PFAS

IN BUILDING PRODUCTS

Challenges and Solutions on the Path Towards Circular Construction

COLOPHON

PFAS in Building Materials – Challenges and Solutions on the Path Towards Circular Construction. September 2025.

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The project team consists of experts from the Danish Technological Institute, WSP Denmark A/S, Henning Larsen Architects, Søren Jensen Consulting Engineers A/S, and Green Transition Denmark.

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OVERVIEW OF THE SUPPLEMENTARY REPORTS THE PROJECT GROUP HAS PRODUCED WITHIN THE PROJECT:

'Litteraturstudie om PFAS i byggeriet'.
Udarbejdet af Martha Lewis, Henning Larsen Architects, Anna-Mette Monnelly, Søren Jensen Rådgivende Ingeniører A/S og Katrine Hauge Smith, WSP.

'Konsekvensanalyse for brug af PFAS i byggeriet'.
Udarbejdet af Katrine Hauge Smith, WSP, Rikke Juel Lyng, Teknologisk Institut og Anke Oberender, Teknologisk Institut. Kvalitetssikret af Julie Katrine Jensen, WSP.

'Teknisk rapport – analyse af byggematerialer'.
Udarbejdet af Anke Oberender, Teknologisk Institut. Kvalitetssikret af Katrine Hauge Smith, WSP.

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READING GUIDE

This publication summarizes what we know today about PFAS in construction products. We begin with a series of recommendations for the industry and an introduction to the topic. Then we take a closer look at what international studies indicate and what consequences PFAS in construction can have for the environment and humans. Next, we describe how legislation in the field is currently being formulated and what is being worked on in Denmark and at the EU level. Finally, the results from a series of new tests of building materials are presented along with reflections on how we can use this new knowledge. The purpose of the publication is to uncover how extensive the problem is in the construction industry and which building materials typically may contain PFAS, and then to arrive at recommendations and proposed solutions.

PFAS IN CONSTRUCTION

1.

RECOMMENDA-TIONS FOR THE INDUSTRY

RECOMMENDATIONS FOR THE CLIENT, CONSULTANTS, AND CONTRACTORS

1 Set requirements for manufacturers and suppliers

Request product-specific test results and declarations of building materials in the form of material passports. Additionally, require that the analysis is performed in an accredited laboratory and, if possible, also as an accredited analysis.

Prioritize products where efforts have been made to avoid PFAS.

2 Collaborate with manufacturers and suppliers on good alternatives and request tests

Request documentation for the chemical content in products. This will, in addition to creating more knowledge, contribute to the development of better analysis methods.

Create partnerships that can jointly find suitable alternatives to building materials containing PFAS.

3 Adjust actual needs

Be critical of building materials with special functions, as these are often created using PFAS. Inquire about the chemical content. Consider whether the function is necessary, such as:

- -Water-repellent
- -Stain-resistant
- -Flame-retardant (which can indicate PFAS content, but also includes other flame-retardant chemicals that are also environmentally and health hazardous)
- -Extra durable, extended lifespan

Consider using consultants (architects, engineers, environmental advisors) with knowledge in the field, who specialize in circular construction.

4 Set precise requirements in tenders and support labeling schemes

Create incentives to use building materials that are free from harmful chemicals, for example, through voluntary certifications.

Use threshold values for PFAS as proposed in the PFAS restriction proposal (see fact box).

Recognize companies that lead the way and highlight them as good examples.

5 Handling of materials during renovation

Ensure compliance with current regulations and follow best practices regarding environmental mapping, environmental remediation, and waste management. This ensures that any occurrences of PFAS are handled as effectively as possible.

When testing for PFAS in recycled products, use the proposed threshold values for new materials.

6 Use digital tools for transpa-rency

Use digital tools for transparency.

Implement digital building passports that record whether and where PFAS are included.

Make the information available to the entire value chain for use in later transformation, renovation, and recycling.

RECOMMENDATIONS FOR MANUFACTU-RERS AND SUPPLIERS

1 Map the use of PFAS in materials, building products, and production processes

Be proactive and conduct systematic tests to identify PFAS in existing and new products. As a manufacturer, seek knowledge from your supply chain in the form of documentation of raw materials, ingredients, etc., in your products.

Make the information publicly available so that building products which do not contain the investigated PFAS can be chosen by actors in the construction industry.

2 Investigate the possibility of substitution

PFAS can be designed out of products. Look for alternati-ves to PFAS in your products and document that these alternatives do not have the same or other harmful effects.

3 Educate and inform employees and customers

Develop internal guidelines and training materials about PFAS and alternatives.

Communicate clearly to customers that your company is working to avoid PFAS in its products and describe how you are specifically addressing this task.

Be aware of requirements and guidelines regarding misleading communication. For example, it is not allowed to write PFOA-free, as it is a legal requirement.

4 Use digital tools for transparency

Use digital tools for transparency.

Implement digital material or product passports that declare the contents, including PFAS.

Make the information available to the entire value chain for use in later transformation, renovation, and reuse.

Use independent third parties to assess product data.

2.

INTRODUCTION

"If you're looking for PFAS, you'll find it." This statement often arises among experts, as PFAS is now ubiquitous—in our soil, water, food, and even our blood. In recent years, numerous cases involving these fluorinated substances in our environment have garnered significant public attention. Authorities have conducted sampling of soil, food, water environments, and humans; established taskforces and action plans; and introduced proposals for PFAS bans in Denmark and the EU.

PFAS was previously best known for its use in frying pans and outdoor clothing. However, this chemical group is extensively added to industrial processes and products, primarily due to the substances' resistance to high temperatures and aggressive chemicals. Its widespread application has permeated all sectors of society. The combination of extensive use, poor degradability (persistence), high mobility, strong bioaccumulation potential, and inherent toxicity to humans renders PFAS use a major societal issue[1]. This problem extends far beyond Denmark: various studies indicate that large portions of the European population are exposed to PFAS[2], and a recent mapping by the international Forever Pollution project[3] identified 23,000 contaminated areas across Europe.

The Regions' Knowledge Center for Environment and Resources (VMR) has determined that more than 15,000 sites in Denmark represent potential sources of PFAS pollution in soil, groundwater, and surface water[4]. Major contamination incidents typically originate from factories incorporating PFAS in production, landfills and disposal sites, and areas used for firefighting training. Particularly significant point sources occur where production has historically or currently taken place. Although Denmark has never hosted PFAS manufacturing, these chemicals remain integral to domestic product production.

In addition to point-source pollution, pesticide applications[5] and wastewater discharges[6] substantially contribute to PFAS contamination. Consumer products also cause ongoing pollution, as the chemicals leach out through wear and washing[7]. To address this, the Danish government has imposed restrictions: since July 2025, the sale and import of clothing, shoes, and impregnating agents containing PFAS have been prohibited. Concurrently, the EU has been considering a comprehensive PFAS ban since January 2023, with Denmark as a co-initiator[8].

The pressing need for stricter legislation is underscored in a Nordic Council of Ministers report[9], which estimates that PFAS-related health and environmental impacts cost the European Economic Area (EU, Iceland, Liechtenstein, and Norway) between 52 and 84 billion euros annually. Assessing long-term effects—such as ecosystem damage and diminished vaccine efficacy—poses significant challenges. Therefore, these societal costs must be weighed at least as heavily as industry-estimated expenses when developing new regulations and requirements.

