

Trolldtekt® and sustainability in the built environment

How Trolldtekt contributes to sustainable building certifications.

Sustainability certification of buildings is gaining ground. It is helping to ensure a fact-based and holistic approach to building more sustainably. In the brochure, you can see how Troldekt acoustic solutions contribute to leading certification schemes. You can also read how Troldekt's strategic approach to sustainability has been translated into concrete initiatives.

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Sustainability on formula

Documenting the sustainability initiatives of buildings benefits the environment, indoor climate, user-friendliness, well-being and operating economy.

The voluntary building certifications make it much more manageable to develop more sustainable buildings of high quality. The certifications are a big plus for the people who will use the buildings, for the environment and for the owners of the buildings.

In its Sustainable Buildings Market Study from 2021, Ramboll, the global engineering, architecture and consultancy company, interviewed approx. 700 Nordic, UK and German-based industry stakeholders, including architects, contractors, investors and suppliers. Of the respondents, 94 per cent believe that sustainability is important for running a successful business, 70 per cent see carbon-neutral buildings as a priority, and the majority are already incorporating circular design into their projects.

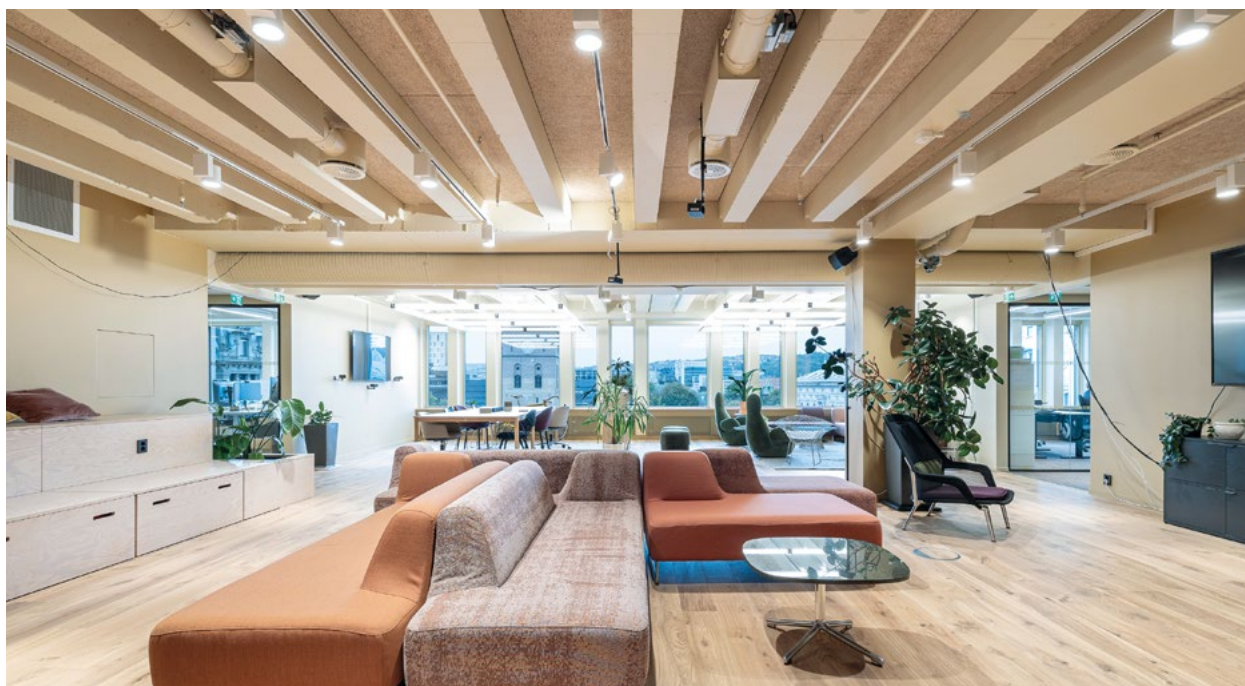
A number of systems exist for the voluntary certification of sustainable buildings. These systems give clients and consultants specific tools for calculating the effect of their various decisions and material choices for sustainability.

How does Trolldtekt contribute?

Trolldtekt acoustic solutions make a positive difference to the certification of buildings. The acoustic panels are made from certified wood from Danish forests (FSC®C115450 and PEFC™) and cement made from Danish mineral resources.

Trolldtekt's business strategy is based on the circular principles of the Cradle to Cradle Certified® concept, and the entire series of Trolldtekt cement-bonded wood wool panels both in natural wood (unpainted) and painted in standard colours is Cradle to Cradle Certified at Gold level.

In collaboration with Ramboll, Trolldtekt has documented how the acoustic solutions contribute positively to the various criteria in a number of certifications. In practice, Ramboll has prepared documentation packages, which help consultants assess Trolldtekt's specific contributions. However, the weighting of the acoustic solutions is always specific to the building in question, including the other material choices.



Project: Stortorvet 7 in Oslo. Architect: DARK Arkitekter.



LEED

LEED (Leadership in Energy and Environmental Design) is administered by the US Green Building Council, and there are LEED-certified buildings in more than 135 countries.

Like several other certification schemes, LEED works to reduce emissions of greenhouse gases from buildings and to promote human health and well-being.

WELL

The International WELL Building Institute™ in the USA administers the WELL certification. The focal point is that buildings must be both healthy and motivating for their occupants.

WELL operates with a number of requirements that have to be met in order to obtain certification – and also a number of scoring criteria that define the certification level.

BREEAM

BREEAM (Building Research Establishment Environmental Assessment Method) is an international sustainability certification for buildings.

BREEAM focuses on ten areas, which include energy, transport, waste as well as health and well-being.

Troldtekt and the circular economy

At Troldtekt, we are working strategically to progress towards a circular economy. The entire range of Troldtekt's cement-bonded wood wool solutions in natural wood (unpainted) and painted in standard colours is Cradle to Cradle Certified® at Gold level.

Since 2012, Troldtekt's business strategy has been based on the internationally recognised Cradle to Cradle product standard. The vision behind Cradle to Cradle Certified is a world where manufacturers design their products for a circular economy – where materials can become part of new cycles.

In practice, our systematic work with the Cradle to Cradle Certified standard means that we hold detailed information about all the substances contained in Troldtekt acoustic panels, right down to 100 parts per million (ppm). Troldtekt acoustic panels are documented as being free of harmful substances and can therefore



Project: The Enterprise Centre at the University of East Anglia, UK. Architect: Architype.

safely be returned to the biological cycle. Additionally, waste from the production of Troldekt acoustic panels is returned to the technical cycle and used as a resource in new cement by Aalborg Portland.

Our ambition is that our cooperation with Aalborg Portland develops to cover building site and demolition waste that currently ends up on municipal recycling centres.

Progress after switching to new paint recipes

In the spring of 2022, Troldekt's acoustic panels advanced two levels from Silver to Platinum in the Material Health category. This paved the way for Troldekt cement-bonded wood wool products to advance towards Gold certification, which was reconfirmed by recertification in 2023.

