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the European Union**



How to increase the reuse of steel structures in existing and new buildings?

**Petr Hradil
Norsk Ståldag, 6.11.2025**

10/11/2025 VTT – beyond the obvious

VTT provides growth with research and development

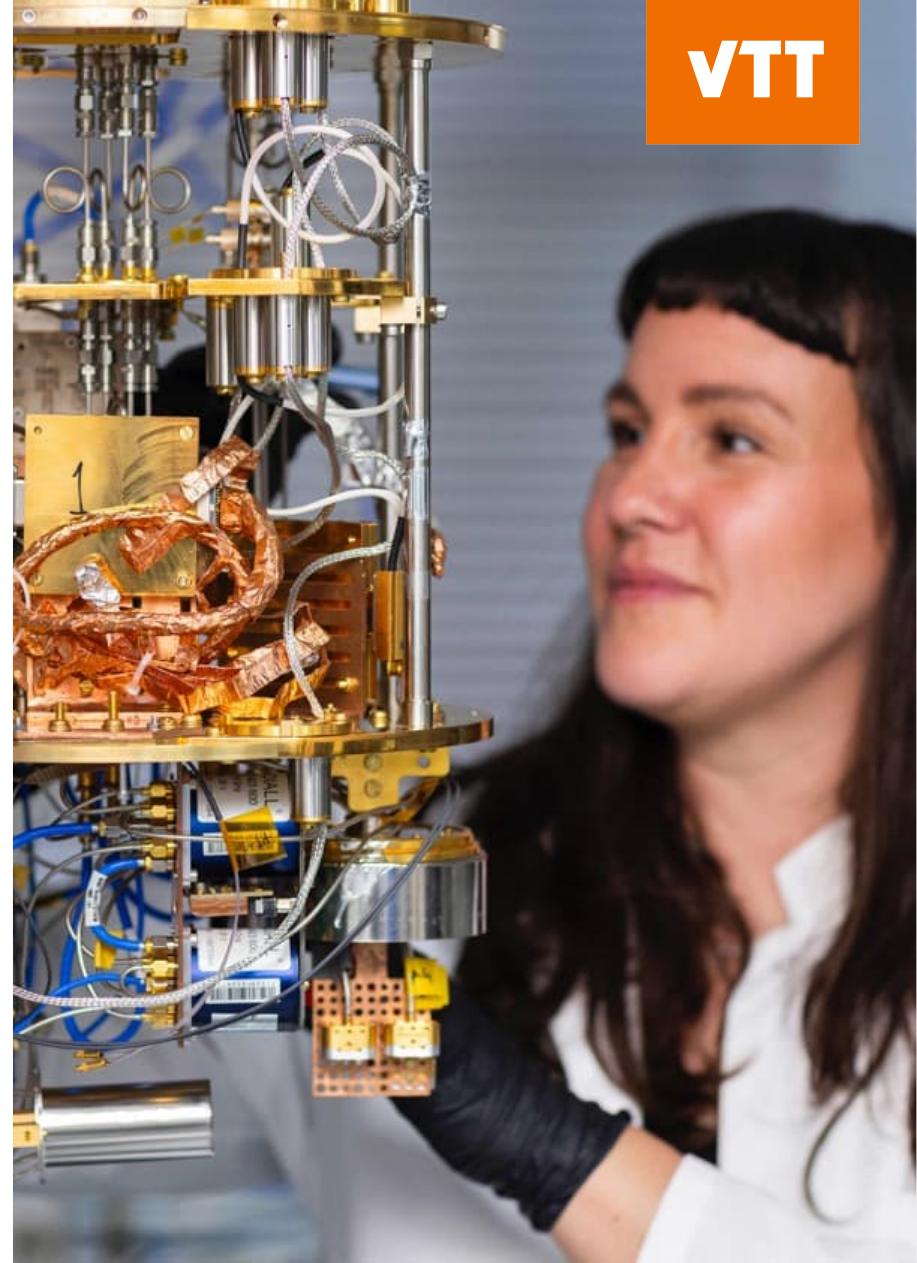
VTT is a visionary research, development and innovation partner for businesses and society and one of Europe's leading research institutions.

We bring together people, businesses, science and technology to solve the world's biggest challenges and create sustainable growth, jobs and well-being.

2,390
employees

1,100
customers

296 M€
operating income



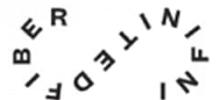
Working with us promotes sustainable renewal of business and industry



A powerhouse of over 50 spin-off companies

VTT LaunchPad is a business incubator that commercializes VTT's research and technology into spin-off companies.

The incubator brings together VTT's researchers and IPR offering, the best business expertise and investors.

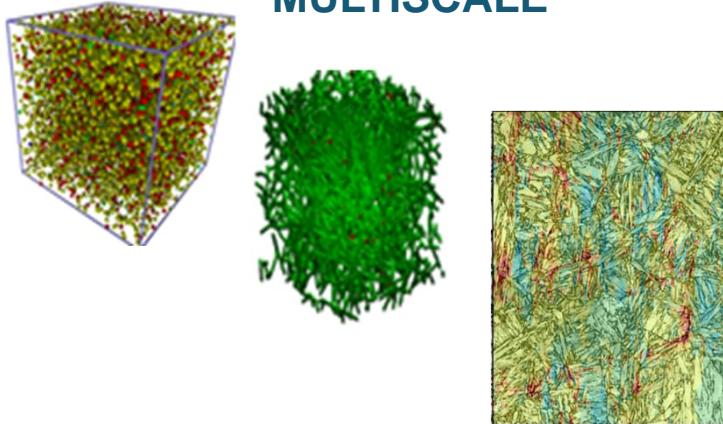


From the material design ...

VTT ProperTune®

VTT ProperTune is a toolset, a collection of software libraries and tools for solving multiscale materials and multiphysical modeling problems. It enables one to efficiently and rapidly set up novel modeling workflows and solvers to address materials modeling and simulation challenges.