PFAS RESTRICTION PROPOSAL

Due to concerns over uncontrolled conditions in the production and use of PFAS, the substances' poor degradability, and the general tendency to substitute banned PFAS with other "new" PFAS, Denmark—together with four other EU countries—has proposed a restriction on the use of all PFAS under the EU's chemical regulation REACH. The aim is to reduce PFAS emissions to the environment and make products and processes safer for humans.

The proposal encompasses the entire supply chain. Therefore, it covers use in production and import into the EU, as well as content in products found in supermarkets, hardware stores, and similar outlets.

The restriction proposal (ECHA, 2023) lists the following proposed limit values:

- 25 ppb for any PFAS compound measured by target analysis (fluoropolymers are not included)
- 250 ppb for the sum of PFAS measured by target analysis (degradation of precursors can be included via TOP assay; fluoropolymers are not included)
- 50 ppm for PFAS (including fluoropolymers). If the total fluoride (TF) content exceeds 50 mg/kg, the producer must document whether the content is due to PFAS.

The proposal is currently under evaluation in the EU.

FOCUS ON CONSTRUCTION

But is focusing solely on consumer products and contaminated soil sufficient to halt PFAS emissions? Evidence strongly suggests that attention must also turn to the buildings in which we live and work.

The construction sector uses large quantities of materials and building products to which we apply many requirements and expectations. These materials must endure over time, resist fire, repel water and dirt, and harmonize with aesthetic and design intentions. PFAS contributes to several such properties, making its presence highly probable in numerous products and production processes—including paint, varnish, wood, furniture, cardboard, paper, rubber, plastic, metal, and chemical industry operations. In 2016, the Danish Environmental Protection Agency mapped sectors in Denmark utilizing PFAS[10], revealing its extensive application in construction.

Consequently, the sector harbors substantial reserves of this hazardous chemical group, both in existing structures and those planned with new materials.

The former PFAS Knowledge Taskforce, established by the Danish government in 2023, concluded in its report (Baun et al. 2023) that PFAS permeates construction widely, with detections across a broad array of samples. Yet no comprehensive inventory exists regarding its locations or concentrations.

The report states: "Fundamental knowledge is lacking on the content, leaching, and contact-based dissemination of PFAS from building materials—during use, reuse/recycling, and disposal." It further highlights that the ramifications of PFAS for waste reuse and management remain insufficiently examined.

Environmental and health considerations underpin all PFAS discussions. Humans encounter potential health risks from exposure across a building's life cycle. Those producing PFAS-laden materials face hazards, as do construction workers. In the operational phase, risks arise if chemicals migrate into indoor air, influenced by their placement, volatility, and exposure to factors like sunlight and moisture.

Renovation, modification, demolition, and material reuse or recycling introduce further challenges. Pressures for circular construction aim to curb resource and energy use, but PFAS contamination impedes these efforts. Effective management of PFAS-bearing construction waste remains unresolved.

These imperatives prompted a team of experts to launch the project "PFAS in New and Existing Building Materials for Renovation."

The project and this publication seek to furnish the construction industry and policymakers with practical tools to confront this formidable PFAS challenge, which the sector must tackle in the near future amid the circular transition of construction.

The project advances the field by compiling existing international studies—such as the American study "PFAS in Building Materials"[11] published by the Green Science Policy Institute—and gathering knowledge on the consequences of PFAS use in construction. Additionally, tests for PFAS in Danish building products have been conducted as part of the project. Drawing from this body of knowledge, targeted recommendations address both industry practitioners and policymakers.

The project group's work has resulted in several publications. In addition to this publication with recommendations for the construction sector, outputs include a policy recommendations memo, a literature review, an impact analysis of PFAS in building products, and a technical report detailing methodologies and product analyses.

WHAT ARE PFAS?

The common term PFAS encompasses more than 12,000 different so-called per- and polyfluorinated chemicals. They degrade extremely slowly (hence the term "forever chemicals") and accumulate in humans and the environment. They are artificially produced for use in, for example, firefighting foam and industry. Fluorinated substances have unique physical-chemical properties that make products oil-, water-, and dirt-repellent, and are therefore used in items such as pans and other cookware, food packaging, furniture, textiles, paint, and care products. PFAS also possess flame-retardant properties.

Fluorinated substances increase the risk of kidney cancer and testicular cancer, elevated cholesterol levels, changes in liver enzymes, slightly reduced birth weight, high blood pressure in pregnant women, and can additionally reduce vaccine efficacy in children. Moreover, they are suspected of being hormone disruptors, which can, among other things, increase the risk of fertility problems as well as the development of behavioral disorders in children.