The advancement from Silver level in Material Health was primarily the result of the introduction of new paint recipes in our production.

The durability-preserving ingredients – biocides – in the paint for the acoustic panels used to be a barrier to obtaining Gold certification. But through intensive work with our paint supplier, we have succeeded in developing a recipe with other durability preservatives that are accepted at Cradle to Cradle Certified™ Gold level.

In 2023, however, Troldekt moved from Platinum to Gold in the Material Health category as a result of stricter requirements in version 4.0 of the Cradle to Cradle Certified product standard without affecting the overall Gold certification.



The entire range of Troldekt cement-bonded wood wool products in natural wood (unpainted) and painted in standard colours is certified in accordance with the Cradle to Cradle Certified product standard at Gold level.

A framework for safe, circular and responsibly manufactured products

The Cradle to Cradle Certified® product programme is essentially a tool for designing and manufacturing more sustainable products. But basing an entire business strategy on the concept is absolutely advantageous.

In 2022, it was 20 years since the seminal book 'Cradle to Cradle: Remaking the way we make things' was published. The book essentially introduced the Cradle to Cradle Certified as we know it today.

We spoke to Dr Christina Raab while she was President & CEO of the Cradle to Cradle Products Innovation Institute, which administers Cradle to Cradle Certified internationally.

Where does the Cradle to Cradle Certified product standard stand in construction today?

"We find progressive developers and builders are increasingly stipulating requirements for Cradle to Cradle Certified product in their tender documents, but it's also increasingly common for the demand to come from the world of finance and investors who want to invest according to ESG criteria."

Christina Raab adds that the major building certifications such as DGNB, LEED, WELL and BREEAM have also helped boost demand for Cradle to Cradle Certified. The schemes recognise certified materials and products and award points for the accordingly. Cradle to Cradle Certified is, essentially, a design concept for product development.

Why does it make sense for a company like Troldekt to make Cradle to Cradle Certified part of its business strategy?






"Working with Cradle to Cradle Certified as a framework tool increases a company's credibility substantially. The requirements are very strict and comprehensive, and it's a third party-verified certification too, which investors, among others, are increasingly asking for," Christina Raab explains.

"Cradle to Cradle Certified can really spark a company's development because it's such a concrete tool for translating commitments into real and measurable action. At the same time, Cradle to Cradle Certified means the company is continuously improving and evolving, enabling companies like Troldekt to stay ahead of the competition," she says.

Christina Raab
Former President & CEO of the
Cradle to Cradle Products
Innovation Institute.



A decade with Cradle to Cradle

	Results 2012-2015	Results 2016-2019	Results 2020-2022
<p>Material health</p> 	<p>Troldtekt acoustic series in natural wood/natural grey and standard colours C2C Certified.</p> <p>Product development based on C2C Certified principles.</p>	<p>As the first private-label products produced for Troldtekt, the wooden strips for Troldtekt® contrast have obtained a Material Health Certificate.</p>	<p>Optimised paint mix, so that the Troldtekt acoustic range in natural wood and standard colours are C2C Certified at GOLD level in material health in 2023.</p>
<p>Material reutilisation</p> 	<p>Recycling of production waste in the biological cycle.</p> <p>Take-back scheme for collecting cement-bonded wood wool construction and demolition waste in Denmark established on a trial basis.</p>	<p>Production waste sorted into a number of fractions to ensure that resources from production waste are recovered at the highest possible value level.</p> <p>Scheme using dust from production as a raw material in new cement from Aalborg Portland established.</p>	<p>Agreement on crushing of panels concluded with external partner with a view to increased recycling in the biological and technical cycles.</p>
<p>Renewable energy</p> 	<p>Ørsted climate partner: 100% renewable energy for electricity consumption (wind power).</p>	<p>New energy-efficient biomass plant run in.</p> <p>Energy consumption per square metre produced has been reduced by approx. 30% compared to 2013.</p> <p>Diesel and gas-powered forklifts have been replaced with electric trucks, so that more than 60% of all trucks are electric.</p>	<p>97.8 per cent of the energy consumed in production comes from renewable sources (wind power and biomass plant).</p> <p>Energy consumption per square metre produced has been reduced by approx. 40% compared to 2013.</p> <p>Diesel and gas-powered forklifts have been replaced with electric trucks, so that 82% of all trucks are electric.</p>
<p>Water stewardship</p> 	<p>No untreated wastewater discharge from production. Water-saving schemes established.</p>	<p>Separate sewerage system for all factory buildings established.</p>	<p>Overflow basin with planting established at new warehouse and logistics facility.</p>
<p>Social fairness</p> 	<p>CSR reporting to UN Global Compact.</p> <p>CSR reporting according to GRI G4.</p> <p>C2C Certified principles introduced into the value chain.</p>		<p>Action plan on noise reduction from the original factory line implemented.</p>



2013



Tier	Basic	Bronze	Silver	Gold	Platinum
Material Health			✓		
Material Reutilisation			✓		
Renewable Energy and Carbon Management				✓	
Water & Soil Stewardship				✓	
Social Fairness			✓		

2014



Tier	Basic	Bronze	Silver	Gold	Platinum
Material Health				✓	
Material Reutilisation				✓	
Renewable Energy and Carbon Management				✓	
Water & Soil Stewardship					✓
Social Fairness				✓	

The tables show developments since 2013 when Troldekt first achieved Cradle to Cradle certification that covered acoustic panels in both natural wood and painted in standard colours.

The Cradle to Cradle Products Innovation Institute has launched version 4.0 of the Cradle to Cradle Certified Product Standard. Troldekt chose to recertify three of the five categories according to the new and more demanding version during a transitional period in 2023. Troldekt is still certified in accordance with version 3.1 in the other two categories.

Categories with certification according to version 4.0:

- Material Health
- Renewable Energy and Carbon Management
- Water & Soil Stewardship

Categories with certification according to version 3.1:

- Material reutilisation
- Social Fairness

Goals for a balanced world

In 2015, UN member countries adopted 17 common goals to ensure the balancing of the environmental and economic dimensions of sustainable development. Troldekt supports all 17 goals, but we have decided to focus on the four goals where we can make the biggest difference.

3 GOOD HEALTH AND WELL-BEING



Contributing to a healthy indoor climate

Troldekt acoustic panels contribute to a healthy indoor climate – both by ensuring good acoustics and because they are made from healthy materials. The panels have been thoroughly analysed in connection with our Cradle to Cradle certification. This means that all the ingredients have been analysed down to 100 parts per million – and that we can document that our acoustic panels do not contain any harmful substances.

Our high material health standards also mean that we sometimes decide to step back from particular courses of action in our product development. Due to uncertainty about the health implications for humans and the environment, we have for example decided not to treat our acoustic panels with the substance titanium dioxide, which may be able to remove NO_x particles from the air.

