Sustainability Case Study

Stora Enso Building Concepts

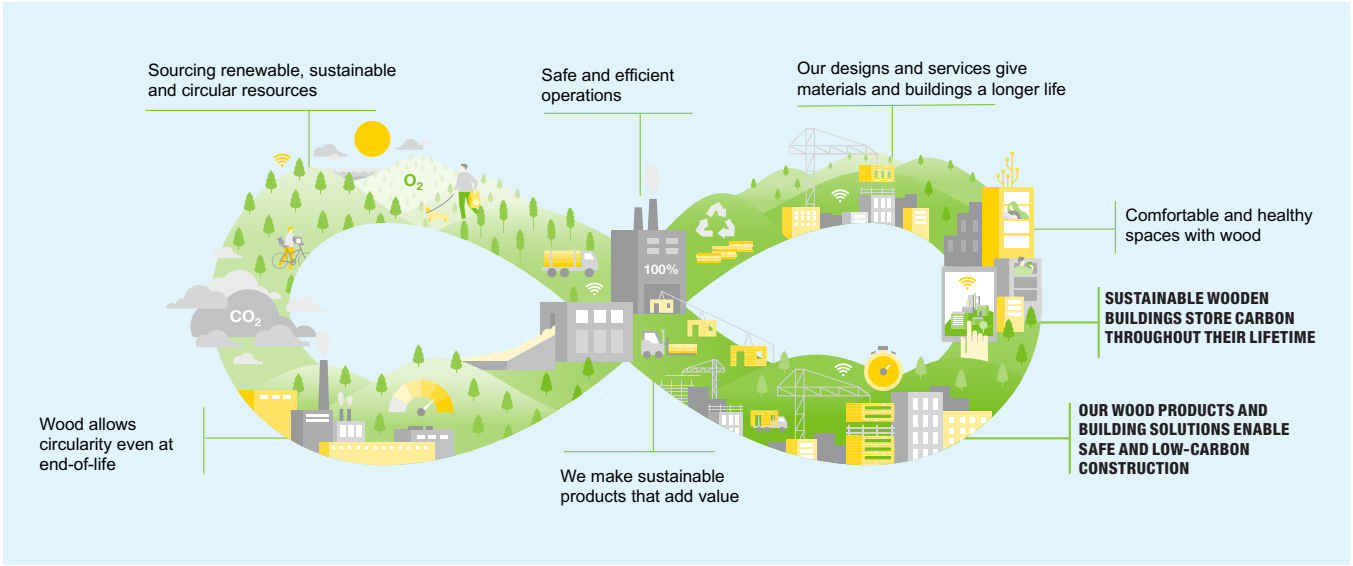
storaenso

Stora Enso's building concepts and life cycle assessments promote low-carbon wood construction

Building Concepts by Stora Enso and life cycle assessment services demonstrate how the company's massive wood products can be incorporated into wooden buildings – to enable low-carbon construction and sustainable buildings that store carbon.

Low-carbon construction & carbon storage

- Wood construction can help achieve net zero carbon buildings and store carbon throughout a building's lifespan.
- Building concepts can play an important role in promoting the early consideration of wood construction and its benefits.
- Life cycle assessment services help communicate the environmental benefits of wood construction.



