The role of coil coatings in building a sustainable environment

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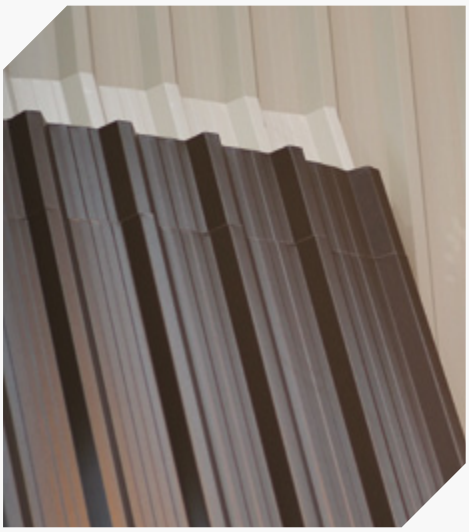
Introduction

Governmental bodies around the world are increasing regulation to push the industry towards achieving net zero by 2050. Many companies in the construction industry, including architects and specifiers, now face the challenge of managing and measuring their Environmental, Social and Governance (ESG) performance so that they can provide regulators, customers and suppliers with crucial data.

These companies also face the added complexity of key raw materials used in coil coatings being re-classified due to their negative environmental and societal impact. Polyfluoroalkyl substances (PFAS), such as PVDF and PVF fluoro-polymers, which coat roofs and metal components of buildings, may be partially or completely banned in some areas within a few years so alternatives will need to be adopted.

There are many challenges to producers and consumers of metal building materials and acting as a good global citizen is no longer simply a competitive advantage for any organization; it is a business imperative that will ultimately decide who wins and who loses in business.

This document aims to increase these stakeholders' understanding of the current changes, the reasons for the change and what action can be taken to remain compliant and competitive.



Regulatory landscape

In its 2021 report (AR6), The Intergovernmental Panel on Climate Change (IPCC – the UN's body for assessing the science related to climate change) stated that human activity has without doubt warmed the atmosphere, ocean and land, resulting in unprecedented changes to our planet. It warned that unless there is a significant reduction in CO_2 and other greenhouse emissions soon, the global temperature will rise by 1.5°C to 2°C (2.7°F) and lead to more extreme weather. The report indicated that these conditions would have dramatic adverse consequences for both human society and the wider planetary ecosystem. The IPCC also reported that this can be avoided through a concerted joint effort by humanity, particularly industry, to reduce greenhouse emissions.

In response, around the world, ESG reporting standards are becoming more standardized and mandatory. In Europe for example, the introduction of the corporate sustainability reporting directive (CSRD) has been introduced. By 2025, over 50,000 organizations, including 4,000 non-EU organizations with large EU operations, must report and comply with the new ESG standards. Their sustainability data across the entire business value chain can, subject to materiality, include CO_2 emissions, waste reduction, and the use of hazardous raw materials classified as substances of concern (SoC).

In other regions, countries such as the US, Hong Kong, and Singapore currently have comply-or-explain policies. Additionally, the IFRS (International Financial Reporting Standards) Foundation has established the International Sustainability Standards Board to develop an ESG reporting framework which is likely to be adopted alongside its existing standards in 144 countries.

To meet these new regulations at home and abroad, companies will have to choose better practices and processes to reduce their own environmental impact and review the environmental footprint of their upstream suppliers and downstream customers.

There will also be a rising expectation of suppliers to inform their customers of less harmful solutions and guide them towards more sustainable products and business practices, there is a growing need to explore a path to achieving a more sustainable built environment without sacrificing performance

Reporting and reducing CO_2 emissions

Companies will need to report the annual reductions in carbon emissions based on carbon footprint calculations from cradle to grave and cradle to gate. Suppliers will need to provide their customers with emission data for all products sold.

Coatings suppliers like AkzoNobel can provide coil and extrusion manufacturers with the carbon and emissions data for their coatings. Coil and extrusion manufacturers can then use these in reporting their Scope 3 emissions and share with architects, suppliers, and construction companies when asked.

