INEOS ChlorVinyls: A Positive Vision for PVC (A)

5

N. Craig Smith and Dawn Jarisch

Introduction

Following a Greenpeace campaign in the late 1990s to boycott PVC products because of environmental concerns, Hydro Polymers Limited decided to embrace the challenge and work with The Natural Step (TNS), an international non-profit organisation promoting a scientific, whole-systems approach to sustainability (Framework for Strategic Sustainable Development; FSSD).[1] TNS spurred and assisted Hydro Polymers on its journey towards sustainability, a proactive approach that produced pioneering innovations, incorporated sustainability into the overall business, and generated major cost savings.

In 2007, Hydro Polymers was acquired by INEOS ChlorVinyls, Europe's largest PVC manufacturer. Aware that the rest of the European PVC producers were taking a less radical approach, the new parent company insisted that any drive to sustainability be part of a Europe-wide cross-company programme. For Dr. Jason Leadbitter, Sustainability Manager at INEOS ChlorVinyls, a passionate advocate of taking a more proactive sustainability approach since 2000, the challenge was to convince the new management, the customer and the wider PVC community to embrace sustainability. Could the tangible progress to date persuade them that an industry-wide transition to sustainable PVC

[1] The Natural Step has developed its work around the world and has been key for the development of a science-based methodology for strategic sustainable development for more than 20 years. This methodology is available to all, continues to be developed in a scientific process, and is known as the Framework for Strategic Sustainable Development (FSSD). See, for example, Robèrt K-H., Broman G., Waldron D., Ny H., Byggeth S., Cook D., Johansson L., Oldmark J., Basile G., Haraldsson H., MacDonald J., Moore B., Connell T. and Missimer M., *Sustainability Handbook*, Studentlitteratur, Lund, Sweden, 2012.

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was realistic and that the above-mentioned approach was the best way to accelerate the pace of change in the industry?

How It All Started

Polyvinyl chloride (PVC) was the material of choice for many consumer and industrial purposes, as it was durable, light weight and economical. But for Greenpeace, PVC was a highly toxic material to manufacture and dispose of. In August 1996, shortly after Leadbitter took on the role of Environmental Manager at Hydro Polymers, he was stunned to see a Greenpeace advertisement in the national press entitled 'Saving our skins' criticising the PVC retail market (see Exhibit 5.1). Demonstrations outside retail stores were staged to raise public awareness and gain support for the idea of regulations to eliminate PVC, by being phased out in the same way as chlorofluorocarbons (CFCs). In an effort to counter these claims, the European PVC resin industry, which represented 25% of a global PVC resin market worth €20 billion, was accused of deception and threatened with a boycott.

The PVC manufacturing process combined ethylene, derived from natural gas, with chlorine, derived from the electrolysis of salt, to produce an intermediate product known as ethylene dichloride (EDC). This was "cracked" via a chemical process to produce vinyl chloride monomer (VCM), which was polymerised in water to produce PVC resin. Resin was combined with additives (typically stabilisers, plasticisers and fillers) in myriad combinations to form PVC compounds. These were 'converted' by processes such as extrusion and moulding into products tailored for different applications.

Firms which converted PVC compounds into end products for sale or made components for downstream companies were known as 'converters'. The resin industry, additive manufacturers and the compounding/converting sector were collectively referred to as the PVC industry.

PVC resin production consumed over a third of global chlorine gas production. The energy-intensive process consumed 1% of global electricity production (mostly carbon-based). Older plants were based on mercury cell technology, which released mercury into the environment. By attacking the PVC industry, Greenpeace threatened the entire chlorine industry. As Pete Roche, a Greenpeace campaigner in the UK, explained: "We held actions at various chlorine plants for a few years but got nowhere, so we switched attention to PVC, at the other end of the production chain."[2]

Environmentalists argued that plasticisers and stabilisers (responsible for PVC's properties such as its flexibility and thermo stability) and the accumulation of by-products from the manufacturing process (primarily dioxins) were unsustainable. They were accused of damaging ecosystems and human health by disrupting the endocrine, reproductive, nervous and immune systems, since they could be emitted into the air, soil and water during production, waste incineration and via leakage from landfill sites. Resistant to natural decomposition, they built up as global pollutants, were absorbed by living organisms and accumulated in the food chain.

[2] Pete Roche, Greenpeace UK, Chemical Week, February 26 1997.

Exhibit 5.1: 'Saving Our Skins'

GREENPEACE Briefing

August 1996

Saving our skins

Skincare products
Alternatives to PVC packaging

If you are buying skincare products, think about the packaging too. If you see that the container is marked with: 3 V then avoid it and choose an alternative instead.

If you shop at the Body Shop you can be sure of avoiding PVC packaging as they don't use it at all. Don't, however, be fooled by other similar 'natural' ranges sold in other places. Our research showed that some of those were packaged in PVC plastic.

The following lists show products that we found packaged in PVC and those that we found packaged in alternative materials. Choose the alternatives.

It's a simple switch – go PVC free!

