 10-year programme marked a leap in the PVC industry’s journey towards sustainability. Perhaps to the surprise of sceptics, and despite a financial crisis and a much-enlarged target area due to the addition of EU member states, all goals were met and in some instances even exceeded. A key achievement was the yearly recycling of over 250,000 tons of PVC waste in 2010, a major feat considering that no infrastructure existed

*The outside world has taken notice of VinylPlus. The Voluntary Commitment has been included in the Rio+20 Registry of Commitments and the recycling target of 800,000 tons/year of PVC highlighted in the UN Summary of Voluntary Commitments registered at Rio+20 Earth Summit in 2012.*



in 1999 and that the material was regarded “un-recyclable” by many. In total, over 1 million tons were recycled during the decade. Other aspects also deserve attention. Already well underway before 2000, the emissions of vinyl chloride monomer and dioxins during manufacturing decreased dramatically under Vinyl 2010—so much that experts and stakeholders no longer regard these emissions as a cause of concern.<sup>1</sup> The year 2001, in fact, marked the endpoint of cadmium-based stabilisers, which the industry had been phasing out since the 1990s. Lead-based stabilisers proved more problematic (and costly) to replace but nevertheless pursued vigilantly with more than 70% decrease.

### **VinylPlus: Taking the Next Steps Toward Sustainability**

Thus, Vinyl 2010 proved highly successful and according to the sustainable development organisation The Natural Step, “a rare example of an industry managing to turn itself around through voluntary action.”<sup>2</sup> But the programme in fact only represented a prelude to what the industry was planning: a commitment to make PVC truly sustainable. This bold and ambitious vision, in essence a paradigm shift, entails looking at the material holistically. Not just how it is manufactured and disposed of, but also how PVC can con-

tribute to a sustainable society where economic growth and human well-being go hand in hand with reduced natural resource consumption. In this new way of thinking, PVC has clear advantages over other materials as it mainly derives from common salt. PVC has a relatively small carbon footprint: the CO<sub>2</sub> impact equivalents are 1.9 kg for 1 kg of PVC versus about 10 kg for 1 kg of aluminum. Moreover, PVC products are light-weight and long-lasting with up to 50-year lifespan, and fully recyclable. These views are underpinned by numerous life-cycle assessments and eco-efficiency studies.

Building on the achievements of Vinyl 2010, the partners—representing 21,000 companies, 500,000 jobs, €80 billion yearly turnover and 6 million tons of PVC resin produced per year—decided to launch a new 10-year voluntary commitment, VinylPlus, undersigned in June 2011. The process hereto was elaborate. First, a fundamental assessment of the sustainability aspects of PVC was conducted. Already at this point it became logical to involve aforementioned The Natural Step since the organisation also has a clear vision of a sustainable society and a history of working with PVC-related issues. As a critical friend of the industry, The Natural Step became involved in laying out the basic principles. Crucial elements were carried over from Vinyl 2010: clear, verifiable targets and deadlines, allowing for transparent monitoring, as well as close cooperation of the entire value chain, from resin producers in one end to recyclers in the other. Furthermore, dead-

<sup>1</sup> Johnsen 2015a

<sup>2</sup> VinylPlus, [http://www.pvc.org/en/news/view/35/european-pvc-industry-launches-ambitious-new-ten-year-sustainability-commitment-and-calls-for-more-support-for-recycling-in-europe-](http://www.pvc.org/en/news/view/35/european-pvc-industry-launches-ambitious-new-ten-year-sustainability-commitment-and-calls-for-more-support-for-recycling-in-europe)



*Recycling of PVC benefits environment and economy. The material can be recycled up to 7 times without loss of performance. In 2014, VinylPlus registered 481,018 tons of recycled PVC waste. The target is 800,000 tons per year by 2020.*

line for all targets would be 2020 and recycling to remain the preferred waste management option. Just as importantly, the programme would be part of a long-term global sustainability drive. The friendship between industry and The Natural Step did not end here, though. To achieve the bold vision of making the production, use and recycling of PVC truly sustainable, the programme builds on The Natural Step's well-recognized science-based framework System Conditions for a Sustainable Society. For PVC, five challenges were identified that form the core of VinylPlus:

*Challenge One: Controlled-Loop Management*

The first and foremost challenge regards recycling in a responsible and traceable way, with an ambitious target of recycling 800,000 tons of PVC waste per year by 2020. This includes developing new recycling technologies to treat 100,000 tons of difficult waste per year and

stimulating converters to use more recycle in their products. Not only should the amount increase, the quality of the recycle should also improve. To track the progress, yearly externally verified audit reports on the recycled amounts are published.

