LEED

LEED version 4.1

This report documents, how Troldtekt acoustic panels contribute to the sustainable building certification scheme, LEED V4.1New Construction. On behalf of building material manufacturer Troldtekt A/S, Ramboll has composed this report and assembled the documentation that LEED assessors need from Troldtekt in order to achieve the sustainable building certification. This report comes with a ready-to-use "documentation-package" with thorough documentation for each relevant LEED criterion.
Please note that the Troldtekt documentation for the LEED sustainable building certification scheme contains confidential information and will therefore only be given to LEED assessors.

Andreas Qvist Secher, Rambøll Danmark A/S // 29. September 2021

This documentation package was produced for Troldtekt A/S by:	Gitte Gylling Hammershøj Olesen Ramboll Denmark A/S
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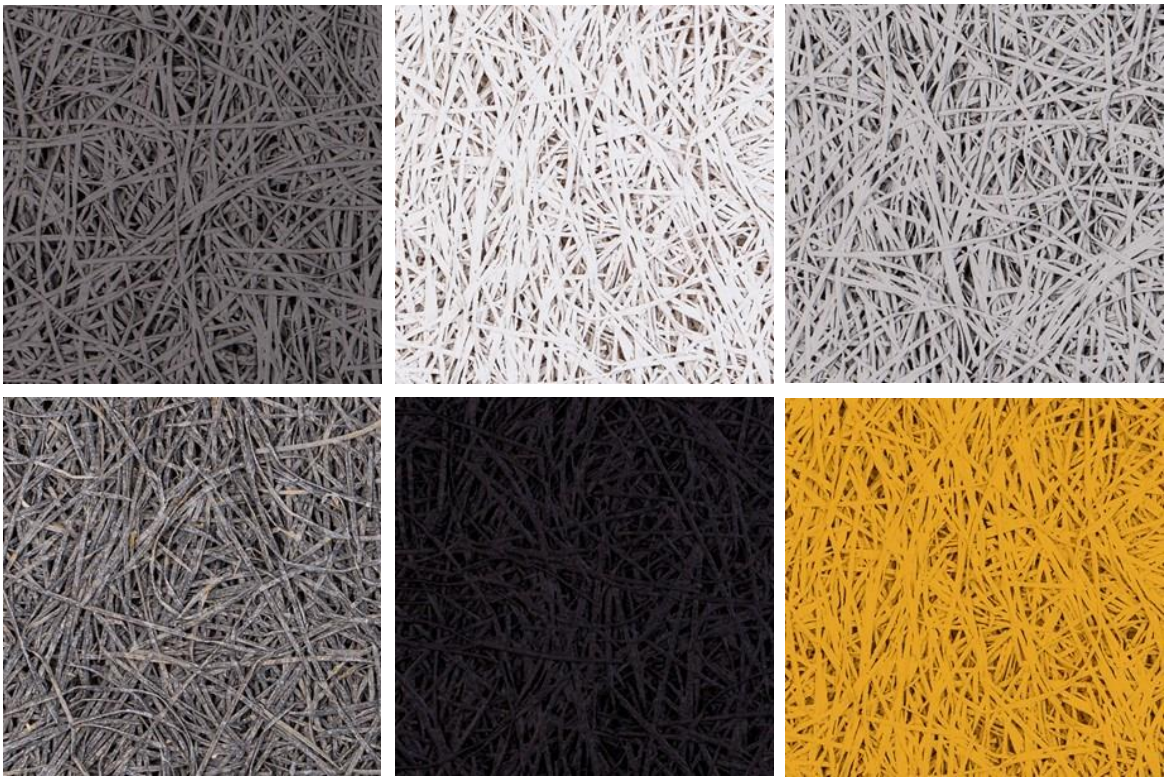
CONTENT IN THE DOCUMENTATION FOLDER

This documentation package for Troldtekt describes the possible positive contribution to a sustainability certification according to the LEED V4.1 for building design and construction. This documentation package is not a sustainability certification or a LEED-certification of Troldtekt's products, but a collection of the documents and information that must be used to document the material in connection with a certification.

Construction materials can be used in different ways and must meet different requirements. Thereby, this documentation package cannot be considered as a certification for construction materials, but more as a well-structured information about the product and its properties. This transparency gives contractors, engineers, and architects the basis to choose the right products for their needs.