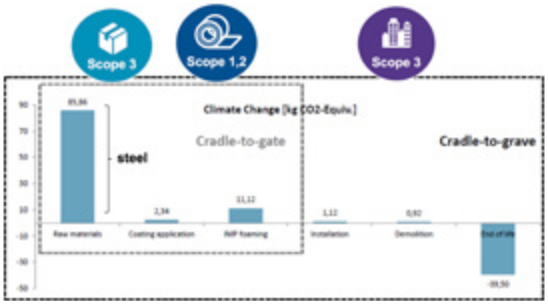
Fig. 1 – An illustration of the emissions reporting data AkzoNobel collects, reports, and provides its customers

One tool used to understand the climate change impact of a product or product family is a Life Cycle Assessment. It provides an estimate of the expected greenhouse gas contribution as well as other environmental impacts like ecotoxicity.

In 2019, CEPE (the European Council of the Paint, Printing Ink, and Artists' Colours Industry) published a life cycle assessment for 1 square meter of coated steel cladding. Figure 2 shows the amount of CO_2 equivalents generated during its manufacture. What becomes clear is that 90% of CO_2 emissions result from steel production (cradle to gate). However, the metal can be recycled at the end of the product lifecycle, and is recovered for new applications and avoids the high carbon footprint processes of virgin steel.

2019 CEPE Life Cycle Assessment

1m^2 of insulated cladding panel applied in a building.



Majority of energy used to create steel, but recovered at end of life when recycled.

Fig. 2 – CEPE's Emissions Life Cycle Assessment of steel cladding

The relative energy consumption of coatings is also comparatively small, much of it coming from the curing process. AkzoNobel continuously strives to reduce the energy consumption in all areas of coatings manufacturing, which reduces its own Scope 3 downstream, and a coil coater's Scope 1 and potentially Scope 2.

Energy Reduction Options

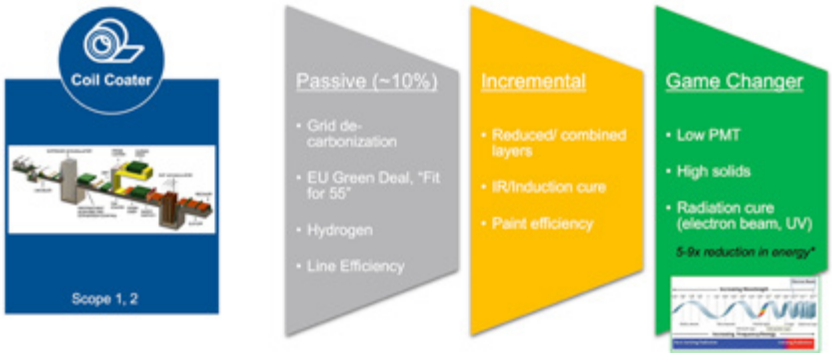


Fig. 3 – How Coil Manufactures can reduce their Scope 1 emissions now and in the future.

In the short term, to reduce the Scope 1 emissions, coil coaters can increase the energy efficiency during production and minimize the amount of coating that is wasted. In the medium term, AkzoNobel is developing products that can be cured at lower peak metal temperatures to save energy. Coaters can reduce energy consumption by switching to infrared and induction-type ovens. In development over the longer term are coatings that could be cured using electron beam radiation, which is estimated to reduce energy consumption by 5-9 times compared to thermal ovens. (See figure 3).

*Radtech Report 2012.

Sustainability and circularity of the built environment

Despite the looming regulations, energy consumption is, however, not falling. In fact, according to the UN's Environment Programme 2022 Global Status Report[1] in 2021, the buildings and construction sector had its largest total energy consumption and CO_2 emissions increase in 10 years, and unless things change, it is unlikely to achieve decarbonization by 2050.

The route to more sustainable building practices should begin at the design stage. Yet a 2022 study by the Architects' Council of Europe[2] found that only 16% of architects frequently use almost zero energy designs, and only 12% incorporate 'circular' design.

Circularity is focused on reducing, reusing, and recycling materials. Metal substrates can be infinitely recycled, but the coating on them cannot. So, reducing the amount of coating used and wasted at all stages of constructing metal building components is critical to keeping the environmental footprint of coatings to a minimum.

Coatings manufacturers like AkzoNobel, for example, strive for a 'right first time' approach, using accurate dosing units, reusing excess material, and implementing digital tools to help assess and improve efficiencies. Coil coaters are seeking advances in digital inventory tracking, to help with just-in-time delivery. This will help reduce the need to over-order, store and potentially discard or waste excess coating.