The insistence on recycling is based on sound reasoning. First of all, PVC is a well-suited material for recycling, as it can be recycled up to 7 times without loss of performance. Since more than 60% of all PVC is used in building applications, it comes in large, easy-to-collect quantities. Practical reasons aside, recycling of course also benefits economy and environment by conserving valuable resources, raw materials and additives. The overall object is to divert as much possible PVC waste from landfills, which is the least preferred waste management option. Some share of the PVC waste is unrecyclable for economic, practical and environmental

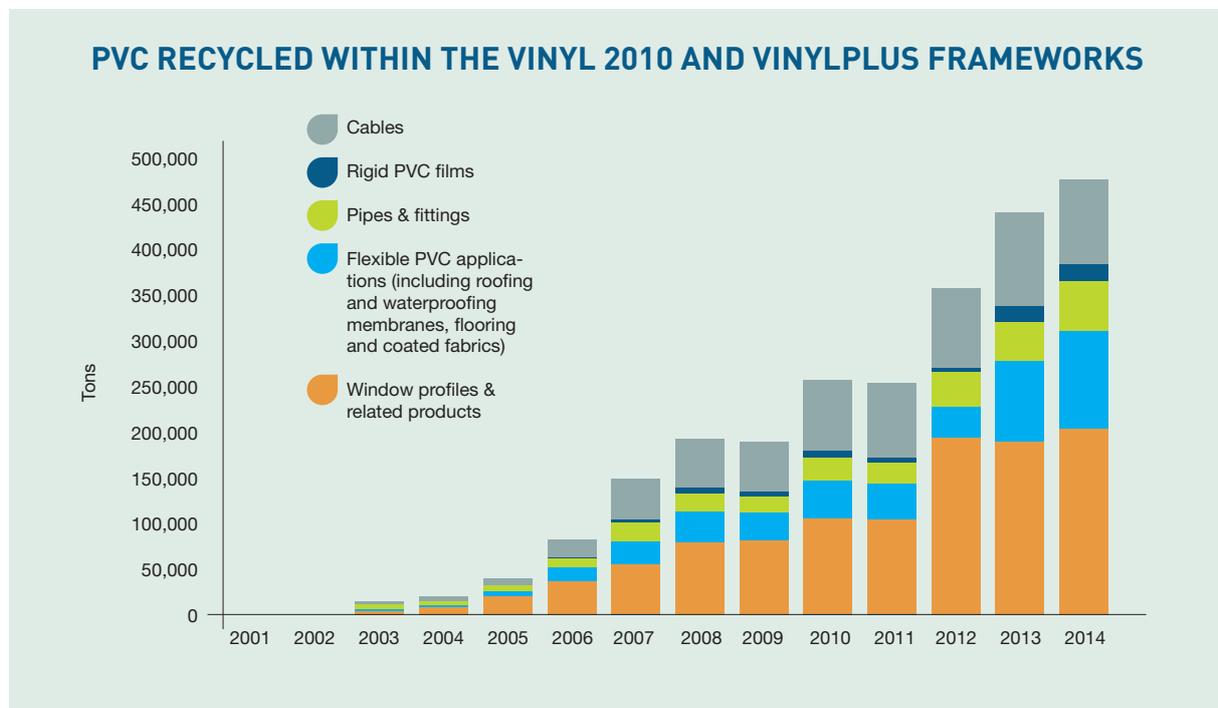
PVC, or vinyl, is the most used plastic material in building and construction. Window frames, flooring, cables, pipes, roofing membranes and wall coverings are just some of the many applications made of PVC. Because most PVC products are long-lasting, fully recyclable, light-weight and have a low carbon footprint, PVC has been recognised as a material for the future.



reasons, and here incineration with energy recovery is favoured. This prioritisation reflects the EU waste hierarchy and also the general agreement that while modern well-managed landfills do not pose ecological problems, PVC is too valuable a resource to landfill. Conversely, PVC helps to generate electricity when combusted in municipal waste incinerators. Two central issues confronting incineration of PVC waste—emissions of dioxins and HCl<sup>3</sup>—must of course be mentioned. Yet strict regulation and state-of-the-art technologies ensure that these emissions are kept below the limits set by EU and national legislators.