Under the Danish Indoor Climate Labelling scheme, Troldekt's products are classified in the best categories for degassing and particle release. And finally, Ramboll has documented how Troldekt contributes points under the leading voluntary building certification schemes. In this context, a healthy indoor climate also plays an important role.

12 RESPONSIBLE CONSUMPTION AND PRODUCTION



Products for the circular economy

At Troldekt, we are committed to minimising our environmental impact and to designing products with long useful lives, and which can live on in the circular economy after the end of their lives.

All the electricity we use in production comes from wind power, and the heat for our drying processes is, for example, generated by our own biomass-fired plant. And when it comes to the operation of our trucks, we have almost completely replaced fossil fuels with green energy.

We sort our production waste into fractions to make the most of the resources at the highest possible value level in both the biological and technical cycles. In the biological cycle, we are working with a number of different solutions that will add another role – or cycle – for our cement-bonded wood wool waste before it ends its days as soil conditioner. At Aalborg Portland, dust from our edging workshop is returned to the technical cycle in the production of cement. We have planned a pilot project with several Danish municipalities which will enable us to scale up the scheme and ensure that end-of-life Troldekt acoustic panels from buildings can also be used in cement production.



Certified according to responsible forestry standards

Norway spruce sourced from Danish forests is one of the two primary raw materials used to produce Troldekt acoustic panels, and we buy a lot of raw wood every year. The raw wood is a healthy and sustainable material because trees absorb CO₂ while they grow.

However, sustainability may suffer if account is not also taken of the animals, plants and people working or living in the forests.

This is where the leading certifications for responsible forestry come into the picture. The international FSC and PEFC certification schemes both set certain standards when it comes to biodiversity, working conditions and the conservation of forest areas. We have decided to use only certified wood, and therefore we are certified under both schemes, which means that all Troldekt acoustic panels are FSC or PEFC-certified. Thus, the wood can be traced back to responsible forestry.



Circular economy alliances

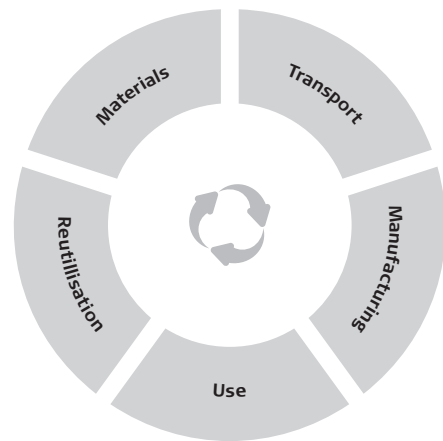
Troldekt works with a number of partners who – like us – are keen to promote circularity in construction.

In Denmark, for example, we have joined forces with FSC Denmark, and together we are calling for more certified forests in Denmark in the public debate. We are also working with Aalborg Portland to derive the greatest possible value from our production waste.

In Germany, we support, among other organisations, Cradle to Cradle NGO, which works to promote the circular economy throughout society, while in Sweden we are a member of Cradlenet, which works for the same purpose. Similarly, we work with several other partners who share our approach – and who are translating principles into action.

Troldtekt acoustic panels from cradle to cradle

Materials, production, transport, use and material reutilisation. Throughout the product life cycle, Troldtekt is committed to optimising resource consumption and processes to ensure that our acoustic solutions contribute added value. This is the thinking behind the circular approach underpinning Troldtekt's Cradle to Cradle business strategy.



Materials

Troldtekt acoustic panels are made from wood and cement. Troldtekt uses only FSC and PEFC-certified wood sourced from Danish forests. And we are continuously working to reduce the carbon footprint of the cement, which is the binder that gives the panels their strength, durability and fire-retardant properties. In 2022, we launched the first Troldtekt acoustic panels based on FUTURECEM™, a cement type with an approx. 30 per cent lower carbon footprint.



Manufacturing

In recent years, we have invested a double-digit million euro figure in new technology at our factory in Troldhede. This has resulted in lower energy consumption as well as an improved working environment. In 2021, 97.8 per cent of the energy used to produce our acoustic panels came from renewable sources – wind power and biofuels. In the 2017-2020 period alone, we reduced the energy consumption per unit produced by as much as 28.6 per cent.



Transport

Even though transport accounts for a relatively small part of their environmental impact of Trolldtekt acoustic panels, we have a strong focus on minimising emissions from freight as much as possible. We use Danish grown Norway spruce and cement from Aalborg Portland. This means that most of our raw material suppliers are less than 150 km away. In addition to minimising CO₂ emissions, the short distances ensure a high security of supply.



Use

Most north Europeans spend 80-90 per cent of their time indoors. At Trolldtekt, we believe that acoustic comfort and a healthy indoor climate without harmful chemicals are crucially important in buildings. In order to highlight the way in which Trolldtekt benefits the indoor climate and makes it easier to choose healthy materials for building projects, we have achieved a number of approvals and certifications, including Cradle to Cradle, Danish Indoor Climate Labelling and Allergy Friendly Product Award.



Reutilisation

At Trolldtekt, we sort our production waste into a number of fractions to create new value. Cement-bonded wood wool can be returned to the biological cycle as a nutrient or to the technical cycle as a raw material in cement production. Today, offcuts from our edging workshop are used in the production of cement at Aalborg Portland. And we are working to find a way of ensuring that end-of-life Trolldtekt acoustic panels – after min. 50-70 years of life – can also be collected and recycled.

Choose acoustic panels based on certified wood

All Troldekt acoustic panels are either PEFC or FSC certified. This means that Troldekt only uses wood from responsible forestry operations and controlled sources for the production of Troldekt acoustic panels.

Once the raw logs have been debarked and dried for six months, the wood can be used as a raw material in Troldekt acoustic panels.

Troldekt uses only certified wood in production. All of the wood is PEFC-certified, while a proportion of it is also FSC-

“ For the industry that buys the wood, there are requirements for documentation and traceability. So a builder who chooses an FSC-certified product receives documentation that the wood comes from an FSC forest. At the same time FSC-certified wood awards points to the leading building certifications that have been gaining momentum in recent years.

Søren Dürr Grue, CEO at FSC Denmark

certified. This also means that all Troldekt acoustic panels have one of the two certifications. In this way, Troldekt meets the increasing demand from the construction industry for responsibly sourced wood, which is a sign of the industry's green transition. The fact that the wood comes from local forests so that it does not have to be transported by truck over long distances, weighs even more positively in relation to its carbon footprint. With the certifications, we also have documentation that forestry takes into account both biodiversity and the people working in the forests, who must have effective safety equipment and wages according to collective agreements or the equivalent.

Diverse and unspoilt forest

An example of an FSC-certified forest that takes animals and plants into account is Viborg Hedeplantage, from which we source some of the wood for Troldekt acoustic panels. It's a diverse landscape, with long rows of Norway spruce, protected ponds, untouched woodland and areas where the forest floor is teeming with life.