MULTISCALE

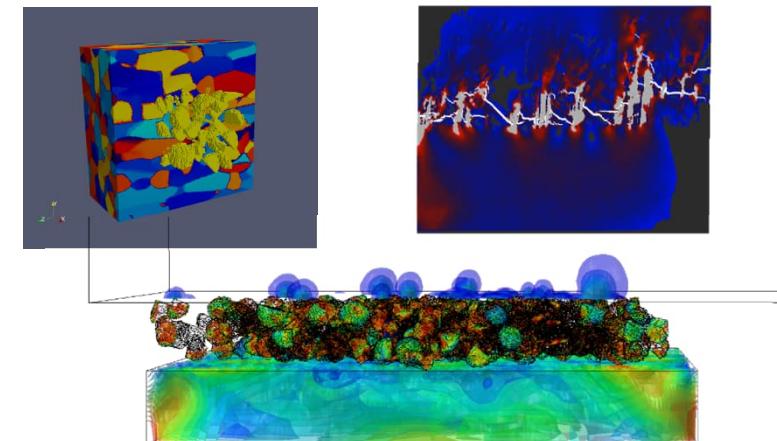


From atomistic to microstructural and to product performance and lifetime

Couplings, concurrencies, interfaces and data across scales and physics



MULTIPHYSICAL



Material properties, manufacturing processes, solidification processes, damage and failure, thermodynamics and kinetics, chemical reactivity, electrochemistry, transport phenomena, electromagnetism, dynamics, process models etc.

VTT ProperTune® reference cases

Use case type: Optimize a material solution (microstructure)



- Optimization of protective composite coatings



Outcome: performance +40%, TTM -60%, what-if-capability

Use case type: New steel grade design



- Discovery and design of new high performance steel grade



Outcome: durability +200-250% , TTM & R&D cost -50%, material & mfg cost: unchanged

Use case type: New material discovery for extreme conditions



- Novel materials for the first wall of fusion reactors



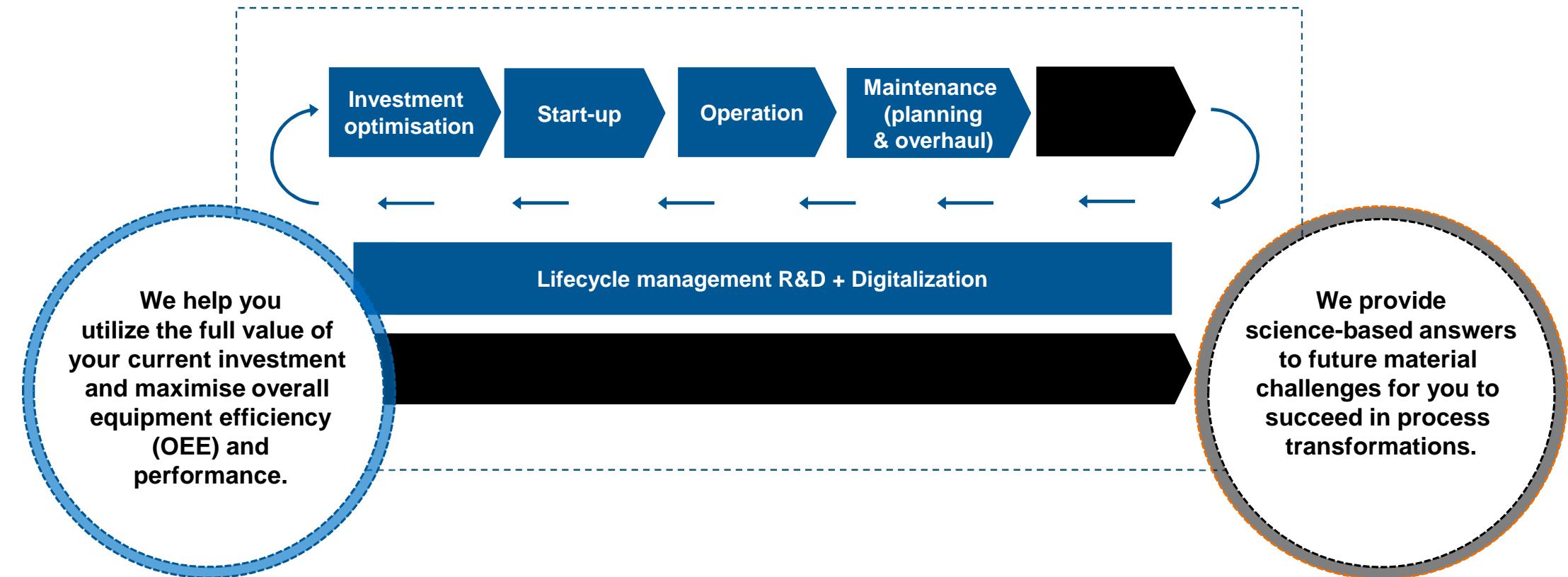
ARPA-E (Advanced Research Projects Agency – Energy) research program ([press release](#))

VTT ProperTune® has been developed together with our industrial partners and applied to their materials and products.

**... to material service life
management ...**

VTT ProperScan

Understanding tomorrow's materials



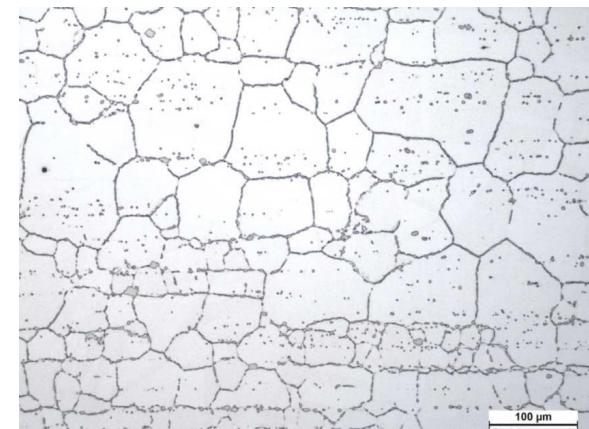
VTT ProperScan

Rejuvenation treatment of gas turbine inner casing material

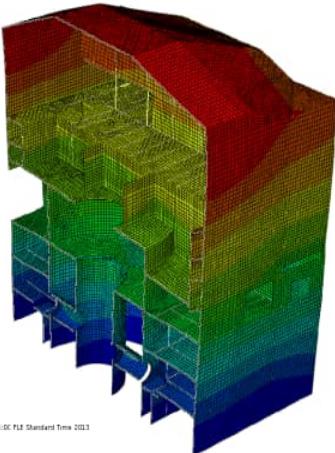
Challenge: Gas turbine service life is approaching the manufacturer recommended limit with no rejuvenation option. The power plant is facing an expensive replacement investment.