✕ Skincare products which we found packaged in PVC plastic

Banana Boat skin care gel range
Boots Natural Collection sunflower body lotion
royal jelly moisturising body spray
Carex antibacterial moisturising hand wash
Galenco antibacterial creme handwash
peach creme handwash
Garnier Nutralia soap free hand wash
Marks & Spencers moisturising body lotion range
royal jelly & honey moisture replenishing body milk
Sainsburys moisturising handwash
Natures Compliments body mist
Natures Compliments eye make-up remover
Natures Compliments facial toner
Natures Compliments foot lotion
Natures Compliments gentle cleansing milk
Natures Compliments light body moisturiser
Natures Compliments light moisturising lotion
Natures Compliments massage oil
Natures Compliments rich body moisturiser
Simple moisturising hand wash
St. Ives chamomile face wash gel
Superdrug moisturising cream wash range
moisturising hand & body lotion
Synergie eye make up remover
Ten-O-Six deep cleanser
medicated cleanser
Tescos Active Response revitalising cleanser
Active Response refreshing toner
antibacterial moisturising handwash
camellia moisturising cream wash
Mild & Gentle pure wash gel
rose moisturising cream wash
Tisserand face lotion
Waitrose Natural Extracts elderflower & yarrow cleanser
Natural Extracts mallow & almond moisturiser
Natural Extracts willow & mountain clover toner

Eliminating PVC would be disastrous for Hydro, whose main products were PVC resin (representing 80% of turnover) and downstream PVC compounds (20%). Moreover, in 1997, the year after the Greenpeace campaign, it had launched a £30 million investment to expand and modernise its PVC resin manufacturing plant at Newton Aycliffe in the UK.

PVC Coordination Group

In response to the campaign and other critics, a number of leading UK retailers, including the Body Shop, Tesco, Asda and the Co-op, came together with Greenpeace to form the UK PVC Retail Working Group. The group commissioned a study of PVC by the National Centre for Business and Ecology (NCBE), a partnership between the Co-operative Bank and four UK universities, to investigate the scientific validity of the anti-PVC claims. When the report was published in September 1997, Greenpeace was surprised by its conclusion: "The study team concludes on balance that the careful manufacture, use, recycling and disposal of PVC products to the highest standards can control the risks associated with the material to acceptable levels."

The working group was then enlarged to include two UK PVC resin producers, Hydro and EVC, and representatives from the UK Environment Agency and Forum for the Future, a leading environmental think-tank co-founded by Jonathan Porritt, who was asked to chair the group. Forum for the Future had taken on the development of the TNS organisation in the UK. Each time Greenpeace representatives articulated arguments against PVC, Porritt asked them to explain how PVC as such was problematic and why the alternatives were better.

> Greenpeace: "There are heavy metals in PVC-production." Porritt: "So, what would happen if PVC was manufactured without heavy metals?"
> Greenpeace: "PVC manufacture is an energy-intensive process requiring 1% of global electricity production." Porritt: "How much energy is used in the manufacture of alternative raw materials?"

As it became clear that the (now named) PVC Coordination Group didn't have the answers to these questions, Porritt pushed them to commission a 'gap analysis' using the FSSD and its principles for sustainability. While this was a risk for the PVC industry (companies such as IKEA and the Co-op had used the same methodology arriving at a conclusion to phase out PVC), the principles were based on science, the mistrust and suspicion surrounding PVC had to be dealt with, and Porritt was at least trying to play fair. Hence the resin producers had little choice but to participate in the gap analysis. TNS was engaged to undertake a detailed study of PVC with the theme "Does PVC have a place in a sustainable society?" This involved all the key stakeholders – the manufacturing chain, end-users, regulators and NGOs.

The Framework for Strategic Sustainable Development

The Framework for Strategic Sustainable Development (FSSD) has been developed through, and continues to be refined in, a comprehensive scientific process. It was continuously developed and scrutinized theoretically, used and tested in reality, and then refined and scrutinized theoretically again. This process was initiated in Sweden in 1989 by cancer scientist and cancer clinician Professor Karl-Henrik Robèrt, who founded The Natural Step (TNS) – a non-profit NGO with the mission of facilitating a learning dialogue between scientists and business. Frustrated by the prevailing piecemeal approach to addressing environmental problems, Robèrt brought leading scientists together to achieve consensus on the basic requirements for a sustainable society. This scientific consensus process has led to basic principles for socio-ecological sustainability and a systems-based strategic planning and management framework that is extensively used by business, municipalities and other organizations around the world. In the PVC context, borrowing Robèrt's words: "There are no sustainable materials, just as there are no non-sustainable materials. There are only sustainable and non-sustainable management practices."

The Sustainability Principles are as follows:

In a sustainable society, nature is not subject to systematically increasing:

1. Concentrations of substances extracted from the Earth's crust (such as fossil carbon and metals);
2. Concentrations of substances produced by society (such as nitrogen compounds, CFCs, and endocrine disrupters);
3. Degradation by physical means (such as deforestation and over-fishing);

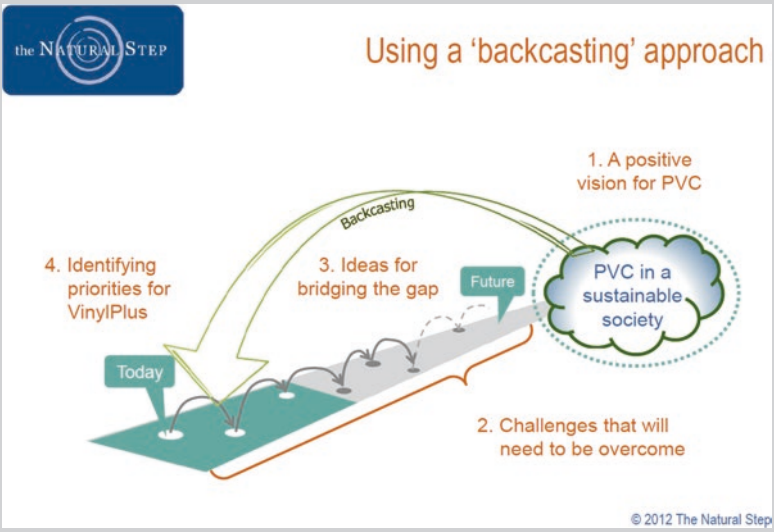
and, in such a society,

4. People are not subject to conditions that systematically undermine their capacity to meet their needs (such as from the abuse of political and economic power).