One of the criteria for an FSC-certified Danish forest is the presence of Danish species such as oak and beech. This helps to ensure a diverse forest landscape. At the same time, dead trees and the tops of felled trees must be left on the forest floor to serve as habitats for insects, a minimum of five trees must be left per logged hectare, and a certain proportion of the forest must be left completely untouched.



FSC stands for Forest Stewardship Council®, and is an international non-profit labelling certification scheme for wood and paper which was established in 1994. FSC is based on ten principles for responsible forestry operations. The certification gives equal priority to social, environmental and economic interests.



PEFC (Programme for the Endorsement of Forest Certification) is the biggest forest certification scheme worldwide, and was established in 1999. It is an approved and recognised ecolabel for responsibly sourced wood for consumers.





New premises for the firm Mandrup Arkitekt | Ingenior in Viborg, Denmark.

New type of cement – even more advantages

Troldtekt acoustic panels based on FUTURECEM have a reduced carbon footprint which is – depending on the product type – between 26 and 38 per cent lower than the footprints of Troldtekt based on traditional cement.

The cement in Troldtekt cement-bonded wood wool is responsible for the strength, durability and fireproofing properties of the acoustic panels. However, the cement also accounts for virtually their entire carbon footprint. Therefore, it is something of a breakthrough that you can now choose Troldtekt based on FUTURECEM cement from Aalborg Portland.

Using FUTURECEM, it is possible to look after the climate while preserving all the well-known advantages of Troldtekt acoustic panels.

Cement with a reduced footprint

FUTURECEM exploits the synergies between calcined clay and limestone filler. In this way, much of the fired clinker



in the cement can be replaced, resulting in cement that has an approx. 30 per cent reduced carbon footprint.

The life cycle analysis on which Troldekt's environmental product declarations (EPDs) are based documents that Troldekt acoustic panels based on FUTURECEM have a carbon footprint over their entire life cycle which is:

- 26 per cent lower than that of Troldekt based on grey cement
- 38 per cent lower than that of Troldekt based on white cement.

The entire range of Troldekt cement-bonded wood wool products in natural wood and painted in standard colours is certified in accordance with the Cradle to Cradle Certified design concept at Gold level. The certification also covers Troldekt based on FUTURECEM.

Recycling

In addition to reducing the carbon footprint of the acoustic panels during production, Troldekt is working on various methods of recycling. This will ensure that as little of the embedded CO₂ as possible is released during incineration when the acoustic panels reach the end of their useful life (typically after 50-70 years) – and thus help to reduce their carbon footprint even further.

In fact, offcuts from Troldekt's factory are already being used in the production of new cement at Aalborg Portland. We have planned a pilot project to establish how the scheme can be scaled up to also include cement-bonded wood wool waste from the demolition of buildings.



How Troldekt benefits the indoor climate

In order to highlight the way in which Troldekt benefits the indoor climate and makes it easier for clients and consultants to choose healthy materials for their projects, we have obtained approvals and certifications under a number of schemes.



Project: Børnehaven Humlebien in Svenstrup, Denmark. Architects: Arkitektfirmaet Hovaldt. Certification: DGNB Gold.



Troldtekt acoustic panels are Cradle to Cradle Certified at Gold level. Troldtekt acoustic panels are documented as being free of harmful substances and can therefore safely be returned to the biological cycle. Additionally, waste from the production of Troldtekt acoustic panels is returned to the technical cycle and used as a resource in new cement by Aalborg Portland.



Troldtekt acoustic panels are indoor climate-certified in the best category by Danish Indoor Climate Labelling (under the Danish Technological Institute) – a voluntary labelling scheme for building products and goods and their impact on the indoor climate. The indoor climate label is common to Norway and Denmark and is recognised worldwide.



Troldtekt acoustic panels are classified in the M1 category by the Finnish Indoor Air Association and the Building Information Foundation RTS. The classification system categorises building materials based on emission classes – i.e. how many substances the materials release to the air. Emission class M1 corresponds to the best quality (lowest emission rate).



Troldtekt acoustic panels have earned Allergy UK's Allergy Friendly Product Award. The Allergy Friendly Product Award is only given to products that improve health and well-being for asthma and allergy sufferers. In connection with the award, Troldtekt has been studied and assessed by Allergy UK's panel of consultants and scientific experts.



Troldtekt acoustic panels have been environmentally assessed by the Swedish SundaHus Material Data system and categorised as class A, which comprises products with the smallest negative impact on human health and the environment.




Troldtekt acoustic panels are classified as 'low emission', and thus benefit nature and human health under the voluntary and independent German Blue Angel ecolabelling scheme.



EPDs provide full transparency across products

Consultants and clients have access to new environmental product declarations (EPDs) for the different Trolldtekt cement-bonded wood wool products. The EPDs state, among other things, the carbon footprint from the life cycle of the acoustic panels. The EPDs are third party-verified and can be downloaded online at Trolldtekt and EPD Denmark.

A large outdoor lumber yard with stacks of logs and cut timber under a cloudy sky. The stacks are arranged in rows, with some logs still in their natural bark and others cut into rectangular beams. The ground is a mix of dirt and grass. In the background, there is a line of trees and a cloudy sky.

“ Transparency is crucial for us when making EPDs available. This is why we have separate EPDs for our various products rather than just calculating average values. The assessments of our products' life cycles therefore contain data on more stages than are mandatory for EPDs under the EN 15804-A1 standard. This means that we are ahead of the game with regard to future EPD versions, which will be prepared according to the new EN 15804-A2 standard.

Vibeke Pedersen, Head of R&D, Tech at Troldekt A/S

A number of environmental product declarations (EPDs) now make it easier to get an overview of the total environmental footprint of Trolldtekt's acoustic panels. This is useful when, as a consultant or client, for example, you need to have a building certified as sustainable.

The environmental impact of raw materials, transport, production, use, disposal and the potential for recycling are reflected in the life cycle analysis on which the EPDs are based. Accordingly, the EPDs are a useful tool for consultants and clients when gathering and assessing documentation about building goods.

Transparency and thoroughness have been keywords in working with our EPDs. The assessments of the life cycles of the Trolldtekt products therefore contain data on more stages than are mandatory for EPDs in accordance with the EN 15804+A1 standard. This means that we are at the forefront when it comes to future EPD versions, which will be prepared according to the new standard EN 15804+A2. Furthermore, we have chosen to prepare product-specific EPDs for our various products rather than working with average values.

The actual life cycle analyses have been prepared by Stefan E. Danielsson, MSc, who has been affiliated to the cement manufacturer Aalborg Portland. All 14 EPDs have subsequently been verified and published by Institut Bauen und Umwelt e.V. (IBU), which has a mutual recognition agreement with, among others, EPD Denmark.