Introduction

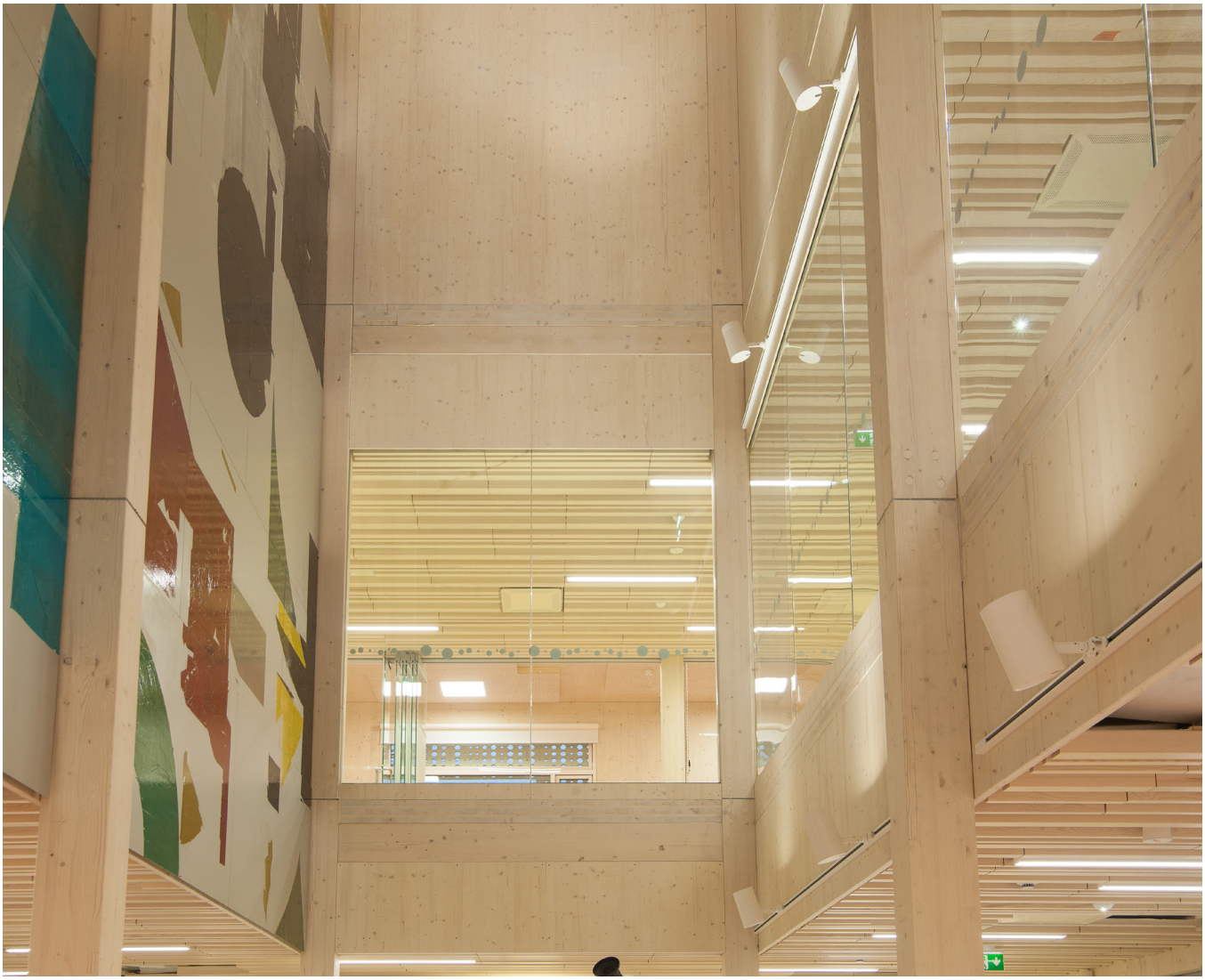
Global challenges and opportunities

The growing global population and urbanisation are driving the demand for more homes, commercial and public buildings in cities around the world with the global floor area in buildings expected to double to more than 415 billion m^2 by 2050[i]. However, as 39% of energy-related CO_2 emissions globally are from buildings and construction[ii] – with concrete, steel and bricks representing between 8–15% of total global emissions and 40% of global materials used in construction[iii] – we need to decarbonise the building sector. Wood products offer cost-competitive, low-carbon and renewable alternatives to concrete and steel construction. They also help streamline construction by speeding up processes and reducing disruption, as well as storing carbon throughout their lifespan.