FIGURE 1. PFAS FLOW AND THE CONSTRUCTION LIFE CYCLE

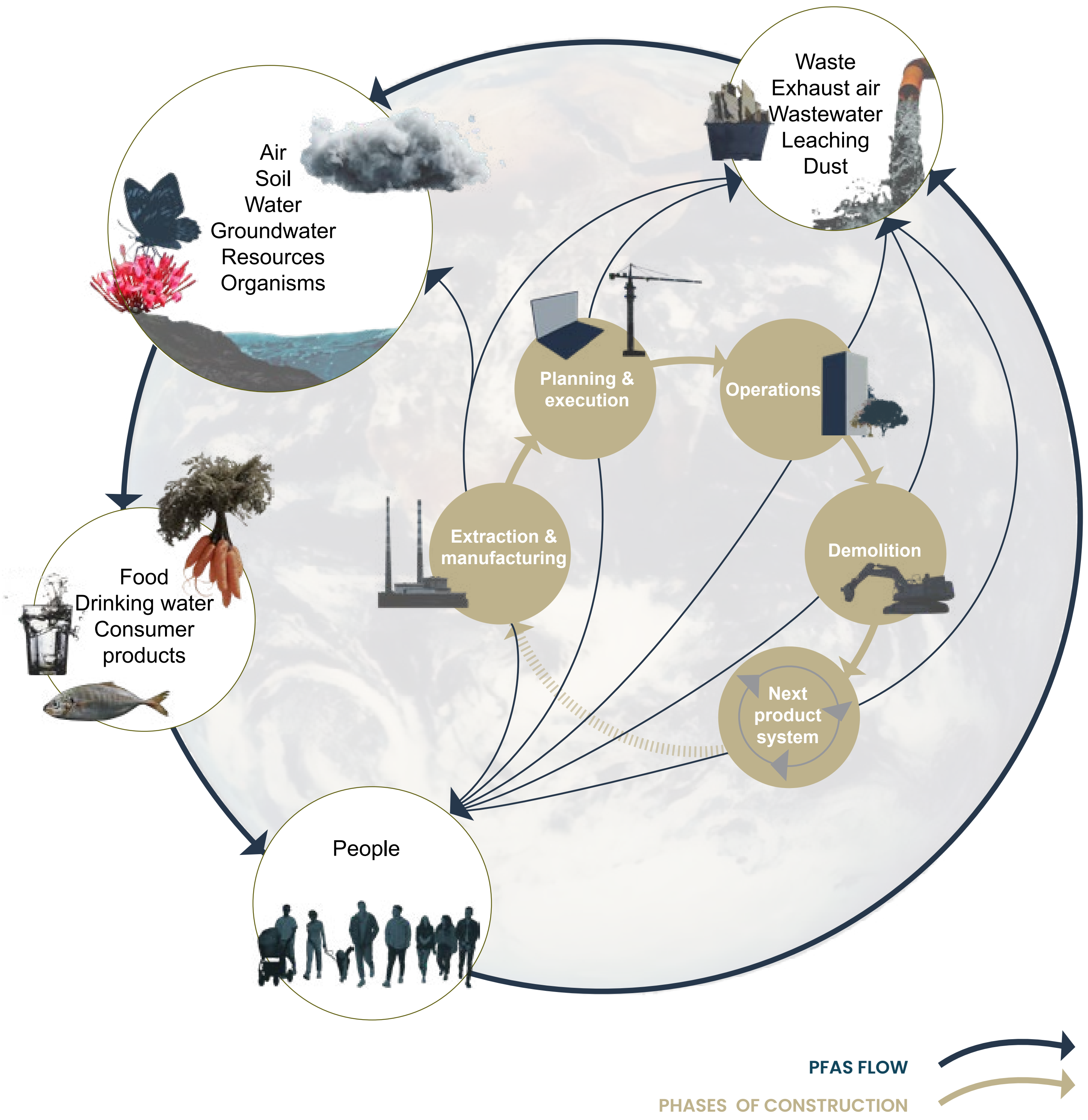

Figure 1. The diagram illustrates how PFAS off-gasses and leaches directly from various phases of a building's life cycle. PFAS circulates in water, soil, air, land and marine environments, organisms, resources, food, and beverages, before transferring to humans. It spreads further through channels such as waste streams. Copyright PFAS IN CONSTRUCTION PRODUCTS 2025. Graphics by Anna-Mette Monnelly and Martha Lewis. Photo rights following the terms by Unsplash.

BACKGROUND ON THE PROJECT 'PFAS IN NEW AND EXISTING BUILDING MATERIALS FOR RENOVATION'

The project investigates and communicates the extensive challenge of PFAS in construction. The aim is to create better oversight and provide knowledge and recommendations to construction stakeholders, enabling them to avoid PFAS. This will reduce risks to humans and the environment while ensuring opportunities for reuse and recycling to benefit the climate.

The team consists of experts from the Danish Technological Institute, WSP Danmark A/S, Henning Larsen Architects, Søren Jensen Consulting Engineers A/S, and the Council for the Green Transition.

The project is funded by the Owners' Investment Fund and Realdania.

3.

PFAS IN CONSTRUCTION PRODUCTS

– THE LITERATURE STUDY

In the construction industry, testing for PFAS or other harmful chemicals in products and materials is generally not conducted during building, renovation, or demolition activities. Safety data sheets typically do not comprehensively disclose all types of PFAS or their specific concentrations, as requirements focus on hazardous substances above certain thresholds rather than exhaustive chemical inventories. Existing knowledge instead derives from studies by researchers or authorities that have examined product databases, patents, product websites, and tested selected building materials.

As part of this project, a comprehensive review of Danish and international studies relevant to PFAS in construction has been conducted. These findings are summarized in a literature study[12], whose purpose is to identify building products containing PFAS and thereby provide an overview of their use in construction materials. In this context, the "PFAS Circle" illustration was developed, drawing on knowledge from five reviewed studies.

The overarching message of the figure is that PFAS can occur in many construction products. This does not necessarily reflect PFAS content in products on the Danish market. However, it offers a strong indication of where to look, serving as a key foundation for selecting Danish market products for PFAS testing in this project (see the section "Testing of Danish Building Products").

Figure 2 displays a wide range of building products in which at least one of the five reports has identified PFAS content (both polymers and non-polymers). Using information from the ITRC PFAS Technical and Regulatory Guidance, the PFAS substances are categorized into one of three PFAS classes[13]:

- Perfluoroalkyl acids
- Polyfluoroalkyl acids
- Fluorinated polymers

F-gases are not documented in this overview. Black lines for some building products extend across multiple rings, indicating multiple PFAS classes found in the same product type. The diagram also reveals whether PFAS is used in the product itself, in surface treatments, or both.

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FIGURE 2. PFAS IN CONSTRUCTION PRODUCTS – A LITERATURE STUDY REVIEW

Figure 2. The PFAS Circle shows building products that, according to a literature review, are likely to contain PFAS. Each building product in the figure is connected to colored circle segments indicating the type of PFAS present in the material and/or its surface treatment. The PFAS Circle was developed and quality-assured by Henning Larsen Architects and Søren Jensen Consulting Engineers A/S. Copyright PFAS CIRCLE 2025. Images used in accordance with Rambøll Adobe Stock Licence. Graphics by Anna-Mette Monnelly and Martha Lewis.

THE FIVE STUDIES INCLUDED IN THE PFAS CIRCLE

Five international studies have been reviewed. The PFAS Circle shows the building products that, according to the reviewed studies, have been found to contain PFAS. Two of the reviewed reports have physically tested a range of building products (Bečanová et al., 2016)[14], (Janusek et al, 2019)[15]. One of the reports is a study of so-called use-categories (Glüge et al, 2020)[16]. One report is a continuation of one of the physical test reports (Knepper and Janousek, 2020)[17]. And the final report is based on reviews of patent applications (Rojello et al; 2021)[18].

4.

CONSEQUENCES FOR HUMANS & ENVIRONMENT

PFAS exhibits a range of documented toxicological effects. Considerable knowledge exists particularly regarding PFOS and PFOA, with around 20 other PFAS substances also relatively well-studied. For the remainder of the chemical group, toxicological or ecotoxicological data remain extremely limited today.

PFAS has been shown, among other things, to act as endocrine disruptors and carcinogens, exhibit immunotoxicity, and produce metabolic effects in humans (Baun et al. 2023). Many investigated PFAS substances are classified as persistent, bioaccumulative, and toxic (PBT) or very persistent and very bioaccumulative (vPvB) under the EU's REACH regulation.

Considering the threshold set by the European Food Safety Authority (EFSA) for daily tolerable intake[19], both humans and the environment are generally overexposed to several of the most well-studied PFAS substances. This raises the question of the extent to which PFAS use in the buildings we inhabit, construct, and demolish impacts humans and the environment.

The overall consequences of PFAS in building products cannot be assessed solely from isolated findings in selected materials. The physicochemical properties and toxicology of individual substances play a role, as does the specific application of the material in construction. Moreover, knowledge of properties and toxicology is lacking for the vast majority of PFAS substances.

Nevertheless, exposure risks can be examined. In the project "PFAS in New and Existing Building Materials for Renovation," current knowledge on this precise issue has been investigated, with results detailed in the report "Impact Analysis of PFAS Use in Construction"[20]. This analysis takes as its starting point the impacts of PFAS use across the entire life cycle of building products.