The FSSD includes a technique called 'backcasting' (see Exhibit 5.2), which entails creating a vision of success (framed by the sustainability principles) in the future, looking back from that vision to today's situation, and figuring out how to bridge the gap.[3] This differs from pure 'forecasting' – which extrapolates from prevailing trends to the future and then attempts to fix any foreseen problems, an approach that Robèrt claims is "bound to lead to more problems further ahead and even more confusion".

[3] See video: Sustainability plan: How might Einstein solve our problems? (backcasting) https://www.youtube.com/watch?v=DeDm-HTFuiY&list=PLEXqjIYY5zi6hWCvm5idXYLH2Qtv7fT-f&index=6

Exhibit 5.2: Backcasting Approach to PVC



Backcasting in the FSSD entails:

A (Awareness) – participants learn about the basic principles for human society to be sustainable (using the FSSD), share and discuss the topic or planning endeavor and agree on a vision of success.
B (Baseline mapping) – participants explore the current situation. They list the main current challenges in relation to the sustainable vision as well as current assets to deal with those challenges.
C (Creating possible solutions) – participants brainstorm possible solutions to the challenges discovered in step B.
D (Down to action) – participants prioritise actions developed during step C. Decisions and plans are evaluated for being flexible enough to handle change without losing overall direction, likely to produce progress to the vision, and adequate return on investments.

July 2000, Consensus-Building Report

TNS (UK) published its findings in a consensus-building report in July 2000. Having tested PVC in relation to the sustainability principles, the report asked the question – "Is there a place for PVC in a sustainable world?" What would it mean for PVC and its management to comply with the principles and bridge the gap between the existing situation and the future vision? Based upon in-depth research, and using consensus based workshops for all stakeholders including supporters and opponents, the final report concluded,

with the backing of participants, that PVC has a role in a sustainable society provided five specific and systemic challenges for the material and its use, were to be overcome[4]:

1. To become carbon neutral;
2. Closed-loop recycling;
3. No accumulation of emissions in the environment;
4. The industry to adopt sustainable additives;
5. Challenging the value chain to collaborate to become more sustainable.

To the relief of the PVC resin producers, The Natural Step study concluded that although PVC was currently unsustainably managed, none of the five challenges was technologically insurmountable. But even if the potential existed, the industry had to assess whether the challenges could be overcome in a commercially viable way. Porritt averred that,

> PVC may or may not have a place in a genuinely sustainable future (depending on whether or not it can meet the challenges outlined in our evaluation), but exactly the same questions must be asked of all materials, man-made or natural, before leaping to what are often ill-judged and unscientific conclusions.

Greenpeace, however, insisted that the goals were unattainable and withdrew from the PVC Co-ordination Group.

Vinyl 2010

In addition to the pressures from Greenpeace, the European Commission published a green paper, urging the PVC industry to address environmental concerns.[5] In response to this, in March 2001, European resin producers and converters made a voluntary 10-year commitment to minimise the environmental impact of production, an industry initiative known as 'Vinyl 2010'.[6]

Vinyl 2010 focused on recycling and substitution of heavy metals. With 17 million tonnes of plastics entering the waste stream within Europe, and landfill constraints developing in many member states, further pressure to recycle PVC could be expected. Consequently, Vinyl 2010 set a target to recycle 200,000 tonnes p.a. of post-consumer PVC waste by 2010. Vinyl 2010 also set a voluntary target for the industry to be lead-free by 2015 in the hope of avoiding anticipated European legislation. Both the recycling and the heavy metal substitution targets set for 2010 were exceeded.

[4] July 2000, "PVC: An Evaluation Using The Natural Step Framework", The Natural Step.

[5] See: http://ec.europa.eu/environment/waste/pvc/green_paper_pvc.htm

[6] See: http://www.bpf.co.uk/Members/Vinyl_2010_Voluntary_Commitment.aspx

Hydro Works with The Natural Step

Leadbitter was convinced that going beyond Vinyl 2010 and embracing the challenges of the consensus-building report would not only enable Hydro to pre-empt future regulation but provide a competitive advantage on sustainability issues. It was not an easy decision given the dilemma facing Hydro at the time:

> We had to think whether to build the walls higher or engage with the environmentalists. Do we invite them into the boardroom? Can we get them to sit round the table? This was what we did and it was a changing point in the whole culture and mentality of Hydro.

Following publication of the consensus-building report, Hydro's President, Anders Hermansson, was keen to meet Robèrt. The two men hit it off immediately and agreed to bring in a wider group of managers involved in the PVC resin production process. Robèrt and his team at TNS were engaged to undertake a deeper analysis of what it would take to create a sustainable PVC resin business, and to educate the top 40 managers in The Natural Step approach (the FSSD) and the related five challenges for PVC so that they understood the scale of the task.