Troldtekt acoustic panels consist of natural materials wood and cement extracted from the Danish subsoil. The combination of wood and cement creates Troldtekt's unique sound-absorbing properties and ensures good acoustics in the architecture. The material has a natural strength, withstands humid environments and at the same time provides effective fire protection. Troldtekt acoustic panels are natural product and are documented sustainable throughout the products' life cycle.

When you choose to integrate Troldtekt boards in your building, you ensure a building with good acoustics, a healthy indoor climate, documented sustainability, effective fire protection, natural strength, and flexible design options. It is a product that offers several acoustic solutions, based on the choice of surface structure, edge profile, suspension, colour, board size and board expression.



These photos present some of the colours for Troldtekts panels.

This documentation packed is produced by Mathilde Husted and Rikke Schack, Rambøll Denmark A/S for Troldtekt A/S.
This documentation packed is last updated 13.07.2021

INTRODUCTION TO LEED

LEED is a rating system for the design, construction and operation of high-performance green buildings. For the last 18 years, various versions of LEED have pushed the global green building market forward progressively. LEED was established in 1998 and is the American sustainability certification scheme for buildings. LEED stands for:

Leadership in
Energy and
Environmental
Design

LEED is administered by the U.S. Green Building Council and you can find LEED-certified buildings in more than 135 countries all over the world. You can find more information about LEED at https://www.usgbc.org/leed.

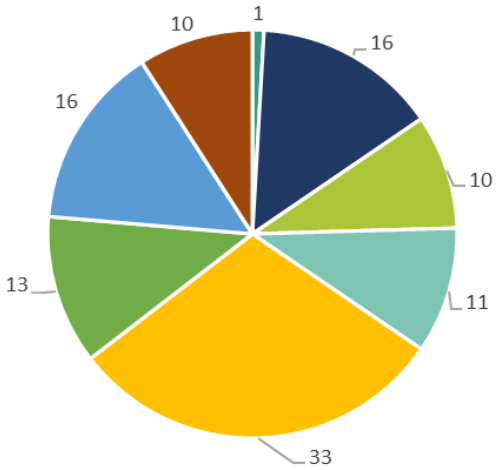
LEED v4.1 is the next generation standard for green building design, -construction, -operations, and -performance. With regions and markets moving at different paces, the new update for the LEED certification system improves the standards, encouraging leadership and creating a more user friendly, accessible, and collaborative platform and certification system. LEED is a system that are stepping up with initiatives to reduce greenhouse gas emissions as well as expanding activities that impact human health and well-being.

LEED helps buildings to focus on efficiency and leadership, and returns of the triple bottom line i.e. people, planet and profit. Today's version of LEED v4.1 raises the bar on building standards based on the following 8 credit.

Integrative Process | Location & Transportation | Sustainable Sites | Water Efficiency | Energy & Atmosphere | Materials & Resources | Indoor Environmental Quality | Innovation + Regional Priority

Projects pursuing LEED certification earn points for various green building strategies across several credits based on the number of points achieved. A project earns one of four LEED rating levels: Certified (40-49 points), Silver (50-59 points), Gold (60-79 points) or Platinum (80+ points).

Below, you will find all LEED-criteria and possible points achievable, for new building construction, and can provide LEED assessors with documentation. Be aware that some criteria require product- as well as project-specific data.
* The number of credits varies according to building type.



This diagram shows the number of criteria for each of the 8 credits.

WEIGHTING OF CREDITS

Integrative process		**1**
Credit	Integrative Process	**1**
Location and Transportation		**16**
Credit	LEED for Neighborhood Development Location	16
Credit	Sensitive Land Protection	1
Credit	High Priority Site	2
Credit	Surrounding Density and Diverse Uses	5
Credit	Access to Quality Transit	5
Credit	Bicycle Facilities	1
Credit	Reduced Parking Footprint	1
Credit	Electric Vehicles	1
Sustainable Sites		**10**
Prereq	Construction Activity Pollution Prevention	Required
Credit	Site Assessment	1
Credit	Protect or Restore Habitat	2
Credit	Open Space	1
Credit	Rainwater Management	3
Credit	Heat Island Reduction	2
Credit	Light Pollution Reduction	1
Water Efficiency		**11**
Prereq	Outdoor Water Use Reduction	Required
Prereq	Indoor Water Use Reduction	Required
Prereq	Building-Level Water Metering	Required
Credit	Outdoor Water Use Reduction	2
Credit	Indoor Water Use Reduction	6
Credit	Cooling Tower Water Use	2
Credit	Water Metering	1
Energy and Atmosphere		**33**
Prereq	Fundamental Commissioning and Verification	Required
Prereq	Minimum Energy Performance	Required
Prereq	Building-Level Energy Metering	Required
Prereq	Fundamental Refrigerant Management	Required
Credit	Enhanced Commissioning	6
Credit	Optimize Energy Performance	18
Credit	Advanced Energy Metering	1
Credit	Grid Harmonization	2
Credit	Renewable Energy	5
Credit	Enhanced Refrigerant Management	1
Materials and Resources		**13**
Prereq	Storage and Collection of Recyclables	Required
Prereq	Construction and Demolition Waste Management Planning	Required
Credit	Building Life-Cycle Impact Reduction	5