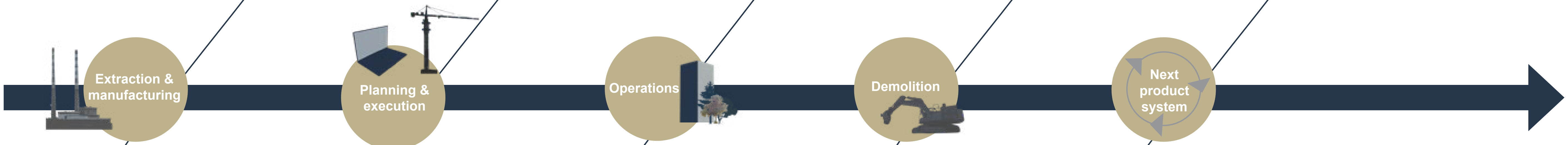
Figure 3 on pages 20-21 presents a summary of the impact analysis, segmented by construction life cycle phases. Most documentation exists on PFAS occurrence and exposure risks during building product manufacturing and the waste phase. Many issues remain unresolved, particularly the consequences of reusing and recycling PFAS-containing building products, which are minimally addressed. Similar gaps apply to incineration of construction waste, where documentation is lacking on the degree of PFAS destruction, required temperatures, and overall incineration effectiveness.

During a building's operational phase, PFAS may release into the indoor environment through dust and air we encounter daily. Substances could also leach from roofs and facades under exposure to sun and rain, entering wastewater and aquatic ecosystems. Knowledge of these risks remains limited, while occupational health concerns during construction, renovation, or demolition are largely undocumented.

PFAS IN CONSTRUCTION

PFAS IN CONSTRUCTION

FIGURE 3. PFAS EMISSIONS IN THE CONSTRUCTION LIFE CYCLE – KNOWLEDGE MAPPING



Extraction & manufacturing

Health:
There is increased risk of PFAS exposure for persons working with PFAS, including the risk of Teflon fever.

Populations in areas with PFAS contamination can be exposed to PFAS through consumption of contaminated food or contaminated water.

Air:
The extent of PFAS emissions to the air through industrial smoke is unknown and is currently being investigated by the Danish Environmental Protection Agency.

Soil and water:
Historic use of PFAS is the cause of many soil and groundwater contaminations in Denmark.

Planning & execution

Health:
Use of PFAS in building products can increase exposure risks for workers, for example through the use of paints and spray products or due to dust formation.

Particular focus on occupational environment and heating, cf. risk of Teflon fever.

Air:
PFAS can spread to the external environment from off-gassing of paint, use of spray products, and dust formation.

Soil and water:
Use and processing of PFAS-containing building materials on construction sites can generate dust, posing a risk of contaminating the external environment.

Operations

Health:
PFAS in dust and indoor air has been detected in foreign studies. A foreign study also shows that paint can be a source of PFAS in indoor air.

PFAS can additionally be applied during the operational phase of buildings, for example through floor polish or similar products.

Air:
The presence of FTOHs in building materials used outdoors indicates a risk of PFAS off-gassing into the atmosphere, where they can be converted into other harmful substances.

Soil and water:
Risk of leaching to the external environment, either directly to soil and water environments or via the wastewater system. In particular, painted facades and fences are assessed to be a potential source.

The presence of PFAS in paint has been confirmed, but leaching has not been investigated.

Demolition

Health:
Demolition of PFAS-containing buildings can potentially expose individuals to PFAS, for example through dust formation.

No knowledge has been found regarding impacts on the working environment during renovation or demolition.

Air:
Processing of PFAS-containing building materials on demolition sites can generate dust, posing a risk of contaminating the external environment.

Soil and water:
Dismantling of heat pumps and other refrigeration systems poses a risk of releasing fluorinated gases. These can be converted to TFA, which has been found in groundwater in Denmark.

Next product system

Health:
Waste management can potentially expose individuals to PFAS, for example through dust formation.

No knowledge has been found regarding impacts on the working environment during waste management.

Air, soil and water:
Waste management of PFAS-containing building materials has a number of risks:

Recycling and reuse
Data is missing.

Material recovery
Concrete and bricks that have been surface-treated with PFAS can release PFAS into the environment.

Incineration
Studies on whether Danish incineration plants destroy PFAS sufficiently have not reached a final conclusion.
Destruction of fluoropolymers has not been studied extensively.

Landfill
Danish studies show extensive findings of PFAS.
This may originate from deposited building materials. Leaching of PFAS from old landfills has been confirmed.

Storage of waste
Studies from Denmark show that PFAS can leach from stored waste.

Wastewater
Studies from Denmark show that wastewater contains PFAS.

Figure 3. Copyright PFAS IN CONSTRUCTION PRODUCTS 2025. Photo rights following the terms of Unsplash. Graphics by Anna-Mette Monnelly, Katrine Hauge Smith and Martha Lewis.

The figure continues on the next page.

5.

WHAT ABOUT REGULATION?

The health and environmental issues associated with PFAS compounds have been known for many years. However, the focus has especially centered on specific fluorinated substances that have been banned following major scandals and public attention. This particularly applies to PFOS, which today is the best-regulated fluorinated substance and has been practically phased out in all applications. Subsequently, PFOA and a few other PFAS substances have also been restricted.

This long-standing one-sided focus on specific fluorinated substances has meant that companies are instead simply choosing other types of PFAS compounds. The use of these has therefore increased dramatically in recent years, and many more types of PFAS substances have entered the market[21].

In the last ten years, the regulation of the use of these substances has intensified at both international and national levels, as more and more is known about the mobility of these substances and their harmful environmental and health effects.

The EU has now established regulations for the use, discharge, monitoring, and management of selected PFAS substances in a number of regulations and directives. Many of these regulatory frameworks are relevant to the value chain in the construction industry, as they set limit values for PFAS in products. For a complete overview, read more on the Danish Environmental Protection Agency's website[22].

Moreover, Denmark has a number of national-specific regulations for PFAS in the environmental sector, where only a few are potentially relevant to the construction industry. At present, there are thus no specific limit values for PFAS in building materials and construction waste. The most significant of the existing rules and requirements will be reviewed in this chapter.

QUALITY REQUIREMENTS & QUALITY CRITERIA

For a wide range of different environments, such as soil and water, Denmark (and the EU) have established environmental quality requirements or criteria. Environmental quality requirements are legally binding limit values that are permitted in different environments, such as drinking water, and should not be exceeded as a rule. They are established in European or Danish legislation. Environmental quality criteria are a tool for, for example, municipalities, that can help set a limit value. The criteria are only advisory.

In recent years, both requirements and criteria for PFAS have been significantly tightened, and they also include more PFAS substances than before[23]. The construction sector, however, will rarely be directly affected by these requirements and criteria, as there typically are not controlled discharges of PFAS from construction to either soil or water. The concern, however, is that PFAS may be released from construction into these various environments through uncontrolled leaching/contamination (for example, through exposure to sun and rain) and through the waste management process.

However, there are a number of national laws and regulations that govern PFAS in applications, some of which follow from EU directives. They are described below.