New technology reduces carbon footprint

The current EPDs replaced Trolldtekt's previous version from 2014. Since then, Trolldtekt has invested a double-

digit million euro figure in expanding and modernising its production facilities with more energy-efficient technology and the use of renewable energy. This has resulted in a significantly reduced carbon footprint overall (Global Warming Potential).

Trolldtekt acoustic panels are manufactured from Danish wood and cement. Cement production emits considerable amounts of CO₂, but the wood content in the production stage pulls in the opposite direction. This is because wood binds CO₂ when the tree is growing. In addition, the cement means that an acoustic panel absorbs CO₂ during its use stage as a result of the chemical process of carbonatisation.

Circular initiatives hold huge potential

The CO₂ that is stored in the wood is released if the Trolldtekt acoustic panels are incinerated at the end of their useful life (typically after 50-70 years). This impacts stage C4 in the EPDs, which covers disposal.

Different waste scenarios can result in large differences in the declared CO₂ emissions in stage C4 of the EPD. Because Trolldtekt's production is based in Denmark, and because Denmark is our main market, our declarations have to be based on the waste scenario that applies in Denmark, which for cement-bonded wood wool is incineration.

We expect that, within the next few years, it will be possible for end-of-life Trolldtekt acoustic panels to add more value in the circular economy. We have planned a pilot project together with several Danish municipalities which involves collecting cement-bonded wood wool waste for use, for example, as a raw material in new cement at Aalborg Portland. If all goes according to plan, this is expected to result in a reduced carbon footprint.

Separate EPDs for 14 products

Environmental product declarations are a tool for professionals in the construction industry who need to know about the environmental impact of various building materials. Trolldtekt has had 14 product-specific EPDs prepared and third party-verified according to the European standard EN 15804+A1.

The different EPDs take into account:

- > Product type (Trolldtekt acoustics or Trolldtekt A2)
- > the thickness of the acoustic panels (25 mm or 35 mm)
- > the type of cement used to produce the panels (traditional or FUTURECEM)
- > whether the panels are painted or unpainted



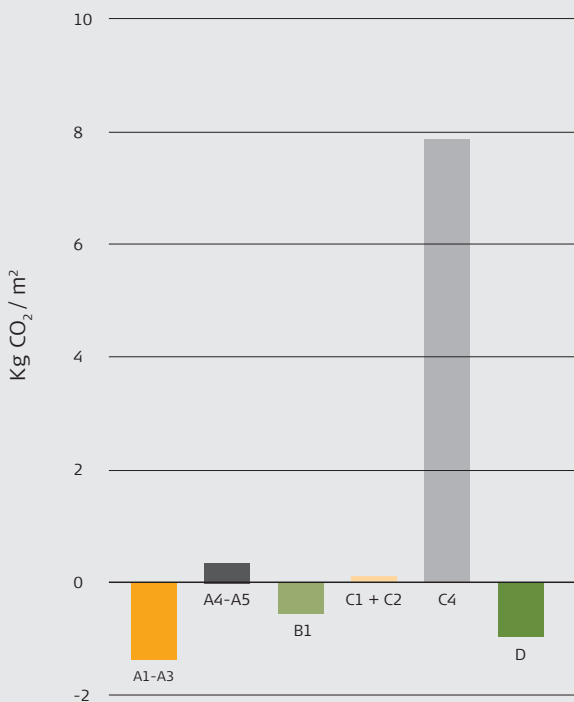
- > Download Trolldtekt's EPDs at www.trolldtekt.co.uk

Complete overview of environmental footprint

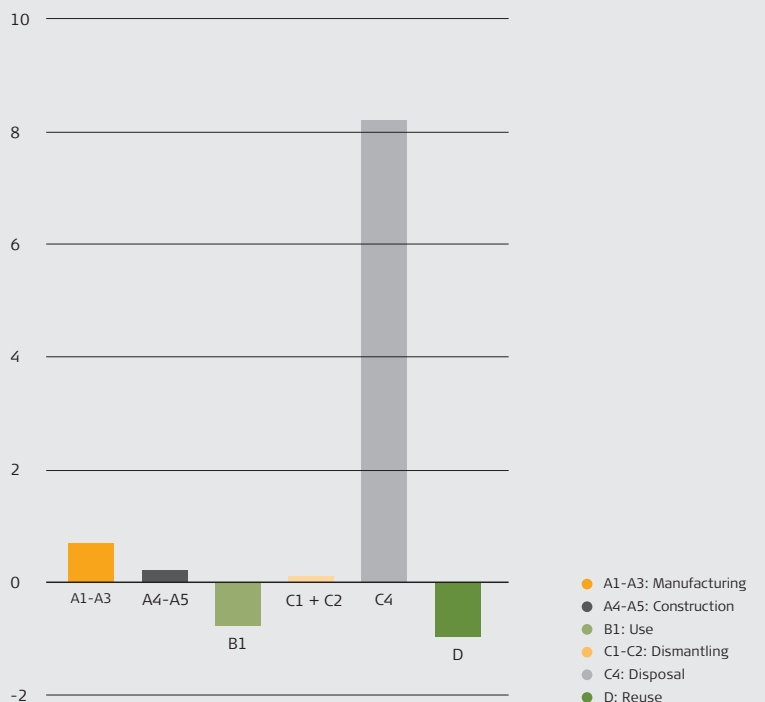
Troldekt's EPDs are prepared in accordance with EN 15804-A1, and cover stages A1-A3, A4-A5, B1, C1-C2, C4 and D. When comparing several products, it is important to conduct the assessment based on the same stages.

Description of the system boundary (x = included in LCA; MND = module not declared; MNR = module not relevant)																	
Product stage			Construction stage		Use stage								End-of-life stage				Benefits and loads beyond the system boundaries
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction/demolition	Transport	Waste processing	Disposal	Reuse/recovery/recycling potential	
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D	
x	x	x	x	x	x	MND	MNR	MNR	MNR	MND	MND	x	x	MND	x	x	

Troldekt based on FUTURECEM



Troldekt based on grey cement



The graphs show the carbon footprint of Troldekt acoustic panels based on either traditional grey cement or FUTURECEM in the various life cycle phases.

FUTURECEM ensures a negative footprint in stages A1-A3, as the wood absorbs more CO₂ while the trees are growing than is emitted during the production of cement, raw material transport and production of the acoustic panels.

During use (stage B), the carbon footprint is negative for all Troldekt acoustic panels because the panels absorb CO₂ via the chemical process of carbonatisation. During disposal (C4), embedded CO₂ is released, and the carbon footprint is therefore positive.

Since the incineration of Troldekt cement-bonded wood wool generates energy that can replace energy from fossil fuels, a negative carbon footprint has also been registered under recycling potential (D).

The total carbon footprint for Troldekt acoustic panels based on traditional grey cement is 7.41 kg CO₂-eq/m² throughout their entire product life cycle, while for Troldekt acoustic panels based on FUTURECEM it is 5.45 kg CO₂-eq/m².