Robèrt visited all of the Hydro sites, where he hosted workshops, coached and presented to senior, middle and junior management. Mapping flows of raw materials and energy, workshop participants were challenged to think about "What could we do, in a step-by-step fashion, to make PVC fully sustainable and meet the five key sustainability challenges for Hydro?"

In seeking to demonstrate that PVC could be safely manufactured and used, TNS compared itself to a "critical friend" – one who could be trusted to ask provocative questions, provide data to be examined through another lens, and to critique Hydro's efforts constructively.

Eager to inject a stimulus to get sustainability projects off the ground (notably the energy reduction project and any 'low-hanging fruit' which Hydro decided to tackle first) as well as convince the cynics in the company, Hermansson committed to provide NOK25 million (approximately €3 million) per year for 3 years from 2002, mainly for longer term projects. This was in addition to normal capital expenditure. A board was set up to allocate funding to the best projects. Additionally, Hermansson instigated an annual Sustainability Summit (that Robèrt attended), which allowed dissenters to voice their opinions and concerns. Once won over, they were often among the strongest advocates of the process.

Once employees got to grips with the framework as a means to achieve the end goal of sustainability, they learnt to plan, act, and apply the approach to their everyday work by undertaking manageable short projects. This generated a sense of purpose and achievement, accelerating the implementation process. From 2001 to 2004, senior management gave high priority to sustainability and maintained a close interest in it, inviting Robèrt and the TNS team back regularly to scrutinise investments, run workshops and education sessions, and give assurance on the steps taken.

Hydro employees identified and implemented numerous internal initiatives. The five key sustainability challenges were addressed at both the local and Hydro-wide

level. At any one time there could be four company-wide projects running for each challenge, as well as smaller local projects and further suggestions in the pipeline. Up to 120 people were involved in one or more projects (10% of the workforce). Local teams had five to six people per site/challenge and competition occurred among the scientists. Project leaders posted minutes from their meetings and spreadsheets with their creative ideas in a database.

An annual meeting provided an opportunity for team leaders to pitch their ideas to the board for potential capital investment. To quantify the value of each sustainability project, they had to provide details such as benefits vs. cost and likelihood of success. For example, for the Carbon Neutrality project (challenge No. 1), local teams were asked to both create and measure ideas of how to reduce carbon emissions from their plants, prompting a flood of potential project ideas. Employees had apparently thought about this for some time but had never been given the opportunity for creative thinking (or funding) until carbon neutrality became a strategic priority. Projects were assessed on the basis of the highest CO_2 savings per Norwegian Kroner invested. Funding was awarded to projects that provided the best value in this respect in combination with their chances of success.

The decision to put the company on a path towards sustainability gave individuals the creative freedom to think outside the box. One experienced chemical engineer came up with a speculative idea known as "adiabatic volume", a breakthrough innovation with the potential to increase yield from the VCM cracker without further heat input. Despite the high investment required – with a payback period up to 3 years – estimated savings of 8800 tonnes of CO_2 per annum meant that the project was executed at a cost of around £1 million. Ironically, immediately after installation, energy prices soared unexpectedly. Although the carbon savings were marginally lower than predicted, the payback took less than a year. Within 3 years, all three of Hydro's VCM crackers had the new technology, yielding combined savings of £3 million and 24,000 tonnes of CO_2 annually.

Other projects were less easy to quantify. For example, a project to reduce traces of dioxin formation (Challenge No. 3) proved difficult to quantify, yet this did not prevent significant investment. Some projects were more strategic. For example, phasing out lead stabilisers with more expensive alternatives did not make economic sense, but Hydro was keen to differentiate itself from competitors with lead-based formulations. A couple of projects proved unsuccessful, such as the purchase of two wind turbines for £140,000 which were never put into operation due to objections from the local electricity company and problems obtaining planning permission.

Prior to starting the sustainability journey, every tonne of PVC resin produced by Hydro emitted 1.8 tonnes of carbon dioxide. Investments in green energy achieved a 20% reduction in CO_2 emissions between 2001 and 2006, reaching Kyoto Protocol targets for 2012 in the first 4 years.

Corporate newsletters highlighted the progress toward the five challenges and employees took pride in what was achieved, in contrast to the frustration felt when they had been under attack by Greenpeace. By 2004, when Jan-Sverre Rosstad became Senior Vice-President of Hydro, a significant shift in internal culture had

occurred. The annual employee survey (September 2004) reflected a 15% increase in employee recognition of the company's environmental commitment in response to the question "Does Hydro put the environment first?" Not only were employees buying into the process as a result of actions witnessed first-hand (with visible support from top management), but the resulting innovations had reduced some of the risks to which competitors were now exposed.

Hydro's proactive approach had produced pioneering innovations to address the challenges ahead of its competitors and the regulators. By 2005, sustainability was no longer treated in isolation; targets were fully integrated into the business planning process and were generating cost savings. Hydro had demonstrated that the sustainability challenge could be met: it could measure the gap between the current position of PVC resin in relation to the end goal of sustainability, and spell out how it was systematically being closed.

Nonetheless, Rosstad wondered how to keep capitalising on Hydro's sustainability initiatives as the early wins were realised. For PVC resin to be fully sustainable, the entire value chain would need to align with the sustainability challenges over time. Rosstad felt that Hydro was "well positioned for this next phase of the challenge, gaining momentum in the marketplace which will hopefully translate into a snowball effect." He decided to embark on the fifth challenge by hosting workshops with suppliers in Hydro's value chain "to extend the business benefits of addressing sustainability implications of PVC to a wider range of stakeholders" as well as to "demonstrate PVCs long-term ability in becoming a fully sustainable material". (Hydro Polymers' *Environmental Newsletter*, October 2005).