Credit	Building Product Disclosure and Optimization - Environmental Product. Declarations	2
Credit	Building Product Disclosure and Optimization - Sourcing of Raw Materials	2
Credit	Building Product Disclosure and Optimization - Material Ingredients	2
Credit	Construction and Demolition Waste Management	2
Indoor Environmental Quality		**16**
Prereq	Minimum Indoor Air Quality Performance	Required
Prereq	Environmental Tobacco Smoke Control	Required
Credit	Enhanced Indoor Air Quality Strategies	2
Credit	Low-Emitting Materials	3
Credit	Construction Indoor Air Quality Management Plan	1
Credit	Indoor Air Quality Assessment	2
Credit	Thermal Comfort	1
Credit	Interior Lighting	2
Credit	Daylight	3
Credit	Quality Views	1
Credit	Acoustic Performance	1
Innovation		**6**
Credit	Innovation	5
Credit	LEED Accredited Professional	1
Regional Priority		**4**
Credit	Regional Priority: Specific Credit	1
Credit	Regional Priority: Specific Credit	1
Credit	Regional Priority: Specific Credit	1
Credit	Regional Priority: Specific Credit	1

LEED V4.1 BUILDING TYPOLOGIES

LEED v4.1 is the newest version of the LEED certification system and contains ll iterations and pilot version since the last version v4.1. For this documentation packages there is a focus on the project type "New constructions and major renovations". The list above, illustrates the various points achievable within the credit, for this type of project

The table presented above lists, as described, all LEED credit. Each credits consists of a number of optional credits and mandatory prerequisites. The marked credits/Requisites indicate where Troldtekts products can have an influence. The highlighted credits/Requisites do not show that Troldtekts products can secure the points, but it describes where Troldtekts products can contribute positively to scoring points in connection with a building certification.

Figure 1 provides an insight into how much of the total LEED score, Troldtekt can have a positive impact on. Troldtekts products will have the greatest influence within the credit of "Materials and Resources" and "Indoor Environmental".

Figure 1: How Troldtekt can possibly influence the LEED credits.