Solution:

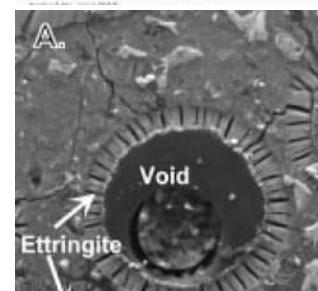
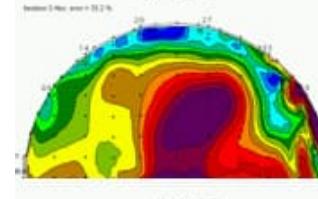
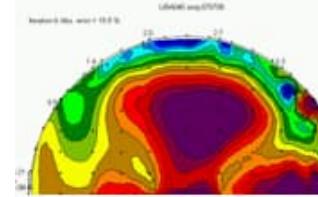
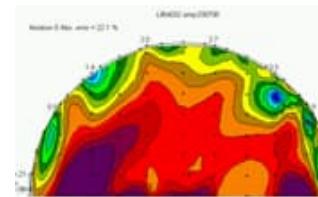
- VTT carried out metallographic analysis and mechanical testing of heat-treated material samples
- The results confirm that heat treatment of casing will offer sufficient rejuvenation potential of the material properties to facilitate the targeted service life extension
- Helen proceeded with the heat treatment and brings the gas turbine casing back in operational use in summer '22



Structural Materials



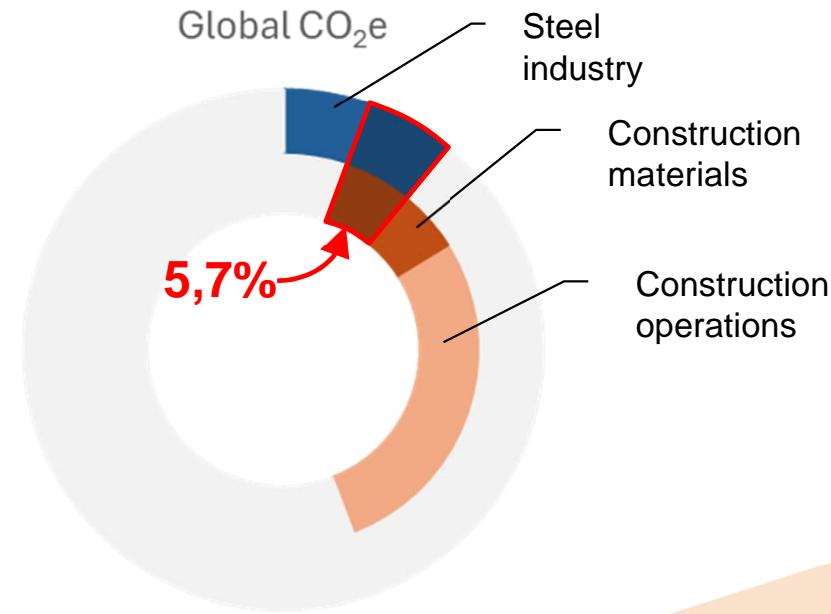
- **Developing solutions** for the construction sector to achieve **net zero carbon emissions** by 2035 through **building material innovations**
- Enable **full circularity of building materials** through new re-processing, re-cycling and re-use concepts
- Increase structures, components and materials **resilience and safety** through **digitalisation** and **ageing management** solutions



**... to solutions beyond
the service life boundaries**

Constructional steel causes significant CO₂e impact globally

- Construction industry is responsible for ~39% of global CO₂ (11% materials, 28% operations)
- Steel industry is responsible for ~8% of global GHG emissions ~11% of global CO₂
- Constructional steel share is ~52% of total steel production



Source: World Steel Association, World Green Building Council

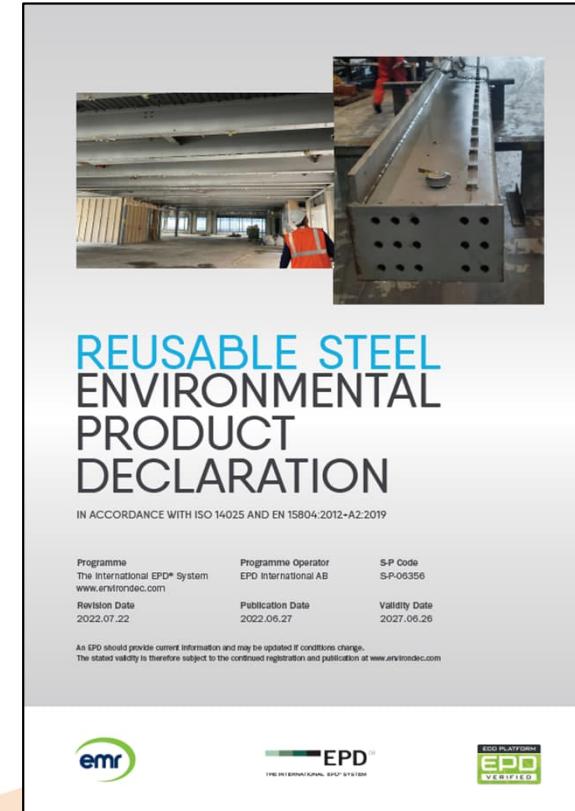
Constructional steel offers significant CO₂ saving when reused



product stage
333 kgCO₂e/t

86%
reduction

product stage
47 kgCO₂e/t



2017-2020

PROGRESS

PROVISIONS FOR GREATER REUSE OF STEEL STRUCTURES



VTT

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■ Protocols

- Pre-deconstruction audit protocol
- Material testing protocol
- Deconstruction protocol

■ Guides

- Existing buildings
- New buildings

■ Assessment methods

- LCA & LCCA for reused steel
- Reusability index

■ Case studies

- 11 factsheets

■ Other results

- Definition of product and waste
- Connections for envelopes
- 3D scanning with drones
- Deconstruction techniques

Circular standardization

EN 1090-1

- CE marking of reused steel constituents

TS 1090-201

- testing protocol for reused steel

CEN/TC250/SC3/AHG

- design rules for reused steel

EN 17662

- PCR for steel (including reuse)

CEN/TC350/SC1/WG5

- circularity assessment

CEN/TC350/SC1/WG8

- pre-demolition audit protocol

ISO 16739

- building information modelling (IFC specification)