*Challenge Two: Organo-Chlorine Emissions*  
VinylPlus commits to addressing concerns relating to the undesired release of persistent chlorinated organic compounds from the whole life cycle of PVC to avoid any systematic increase of any concentrations in nature. Specific targets include engaging with external stakeholders on emissions, 100% compliance with the 1995 charter, risk assessment for the transportation of major raw materials, in particular vinyl chloride monomer, and zero-accident rate with vinyl chloride monomer release during transportation.

<sup>3</sup> Johnsen 2015a & 2015b



With Vinyl 2010 and now VinylPlus, recycling of PVC has increased dramatically since the 1990s. In 2014 alone, almost 500,000 tons were recycled. VinylPlus is then well on the way to meet the ambitious target of recycling 800,000 tons of vinyl per year by 2020.

Source: VinylPlus Progress Report 2015.



Christophe Yvetot from the UN Industrial Development Organization spoke at the 2015 Vinyl Sustainability Forum in Cannes, France: "As a member of the Green Industry Platform, the vinyl industry can actively contribute to the global sustainability agenda through its continuous efforts to reduce its environmental and climate footprint and to develop new green products, services and jobs that will support a more sustainable world."

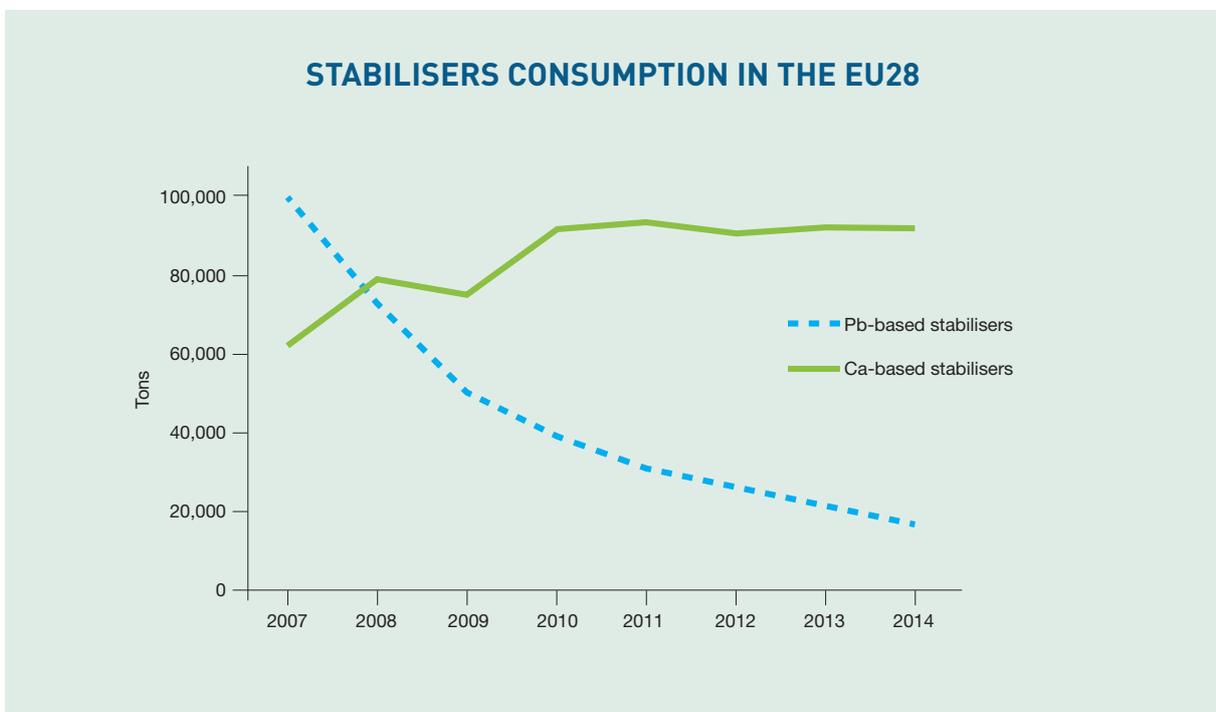
Source: Green Industry Platform News Bulletin, May 2015, <http://eepurl.com/boUORX>.