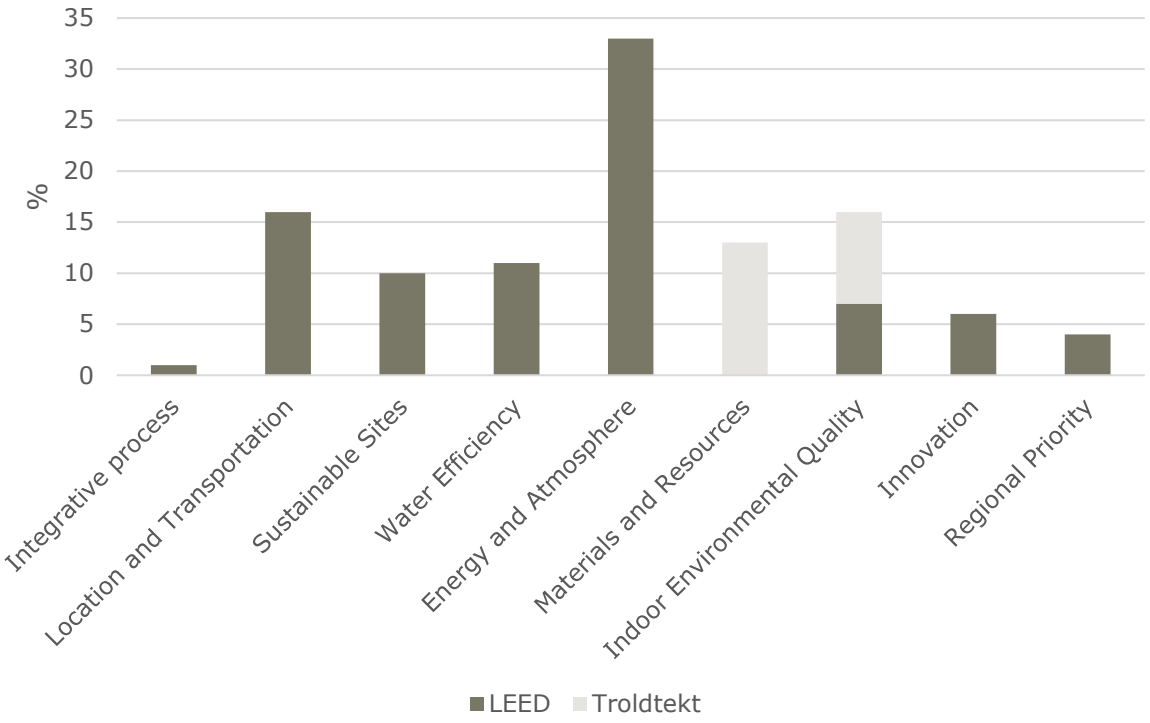
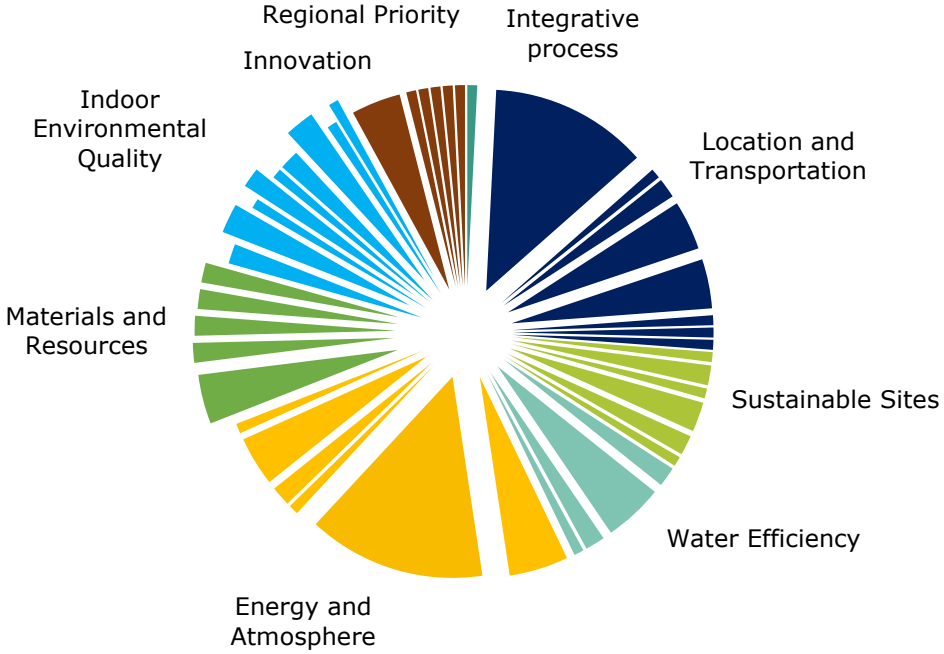


Figure 2 provides an insight into how large an impact Troldtekt's product has on the individual credit for preconditions and optimizations, respectively, as well as how much weight they have in the overall score.