5.1 WASTE LEGISLATION

Prior to renovation and/or demolition, the developer must, according to § 4 of the Executive Order on the Management of Waste and Materials from Construction and Demolition Work[24], conduct an environmental screening of the building or the affected parts of the building to identify the presence of problematic substances (this also applies to PFAS, although the substance group is not specifically mentioned). The environmental screening must be carried out if the renovation or demolition generates more than 1 ton of waste, or if double-glazed windows manufactured in the period 1950-1977 are being replaced.

If the screening indicates the presence of problematic substances, an environmental mapping must be carried out, which includes analyses of representative samples of the relevant materials. The results of the environmental screening and mapping must, according to the aforementioned executive order, be included in a report to the municipality at least 14 days before the work begins. If it involves demolition work exceeding 250 m^2, the screening and mapping must be included in a demolition plan for selective demolition, which must be submitted to the municipality at least three weeks before the work starts.

Although PFAS is not directly mentioned in the Executive Order on the Management of Waste and Materials from Construction and Demolition Work, PFAS has been detected in construction waste in previous studies. Unlike other problematic substances, there is no limit value for PFAS regarding the handling of construction waste. This makes it difficult, for example, for the environmental mapper to provide recommendations for the proper handling of contaminated material fractions. Additionally, many treatment facilities will not accept waste with PFAS, as it is currently not covered by environmental approvals. Therefore, it will be very difficult to find a suitable treatment facility if PFAS is detected in the waste[25].

5.2 CONSTRUCTION PRODUCTS REGULATION

The revised Construction Products Regulation (CPR)[26], which came into effect on January 7, 2025, contains new provisions that may impact PFAS in construction products. The Construction Products Regulation has been developed in accordance with the Regulation on Ecodesign for Sustainable Products (ESPR). Key points from the Construction Products Regulation include:

1. DIGITAL PRODUCT PASSPORT:

The revised Regulation requires the establishment of Digital Product Passports (DPP) to ensure that construction products comply with requirements related to safety, health, and the environment. The DPP will contain data on substances, technical specifications, and compliance details, stored in 'Technical Documentation', accessible primarily to regulatory authorities. This approach will, however, continue to put the developer/construction industry at a disadvantage in terms of gaining knowledge about the substances in the construction product.

2. ENVIRONMENTAL & HEALTH PROPERTIES:

There is a requirement that construction products must meet minimum standards for environmental and health properties, which may include restrictions on the content of PFAS.

Annex 1. Basic Requirements for Construction Works, Point 3: *"Protection against adverse hygiene and health impacts related to construction works The construction works and any part of them shall be designed, constructed, used, maintained and deconstructed or demolished in such a way that they, throughout their life cycle, do not adversely affect the hygiene or health and safety of construction workers, occupants, visitors or neighbours as a result of any of the following:*

- *the emissions of hazardous substances, volatile organic compounds or hazardous particles, including microplastics, into indoor air;*
- *the emission of hazardous radiation into the indoor environment;*
- *the release of hazardous substances into drinking water or substances which have an otherwise negative impact on drinking water;*
- *the passage of moisture to the interior of the building;*
- *faulty discharge of waste water, emission of flue gases or faulty disposal of solid or liquid waste into the indoor environment"*

3. PUBLIC PROCUREMENT:

There is a requirement that public procurement of construction products must comply with minimum standards for environmental sustainability and opens up the possibility to set more ambitious requirements, which in principle could include restrictions on PFAS content.

From January 8, 2026, all products that are marketed must comply with the new requirements in the Construction Products Regulation. Although the regulation does not specifically mention PFAS, there is a requirement to document the emission of hazardous substances and, where relevant, include information about the construction product's content of hazardous substances. This can include PFAS. In such cases, this information must be included in the product's passport. This means that manufacturers and suppliers of construction products should be aware of the PFAS content in their products.

5.3 EU TAXONOMY

In the work on the EU's Omnibus proposal, the EU Taxonomy for sustainable economic activities is also included, and hence a number of changes, including to Appendix C where various requirements for chemicals are described, are expected.

At the time of publishing the Danish PFAS report, the final wording of the Omnibus changes had yet to be decided. With this English translation, the current requirements in the EU Taxonomy Omnibus proposal text are described below.

Although the EU Taxonomy does not explicitly mention PFAS, these substances fall under the criteria for "Do No Significant Harm" in relation to "pollution prevention and control," which is environmental objective 5. More specifically, it means that the following requirements would address a limited number of PFAS:

- Substances listed in Annexes I or II to Regulation (EU) 2019/1021, (POPs Regulation) except in the case of substances present as an unintentional trace contaminant. This includes the PFAS groups PFOA and PFOS;
- Substances on the EU's chemical legislation, REACH's Candidate List, that occur in > 0.1% (by mass). Selected PFAS substances fall under this category, but the vast majority of PFAS substances are not covered by REACH;
- Substances on the EU's chemical legislation, REACH Annex XVII. Currently this restriction list explicitly identifies two PFAS groups, C9–C14 PFCAs, their salts and related substances and PFHxA, its salts and PFHxA-related substances.

5.4 ACTION PLANS FOR PFAS

THE NATIONAL ACTION PLAN FOR PFAS

Denmark has a national action plan for PFAS for the period 2024–2027[27]. The plan is based on three principles: cleaning up, mitigating and containing PFAS contamination in Denmark. For the construction sector, the areas "mitigation" and "containment" are particularly relevant and may have a direct impact.

In the "mitigation" area, the PFAS action plan aims to limit new inputs of PFAS in Denmark so that workers, the general population and the environment are not exposed to further contamination and exposure. It specifies, for example, the implementation of bans on PFAS in relevant product groups, which may at a later stage come to include construction products. In addition, there is a focus on campaigns to guide public procurers and private companies so they can set appropriate requirements through their purchasing.

On the "containment" area, the intention is to prevent spreading to the environment. Here it is described that knowledge building and enhanced monitoring will form the basis for actions to reduce unacceptable exposure to PFAS. Current projects on PFAS in construction products, as well as similar studies, will contribute to this knowledge building.

There are no concrete requirements for the construction sector in the action plan.

INTERNATIONAL ACTION PLANS

Not many other countries have action plans, but many have significant focus on PFAS. In these countries, the focus is often directed towards the presence of PFAS at current and former production facilities. However, there is also focus on work with binding limit values, increased knowledge building, and waste management. Examples of concrete measures can be found, for example, in France[28] and the Netherlands[29].

CONSTRUCTION SECTOR – SPECIAL ATTENTION

The above means that the construction sector must be aware of legislation covering PFAS in several areas. Here are some of the most important initiatives listed:

- **Screening during renovation/demolition:**
  If renovation or demolition results in the generation of more than 1 ton of waste, § 4 of the Danish Executive Order on the Handling of Waste and Materials from Construction and Demolition Work requires screening and mapping of hazardous substances.
- **Documentation of chemical content in materials:**
  The EU Taxonomy and the Swan Ecolabel require documentation of chemicals in construction products – including PFAS, which are not yet banned but are recommended to be avoided.
- **Monitoring and preparation for future bans:**
  The industry should prepare for new restrictions under, among others, REACH, including planning substitution, monitoring, and communication with suppliers.
- **PFAS in construction products:**
  PFAS are used in a range of different construction products, and the PFAS cycle as well as the test results of Danish construction products (see the section 'Testing of Danish construction products') provide an indication of where PFAS may be present. However, there is very limited knowledge about the extent. Therefore, request declarations of content, safety data sheets, and analysis data from suppliers.