A leader in massive wood construction

Stora Enso Wood Products is transforming from a traditional classic sawn products manufacturing company into a leading provider of innovative and sustainable wood-based solutions. These include cross laminated timber (CLT), laminated veneer lumber (LVL), glued laminated timber (GLT) and a wide variety of related further-processed products that provide added value to customers and society.

Stora Enso's Wood Products is the largest supplier of wooden construction material in Europe and the fourth largest in the world with over 17 production units in 10 different countries. CLT panels are produced in Austria and Sweden, and LVL panels in Finland.



Green building leadership

By producing and promoting building concepts, Stora Enso works to overcome the barriers to incorporating wood products in buildings – and ultimately achieve low-carbon construction. It does this by promoting so-called project delivery ecosystems that bring together and inspire the various actors throughout the value chain to cost effectively deliver better and more sustainable buildings. The creation of a trusted ecosystem for wood buildings will allow developers, investors and designers to specify and deliver more buildings based on Building Concepts by Stora Enso.

Stora Enso also offers a freely downloadable Building Information Modelling (BIM) Toolbox for architect's to easily access Building Concepts by Stora Enso and incorporate products and wood-based components into their projects. The toolbox allows Stora Enso's products and components to be downloaded as 3D BIM objects. BIM models can be used as a basis for Life Cycle Assessments (LCAs) to articulate and optimize a building´s environmental performance.

Carbon sequestration and storage

Trees grow by absorbing carbon dioxide from the atmosphere and store it as biogenic carbon. In European forests, the average rate of sequestration is 750 kg of carbon dioxide per 1 cubic meter of wood (conifers). This carbon dioxide is stored in the wood as carbon, half of dry density of the wood is carbon. At end-of-life, when ultimately wood products from sustainable managed forests are burned to generate bioenergy, the biogenic carbon will be released as biogenic CO_2 and absorbed by a new generation of growing trees. The longer the biogenic carbon is stored, the greater the environmental benefit as longer storage increases the sink for CO_2 emissions.

Stora Enso's wood-based building concepts

Building Concepts are intended for designers, contractors, building owners and developers, and include key issues to consider when building in wood, such as building form, grid sizes and facades and also structural considerations such as acoustics, fire, ventilation, heating and cooling. Building Concepts are developed together with value chain partners and are informed by life cycle cost and life cycle analyses.

Stora Enso currently has three building concepts available: Offices, Residential multi-storey and Schools. These concepts are freely available from Stora Enso's website to help construction partners to evaluate wood construction and the benefits related to combatting global warming and resource efficiency[iv].