The PVC Resin Market in 2005

In 2005, the global PVC resin market was worth over €36 billion, with annual consumption exceeding 36 MT. Over 60% of PVC resin was used in the manufacture of pipes and window frames for the construction sector. Although losing ground across some product applications, global production capacity was expected to exceed 40 million tonnes by 2010, driven by accelerating demand from Asia. In 2005, Asia accounted for 43% of PVC resin demand, with China increasingly making its influence felt. Between 1998 and 2005, China's annual PVC resin consumption had increased from one million to over seven million tonnes. On the supply side, China was ramping up its domestic PVC resin manufacturing capacity with little concern for environmental sustainability. It envisioned production increases of one million tonnes year-on-year from 2006 to 2010, relying on its cheap labour, vast coal reserves, and more energy-intensive and polluting acetylene process technology. This technology had been phased out and replaced by ethylene-based production in Europe in the 1960s.

It was a cyclical market. PVC resin prices varied from month to month, driven by the price of raw materials and manufacturers seeking to keep capacity utilisation high. Consequently, the value of the market changed each year even if production

capacity and volumes remained static. In Europe, ethylene accounted for half of production costs, with energy costs the next highest cost component.

Europe's PVC resin market represented over 25% of global consumption in 2005, supplied by ten European producers. European production capacity was 9.1 million tonnes. The top 3 producers were INEOS (1.3 MT), Solvay (1.2 MT) and Arkema (0.8 MT). Hydro in fourth place (0.7 MT) had the lowest costs in Europe, benefiting from its integrated supply chain. Given the capital-intensive nature and relatively low margins of the sector, this was a significant advantage. In 2005, Hydro's operating income was €8.6 million, while competitor EVC/INEOS[7] reported losses of €13.2 million.

For decades, market growth in Western Europe had been driven by applications for door and window frames and pipes, but as the market matured, growth was projected to be only 0.5% per annum to 2008. Running on tight margins, many players wondered how sustainability could be good for business when their only priority was survival.

Engaging Suppliers and Customers

Both Leadbitter and Rosstad believed key suppliers must understand Hydro's approach to sustainable PVC based on the FSSD if future partnerships to address the sustainability challenges were to succeed. In April 2005, Hydro invited its ten top strategic raw material suppliers to Stenungsund, Sweden, to explain the sustainability challenges facing PVC and communicate Hydro's strategy. The workshop offered an opportunity for them to grapple with the sustainability implications for their own product development set against the practical realities of creating sustainable products in a commercially viable timeframe.

Feedback from those attending was positive. Hydro's commitment to sustainability virtually guaranteed demand for suppliers' sustainable product innovations – their ideas would be taken seriously because of Hydro's sustainability drive. One company produced a new stabiliser system that offered an alternative to using lead and a reduced environmental footprint. Suppliers also began to develop their own sustainability initiatives. For example, The Natural Step worked extensively with Rohm and Haas, one of Hydro's top strategic suppliers, helping them at strategic and operational levels to apply the FSSD including a new vision and 'Six Commitments for Sustainability'.

Hydro now had to convince its customers that sustainable PVC was a viable long-term option over alternatives such as wood, plastic or aluminium. It had to demonstrate the tangible added-value of its increasingly sustainable PVC resin products, and position the brand accordingly. In March 2006, as Leadbitter and Rosstad prepared for a crucial workshop with Hydro's key UK customers (see Exhibit 5.3). They felt it was time to talk openly about what Hydro had achieved and create demand for further innovations by showcasing its strategy for sustainable PVC and progress to date.

[7] EVC had been acquired by INEOS.

Would customers understand the process the company had embarked on in 2001, and appreciate the advantage of full sustainability as opposed to the issues-driven approach of its competitors? How could Hydro enhance their perception of Hydro's brand without alienating them? If customers weighed up the implications of the sustainability challenges for the industry, would they contemplate making the transition to fully sustainable PVC or dispute its viability on commercial grounds? If PVC was seen to be a losing battle, they might devise exit strategies to cut their losses. Given the availability of alternative materials (e.g., for products like window frames), would they switch to substitutes and exit PVC-based manufacturing? (see Exhibit 5.4).

Exhibit 5.3: Background on Key Customers Attending the Sustainability Workshop

The key customers attending the workshop included the following major product areas.

Building and construction

The most significant group of workshop participants, in terms of volumes sold by Hydro Polymers in the UK, was suppliers to the construction industry. These customers purchased either PVC resin and/or PVC compounds to fabricate extruded profile in applications such as pipes, window frames, facia and soffit boards.

They were faced with increasing pressures to demonstrate the sustainability of their products through increased regulation, especially in relation to social housing, including new sustainability drivers being developed from the Offices of the Deputy Prime Minister (ODPM), requirements from bodies such as English Partnerships, and private finance initiatives. In addition, they experienced pressure from many of their own customers, house builders and architects increasingly being required to demonstrate that they were using sustainable materials in construction.

Their expectations of the workshop were to learn how sustainability could be implemented within their businesses – more especially whether it could help towards the increasing requests for "sustainable materials". They were also looking towards collaboration with their suppliers and across the industry over recovery of PVC for recycled applications. For most participants, the workshop was seen as a new way of looking at their respective businesses and most were keen to learn from the experience.