CEN/TC250/SC3/AHG

EN 1090-1

EN 17662

TS 1090-201

ISO 16739

CEN/TC350 SC1/WG5

CEN/TC350/SC1/WG8

Environmental assessment

Design

Construction (assembly)

Marketing distribution

Use

Reuse

Recycling

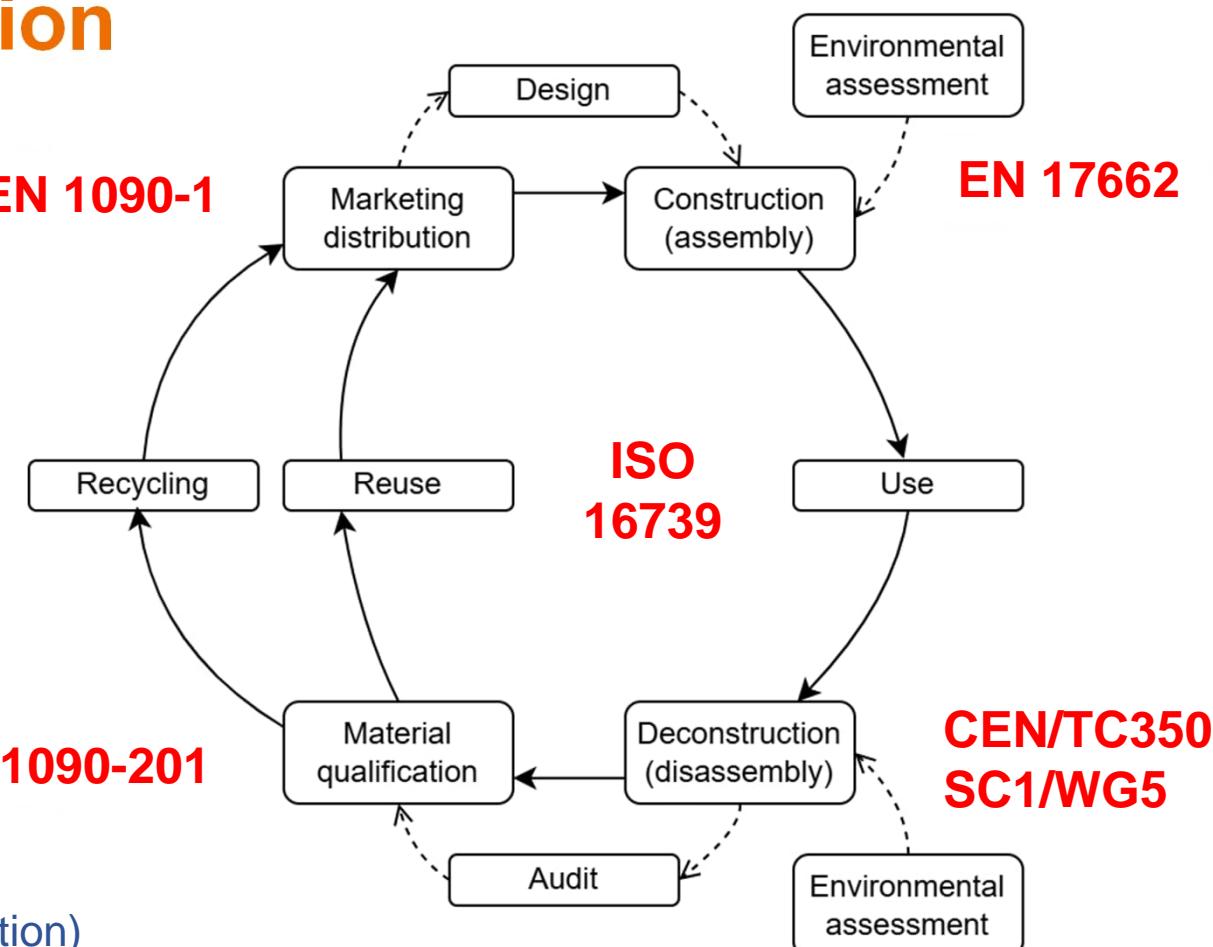
Material qualification

Deconstruction (disassembly)

Audit

Environmental assessment

Environmental assessment



How to increase the reuse of steel structures in existing and new buildings?

Develop instructions for the practitioners

Let people know that reuse is even possible

Show examples

- **Dissemination materials**
 - Internet presentations
 - Brochures
 - Workshops/webinars
- **Standards and guides**
 - Existing buildings
 - New buildings
- **Assessment methods**
 - Impacts of steel reuse
- **IT tools**
 - Mobile apps
 - Web apps
 - Other tools
- **Case studies**
 - Factsheets

2023-2025

ADVANCE

ACCOMPANYING MEASURE FOR DISSEMINATION, VALORISATION
AND COLLABORATIVE EXPLOITATION OF CIRCULARITY
OF CONSTRUCTIONAL STEEL PRODUCTS



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- **Dissemination materials**
 - Website
 - Brochures (20 languages)
 - 10 workshops/webinars
- **Updated guides** (7 languages)
 - Existing buildings
 - New buildings
- **Assessment methods**
 - Updated LCA for steel reuse
- **IT tools**
 - Updated mobile LCA app
 - Web app
 - Minigame
- **Updated case studies**
 - 5 additional factsheets



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PROGRESS & ADVANCE outcomes

<https://www.steelconstruct.com/eu-projects/advance/>



Homepage / EU projects / ADVANCE

ADVANCE

Accompanying measure for Dissemination, Valorisation and Collaborative Exploitation of circularity of constructional steel products

2023-2025
ADVANCE
ACCOMPANYING MEASURE FOR DISSEMINATION, VALORIZA
TION AND COLLABORATIVE EXPLOITATION OF CIRCULARITY
OF CONSTRUCTIONAL STEEL PRODUCTS

The project's ambition is to contribute to greenhouse gas reduction and circular economy goals by addressing these challenges in both deconstruction and reuse of existing steel buildings, and in the design of new buildings, their construction and documentation to facilitate future reuse. Its scope includes reuse of constituent products, fabricated components, and reuse of component assemblies. The reused material may originate from primary structures (frames, see Figure 1), secondary structures and envelopes.