Office concept

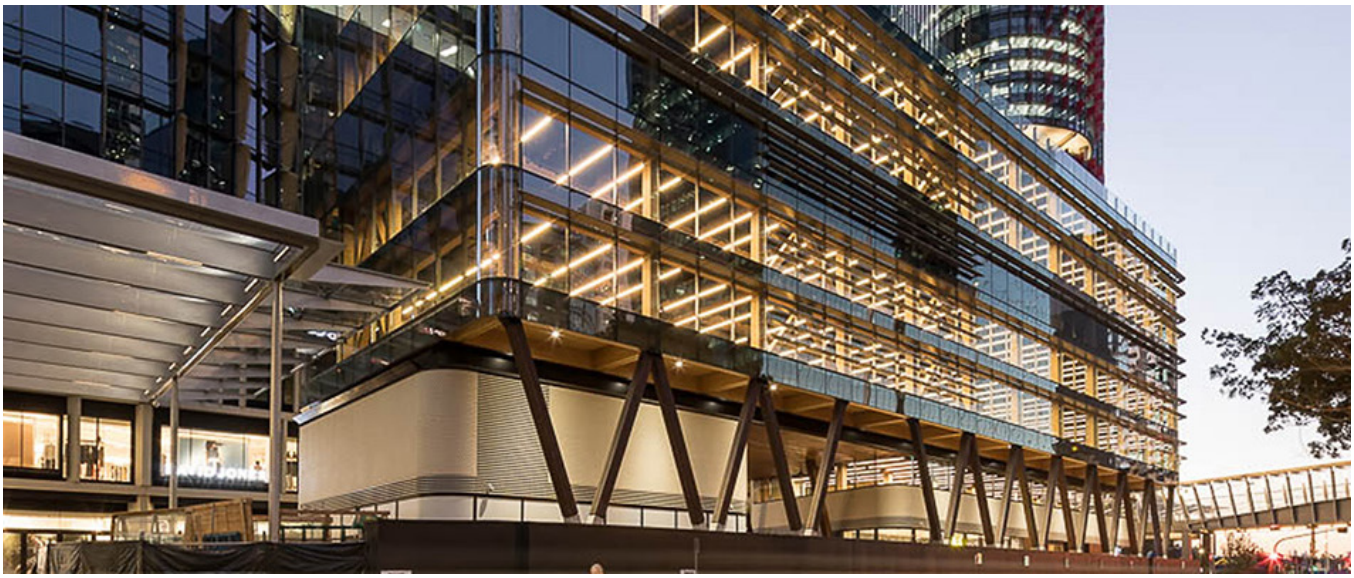
The office building concept aims at being a guide to creating the most efficient office building based on Stora Enso's massive wood products such as CLT, LVL, glulam and rib panels. The concept has been developed to meet the most relevant commercial office requirements, based on an open floor layout. The concept can be adjusted to meet specific project or market needs. The concept has been developed together with engineering and design consultancy Ramboll, architect Scott Brownrigg, construction and property consultancy Gardiner & Theobald, and real estate and investment management firm JLL (Jones Lang LaSalle Inc.).

Residential multi-storey concept

The core of the concept is Stora Enso's solid structural wall or floor panels. These engineered wood components enable an industrial method of construction that reduces assembly time on site. This concept proposes a wooden based design strategy to create open and flexible living spaces. The concept has been developed together with the consultancy Sweco.

School concept

The school concept is based on a 600m^2 school module with a capacity for about 100 to 150 students. The school concept design is based on Stora Enso products; CLT, LVL, rib panels and glulam products such as beams and posts. The open-plan layout facilitates open activities, communication and group teaching. The concept has been developed together with architect Futudesign and has been informed by input from various stakeholders including users.

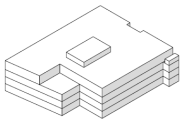
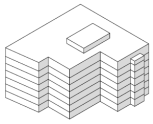
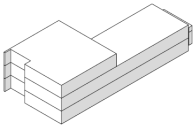
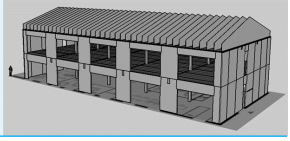


Low carbon construction and carbon storage

The Building Concepts by Stora Enso shows what possibilities exist when it comes to constructing buildings from wood. It is intended for designers, contractors, building owners and developers, allowing them to gain an understanding of how to create buildings from Stora Enso's wood products. Life cycle design aims to achieve building solutions that consider life cycle costs and contributes to higher construction quality, longer service times, building adaptability, healthy indoor environments, low energy demand and carbon emissions. Life cycle assessment case studies for the building concepts (table) illustrate the whole life cycle carbon impacts and benefits of wooden products in buildings.

The concepts´ carbon emissions

Life cycle assessment (LCA) calculations have been performed to inform the concept development. The LCA Global Warming Potential indicator is used to calculate all greenhouse gas emissions including carbon (CO_2) emissions from the building lifespan (material manufacture, construction, maintenance, renovation and deconstruction). The calculation results are used to estimate the operational, embodied and biogenic carbon of building based on the above concepts. A building´s life cycle carbon emissions are divided into embodied and operational carbon[v], where embodied emission result from the building materials and construction work, and operational emissions from use stage energy consumption.