These customers were heavily dependent upon PVC, which remained the only viable plastic for use in window frames and plastic profiles. On that basis any loss of PVC markets would be a direct loss of business to them. Alternative products for use in window frames (timber and/or aluminium) required vastly different processes of fabrication from the invested infrastructure in their own companies already dedicated to processing PVC.

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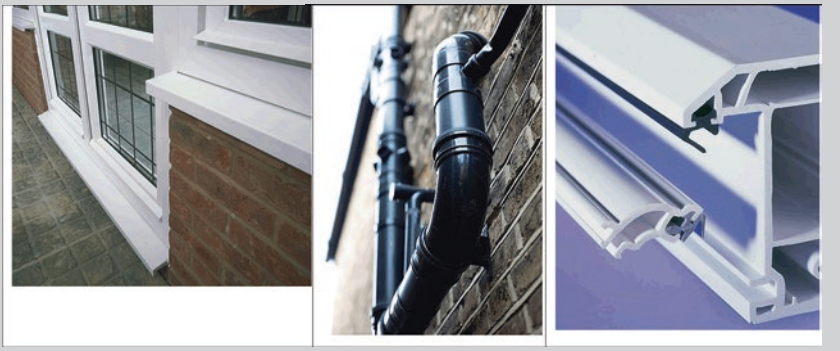
Exhibit 5.3: (continued)



Pictures courtesy of ECVM (Plastics Europe)

Flooring

Other participants were manufacturers supplying vinyl-based systems to a diverse range of customers in the flooring industry. They had many of the same issues as participants in building and construction. However, unlike construction, these manufacturers could offer alternatives such as linoleum and wood laminate to their customers. Nevertheless, PVC (or vinyl as it is usually referred to within the flooring industry) remained a hugely important material in their portfolio, offering advantages over the alternative materials. These participants were under increasing pressure to demonstrate the recycling potential of their products. For them the workshop served as an opportunity to highlight the need for supply chain engagement in order to address the recycling challenge jointly.

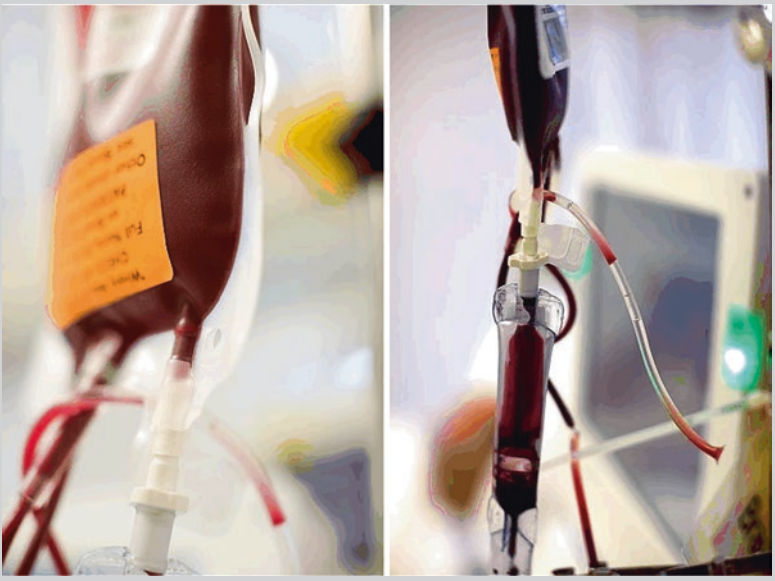
Picture courtesy of Polyflor

(continued)

Exhibit 5.3: (continued)

Medical

There were several participants from the medical industry, supplying PVC-based devices for use in a wide range of disposable but critical healthcare applications, such as blood tubing and containers for blood and intravenous solutions. Their main expectations were to gain a better insight into the sustainability implications for PVC. In the main, the threats to their business came from one of the additives used within the PVC rather than the PVC itself, i.e. the plasticiser known as DEHP (di 2-ethylhexyl phthalate, the softening agent to make PVC flexible). While there have been many attempts by other material producers to provide PVC alternatives based on other plastics, PVC still offered the best overall combination of properties and was cost-competitive.



Pictures courtesy of ECVM (Plastics Europe)

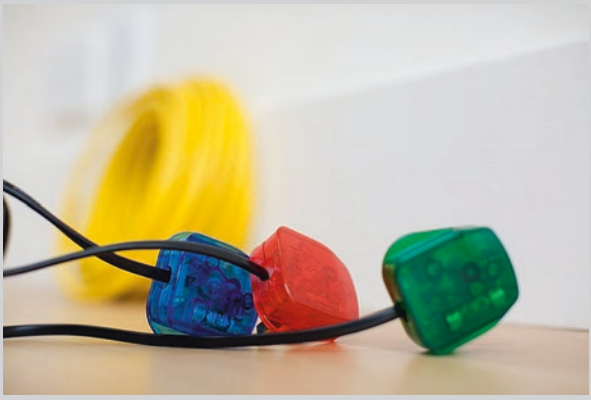
Moulding products

Several participants supplied the industry with mouldings for a wide range of applications. Unlike profile manufacturers, who extrude PVC in continuous lengths, these manufacturers processed PVC for a diverse range of applications using injection moulding. They also used a range of other thermoplastic

(continued)

Exhibit 5.3: (continued)

materials and were less dependent on PVC than profile producers. Like flooring, PVC offered some advantages for certain applications compared to alternative thermoplastics. It cost less and, unlike other thermoplastics, did not require the use of anti-flammables such as brominated fire retardants. These participants saw the sustainability workshop as a mechanism to learn more about the positive aspects of addressing sustainability. They planned to use these in their promotional literature.