ADVANCE

- » Factsheets
- » Media
- » Presentations and brochures
- » Project outputs
- » Partners

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the European Union

ADVANCE is an EU funded project
(Grant Agreement Number 101112269)



VTT

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Brochures





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Recommendations for Reuse



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The ADVANCE project's ambition is to contribute to greenhouse gas reduction and circular economy goals by addressing these challenges in both deconstruction and reuse of existing steel buildings, and in the design of new buildings, their construction and documentation to facilitate future reuse. Its scope includes reuse of constituent products, fabricated components, and reuse of component assemblies. The reused material may originate from primary structures, secondary structures and envelopes.

The reduction of greenhouse gas emissions of steel industry became essential in the recent years with the major focus on the construction sector, the single largest source of its environmental footprint. The construction sector comprises the opportunity to establish steel-based technologies in a leading position for the decarbonisation of other relevant industries dependent on steel solutions.

ECCS
CECM
EKS
EUROPEAN CONVENTION FOR CONSTRUCTIONAL STEELWORK
CONVENTION EUROPÉENNE DE LA CONSTRUCTION MÉTALLIQUE
EUROPAISCHE KONVENTION FÜR STAHLBAU
publications@steelconstruct.com | www.steelconstruct.com

TC14 is the Technical Committee within ECCS for Sustainability and Eco-Efficiency of Steel Construction. The committee aims to promote developments in industry, research and teaching communities that strengthens knowledge and capabilities in relation to sustainable steel construction.

The basic area of the work includes, for example, the following aspects: Management of overall building performance during the whole lifecycle; Techniques for the improved environmental performance; Techniques for a high quality and comfort of the indoor environment; Energy efficiency; Minimization of resources and use of raw materials.

EUROPEAN RECOMMENDATIONS FOR REUSE OF RECLAIMED STEEL PRODUCTS

— Volume 1: Reusing existing steel products and buildings —

Technical Committee 14
Sustainability & Eco-Efficiency of Steel Construction,
in the frame of Advance Project

2025

EUROPEAN RECOMMENDATIONS FOR REUSE OF RECLAIMED STEEL PRODUCTS — VOLUME 1



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The ADVANCE project's ambition is to contribute to greenhouse gas reduction and circular economy goals by addressing these challenges in both deconstruction and reuse of existing steel buildings, and in the design of new buildings, their construction and documentation to facilitate future reuse. Its scope includes reuse of constituent products, fabricated components, and reuse of component assemblies. The reused material may originate from primary structures, secondary structures and envelopes.

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EUROPEAN RECOMMENDATIONS FOR REUSE OF RECLAIMED STEEL PRODUCTS

— Volume 2: Building design recommendations to facilitate future deconstruction and reuse —

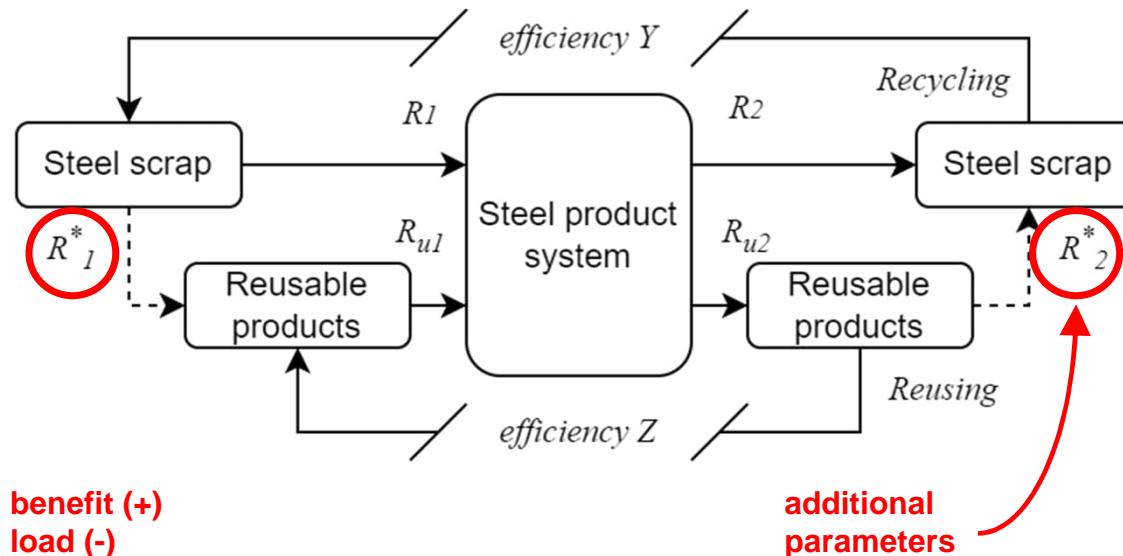
Technical Committee 14
Sustainability & Eco-Efficiency of Steel Construction,
in the frame of Advance Project

2025

EUROPEAN RECOMMENDATIONS FOR REUSE OF RECLAIMED STEEL PRODUCTS — VOLUME 2



Updated LCA methodology



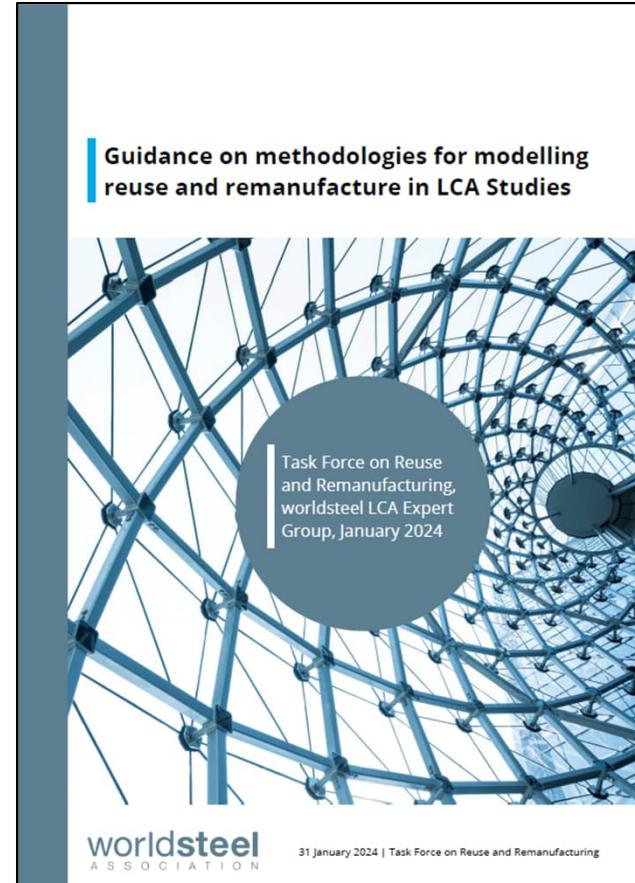
$$\text{net benefit of recycling} = (R_2 - R_1 + (R_{u2} - R_{u1})(R_2^* - R_1^*)) X_{sc}$$

$$\text{net benefit of reuse} = (R_{u2} - R_{u1})(X_{inc\ recycling} - X_{refurb})Z$$