During 2024, we will phase out natural grey for the benefit of FUTURECEM in order to reduce CO₂ emissions.



How Troldekt contributes to

BREEAM

When using BREEAM to certify a building, it is positive that Troldekt is documented as being a healthy material, that the wood in the acoustic panels is sourced from responsible forestry, and that the EPDs map the environmental impact.

BREEAM stands for Building Research Establishment Environmental Assessment Method, and is an internationally recognized certification tool for sustainability in buildings. Both new construction and renovation projects can be certified at five different levels, depending on the building's overall score. 'Outstanding' is the highest rating, which requires more than 85 per cent of the possible points.

At the opposite end is the rating 'Pass', which requires 30-45 per cent of the possible points.

Wood from responsible forestry operations

Several of Troldekt's documented sustainability initiatives count positively towards BREEAM certification. For example, it counts that Troldekt has

↑ The Enterprise Centre at the University of East Anglia has been dubbed the UK's Greenest building. It is also the first large scale building to target both Passivhaus Certification and BREEAM Outstanding (the highest rating), two of the most rigorous sustainability environmental standards. Architects: Archetype

fully documented the raw materials which are used to manufacture the acoustic panels, and that the low level of degassing from the panels has been demonstrated through several indoor climate certifications.

It is also relevant that Troldekt, via EPDs, has documented its environmental impact in the various phases of the product's life cycle.

Moreover, it also counts positively that the wood in the acoustic panels comes from responsible forestry operations (FSC and PEFC).

In addition, Troldekt's acoustic properties have a positive impact.

Troldtekt can contribute to ten out of 46 criteria



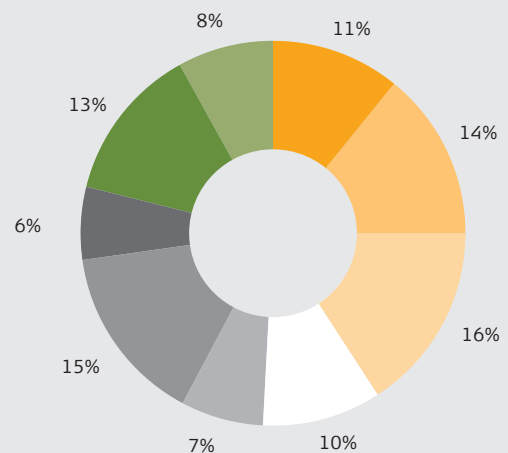
The manuals for BREEAM UK certification are divided into nine sustainability categories which each cover a number of credit-scoring criteria. 'Innovation' is a tenth category to which no criteria are attached, but which can earn additional credits. Troldtekt contributes towards ten criteria across four assessment categories.

Category	Category weight of 100%	Criterion
Management	11%	Man 03 Responsible construction practices
		Man 04 Commissioning and handover
Health & well-being	14%	Hea 02 Indoor air quality
		Hea 05 Acoustic performance
Materials	15%	Mat 01 Environmental impacts from construction products – Building life cycle assessment (LCA)
		Mat 02 Environmental impacts from construction products – Environmental Product Declarations (EPD)
		Mat 03 Responsible sourcing of construction products
		Mat 06 Material efficiency
Waste	6%	Wst 01 Construction waste management
		Wst 06 Design for disassembly and adaptability

The weighting of the nine categories in the overall assessment:

BREEAM UK

Management	11%	Waste	6%
Health & wellbeing	14%	Land use & ecology	13%
Energy	16%	Pollution	8%
Transport	10%		
Water	7%		
Materials	15%		



The table is based on BREEAM UK NEW CONSTRUCTION, Version 6.0.0

Please note that Troldtekt cannot meet the criterion's entire score, but the acoustic panels have a positive influence on the criterion's overall score.

> [Download the full documentation package at www.troldtekt.co.uk](http://www.troldtekt.co.uk)



How Troldekt contributes to

LEED

Troldekt satisfies the strict documentation requirements for building materials that contribute positively to LEED certification. The use of certified wood and the possibility of recycling also contribute points.

LEED stands for Leadership in Energy and Environmental Design, and is an American certification scheme which is used to certify sustainable buildings in more than 135 countries. Like several other widely used certification schemes, LEED aims to reduce emissions of greenhouse gases from buildings and to promote human health and well-being.

LEED certification covers nine overall areas which have a number of criteria attached. Some criteria are mandatory (prerequisites), while others are voluntary (credits). The total point score determines whether a building can be certified and at which level – certified, silver, gold or platinum.

↑ In Stuveriet – a new office building, which is part of the Masthuggskajen water-front development in Gothenburg (Sweden) – businesses can now rent office space with sea views. The building is seeking to achieve LEED Platinum certification, LEED's top certification for eco-buildings in Sweden. Architects: Erdegaard Arkitekter.

Contributes positively in many ways

Troldekt makes a positive contribution to several criteria in the Materials and Resources and Indoor Environmental Quality (IEQ) categories. Among other things, this is because all the wood in Troldekt acoustic panels is certified in accordance with the leading standards for responsible forestry operations (FSC and PEFC), and because Troldekt, through its Cradle to Cradle certification and several climate certifications, is able to document material health. The acoustic properties of the Troldekt panels also play a role in indoor climate assessments.

In addition, the possibility of returning production waste and cut-offs from Troldekt panels to the biological and technical cycles also makes a positive contribution towards LEED certification. As do the environmental product declarations, which provide full transparency as regards the environmental impact in the various life cycle phases.



Troldtekt can contribute to 22 out of 110 points

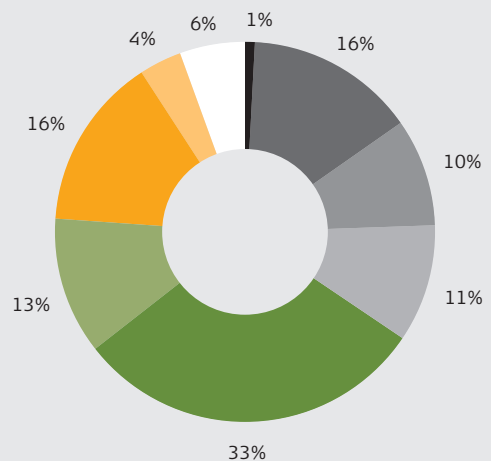
A building can score max. 110 points in a LEED certification. Troldtekt contributes positively towards criteria which account for 22 of the points – corresponding to 20 per cent. The criteria towards which Troldtekt contributes are all within the areas 'Materials & resources' and 'Indoor environmental quality'.