Pictures courtesy of ECVM (Plastics Europe)

Exhibit 5.4: Sustainable PVC Versus Competing Materials

Hydro Polymers had recognised the need to accelerate the pace of change of addressing sustainability within the PVC industry. One of the key drivers in the UK had been the increasing pressure from the Building Research Establishment (BRE) whose model, "The Green Guide on Construction Materials," was starting to appear widely. The guide, initially designed for the Post Office to rate materials in specific applications, was based on a complex set of environmental profiles, yet the outcome was a simple rating of either A, B or C, where A was good and C poor from an environmental perspective. Architects, construction companies and other specifiers turned off by the complexities of life cycle analysis could see the benefit of using such a tool as a simple means of materials selection.

At the time of the workshop, the generic rating for PVC for use in window profiles was C, while timber windows had an A rating. For other applications such as flooring, PVC scored favourably and so the BRE rating was not seen as a threat. Hydro Polymers' window customers had highlighted that the threat of a poor rating was directly impacting their business, and the threat itself was likely to increase. Other influential bodies such as English Partnerships had already decided that they would not use C-rated materials for new build applications. PVC was losing market share as a direct result of this rating. There was clearly a pressing need to undertake a review on improving the rating of PVC for use in windows and this was being addressed by a joint effort across the industry. The main options to improve the rating were identified by Hydro Polymers as:

- Extend the life of PVC windows within the Green Guide from its current estimated length of 25 years (an estimate the industry was confident was wrong)
- Reduce the environmental footprint of PVC
- Introduce recycled PVC into new profiles

The first option was being tackled across the UK industry via demonstrations to BRE that PVC windows lasted significantly longer than 25 years, i.e., at least 35 years. However, the second and third options were clearly dependent on product sustainability initiatives and demonstrated the need to address sustainability challenges from a real business perspective.

So while the BRE assessment was clearly a threat to the industry, Hydro Polymers also saw it as an opportunity ultimately to improve PVC's rating versus competing materials such as timber. If the industry generic rating was insufficient and PVC continued to lose ground to competing materials, there was still the option of a specific rating for Hydro Polymers' own PVC – not its first choice but a potentially shrewd business differentiator if needs be.

Even if customers accepted that an industry-wide transition to sustainable PVC was possible, would they support Hydro's strategy when other European PVC resin producers were taking a less radical approach? Would they see a cost advantage to the more incremental approach (despite Hydro's experience to the contrary)? Would they choose to 'wait and see' or perceive added value for their own customers and embrace the drive for full sustainability?

As Leadbitter and Rosstad pondered these questions, they knew they must give the meeting their best shot. Getting just one or two big customers to buy into the sustainability initiative was critical if Hydro was to embark on the next stage.

At this point, Hydro's sustainability programme (in conjunction with TNS) was beginning to be recognised. Employees had embraced its values and goals enthusiastically and many felt that the programme had been beneficial. For example, it had featured in a leading environmental journal, *Environmental Data Services*,[8] a publication traditionally hostile to PVC. The October 2005 edition of Hydro Polymers' *Environmental Newsletter* summarised the company's progress on the key sustainability challenges as follows:

1. Carbon neutrality: "Significant progress has been made over the last 4 years to reduce our CO_2 emissions from our manufacturing processes. To date this has led to over 80 Kg of CO_2 reduction per tonne of PVC produced… [achieving] our "Kyoto Protocol" target (12% reduction) in just 4 years… with the introduction of our new chlorine plant at Rafnes… the predicted reduction by 2007 will be 28% lower than the CO_2 emissions in 2000."
2. Closed-loop recycling: "Steady progress has been made on developing our EcoVin product line. The compound is manufactured from post-industrial scrap… to date we have had nearly 2500 tonnes of sales that could have otherwise been destined to landfill."
3. Elimination of persistent organic pollutants: "The reported dioxin levels across the whole of our operations continue to reduce" (a graph included in the newsletter indicated levels had halved in 4 years). "Levels are anticipated to be extremely small on the basis that the new [chlorine] plant uses new materials that have less propensity for catalysing dioxin formation."
4. Sustainable additives: "Hydro Polymers… will be lead-free by the end of 2007" (well in advance of the 2015 deadline under Vinyl 2010). "The main stabilisers used to replace lead will be based either on Calcium/Zinc and/or OBS based systems."
5. Raising awareness across the industry: "Complementing the raw material supplier event in April, invitations were also extended to our customers to attend a Marketing/Sustainability workshop during the official opening of the new chlorine plant at Rafnes in Oslo at the end of August." A DVD of the key presentations at the supplier event was also made available to those unable to attend.

[8] ENDS, May 2005, "Hydro Polymers: Searching for a more sustainable PVC", Environmental Data Services, Report 354, p. 25–28.

Nevertheless, some dissenters remained. Also in October 2005, *Green Futures*, a Forum for the Future publication, interviewed Mark Strutt of Greenpeace UK, who had left the PVC Co-ordination Group back in 2000. His stance remained unchanged:

> Unless Hydro can show it can make PVC without chlorine, and without using toxic and persistent additives, then we are not interested in small improvements. We still believe that PVC is inherently unsustainable and completely unnecessary, as alternatives exist for virtually all its applications.