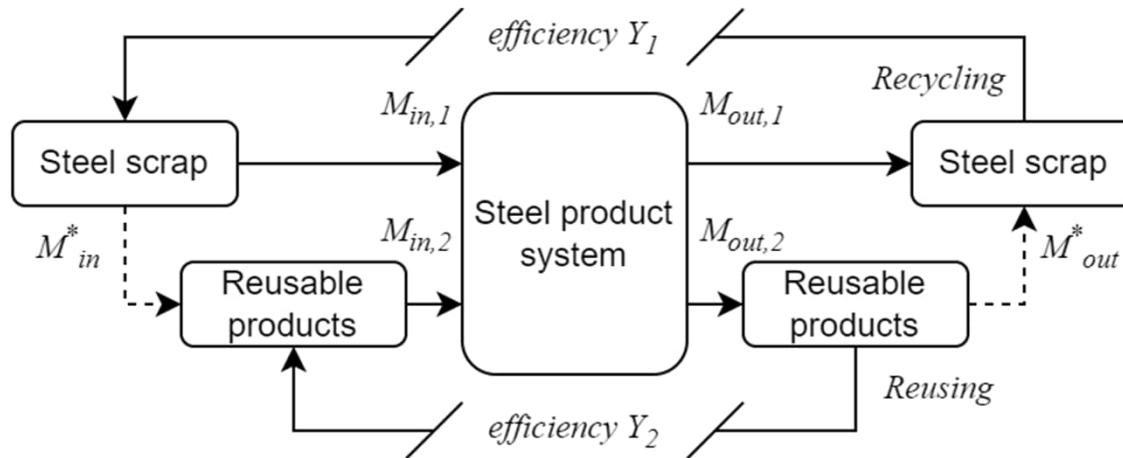
$$X_{inc\ recycling} = X_m - (R_2^* - R_1^*) X_{sc}$$

pr primary production
re recycling
m manufacturing

$$X_{sc} = (X_{pr} - X_{re})Y$$



Updated LCA methodology



$$e_{moduleD1.1} = \left(M_{out,1} - M_{in,1} + (M_{out,2} - M_{in,2}) \frac{M_{out}^* - M_{in}^*}{M} \right) \cdot (E_{MR,1} - E_{VM,1}) Y_1$$

$$e_{moduleD1.2} = \left(M_{out,2} - M_{in,2} \right) \cdot \left(E_{MR,2} - E_{VM,2} - \frac{M_{out}^* - M_{in}^*}{M} (E_{VM,1} - E_{MR,1}) \frac{Y_1}{Y_2} \right) Y_2$$

benefit (-)
load (+)



2023-2025
ADVANCE
ACCOMPANYING MEASURE FOR DISSEMINATION, VALORISATION
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OF CONSTRUCTIONAL STEEL PRODUCTS

Research Fund for Coal and Steel
Grant agreement No: 101112269



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**Environmental assessment
of constructional steel reuse:
Methodology report**