### Challenge Three: Sustainable Use of Additives

An essential component of PVC products, additives should also be used in sustainable way in order to prevent systematic accumulation of man-made substances in the environment. Already well underway during Vinyl 2010, lead-based stabilisers' substitution should be completed in the EU28 by end-2015. The substitution of hazard classified low-molecule weight phthalates by high-molecule weight phthalates and other plasticisers is continuing apace.

### Challenge Four: Sustainable Energy & Climate Stability

The fourth challenge entails minimising climate impacts through the reduction of energy and raw material consumption, potentially switching to renewable energy and raw material sources. A concrete target is a 20% reduction in energy consumption for PVC resin producers by 2020. Additional actions are assessing how PVC can contribute to a low-carbon society and promoting best practice energy use.



Lead-based stabilisers are steadily being replaced by calcium-based stabilisers, and their substitution should be completed by the end of 2015. Cadmium has been phased out since 2001.

Source: VinylPlus Progress Report 2015.

*"Your cradle-to-cradle approach is exactly what is needed." Ambassador Tomas Anker Christensen, Senior Advisor for Partnerships at the UN, speaking at the 2013 Vinyl Sustainability Forum in Istanbul, Turkey. The annual event brings together stakeholders from academia, government bodies, the UN, the European Commission, retailers and all sectors of the PVC industry. With the theme "More Vinyl, Less Carbon," the 2015 Forum in Cannes, France showed how the industry is helping combat climate change.*

### Challenge Five: Sustainability Awareness

Last not but least, VinylPlus commits to building sustainability awareness across the value chain, including stakeholders inside and outside the industry. A non-technical yet fundamental challenge, the key here is to continuously engage in dialogue about the progress toward sustainability on the basis of transparency, openness and scientific rigour. This exposes the programme to external scrutiny and potential criticism but is considered essential nevertheless. Targets include a public, independently audited progress report to be published annually, yearly external stakeholder meetings, a VinylPlus product label, and promoting VinylPlus' sustainability principles to the audiences outside EU28. An independent monitoring committee with a majority of non-industry members—counting representatives of the European Parliament and Commission, trade unions, and consumer organisations—oversees the progress.

### 2015: More Than Halfway There

Midway through the 10-year programme, the year 2015 provides an opportunity to assess how far VinylPlus has come. In short, progress is being made on all challenges, and some targets have already been met. Most striking is the rate of recycling, with 481,018 tons PVC waste recycled in 2014 alone. Indeed, recycling is a top priority. In 2014, 75% of the total €5.75 million expenditure went to waste management and



technical projects. Clearly, the issue of legacy additives represents an obstacle in this regard. The long life of most PVC products means that additives present in current waste were those used several years or even decades ago. Some of these substances, and lead in particular, may now be classified as hazardous and restricted by legislation. VinylPlus is working closely with the competent authorities to address this issue, so that recycling can continue to grow and contribute more and more to the circular economy whilst ensuring that impacts on human health and the environment are adequately controlled.