Figure 2: How Troldtekt can possibly influence the LEED Credits



OVERVIEW OF CRITERIA AND DOCUMENTATION

CRITERIA		DOCUMENTATION
Materials and Resources	Construction and Demolition Waste Management Planning	8_Cradle To Cradle_Certificate_2023.pdf 29_Recycling Instructions.pdf
Materials and Resources	Building Life-Cycle impact Reduction	1_EPD_Troldtekt_Natural Wood_Unpainted.pdf 2_EPD_Troldtekt_Natural Wood_Painted.pdf 3_EPD_Troldtekt_Natural Grey_Unpainted.pdf 4_EPD_Troldtekt_Natural Grey_Painted.pdf 5_EPD_Troldtekt_A2-Natural Wood_Unpainted.pdf 8_Cradle To Cradle_Certificate_2023.pdf
Materials and Resources	Building Product disclosure and Optimization – Environmental Product Declarations	1_EPD_Troldtekt_Natural Wood_Unpainted.pdf 2_EPD_Troldtekt_Natural Wood_Painted.pdf 3_EPD_Troldtekt_Natural Grey_Unpainted.pdf 4_EPD_Troldtekt_Natural Grey_Painted.pdf 5_EPD_Troldtekt_A2-Natural Wood_Unpainted.pdf 8_Cradle To Cradle_Certificate_2023.pdf
Materials and Resources	Building Product disclosure and Optimization – Sourcing of raw materials	10_Troldtekt_FSC_Certificate.pdf 11_Troldtek_PEFC_Certificate-pdf.pdf 19_Ørsted_Guarantee of origin_Troldtekt.pdf 29_Recycling Instructions.pdf
Materials and Resources	Building Product disclosure and Optimization – Material Ingredients	6_Okobau_End_of_life_Holzwerkstoffe_in_MVA.pdf 7_Blauer Engel certificat (002).pdf 8_Cradle To Cradle_Certificate_2023.pdf 29_Recycling Instructions.pdf 58.2CEILING PAINT 7344-20_208_20_UK.pdf 59.2_CEILING PAINT 7344-20_WHITE_20_UK.pdf

		62.2_CEILING PAINT 7344-20_'HY 7400 GRÅ ''202'''_2020-09-25_UK.pdf 63.2_TEKNOCRYL AQUA 7346-00_2020-02-20_UK.pdf
Materials and Resources	Construction and Demolition Waste Management	8_Cradle To Cradle_Certificate_2023.pdf 29_Recycling Instructions.pdf
Indoor Environment	Low-emitting materials	13_Troldtekt_Allergy Friendly Product.pdf 16_Danish Indoor Climate Labelling Certificate.pdf 17_M1_EMISSION CLASSIFICATION OF BUILDING MATERIALS.pdf 58.2CEILING PAINT 7344-20_208_20_UK.pdf 59.2_CEILING PAINT 7344-20_WHITE_20_UK.pdf 62.2_CEILING PAINT 7344-20_'HY 7400 GRÅ ''202'''_2020-09-25_UK.pdf 63.2_TEKNOCRYL AQUA 7346-00_2020-02-20_UK.pdf
Indoor Environment	Construction Indoor Air Quality Management Plan	13_Troldtekt_Allergy Friendly Product.pdf 16_Danish Indoor Climate Labelling Certificate.pdf 17_M1_EMISSION CLASSIFICATION OF BUILDING MATERIALS.pdf 58.2CEILING PAINT 7344-20_208_20_UK.pdf 59.2_CEILING PAINT 7344-20_WHITE_20_UK.pdf 62.2_CEILING PAINT 7344-20_'HY 7400 GRÅ ''202'''_2020-09-25_UK.pdf 63.2_TEKNOCRYL AQUA 7346-00_2020-02-20_UK.pdf
Indoor Environment	Daylight	42.1_Technical_data_sheet_Acoustic_EN.pdf 44.1_Technical_data_sheet_Plus_EN.pdf 48.1_Technical_Data_Sheet_Design_EN.pdf
Indoor Environment	Acoustic performance	31_Sound absorption values_Ceilings.pdf 32_troldtekt_sound_absorption_values_EN.pdf

LEED – MATERIALS AND RESOURCES

Construction and Demolition Waste Management Planning

Requirements and Documentation	Weighting
The intention with this credits is to reduce construction and demolition waste disposed of in landfills and incineration facilities by recovering, reusing, and recycling materials. By developing and implementing a construction and demolition waste management plan there will be identify a waste diversion goals for the project and at the same time specify whether materials will be separated or comingled and describe the diversion strategies planned for the project. Troldtekt acoustical panels are both biodegradable and recyclable providing that the product is grinded into small pieces. The packing consists of cardboard and/or foil wrap (plastic). Both waste groups can be recycled on the construction site, however, there is a tendency to recycle the cardboard and incinerate the foil wrap. For documentation in this credits Troldtekt delivers the following documents for the documentation: A. Cradle to Cradle B. Recycling instruction	Prerequisite