Hydro Polymers pressed on, all the same. At one of its FSSD workshops, it decided to develop a distance-learning course with actors in its value chain, thereby enabling a more cohesive approach to support each other's sustainability approaches. Hydro Polymers and TNS joined forces with Blekinge Institute of Technology, Karlskrona, Sweden. A semi-distance course was developed and delivered and in this way the key suppliers and customers were trained in the FSSD. Attendees also received 7.5 university credits. Based on the shared mental model for systematic planning incorporated in this training, a cascading effect of actions and business developments occurred across the supply chain, eventually leading to a 10-year sector agreement. The companies agreed to embark on a joint venture to eventually comply with the FSSD sustainability principles.

The INEOS Takeover

In 2006, Norsk Hydro, Hydro's parent company, decided to dispose of the PVC business. Chris Welton, Hydro's European Head of Communications, felt that the sustainability programme would be perceived by potential buyers of the company as an attractive business proposition and should help to sell the business. Europe's largest European PVC resin producer and the UK's largest private company, INEOS, expressed an interest.

Culturally, INEOS was driven by business efficiency. Its main owner, Jim Ratcliffe, had started INEOS in 1998 by purchasing an ethylene oxide chemical plant in Antwerp, Belgium, previously owned by BP. Subsequently, INEOS had acquired a number of other commodity chemical businesses from blue chip companies seeking to divest these assets. Ratcliffe believed that big chemical businesses could be inefficient and aimed to double the earnings of the businesses INEOS acquired over 5 years. He ran a lean operation and had a reputation for being a hard-nosed businessman. According to the *Financial Times*,

> The formula was simple: take on a lot of debt to fund the purchase, reduce it through cost savings and other measures, and start all over again. Once in charge, INEOS would go in hard, stopping spending overnight. Many of the companies would have excessively high costs and the aim was to stop waste immediately.[9]

[9] Financial Times, February 7, 2014.

At the time of discussions, INEOS was heavily involved in the industry's Vinyl 2010 programme. Hydro was a member of Vinyl 2010 whilst also pursuing the five key challenges from The Natural Step analysis. Both approaches were respected because an outside party set the agenda with which the participants complied.[10] Vinyl 2010 required PVC producers to pay a membership subsidy (the size of which increased according to the volume they produced). As the largest producer in the European PVC industry INEOS was therefore the largest financial contributor. As such it had a political interest in Vinyl 2010 initiatives and wanted to ensure that its hard-earned cash was invested wisely.

Hydro was the only company in the PVC industry following the FSSD approach to sustainability and was way ahead of the rest of the European PVC industry, whereas for INEOS the Vinyl 2010 programme was working well and had the added advantage of industry backing and support from the European Commission. The Commission had set criteria for product stewardship and the industry was complying. Indeed most of the companies involved in Vinyl 2010 were reluctant to adopt the FSSD approach because it went so much further. Since Greenpeace and other activists were no longer pressing the industry to reduce its carbon footprint, why bother to invest in seemingly unnecessary reductions?[11] Rather than seeing Hydro's efforts as complementary to the existing Vinyl 2010 voluntary commitment, it was seen as 'going off at a tangent' or 'in conflict'.

The potential merger required two rounds of negotiations with the European Commission, so the acquisition process lasted many months, during which there was considerable uncertainty within Hydro. Executives wondered whether the journey with TNS would be cut short. Leadbitter recalled:

> The 'bedding in' process took a number of months. Whilst no one from INEOS said they would throw out our sustainability approach, they took a cautious approach to it, preferring to look at the best practices of each of the companies. The whole process took a lot longer than anticipated, during which time we wondered how our jobs would be affected.

In May 2007, INEOS acquired Hydro for NOK5.5 billion, (€670 million). Leadbitter and the PVC resin business became part of INEOS ChlorVinyls, while the PVC compound business became part of INEOS Compounds. Ex-Hydro executives wondered whether they would be able to persuade INEOS of the value of the TNS approach. Would sustainability even have a role in the new organisation?

In some instances, sustainability was accommodated within areas of business efficiency. For example, Ashley Reed, Business Director of INEOS ChlorVinyls (and later CEO of INEOS Enterprises), though a tough operations guy, was willing to listen if a good business case could be made. But overall INEOS felt that it was not possible to make just one company out of a whole supply chain sustainable. For a sustainability agenda to have an impact, it needed to be part of a broader European cross-company programme.

[10] In the case of Vinyl 2010, the third party setting the agenda was the European Commission. For Hydro Polymers it was The Natural Step.

[11] Greenpeace was pursuing other agendas.

Moreover, as INEOS was contributing so much to Vinyl 2010, any sustainability ideas should be developed within the scope of that industry-wide initiative. At the outset, Leadbitter didn't see the benefits of this approach, but he gradually came round to the idea:

> Initially I felt torn. I selfishly didn't want to hand over our sustainability approach to the rest of the PVC industry, as I had seen how well the approach had worked to give a competitive advantage to our own company. However, I also realised that it was the right thing to do, and it would give us greater exposure and more credibility with customers. The more I thought about it, the more attractive it became. We had reached a point where it would be a natural progression for us to broaden the programme and involve the whole of the European industry. I realised the benefit of capturing both approaches and demonstrating to the wider community how well it had worked for Hydro.

But the timing was bad. INEOS had taken on a vast amount of debt to fund its many acquisitions and was badly hit by the 2008 financial crisis. Long-term decisions would have to wait – cost-cutting was the first priority.