Case study	Storey	Structure	Gross Internal Floor Area (m^2)	
Office concept - study 1	4-storey – doughnut-shaped layout	LVL and GLT columns and beams and CLT panels	9 716	
Office concept - study 2	7-storey – L-shaped with core in vertex	LVL and GLT columns and beams and CLT panels	11 566	
Office concept - study 3	2–3-storey – linear with offset core	LVL and GLT columns and beams and CLT panels	1 739	
Residential multi-storey	14-storey – square tower	LVL and CLT panels	5 228	
School concept	2-storey – linear school module	LVL and CLT panels, columns and beams	1 160	

Life cycle assessment scope

Case study assessments include all main building materials and installations, material transport and construction activities, the use phase, and end-of-life scenarios. Interior furnishings and fittings were excluded.

Life cycle modules included:
A1–3 Product stage,
A4–5 Construction process stage,
B4–5 Use stage: Material replacement and refurbishment,
B6 Use stage: Operational energy use,
C1–4 End of life stage, and
D Benefits and loads beyond the system boundary.

The assessment period lifespan was 50-years for the office and school case studies and 60-years for the residential multi-storey case studies. Results are calculated for gross internal floor area (GIFA).

The office concept case studies

All office concept case studies are designed to optimise the use of different wood products, such as CLT, LVL and beams.

Global warming potential kg CO_2e/m²/a	Study 1	Study 2	Study 3
A1–3 Product stage	4.90	4.95	4.97
A4–5 Construction stage	0.39	0.40	0.45
B1–7 Use stage	85.37	83.58	52.91
C1–4 End-of-life stage	0.16	0.28	0.37
A–C Total	90.82	89.21	58.69
Additional information kg CO_2e/m²/a			
D Benefits and loads beyond the system boundary	-2.61	-2.73	-2.79
Biogenic carbon storage	-3.01	-2.84	-3.29

The residential multi-storey concept case study

The Lighthouse Joensuu project is the highest (14-storey) wooden building in Finland. See the Stora Enso Lighthouse Joensuu Sustainability Case Study[vi] for more details.

Global warming potential kg CO_2e/m²/year	Lighthouse Joensuu
A1–3 Product stage	5.52
A4–5 Construction stage	0.58
B1–7 Use stage	22.59
C1–4 End-of-life stage	0.74
A–C Total	29.42
Additional information kg CO^2e/m²/year	
D Benefits and loads beyond the system boundary	-4.04
Biogenic carbon storage	-5.39

The school concept case study

The LCA calculations are for a 1 200 m² school module, which is the reference 2-storey school building in Stora Enso School concept.

Global warming potential kgCO_2e/m²/a	School concept
A1–3 Product stage	3.29
A4–5 Construction stage	0.46
B1–7 Use stage	36.15
C1–4 End-of-life stage	0.28
A–C Total	40.19
Additional information kg CO_2e/m²/a	
D Benefits and loads beyond the system boundary	-1.50
Biogenic carbon storage	-3.21

Life cycle carbon emissions:

Embodied carbon is the greenhouse gas emissions associated with materials and construction processes throughout the whole life cycle of a building or infrastructure.

Operational carbon emissions are generated by the energy used to operate the building or infrastructure.

Biogenic carbon storage refers to carbon removed via sequestration from the atmosphere and stored as carbon in a product.

Towards net zero embodied carbon

Stora Enso supported the World Green Building Council's (WGBC) 'call to action' report – Bringing embodied carbon upfront – which aims to advance the market towards Net Zero Embodied Carbon (NZEC) as part of a whole life cycle approach. The report seeks to promote stakeholder cooperation to ultimately achieve 100% net zero carbon buildings by 2050.