LEED – Materials and resources

Building Life-Cycle Impact Reduction

Requirements and Documentation	Weighting
The intention with this credits is to encourage adaptive reuse and optimize the environmental performance of products and materials. Demonstrate reduced environmental effects during initial project decision-making by reusing existing building resources or demonstrating a reduction in materials use through life-cycle assessment. A Life Cycle Assessment (LCA) is completed for the building components with the purpose of reducing the life cycle impact of the project. Troldtekt provides the auditor with following information of the product: A. Troldtekt environmental product declaration (EPD natural unpainted, EPD natural painted, EPD grey unpainted, EPD grey painted and EPD λ2) B. Cradle to Cradle certificate. C. Recycling instruction	2-5 points

LEED – Materials and resources

Building Product Disclosure and Optimization – Environmental Product Declarations

Requirements and Documentation	Weighting
The intention with this credits is to encourage the use of products and materials for which life-cycle information is available and that have environmentally, economically, and socially preferable life-cycle impacts i.e. the availability of Environmental Product Declarations and the type of declaration. Troldtekt provides the auditor with following information of the product: A. Troldtekt environmental product declaration (EPD natural unpainted, EPD natural painted, EPD grey unpainted, EPD grey painted and EPD A2) B. Cradle to Cradle certificate. C. Recycling instruction	2-5 points

LEED – Materials and resources

Building Product Disclosure and Optimization Sourcing of Raw Materials

Requirements and Documentation	Weighting
The intention with this credits is to encourage the use of products and materials for which life cycle information is available and that have environmentally, economically, and socially preferable life cycle impacts. There is a focus on the quality of the data available when assessing the environmental impact of materials used in the building construction.	1-2 points
RAW MATERIAL SOURCING The production of acoustical panels takes place in Troldhede, Denmark. All material suppliers are located in Denmark and the distance from the material suppliers to Troldtekt's production facilities are as follows:	Project specific

Troldtekt acoustic:

Material	Distance from supplier to plant	Content
Cement	160 km	30-40%
Timber	Maximum 150 km	30-40%
Water	1 km	20-25%
Water glass	25 km	0.2%
Accelerator	85 km	0.3%
Other non-recycled material	60 km	10%

Troldtekt A2:

Material	Distance from supplier to plant	Content
Cement	160 km	30-40%
Timber	Maximum 150 km	30-40%
Water	1 km	20-25%
Water glass	25 km	0.2%
Accelerator	85 km	0.3%
Paint	80 km	0.35 kg/m^2 (1m2 = 10 kg)
Other non-recycled material	60 km	10%

Please contact Niels Kappel (NKA@troldtekt.dk) if further information about suppliers is required.

Requirements and Documentation	Weighting
This criterion focuses on the quality of the data available when assessing the environmental impact of materials used in the building construction. The following demonstrates commitment to meeting voluntary standards which promote long-term ecologically responsible land use, reduction of environmental harms from the extraction and manufacturing processes and responsible sourcing of materials: <u>CERTIFIED TIMBER</u> Troldtekt uses FSC and PEFC certified wood in the production of the acoustical panels. Troldtekt must be informed of whether FSC or PEFC certification is required when the order is placed so the correct Chain of Custody number is provided on invoices. The annual average content of certified wood is 70%. The precise percentile is stated on the project invoice. Troldtekt provides assessors with the following: A. FSC certificate B. PEFC-certificate The contractor must provide the assessor with: C. Invoices with the project specific percentile of certified timber and the type of certification <u>RENEWABLE ENERGY SUPPLY</u> All electricity used in production of Troldtekt's acoustical panels is purchased at DONG Energy and a certificate of purchase is enclosed in: D. Guaranty of origin	

LEED – Materials and resources

Building Product Disclosure and Optimization – Material Ingredients

Requirements and Documentation	Weighting
The intention with this credits is to focus on disclosure of chemical compounds used in the production of Troldtekt's acoustical panels. The aim is to identify and reduce potential health risks from building materials utilized in the construction of buildings. Troldtekt acoustical panels are both biodegradable and recyclable providing that the product is grinded into small pieces and a recycling concept has been developed. The packaging consists of cardboard and/or foil wrap (plastic). Both waste groups can be recycled on the construction site, however, there is a tendency that contactors choose to recycle the cardboard and incinerate the foil wrap. Troldtekt provides the assessor with following information about the acoustical panels documenting compliance with OPTION 1. MATERIAL INGREDIENT REPORTING and OPTION 2. MATERIAL INGREDIENT OPTIMIZATION: A. Cradle to Cradle Silver certificate B. Blaue Engel certificate C. TEKNOS Paint, TEKNOS White, TEKNOS Grey & TEKNOS Aqua. The following documentation contains information about the disposal and potential recycling of the acoustical panels: D. Recycling instruction	1-2 points