6.

TESTING OF PRODUCTS (DK)

As previously described, international studies show that PFAS can be found in many types of construction products. In this project, we aimed to contribute new knowledge and turned our attention to Denmark. We tested a selection of construction products that were purchased at Danish hardware stores or online, obtained as samples from manufacturers, or collected at construction sites. This effort has been led by the Danish Technological Institute and Henning Larsen Architects. The samples were sent to the accredited analysis laboratory Eurofins, which has conducted the preprocessing, testing, and analysis.

FIGURE 4. PFAS IN CONSTRUCTION PRODCUCTS – LITERATURE REVIEW AND NEW TESTING RESULTS

INDICATION OF PFAS

- (black line) PFAS indicated in other studies and PFAS class identified in the literature study phase of the 2025 Danish Realdania / GI project. The intersection of the black line and the colored circles indicates the PFAS class.
- (red line) PFAS indicated in the testing of the 2025 Danish Realdania / GI project; the class is not identified.

PFAS CLASS: NON-POLYMERS

PER-FLUORO-ALKYL SUBSTANCES & POLY-FLUORO-ALKYL SUBSTANCES

- PFAS is in the product
- PFAS is in a surface treatment of the product
- PFAS is both in the product and in the surface treatment

PFAS CLASS: POLYMERS

FLUOROPOLYMER SUBSTANCES

- PFAS is in the product
- PFAS is in a surface treatment of the product
- PFAS is both in the product and in the surface treatment

Figure 4. The PFAS circle shows construction products that may contain PFAS, based on a literature review of, among other things, tests and patent analyses from a number of published reports. Seven product types are marked in red, indicating, according to the project's test results, a potential PFAS content. The red lines do not indicate PFAS classes, in contrast to the black lines for the other product types. F-gases are not included in the PFAS Circle. The PFAS Circle was developed and quality-assured by Henning Larsen Architects and Søren Jensen Consulting Engineers A/S. Copyright PFAS CIRCLE 2025. Images used in accordance with Rambøll Adobe Stock Licence. Graphics by Anna-Mette Monnelly and Martha Lewis.

The selection criteria for testing consisted of:

- Best-selling construction products in Denmark, based on statistics from a major Danish hardware store
- Business to Business: In certain product categories, focusing on products primarily sold B2B
- An equal distribution of products that are exposed to either outdoor or indoor environments
- Products with established or potential recycling solutions
- Products made of both mineral and bio-based materials
- Uses of PFAS in construction products from the initial literature study (see PFAS Circle).

In Figure 5, you can see how the 44 selected materials are distributed among the product categories.

FIGURE 5. PFAS IN CONSTRUCTION PRODUCTS – PRODUCTS SENT TO TESTING

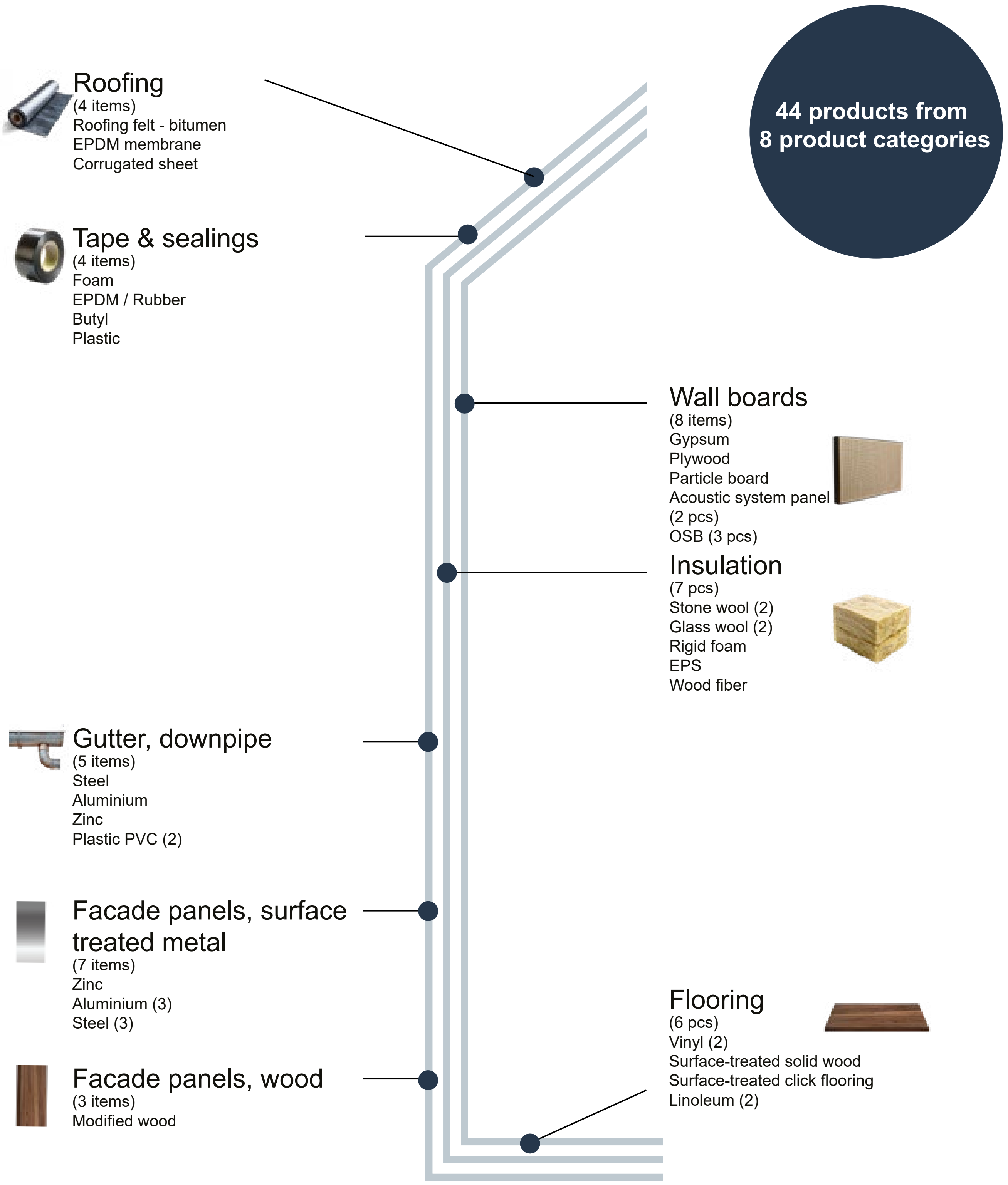


Figure 5. A total of 44 different construction products were selected, distributed across eight product categories. Illustrated based on whether the construction product is exposed to outdoor environments, indoor environments, or encapsulated between two other materials (insulation). Copyright PFAS IN CONSTRUCTION PRODUCTS 2025. Images in accordance with Rambøll Adobe Stock licence. Graphics by Anna-Mette Monnelly and Martha Lewis.