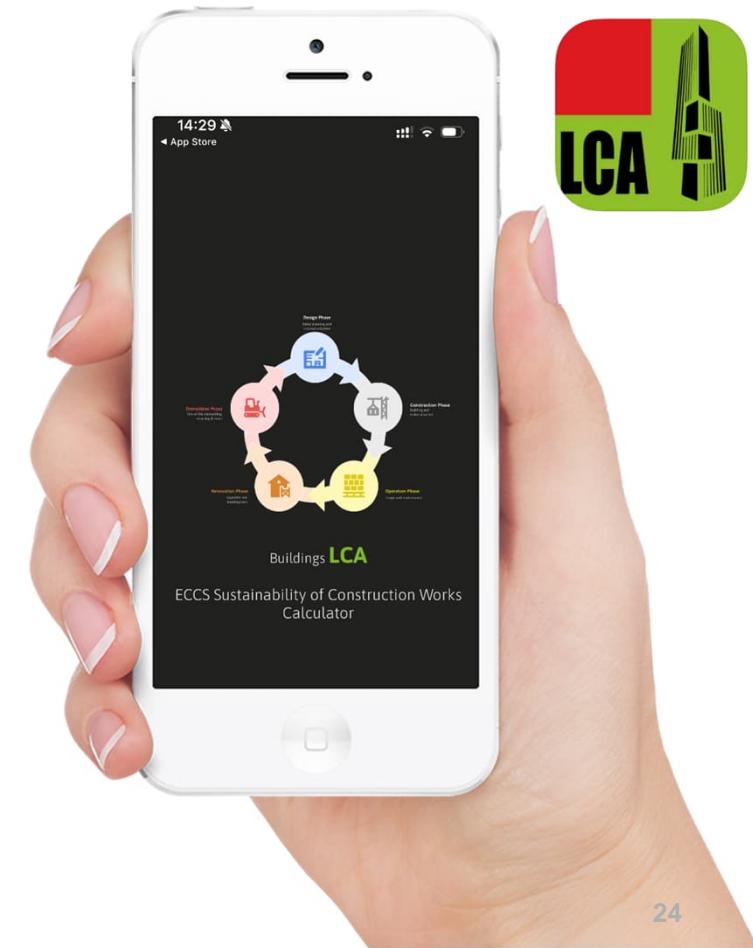
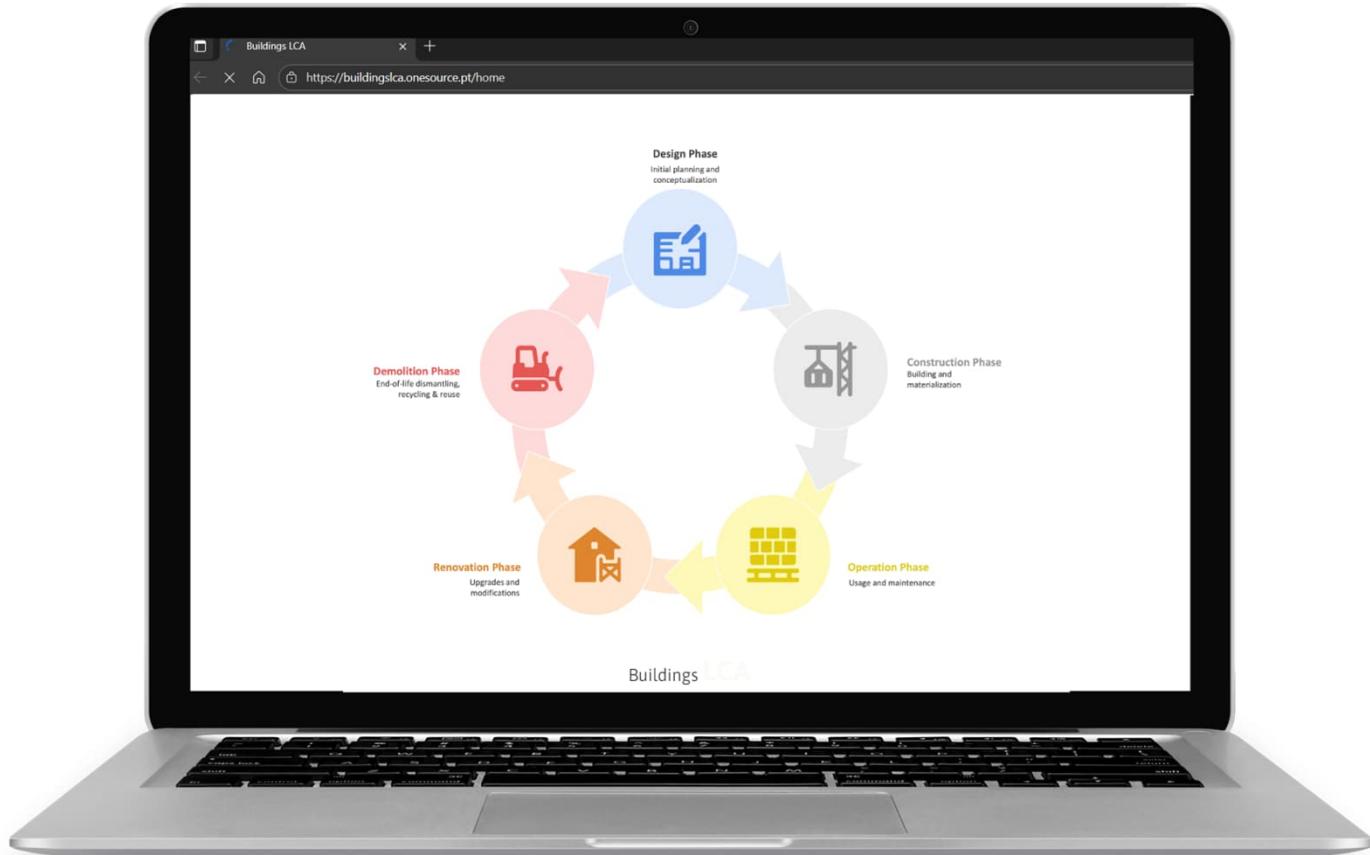
February 2024



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Mobile app and web tool

<https://buildingslca.onesource.pt/>



Online minigame

<https://scratch.mit.edu/projects/1161220510/>



**VTT**

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Case studies

2023-2025 ADVANCE
ACCOMPANYING MEASURE FOR DISSEMINATION, VALORISATION AND COLLABORATIVE EXPLOITATION OF CIRCULARITY OF CONSTRUCTIONAL STEEL PRODUCTS

VTT **up** **Universität Regensburg** **ESB** **ETH Zürich** **FEU** **RWTH AACHEN UNIVERSITY** **T** **Teräsrakennushallitus** **cticm** **bauforumstahl** **ArcelorMittal**

Reuse of Steel Case Study no. 12
Design for circularity – Petite Maison, Luxembourg

Project summary
Client: University of Luxembourg (UL)
Subsidized by: Esch2022 and frésh-asbl
Location: Luxembourg, Cité du Lac, Gare du Luxembourg
Architects: Carole Schmit (UL), Dragos Ghita (UL)
Structural engineers: András Kozma (DESA)
Odenbreit (UL)
Engineering: Beto Ingénierie, Consilec, BIM
DESA Ingénierie, Consilec, Geri Secure, S.A.
Ingénieurs-paysagistes, Metraco, Paul Wurth
Architects, Schroeder & Associates
Construction cost (including demolition): 1.5 million euros

Description of the new building
The Petite Maison building, located in Esch-Belval, Luxembourg, was initiated as an architect January 2021 to promote the circularity of construction materials and culture. The project comprised design, construction, use and deconstruction phases specifically designed for disassembly/deconstruction and reuse, incorporating the latest as European project REDUCE* on demountability and reuse of composite structures.

The main part of the building structure consisted of:

- a steel frame, measuring 10.8 meters (m) x 8.1 m, following a structural grid of 1.35 m;
- modular and prefabricated structural kits in standard sizes, including concrete slabs with timber formwork systems, adjustable steel connections;
- diagonal bracing systems (front and wall);
- timber roof with steel profiled cladding sheets, supported by steel posts;
- timber wall panels, partitions, cladding, and
- prefabricated concrete foundations.

During the use phase, the building was open for guided public visits, workshops, lectures, and exhibitions. A mobile exhibition on deconstruction, designed by Rotor in Brussels, as part of the FCBRE was hosted in Petite Maison as well and was open to public visit from December 2023.

In August 2023, the deconstruction of the Petite Maison building commenced. QR codes were placed on reusable building components, linking them to a virtual database to facilitate future reuse. The building is currently under construction.

Reuse of steel sheet piles
Sheet piles can be applied in many fields, such as water transport solutions like quay walls, hazard protection solutions such as dams, modular structures, temporary railings, industrial structures, underground car parks, and environmental protection solutions such as polluted soil remediation. The modularity of steel sheet piles facilitates their reuse: they can be extracted from the ground at the end of their service life. In temporary applications, steel sheet piles are often reused multiple times in the same project or for subsequent projects. There are two main types of sheet piles:

- Temporary applications for example, cofferdams in water, linear excavations, water retention, complicated utilities installation and repairs, and limitation of settlement in nearby structures and services.
- Permanent applications for example, quay walls, railings, industrial structures, underground car parks, and environmental protection solutions such as polluted soil remediation.