Theme		Points
Materials & resources	Prereq	Construction and demolition waste management – management planning Required
	Credit	Building life-cycle impact reduction 5
	Credit	Building product disclosure and optimisation – environmental product declarations 2
	Credit	Building product disclosure and optimisation – sourcing of raw materials 2
	Credit	Building product disclosure and optimisation – material ingredients 2
	Credit	Construction and demolition waste management 2
Indoor environmental quality	Credit	Low-emitting materials 3
	Credit	Indoor air quality assessment 2
	Credit	Daylight 3
	Credit	Acoustic performance 1

The weighting of the nine areas in the overall assessment:

LEED

● Integrative process	1%	● Materials & resources	13%
● Location & transportation	16%	● Indoor environmental quality	16%
● Sustainable sites	10%	● Regional priority	4%
● Water efficiency	11%	● Innovation	6%
● Energy & atmosphere	33%		



The table is based on LEED version 4.1 New construction.

Please note that Troldtekt cannot meet the criterion's entire score, but the acoustic panels have a positive influence on the criterion's overall score.

> [Download the full documentation package at www.troldtekt.co.uk](http://www.troldtekt.co.uk)



How Troldekt contributes to

WELL

Troldekt ceilings contribute to a healthy indoor climate and good acoustics. This counts towards the WELL certification, which focuses in particular on the health and well-being of users.

The aim of WELL is that a certified building should be healthy and motivating to spend time in. The certification was launched by the American International WELL Building Institute™ in 2014, since when a version 2 has been published which can be used across various building types.

WELL operates with ten so-called concepts, which each have a number of features attached. On top of which, 'Innovation' is an addition to the concepts. Some features are mandatory preconditions, and all of them must be met for the project to be certified in the WELL system. The total number of points within the other features – so-called optimisations – determines at which level the building can be certified.

↑ The EDGE Grand Central Berlin offers state-of-the-art workspace across almost 14,000 m² and has been particularly recognised for the ecological qualities of its construction. Some of the walls feature acoustic elements by Troldekt to ensure essential sound absorption properties. The innovative office building is DGNB Platinum certified and certified according to WELL Gold Core & Shell. Architects: Bolwin Wulf Architekten Partnerschaft mbB, Berlin.

Healthy materials and full transparency

Troldekt contributes towards most of the criteria covered by the concepts Air, Sound and Materials. As regards the Sound concept, Troldekt cement-bonded wood wool's unique sound-absorbing properties have a big impact.

In terms of the concepts Air and Materials, material health in particular plays a key role. In connection with the Cradle to Cradle certification, it is well-documented that Troldekt acoustic panels do not contain substances that are harmful to humans or the environment. And under Danish Indoor Climate Labelling (under the Danish Technological Institute), Troldekt's indoor climate label is in the best degassing and particle emissions categories.

The fact that it is completely transparent which substances can be found in a Troldekt acoustic panel also counts positively as a criterion in WELL.

Troldtekt can contribute to 17 out of 120 features



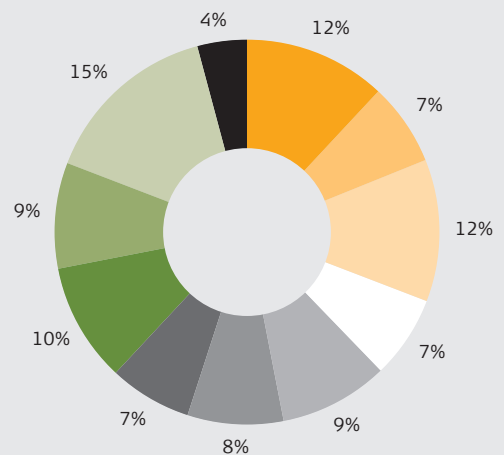
Troldtekt contributes towards 17 of the 120 features in the WELL standard.

Theme	Feature ID	Feature Description
Air	A01	Air quality
	A04	Construction pollution management
	A05	Enhanced air quality
	A14	Microbe and mould control
Light	L05	Visual balance
Sound	S02	Maximum noise levels
	S03	Sound barriers
	S04	Reverberation time
	S05	Sound-reducing surfaces
	S06	Minimum background sound
	Materials	X01
X05		Enhanced material restrictions
X06		VOC restrictions
X07		Material transparency
X08		Materials optimization
X11		Cleaning products and protocols
Community	C04	Occupant survey

Features in the overall rating:

WELL V2 BUILDING STANDARD

● Air	12%	● Sound	7%
● Water	7%	● Materials	10%
● Nourishment	12%	● Mind	9%
● Light	7%	● Community	15%
● Movement	9%	● Innovations	4%
● Thermal comfort	8%		



The table is based on the WELL v2 Q1 2021 Building Standard.

Please note that Troldtekt cannot meet the criterion's entire score, but the acoustic panels have a positive influence on the criterion's overall score.

> [Download the full documentation package at www.troldtekt.co.uk](http://www.troldtekt.co.uk)



C2C LAB: Living laboratory for sustainability

In Berlin, the world's first knowledge centre for Cradle to Cradle was created in a concrete building from the GDR era. The C2C LAB was renovated exclusively with healthy, recyclable building materials. This includes several Troldekt variants on ceilings and walls.

The C2C LAB is located in a residential building from 1986 in the Prenzlauer Berg district of Berlin. Here, architects can now experience and experiment with Cradle to Cradle Certified building materials and material cycles. This is not only ensured by the many training courses, guided tours, expert forums, seminars and workshops that take place in

the laboratory. The house itself is also a prime example of the interior design of an older building with healthy materials.

The building is a so-called Plattenbau using large, prefabricated ferro-concrete slabs, a type of prefabricated



construction method which was typical of East Germany. Today, the premises are equipped sustainably: with plant walls that purify the air, with carpets that bind fine dust, and with office furniture, which are healthy not only for people, but also for the environment.

Cradle to Cradle Certified acoustic solutions

Troldtekt acoustic solutions in various variants have been installed on ceilings and walls and are Cradle to Cradle Certified in gold. The meeting and conference rooms are fitted with Troldtekt ceilings in natural wood, while other meeting rooms and conference walls are clad with grey Troldtekt panels – and with a fascinating mosaic of acoustic panels in natural wood and painted white or grey.

As part of the renovation, the building's ground floor was completely redesigned. The old walls were demolished, and new glass partitions have been used to create eight rooms which are lighter and more open. Old, damaged floors were removed and replaced with carpets and new hard floors. In order to get as much daylight as possible into the ground floor, the window apertures were enlarged and replaced with a modern window system.

The goal is to lead the way

The goal in the renovation and establishment of the C2C LAB is to lead the way in the use of healthy building materials. That's why all the materials used in the 400-square-metre laboratory live up to the strict Cradle to Cradle Certified criteria for healthy products which can be returned to nature or recycled into new products. The building techniques used also met the Cradle to Cradle Certified criteria, which means that no materials have been glued together using foam or other adhesives.





University of East Anglia, England

Project: The Enterprise Centre at the University of East Anglia, UK

Architects: Architype

Troldtekt solution: Troldtekt acoustic panels

The Enterprise Centre at the University of East Anglia has been dubbed the UK's Greenest building. It is also the first large scale building to target both Passivhaus Certification and BREEAM Outstanding (the highest rating), two of the most rigorous sustainability environmental standards.