There are currently no analytical methods that can analyze all PFAS compounds. The choice of analytical methods used in this project aligns with the restriction proposal (ECHA, 2023). See the text box on the PFAS restriction proposal earlier in the publication.

For a more thorough review of the selected analytical methods and the reasons they were chosen for analysis, one can read the 'Technical Report - Analysis of Building Materials' (In Danish).[30]

The following tests were conducted:

- Total organic fluorine (TOF) through determination of total fluorine (TF) and total inorganic fluorine (TIF)
- 69 specific PFAS compounds (target analysis)
- For three selected samples, TOP analysis (Total Oxidizable Precursors) was also conducted

FIGURE 6. RESULTS FROM THE STUDY: PFAS IN CONSTRUCTION PRODUCTS – TEST RESULTS

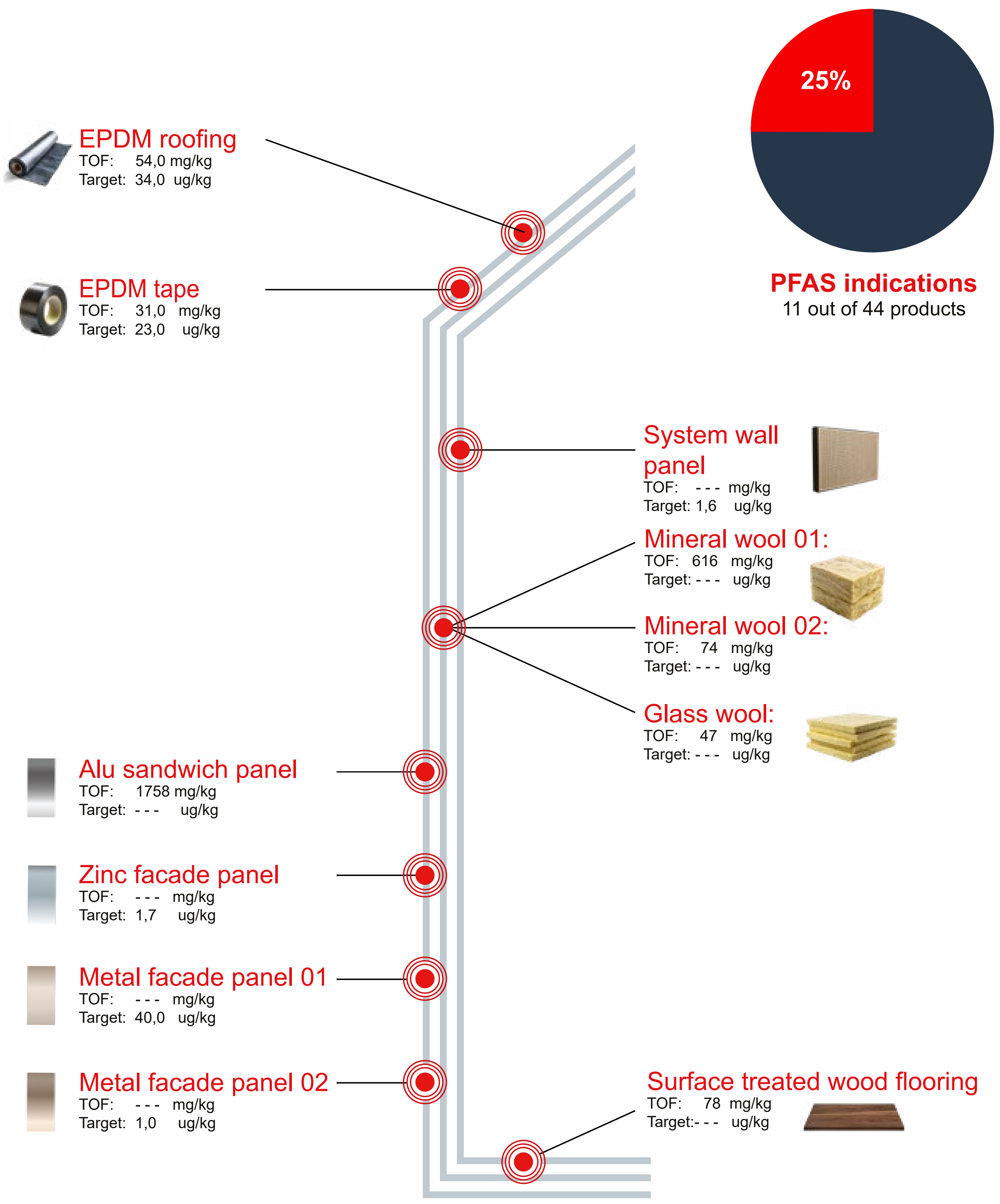


Figure 6. The illustration shows the 11 construction products where the analysis tests indicated the presence of PFAS target substances or suggested PFAS content via TOF analysis. The illustration demonstrates that within a product category, there can be significant variations in whether specific products contain PFAS. Copyright PFAS IN CONSTRUCTION PRODUCTS 2025. Images in accordance with Rambøll Adobe Stock licence. Graphics by Anna-Mette Monnelly and Martha Lewis.

A total of PFAS and organic fluorine compounds were found in 11 out of 44 construction products. Nine construction products could not be tested for total organic fluorine content (TOF) due to sample technical reasons. In the graphics, only results higher than the detection limit of 10 mg/kg for TOF and 1.0 µg/kg for target are indicated. The detection limit solely represents the lowest concentration of a substance at which the analysis method can reliably detect the substance, and thus it does not reflect whether the content level poses a risk or is harmful.

Out of the approximately 12,000 PFAS substances on the market, the target analysis tested for 69 substances. Therefore, a negative test for target substances does not necessarily mean that the construction product from which the sample originates is PFAS-free. Within a product category, there can be significant variations in whether PFAS is present in specific construction products.

The analyses showed the following overall results:

- 8 samples had total fluor (TF) content above the restriction proposal's suggested limit value of 50 mg/kg. This means that, according to the restriction proposal, manufacturers must document that the substance is PFAS, including whether it is organic fluorine.
- TOF (total organic fluorine) was detected in 7 out of 35 samples with concentrations ranging from 31 to 1758 mg/kg, indicating the presence of PFAS.
- PFAS target analysis was conducted for all 44 samples. Specific PFAS compounds were found in 6 out of 44 samples with concentrations ranging from 1 to 40 µg/kg.
- The highest concentrations (20-40 µg/kg) were measured for 6:2 FTOH in three samples, which for two of the tested construction products would mean exceeding the proposed restriction limit value of 25 µg/kg.
- Other detected PFAS compounds included PFBA, MePFBSA, 6:2 FTS, and diSAmPAP with concentrations ranging from 1 to 1.7 µg/kg.
- Of the 44 samples included in the study, it was not possible to perform the TOF determination on 9 products due to the material properties of the products.

HANDLING OF LIMIT VALUES ACCORDING TO THE RESTRICTION PROPOSAL IN THE EU (ECHA, 2023)

INFORMATION REQUIREMENTS: If the total fluorine content (TF) exceeds 50 mg F/kg, the manufacturer, importer, or downstream user must, upon request, provide evidence of whether the fluorine measured as content (TF) originates from PFAS or non-PFAS substances. This evidence must be submitted based on the results of total fluorine (TF) and not by approximating a total PFAS value.