Temporary applications, such as excavation pits, have shorter life cycles, often under 2 years. Commonly, sheet piles for such projects, with sections sometimes reused up to 10 sections are particularly suitable for reuse due to their compactness and high stiffness. A profile (50 cm) is typically removed if deformations or damages from the installation process are too large. In addition, it is becoming increasingly accepted by project owners to install used sheet piles. After long service lives, the sheet piles can still be extracted from the soil, being as input for a newly produced steel. This establishes a perfect cycle for the infinite use of degradable material properties.

Reuse of steel sheet piles in temporary applications
Decontamination of polluted soils:
Soil decontamination projects involve enclosing contaminated areas with sheet pile walls, typically including surrounding the area with an impermeable sheet pile wall, excavating contaminated soil, and then removing it.

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Reuse of Steel Case Study no. 13

Reuse of steel sheet piles

Project summary
Project: Remediation of "Schwarze Pumpe" Spring, Gaggenau, Germany
Project owner: LMBV GmbH
Design: Arge, CDM Smith
Contractors: Arge Lohbe / Bauer
Steel product: Sheet pile PU 22+14.0 m - 2.0 m
Steel manufacturer: ArcelorMittal
Construction cost: N/A

Description of the existing building
The original building was situated in Gennemilliers in the north of Paris. The building served as indoor riding ring. It has been designed as a frame structure with hot rolled IPE sections used for the columns and trusses. In the trusses, the columns are supported by equal length sets of different sizes: L50x5 used for the upper chord, L60x6 used for the lower chord, L40x4 used for the uprights and diagonals in the centre of the truss and again L50x5 used for the truss elements near the columns. The connection between truss elements and upper and lower chord may be seen as specific feature as these connections are welded. In total there are four trusses in the hall.

During the initial inspection of the existing building several members were observed to have suffered from buckling. These trusses were not re-usable and therefore they had been separated from trusses planned to be reused. Nonetheless, these trusses were kept in order to be used for the reassessment of material properties of the structural steel elements.

Picture 1 Deconstruction of steel frame hall in Hakaniemi, Finland

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Reuse of Steel Case Study no. 14

The deconstruction and reassembly of a hall with truss

Project summary
Client: S.YTE OY
Contractor: VIRY-FAR
Architect: ER ARCHI
Structural engineers: ALBYX, IC
Steel fabricator: VIRY-FA
Original steelwork: 1970s

Description of the existing building
The original building was situated in Gennemilliers in the north of Paris. The building served as indoor riding ring. It has been designed as a frame structure with hot rolled IPE sections used for the columns and trusses. In the trusses, the columns are supported by equal length sets of different sizes: L50x5 used for the upper chord, L60x6 used for the lower chord, L40x4 used for the uprights and diagonals in the centre of the truss and again L50x5 used for the truss elements near the columns. The connection between truss elements and upper and lower chord may be seen as specific feature as these connections are welded. In total there are four trusses in the hall.

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Picture 2 In the middle is the temporary market hall, the old Market Hall

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Reuse of Steel Case Study no. 15

The deconstruction and reassembly of steel hall in a new complex of buildings in Râmnicu Vâlcea, Romania

Project summary
Location: Helsinki, Finland
Owner: City of Helsinki
New Owner: Valtion Rakennushallitus
Contractor / client of demolition: Pürkispaja
Demolition contractor: Pürkispaja
Deconstruction time: Fall 2023
Auction sale price of hall: 440 000 euros

Description of the existing building
The original building was situated in Gennemilliers in the north of Paris. The building served as indoor riding ring. It has been designed as a frame structure with hot rolled IPE sections used for the columns and trusses. In the trusses, the columns are supported by equal length sets of different sizes: L50x5 used for the upper chord, L60x6 used for the lower chord, L40x4 used for the uprights and diagonals in the centre of the truss and again L50x5 used for the truss elements near the columns. The connection between truss elements and upper and lower chord may be seen as specific feature as these connections are welded. In total there are four trusses in the hall.

During the initial inspection of the existing building several members were observed to have suffered from buckling. These trusses were not re-usable and therefore they had been separated from trusses planned to be reused. Nonetheless, these trusses were kept in order to be used for the reassessment of material properties of the structural steel elements.

Picture 1 Deconstruction of steel frame hall in Hakaniemi, Finland

2023-2025 ADVANCE
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Reuse of Steel Case Study no. 15

Deconstruction and relocation of four standard kit modules in a new complex of buildings in Râmnicu Vâlcea, Romania

Project summary
Client: S.C. CCS IMOB CONSTRUCT S.R.L.
Structural engineers: S.C. BON STEEL S.R.L.

Description of the existing building
A standard kit solution was developed in 2006 to build steel structures adaptable for different locations (climatic/seismic conditions) and applications, in different locations in Romania. The structure of standard kit was designed as 6 bays of 6.0 m, with a span of 15.0 m and a height at eaves of 7m, with possibility to connect several such kits for longer lengths.

Buildings from four construction sites, implemented between 2008 and 2010 in Bala Mare (A), Râmnicu Vâlcea (B), Târgu Mureş (C), and Cluj-Napoca (D) were disassembled, relocated and integrated in a new complex in Sibiu, Romania in 2019. The secondary structure consists of cold-formed steel purlins and side rails. The 3D views of the relocated structures are presented in Figure 1.

Picture 1 3D view of the initial structure (structural model)

Picture 2 In the middle is the temporary market hall, the old Market Hall

Picture 3 In the middle is the temporary market hall, the old Market Hall

Picture 4 In the middle is the temporary market hall, the old Market Hall

Picture 5 In the middle is the temporary market hall, the old Market Hall

Picture 6 In the middle is the temporary market hall, the old Market Hall

Picture 7 In the middle is the temporary market hall, the old Market Hall

Picture 8 In the middle is the temporary market hall, the old Market Hall

Picture 9 In the middle is the temporary market hall, the old Market Hall

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2023-2025

ADVANCE

Accompanying Measure for Dissemination, Valorisation
and Collaborative Exploitation of Circularity
of Constructional Steel Products

Thank you!

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