Many of these advances involve digitizing color. AkzoNobel's coil and extrusion coatings can be viewed on its Canopy app. The colors can be reliably tested on various surfaces, and buildings and using different finishes. This digital process replaces the early stage of finding the desired color and reduces the need to make physical panels for the customer to review. Currently, AkzoNobel makes thousands of color matches every year and creates sample panels for customers. As the color sampling technology improves, color scans will replace all the physical panels currently used and shipped, not only reducing waste and emissions but also time.

Creating cool buildings to reduce CO_2

Coated metal components can also help the built environment achieve net zero in situ. Modern cool chemistry coatings, such as those designed by AkzoNobel, use heat-reflective pigments to help insulate buildings against hot or cold weather. Cool chemistry coatings lower the temperature of a typical roof, for example, by around 20°C/36°F. The insulating effects minimize the use of air conditioning or heating, lowering energy consumption and CO_2 emissions and consequently helping coil coaters, specifiers, building and construction industry reduce their Scope 3 downstream emissions. AkzoNobel's cool chemistry coatings comply with the sustainability ratings for the United States Green Building Council's LEED (leadership in energy and environmental design) green building certification developed by the United States Green Building Council's.

Cooling buildings and infrastructure in this way also helps to reduce the urban heat island effect. Built structures absorb and re-emit the sun's heat, raising the temperature in towns and cities 10-15°C/18-27°F higher than the surrounding countryside[3]. The higher temperature heats up water run-off from buildings and streets, which warms rivers, harming biodiversity in the local environment and secondly the higher temperature increases energy consumption and CO_2 emissions of buildings.

But the most significant potential contribution to sustainability and achieving net zero is reducing the amount of new buildings and new building material being used, created by renovating and reusing buildings and materials. International Resource Panel (IRP) suggests this is the most urgent priority, along with designing new building stock to last as long as possible. The metal substrates in buildings can be recycled repeatedly if they are protected during the lifetime of the building. Coatings systems help to do that.

But herein lies a fundamental conflict to achieving sustainability in the built environment. The IRP also recommends policymakers encourage greater use of non-toxic, sustainable, renewable materials and processes. Traditional coil coatings, the very thing that prevents the corrosion and collapse of metal building structures for up to 40 years and allows metal substrates to be recycled and reused, are made using Fluoropolymers (FPs), which are SoC's (substances of concern). Coil and extrusion manufacturers will need to advise their customers on selecting the best solution based on SoCs and their sustainability ambitions.

[1] https://www.unep.org/resources/publication/2022-global-status-report-buildings-and-construction. [2] The Architectural Profession in Europe 2022 Sector Study.
[3] https://joint-research-centre.ec.europa.eu/jrc-news-and-updates/cities-are-often-10-15-degc-hotter-their-rural-surroundings-2022-07-25_en

Fluoropolymers are enduring

In the metal construction industry, high-performance coil coatings are used to enhance and protect the steel and aluminum substrates of metal roofs and building panels from corrosion and can withstand wear and tear, resist color fading and the chalking effects of UV light and high temperatures. Thus protected, the substrate can be recovered and recycled.

Traditionally, the best-performing coatings are Polyvinylidene Fluoride (PVDF) based. These fluoropolymer (FP) coatings can protect buildings in extreme environmental conditions such as salty marine or hot sandy desert locations for up to 40 years or more. It is why FP-based coatings are a popular choice with architects and building specifiers alike.

However, PVDF and another common resin, Fluoroethylene vinyl ether (FEVE), are PFAS—a broad class of chemicals being called into question due to the potential hazards they pose to the environment. PFAS can bioaccumulate over time in humans, animals, and the environment.

Restricted use was first seen in 2016 when the National Toxicology Program concluded two classes of PFAS chemicals, PFOA (Perfluorooctanoic acid), and PFOS (Perfluorooctane Sulfonate) were harmful to the human immune system. Today, in the US all PFAS are being banned in food packaging and their future is under scrutiny by numerous agencies such as the EPA (Environmental Protection Agency).

The discussion on PFAS

There are between 9,000 and 10,000 chemicals categorized as PFAS. They are called 'forever' chemicals because they can bioaccumulate over time in the human body and in the environment. But opinions differ about whether all PFAS are harmful. Different formulations and chemical compositions mean some molecules are less enduring and less toxic. Also, how people are exposed to them alters how harmful they can be; chemicals in the drinking water are more potent than paint on a roof, for instance.