LEED – Materials and resources

Construction and Demolition Waste Management

Requirements and Documentation	Weighting
The intention with this credits is to focus on reducing construction and demolition waste disposed of in landfills and incineration facilities by recovering, reusing and recycling materials. Troldtekt acoustical panels are both biodegradable and recyclable providing that the product is grinded into small pieces. The packaging consists of cardboard and/or foil wrap (plastic). Both waste groups can be recycled on the construction site, however, there is a tendency to recycle the cardboard and incinerate the foil wrap. Troldtekt provides the assessor with following information of the product: A. Cradle to Cradle certificate B. Recycling concept	1-2 points

LEED – INDOOR ENVIRONMENTAL QUALITY

Low-Emitting Materials

Requirements and Documentation	Weighting
The intent of the criteria is to reduce concentrations of chemical contaminants that can damage air quality, human health, productivity, and the environment. The demand is that a least 90 % of all ceilings, by cost or surface area, meet the VOC emissions evaluation, OR inherently none mitting sources criteria. Troldtekt acoustical panels are provided in a natural and a painted version. Adhesives and sealants are included in the test of the acoustical panels enclosed, demonstrating that the requirements are meet for adhesives and sealants. The panels are tested by the Danish Technological Institute (painted and non-painted) against the Danish Indoor Climate Label. The test focuses on VOC's and Formaldehyde. Products are tested against the ISO 14001 series and the EN717-1 standard. In TEKNOS datasheet it is showed that white 101 panels have a VOC content on 0 g/l. Panels in grey208/202 and black 207 have a VOC content on 2 g/l. A. M1 certificate B. Allergy friendly Product Certificate C. Danisk Indoor Climate Labeling Certificate D. TEKNOS Paint, TEKNOS White, TEKNOS Grey & TEKNOS Aqua.	1-3 points

LEED – Indoor Environmental Quality

Indoor Air Quality Assessment

Requirements and Documentation	Weighting
The intent of the criteria is to establish a better indoor air in the building after construction and during occupancy. Troldtekt acoustical panels are provided in a natural and a painted version. Adhesives and sealants are included in the test of the acoustical panels enclosed, demonstrating that the requirements are meet for adhesives and sealants. The panels are tested by the Danish Technological Institute (painted and non-painted) against the Danish Indoor Climate Label. The test focuses on VOC's and Formaldehyde. Products are tested against the ISO 14001 series and the EN717-1 standard. In TEKNOS datasheet it is showed that white 101 panels have a VOC content on 0 g/l. Panels in grey208/202 and black 207 have a VOC content on 2 g/l. A. M1 certificate B. Allergy Friendly Product Certificate C. Danisk Indoor Climate Labelling Certificate D. TEKNOS Paint, TEKNOS White, TEKNOS Grey & TEKNOS Aqua.	1-2 points

LEED – Indoor Environmental Quality

Daylight

Requirements and Documentation	Weighting
The intent of the criteria is to connect the building occupants with the out-doors, reinforce circadian rhythms, and reduce the use of electrical lighting by introducing daylight into the space. The color of the ceiling influences the lighting requirements, and the ceiling's light reflections effect the volume of light required by the ceiling cladding. Troldtekt acoustic panels easily integrate lighting solutions to maintain even brightness distribution across the ceiling. The total reflectance P8°/diffuse is: Troldtekt acoustic panels white 101 70.8% Troldtekt acoustic panels natural wood 55.2% Troldtekt acoustic panels natural grey 26.3% Troldtekt delivers the following documents for the documentation: A. Technical data sheet Acoustic B. Technical data sheet Plus C. Technical data sheet Design	1-3 points

LEED – Indoor Environmental Quality

Acoustical Performance

Requirements and Documentation	Weighting
The intent of the criteria is to provide workspaces that promote occupants' well-being, productivity, and communications through effective acoustic design. Troldtekt produces acoustical panels that, when implemented correctly in the building design, can facilitate achievements of credits in the LEED system. Troldtekt provides assessors with the following documentation: A. Sound absorption values, celling. B. Sound absorption values., construction C. An acoustical calculator.	1 point