Progress is also significant in regard to additives. Between 2007 and 2014, the use of lead-based stabilisers decreased by 86% in the EU28, and the market share of non-classified phthalates and other plasticisers is growing rapidly. Too, between 2007-2008 and 2012-2013 ECVM member companies' energy consumption decreased by 10.2%, in line with the target of a 20% reduction by 2020. Equally important is the continuing involvement of external stakeholders. Highlights are numerous. VinylPlus participated in the Rio+20 UN Conference on Sustainable Development in 2012 and became a



*Auto parts made of light-weight plasticised and rigid PVC improve fuel economy, and with the right choice of stabiliser the already long-lasting applications last even longer.*

member of the Green Industry Platform, a joint UNIDO and UNEP initiative, in 2013. External stakeholders have been invited to roundtable meetings—two in Vienna and one in Copenhagen—to discuss PVC and dioxins, additives and sustainability. Likewise, annual Vinyl Sustainability Forums bring together industry and policymakers, consumer groups, NGOs and beyond.

Clearly, the outside world is impressed with the voluntary commitment that enables economic growth and job creation with taking care of the planet's future. According to Gwenole Cozigou from the European Union's DG Growth, VinylPlus can be considered as a flagship for the circular economy, and speaking at the 2015 Vinyl Sustainability Forum in Cannes, Christophe Yvetot from the United Nations Industrial Development Organization emphasised the importance of coupling industrialisation and sustainability. In the final analysis, it is safe to say that the European PVC industry is on the path to sustainability. For decades, though, PVC was considered less beneficial to say the least.

## The Early Years of PVC

The commercial story of PVC, or polyvinyl chloride, originated in the 1890s as chemists looked for ways to make use of acetylene and chlorine; two substances that faced overproduction. Fast forward to 1913 when German chemist Fritz Klatte patented a manufacturing process for PVC. But since the material proved too brittle and difficult to produce, further refinements were paramount. These obstacles were to some extent overcome by the 1930s when the first PVC entered the market. Yet the first PVC-based products proved inferior with the buying public. According to an editorial in the trade journal *Modern Plastics*, "they smell, they sweat, the print comes off and they get brittle."<sup>4</sup> During the next decades, as the chemical industry blossomed, so did PVC. Especially the 1950s saw PVC mature as an industry with material quality increasing, production soaring and prices falling throughout the Western world. Indeed, PVC had become a staple of the modern consumer society with endless applications ranging from credit cards over auto parts to building mate-

<sup>4</sup> Meikle 1995, p. 166

rials and medical devices. Yet the commercial success has been accompanied by controversy.

## Sources of Controversy

### *Vinyl Chloride Monomer*

The earliest issue regard vinyl chloride monomer (VCM), the gas from which PVC is made. In the 1970s VCM was discovered to be cancerogenic by a doctor working for the Belgian chemical company Solvay. Subsequently industry took actions to reduce exposure, and today VCM does not pose a problem.

### *Dioxins*

An issue that the industry also has resolved, dioxins encompass a group of bio-accumulating chlorinated organic substances with similar chemical structures, known to cause cancers, skin disorders and damage the immune system. Though dioxins have been known since the late 1800s, it was when a chemical factory outside Seveso, Italy exploded in 1976 that the issue took forefront. Scientists found that dioxins are formed in industrial processes that contain chlorine, or when chloride matter is burned. Due to PVC's high chlorine content—the flipside of its fuel-thriftiness—Greenpeace famously dubbed PVC manufacturing plants “dioxin factories” in 1993.<sup>5</sup> Today, this is not the case as PVC production contributes to 0.1% of total dioxin emissions.

<sup>5</sup> Greenpeace 1993

*The cartoon of Dr. Fritz Klatte was drawn in 2013 by one of Denmark's leading newspaper cartoonists, Anne-Marie Steen Pedersen. The cartoon was created to celebrate the 100th anniversary of Dr. Klatte's patenting of a production process for PVC. Unfortunately for Dr. Klatte, he did not capitalise from all the hard work and hours spent in the laboratory. At the time, the technology did not exist to manufacture PVC at a scale described by the patent. It took several decades before the first products made of PVC became available.*

### *Waste Management*

Historically, PVC waste management has brought much controversy, but again it must be stressed that these issues largely belong to the past. First, dioxins are not only formed in manufacturing processes. They also appear when chlorine-containing waste is burned. Second, the burning of chlorine generates hydrogen chloride (HCl), a gas linked to another headline-generating environmental concern since the 1960s: acid rain. Lastly, for many years the most common stabilisers used in PVC were based on cadmium and lead, two heavy metals detrimental to human health and animal life. All these substances are now subject to strict emission limits in the EU, which are easily met by modern incinerators.