Arkivernes Hus, Norway

Project: Arkivernes Hus, Norway's Archives situated in Stavanger

Architects: Lund+Slaatto

Troldtekt solution: Troldtekt and Troldtekt Plus acoustic panels

Archive House is a unique building where the historical documents and records of the city of Stavanger and other places are stored and studied. Unusually, the 6600 m² of archive storage area is sited underground and almost equals the 8100 m² of working and public areas above.



Alnatura Arbeitswelt, Germany

Project: New construction of Alnatura Arbeitswelt in Darmstadt, Germany.

Architects: haas cook zemmrich STUDIO2050, Freie Architekten PartG mbH, Stuttgart

Client: Alnatura Foundation, Bickenbach

Troldtekt solution: Troldtekt acoustic panels, Grey 208

With its new corporate headquarters in Darmstadt, Germany, Alnatura, the expanding organic products company, has set new standards in contemporary corporate culture and sustainability. The German Sustainable Building Council (DGfNB) has awarded the new headquarters its highest distinction: a Platinum rating.





Chamberlain Hotel, England

Project: The Chamberlain Hotel in London

Architects: Sibley Grove (interior design)

Troldtekt solution: Troldtekt acoustic panels natural grey

Sustainability and ethical design are the keystone principles of a new underground cocktail bar and all-day dining venue owned by Fuller's Brewery near the Tower of London in central London. The designers have focused on specifying as many Cradle-to-Cradle certified materials as possible.

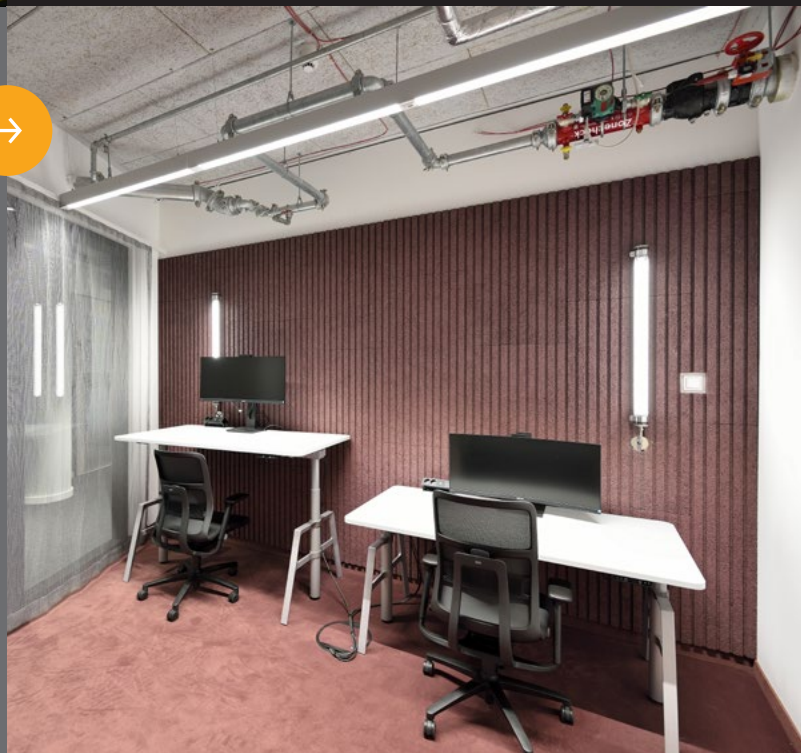
EDGE Grand Central, Germany

Project: EDGE Grand Central Berlin office building and business centre

Architect: Bolwin Wulf Architekten Partnerschaft mbB, Berlin

Troldtekt solution: Troldtekt acoustic panels, custom colours

The EDGE Grand Central Berlin offers state-of-the-art workspace across almost 14,000 m² and has been particularly recognised for the ecological qualities of its construction.



Vestas, Denmark

Project: Vestas Technology R&D Center in western Jutland, Denmark

Architect: Aarhus arkitekterne A/S

Client: Aarhus arkitekterne A/S

Troldtekt solution: Troldtekt acoustic panels natural wood

Vestas Technology R&D Center in western Jutland is the first platinum-certified LEED building in Denmark. The building was designed by architects aarhus arkitekterne a / s who have created a facility which encourages ideas for tomorrow's wind turbines.



Stuveriet, Sweden

Project: Stuveriet, Gothenburg, Sweden

Architects: Erdegard Arkitekter

Troldtekt solution: Troldtekt line, Red custom colour NCS 5030-Y80R

In Stuveriet – a new office building, which is part of the Masthuggskajen water-front development in Gothenburg – businesses can now rent office space with sea views. The design is inspired by the surroundings, and Troldtekt has been selected in a distinctive custom colour for the lower, public areas.

Eminent, Sweden

Project: Eminent office building near Malmö, Sweden

Architects: Kanozi Arkitekter

Troldtekt solution: Troldtekt acoustic panels, natural grey

Employees who thrive perform better. This is Eminent's philosophy and also why its offices were designed to promote the well-being of users, making it the first WELL-certified office building in the Nordic region. Eminent is also Gold-certified by the Sweden Green Building Council.



Pakhuset Braunstein, Denmark

Project: Extension to the Braunstein microbrewery at Køge Harbour, Denmark

Architects: ADEPT

Client: Bryggeriet Braunstein

Troldtekt solution: Troldtekt acoustic panels, natural wood

Pakhuset Braunstein is based on the principles of 'design for disassembly'. This means that the building can be disassembled and moved to another location.

HEALTHY INDOOR CLIMATE SINCE 1935

Troldtekt A/S has been designing, developing and manufacturing Troldtekt acoustic panels since 1935 – from locally sourced raw materials and under modern conditions with minimal environmental impact. Our products are developed and manufactured in Denmark, and distributed in numerous countries around the world.

We are trendsetting

Our vision is to be a trendsetter within intelligent acoustic solutions that focus on a healthy indoor climate. We therefore develop new solutions in close collaboration with industry experts, architects and other building consultants.

We take responsibility

It is important for us to play an important role in society – also for our own sake. We believe companies do well by doing good. We have therefore systematised our social responsibility efforts by committing to the UN Global Compact – the world's largest voluntary corporate social responsibility initiative.

We create added value

The internationally recognised Cradle to Cradle Certified® design concept is a key part of our business strategy. The concept focuses on ensuring that materials add value for the environment, for society and for our business. Through our collaboration with international research and advisory institute EPEA, we ensure that our activities are in line with the international Cradle to Cradle principles.

We are part of a group with ambitious climate goals

Since 2022, Troldtekt has been part of the Kingspan Group, a listed Irish building materials company with operations in more than 70 countries. With its Planet Passionate programme, Kingspan is setting ambitious climate goals that are very much in line with Troldtekt's Cradle to Cradle strategy. Kingspan's ambitious targets include zero waste to landfill and net zero carbon production in 2030.



#troldekt
#goodacoustics

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