The proposed restriction in the restriction proposal applies unless the manufacturer, importer, or downstream user can demonstrate that the product contains fluorine originating from substances other than those covered by this proposed restriction. This can be done, for example, based on measurement data or information obtained in the supply chain.

If compliance with the 50 ppm limit cannot be sufficiently demonstrated, the mixture or article must be withdrawn from the market, either permanently or until the total fluorine content is reduced within the limit.

The concentration limit has been pragmatically selected to match the sensitivity of the total fluorine analysis methods that are to be used for the measurement and monitoring of PFAS, including polymeric PFAS.

CONCLUSIONS FROM THE STUDY

Overall, our study indicates that PFAS are present in diverse construction products on the Danish market, measured both as total organic fluorine and as specific PFAS compounds. We found PFAS in a range of products that are frequently used in construction and that are all available from ordinary Danish DIY/building retailers. In some of the samples, PFAS levels are so high that the construction product may potentially be difficult to place on the market and make available, should the proposed restriction (ECHA, 2023) be adopted in the EU.

The proposed restriction also appears likely to affect the construction sector and manufacturers in other ways. The sector may soon face a requirement to test for and declare PFAS content, and we see a number of challenges in this regard.

There is no single analytical method that can provide a complete picture of the extent of PFAS in a construction product. An investigation will often require a combination of several analytical methods, and even then it is not possible to obtain a fully comprehensive picture. It is currently not possible to test for all PFAS, and one must instead decide which types to test for and which analytical methods to use. It is in itself problematic that one can only test for a small fraction of the approximately 12,000 different PFAS substances on the market.

In the present study, sample preparations for testing the construction products proved difficult for many samples. A chemical analysis typically requires only a small amount of sample material, and it is therefore both time-consuming and in some cases technically challenging to subdivide especially larger and harder construction products in a representative way.

The TOF analysis could not be carried out for nine samples due to the characteristics of the materials. This indicates that the analytical methods have their limitations, including with regard to which materials they can analyse. In other words, the choice of analytical method is important in relation to the materials (i.e. construction material, water, soil, textile – also referred to as the matrix in an analytical context) that are to be examined.

Matrix effects affected the PFAS target analysis for 17 samples, where certain compounds could not be determined. This means that the composition of the material and the presence of impurities/chemical substances in the material can influence the chemical analysis, which in this case occurred in a relatively large number of analyses.

In any case, there is a need for improvement of the analytical methods, and this requires sufficient demand for PFAS testing in construction products. Developments in the analytical field are driven partly by support for research and development and partly by existing PFAS regulation and the associated demand. More requirements for more tests will create incentives to develop better analytical methods that can also provide a more complete picture of PFAS content in construction products.

7.

SUMMARY

PFAS in construction products is an existing issue that is currently not adequately addressed. At the same time, our literature review and impact assessment show that there is a lack of knowledge, including how high PFAS contents are in Danish construction products and which PFAS substances are involved. Moreover, there is insufficient knowledge about how the sector should avoid these harmful chemicals and how construction and demolition waste containing PFAS should be managed. All stages in the building life cycle are challenged by PFAS, with consequences for both health and the environment.

The PFAS Circle developed in this project shows that PFAS may potentially be present in many construction products and in many parts of a building. For the sector, it can be difficult to obtain information about the substances, because this is typically not declared. There is no requirement for such declaration. Increased demand for this information would have a very positive effect, as it would help create awareness along the value chain and could also become a market asset for products where such information is available. The PFAS Circle thus provides a good indication of where to look and for which product groups one should in particular demand construction products without PFAS content.

A recurring conclusion in the impact assessment is that, in all phases of the building life cycle, there is a potential risk of harm to the environment and human health, but also that there are major knowledge gaps. However, the latter must never lead to inaction on the basis of the knowledge that does in fact exist. In parallel with efforts to collect more knowledge through analyses and mapping, it is therefore crucial to take active steps to reduce PFAS use in the building life cycle. This calls for both political action and concrete measures from the sector. The recommendations in this publication point to concrete actions that will support a circular transition of the built environment.

In recent years, PFAS, for example in drinking water, have been increasingly regulated, both in Denmark and beyond our borders. Unfortunately, the development and availability of analytical methods and technologies to document and manage the PFAS problem are lagging far behind.

NEED FOR DEVELOPMENT OF TESTS AND METHODS

To comply with existing and upcoming requirements on PFAS limit values, far more development is needed in the field of analytical methods. Although PFAS analytical methods are being developed and further refined, there are still a number of challenges associated with PFAS analyses of products, as described in more detail in the "Technical Report – Analysis of Construction Materials"(in Danish). The screening methods remain expensive and time-consuming and require substantial expertise to process and interpret the results. At the same time, the many different types of materials (e.g. wood, metal and mineral wool) that need to be tested make it difficult to standardise the methods.

The number of PFAS substances that can currently be tested for also represents a major limitation on how much you can actually learn and the extent to which you can be sure that your product is completely free of intentionally added PFAS. For example, the so-called TOF analysis (Total Organic Fluorine) makes it possible to determine the total amount of organic fluorine in a material. The disadvantage is that it is not possible to see which specific substance has been detected, and the analysis therefore only serves as an indication of PFAS. Different test methods are often combined to obtain a more complete picture of PFAS content (as in this project), but they will still only reveal a subset. It is therefore important to be aware of the choice of analytical methods when comparing studies of PFAS content. Furthermore, there are major differences in the sensitivity of different analytical methods. TOF analyses are less sensitive than target analyses, in which specific PFAS substances are measured, and therefore do not detect PFAS at concentrations as low as those detected by target analyses. In light of the low environmental limit values for PFAS, this is important to bear in mind.

MORE REUSE AND RECYCLING

If the sector gains more knowledge about PFAS content in construction products, this could also lead to more reuse and better recycling, thereby contributing to the circular transition of the built environment. However, there is a need for limit values to navigate by. Just as there are limit values for PFAS in, for example, drinking water, soil and groundwater, a limit value for PFAS in construction and demolition waste should also be established. Furthermore, when setting such a limit value, we recommend that it is simultaneously ensured that treatment facilities for PFAS-contaminated waste are available, so that the contamination challenge is not left to the sector alone.

As described earlier, in recent years there has been increased PFAS regulation, and more is on the way. A point of concern, however, is that such regulation often only covers PFAS substances that are regulated under REACH and listed on the Candidate List, which represents only a small share of the approximately 12,000 PFAS substances in total. Many PFAS substances will therefore continue to fly under the radar, even when new requirements and rules are introduced.

Our new test results show that PFAS are present in a wide range of construction products, and even at sufficiently high concentrations to fall within the scope of the proposed EU PFAS restriction, if adopted in its current form. This constitutes a major challenge for the construction sector and has negative impacts on both human health and the environment.

The sector alone cannot phase PFAS out of the built environment. Political requirements and regulatory frameworks are needed and must be integrated into the transition to circular construction. At the same time, there are a number of tools available to the sector. We have highlighted those we consider most likely to support healthier buildings, a healthier working environment and cleaner waste streams, while also reducing negative environmental impacts.

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