Net Zero Embodied Carbon

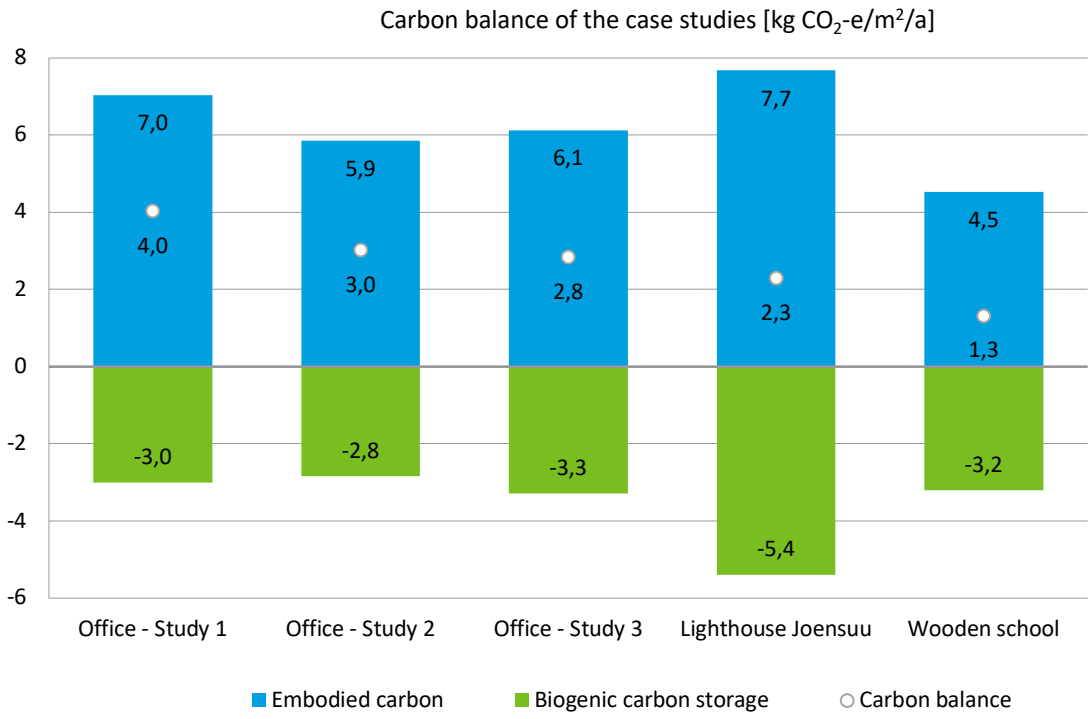
A NZEC building (new or renovated) or infrastructure asset is highly resource efficient with upfront carbon minimised to the greatest extent possible and all remaining embodied carbon reduced or offset in order to achieve net zero throughout its life cycle.

Building concepts can contribute to achieving Net Zero Embodied Carbon

The Stora Enso building concepts are informed by whole building LCA calculations that rely on information from Stora Enso's EPDs and BIM object data to help assess the environmental impacts of wooden buildings.

They can contribute towards the development of NZEC buildings by promoting wood products, which are less carbon intensive than traditional construction materials during their manufacture[vii], and their light-weight nature reduces transport emissions. They also store carbon throughout their lifespan to help realise significant net embodied life cycle carbon savings.

When biogenic carbon content is considered in the carbon balance, embodied carbon emissions can be reduced by 40–70% depend on the case study.



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i IEA. (2016). Towards zero-emission efficient and resilient buildings: Global Status Report 2016.

ii UN Environment. (2017). Towards a zero-emission, efficient, and resilient buildings and construction sector: Global Status Report 2017.

iii Circle Economy. (2018). The Circularity Gap Report: How the linear economy is failing people and the planet and what we can do to close the global circularity gap.

iv Stora Enso. (2020). Building concepts. https://www.storaenso.com/en/products/wood-products/building-concepts.

v WorldGBC. (2019). Bringing Embodied Carbon Upfront. https://www.worldgbc.org/embodied-carbon

vi Stora Enso. (2019). Sustainability Case Study - The Lighthouse Joensuu project. https://www.storaenso.com/-/media/Documents/Download-center/Documents/Sustainability/Lighthouse_Joensuu_LCA_2019.pdf.

vii Hill C. & Zimmer K. (2018). The environmental impacts of wood compared to other building materials. NIBIO RAPPORT, VOL. 4, NR. 56.

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09/2020

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