In 2016 the National Toxicology Program concluded two classes of PFAS chemicals, PFOA (Perfluorooctanoic acid), and PFOS (Perfluorooctane Sulfonate) were harmful to the human immune system, and today their use is restricted or banned worldwide.
In the US all PFAS are being banned in food packaging and water, and their future is under scrutiny by numerous agencies such as the EPA (Environmental Protection Agency).
The National Institute of Environmental Health Sciences' (NIEHS)[4] and the EPA are currently analyzing 100 PFAS to find common toxicity patterns and identify which chemicals are hazardous.

The European Commission is planning to go a step further and ban the whole class of PFAS chemicals. If it does, it would be among the most radical chemical legislation ever proposed. The American Chemical Council says Europe's approach disregards individual chemistries' unique properties. Some suggest fluoropolymers (aside from the already restricted PFOS or PFOA) which are included in the broad definition of PFAS have not been shown to be harmful. Other manufacturers like 3M have already declared they will stop all PFAS and fluoropolymer manufacturing or use by 2025.

The ECHA's scientific committee is consulting and will advise the EU Commission on how wide the ban should be or whether, for certain uses, 12-year exemptions could be allowed. Those exemptions may include EV batteries, hybrid engines, renewable energy installations, semiconductors, and medical devices, as they are fundamental to EU policy on achieving net zero carbon emissions. Member states could then introduce legislation by 2026 or 2027. Any exempt PFAS will need to be included in companies' ESG reporting, along with CO_2 emissions. All along the supply chain, coating manufacturers and coaters, builders, and developers, and building owners will need to report as part of the EU's push towards sustainability across all industries.

4. https://www.niehs.nih.gov/health/topics/agents/pfc/index.cfm#:~:text=What%20Are%20PFAS%3F,ingredients%20in%20various%20everyday%20products.

Are there real **PFAS substitutes?**

A recent OECD[5] report cites research conducted by the University of Wisconsin-Milwaukee which found that while the upfront cost of FP (FEVE)-based coatings were over 25% more than a polyurethane system, after three decades, there was a total cost saving of 16% because it didn't need recoating as frequently.

However, Silicone Modified Polyester (SMP) coatings have improved over the decades and are much closer to the durability of PVDF and FEVE coatings. SMP systems can yield tough, highly scratch resistant coatings which can help prevent the corrosion of metal building components. Polyester (PE) and polyurethane (PU) based coatings are often available at a lower cost than PVDF and FEVE coatings.

Interestingly the OECD reported that in 2021, phasing out FP-based coatings would be possible because their use was fairly low in Europe and the Americas (less than 20% of coatings) with Asia using FPs the most (between 24% and 50%). It also found that other sectors use alternative coatings.

For coil coaters, PVDF coatings are used to improve the durability of metal structures. Coated steel and aluminum are known for their resistance to weathering and extended life of building materials. The durability provided by these PVDF coatings means less maintenance and delay in having to replace them. PVDF coatings are also used to improve manufacturing efficiencies. With that in mind, AkzoNobel has developed coating options that do not contain PVDF or FEVE (PFAS based) resins but do meet the coating performance and processing needs specified by coil coaters and architects.

What substitutes for **PVDF and FEVE are available?**

Coatings have evolved over the years and today perform well in almost all circumstances. SMPs for example, have improved and now offer improved color retention and film integrity. The most advanced SMPs, when used with high-grade pigments, can be as good as PVDF and FEVE.

AkzoNobel has continued to improve coatings performance through its Global Weathering Program. Panels prepared with newer formulations are sent to multiple weathering sites across the globe and color and corrosion performance is tracked for years – sometimes over decades. Results are used to drive innovation and improve the coating's performance. AkzoNobel's CERAM-A-STAR® 1050, for example, is an SMP that has a warranty of up to 30-years against chalking and fade, and a warranty of up to 40 years for film integrity. Its color stability equals that of 70% PVDF formulations coatings because of a proprietary resin combined with select ceramic and inorganic pigments.

Polyester coatings can also provide a robust but more economical alternative. They typically have limited flexibility and less durability than PVDF/FEVE or SMPs but have good corrosion protection and chemical and scratch resistance as well as a broad color range and excellent forming properties. Typically, they are used on garage doors or building components with a slightly shorter expected life or in milder locations.