*Dialogue and openness are core principles in the VinylPlus programme, and on several occasions external stakeholders have been invited to roundtable discussions. In September 2015, for instance, such a roundtable was held in Copenhagen. The diverse group of stakeholders—all involved in environmental and sustainability issues—counted the Danish Environmental Protection Agency, the City of Copenhagen, leading Scandinavian construction companies, environmental NGO's, academia and the waste management sector. Throughout the day, the 25 stakeholders were engaged in lively discussions on PVC, sustainable development and circular economy. Despite the efforts by VinylPlus, the discussions also revealed that there are still concerns when it comes to waste management of PVC.*

### *Phthalates*

The debate over phthalates began in the early 1980s. A heterogeneous and widely used group of chemicals, phthalates are the most common PVC plasticisers. Most attention has centered on low-molecular weight phthalates, some of which are suspected to be harmful to humans and the environment.

Today phthalates, and plasticisers in general, are strictly regulated by REACH, the most stringent chemical regulation in the world. Moreover, the European plasticisers industry is continuously investing in research and innovative technologies to develop substances meeting the highest safety and sustainability criteria.

### **The 1990s: High Stakes for the Industry**

As the new millennium approached the above issues became red hot, and the European PVC industry faced a hostile crowd of political authorities and NGOs. To quote Greenpeace, "PVC is a source of large quantities of a variety of carcinogenic, hormone-disrupting and otherwise toxic chemicals. It cannot be part of an ecological society and

it should be phased out speedily."<sup>6</sup> The ever vocal environmental group was not alone in its critique. A number of European countries were considering various measures targeting PVC, with Denmark and Sweden in the forefront. In 1997, the concerns over PVC in end-of-life vehicles made Danish EU Commissioner for the Environment Ritt Bjerregaard push for a so-called horizontal initiative on all aspects relating to the disposal of the plastic.<sup>7</sup> Five independent studies and a green paper followed, the latter adopted by the Commission in 2000. Policy proposals relating directly to PVC were brewing, one of which included a ban, and it became clear for the industry that something had to be done to gain the trust of policymakers, citizens and other stakeholders. Initial steps were already taken in 1995 when the European Council of Vinyl Manufacturers signed a charter for the production of vinyl chloride monomer and PVC. But this was just the beginning. As we have seen with Vinyl 2010 and now VinylPlus, the European PVC industry has indeed taken up the challenge of sustainability. Through investments, partnerships, openness and transparency, enormous progress has been made since the 1990s. From

<sup>6</sup> Greenpeace 1997, p. 18

<sup>7</sup> European Commission, <http://ec.europa.eu/environment/waste/pvc/index.htm>



*Corridor of Champions. To make the London 2012 Olympics the greenest in history, many tons of PVC manufactured in accordance with Vinyl 2010 principles were used at the main venues and Olympic park. Some of the vinyl was reused or recycled after the Games. At a school in Kent, England, the students now literally walk in the footsteps of champions.*

being heavily criticised, the vinyl industry is today seen as a role model for addressing sustainability challenges. That the industry is on the right track is exemplified by the following quote from UN Senior Advisor Tomas Anker Christensen, keynote speaker at the 2013 Vinyl Sustainability Forum in Istanbul:

“Your cradle-to-cradle approach is exactly what is needed. So, if you look into your supply chain, subsidiaries and other contacts, that kind of conversation and dialogue is part of how we need to do things in the future .... Together we must create and catalyse transformation and change.”<sup>8</sup>

<sup>8</sup> Quoted in Dero 2013

Further proof of the remarkable journey the European vinyl industry has taken is the London 2012 Olympic Games. The organisers wanted the Games to be the greenest in history and thus specified strict sustainability requirements for materials used. As a result, many tons of PVC manufactured in accordance with Vinyl 2010 principles were used for membranes, flooring, cabling and piping. After the Games—lauded as the best ever—some of the PVC was recycled or reused. Thanks to the efforts by Vinyl 2010 and VinylPlus, PVC can today be considered an Olympic material.

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