Chemically similar to polyesters, polyurethane coatings are more scratch resistant and are especially suitable for pre-painted metal. They can produce high-build coatings, which offer increased durability and improved corrosion and UV resistance. They are commonly used in the EMEA region for roof and wall claddings.

[5] Per- and Polyfluoroalkyl Substances and Alternatives in Coatings, Paints and Varnishes (CPVs) Series on Risk Management No. 70 Report on the Commercial Availability and Current Uses – OECD 2022.

Innovating for a sustainable built environment

The IPCC and governing bodies around the world are urging industries to limit their environmental footprint, with greening the built environment being a vital part of this process. Here sustainability not only includes reducing greenhouse gas emissions from the building and construction of the built environment but also throughout the value chain. It also includes assessing SoC's at every stage to improve safety, and reduce waste that is potentially harmful to both the environment and human health.

More regulation is being introduced globally to drive human activity towards net zero in greenhouse gas emissions and reducing the use of SoC's as quickly as possible.

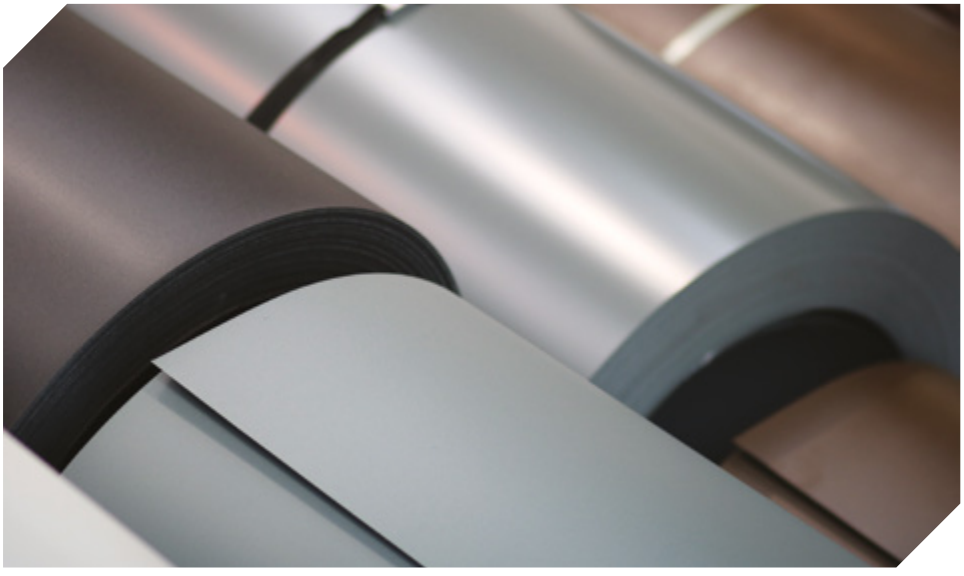
AkzoNobel continues to monitor changes in regulations, and anticipate future trends so that more sustainable solutions are introduced while performance and the overall quality is maintained.

The removal of PFAS for example has become a high priority after the National Toxicology Program concluded two classes of PFAS chemicals, PFOA and PFOS, were harmful to the human immune system (see page 5 'The discussion on PFAS').

Should PVDF and FEVE be regulated out of use as a result of a PFAS ban, AkzoNobel has developed coatings that deliver performance for the building and construction industry and maintain the manufacturing process characteristics necessary for coil coaters to produce high-quality products efficiently.

The coil coating industry also has a pivotal role in the building sector's move towards circulatory and making the built environment more sustainable. Its production processes are already being improved with the aim of reducing carbon emissions which feed into the Scope 3 emissions of its customers. Coil components are created with durability in mind and enable the recycling and reuse of metal substrates, all of which are a priority for the circularity of existing and new buildings.

AkzoNobel is here to help navigate the changing sustainability landscape. Using decades of coating expertise it works with businesses in the built environment, from coil coaters to architects, to create effective, innovative and sustainable solutions. It also advises organizations on how best to protect buildings and at the same time reduce their environmental impact. Together, the coatings and coil manufacturing industries have the opportunity to help architects, developers and specifiers in their quest to a more sustainable built environment.



AkzoNobel also supplies other PVDF containing coatings across the world under other trading names.

To learn more about how you can benefit from conscious coatings please visit: **coilcoatings.akzonobel.com**

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