



Construção Circular, Neutralidade Carbónica e Cidades Inteligentes

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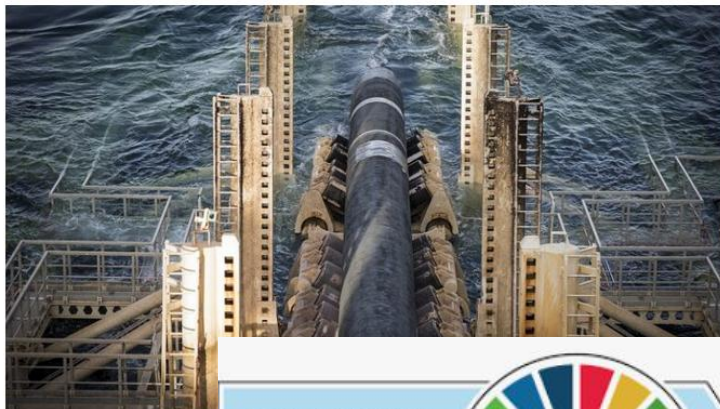
19/12/2019 VTT – beyond the obvious



European Investment Bank ends lending to fossil fuel projects

Published on 15/11/2019, 11:24am

EU finance ministers agreed to phase out EIB lending to unabated oil and gas projects, overcoming opposition from some member states in marathon board meeting

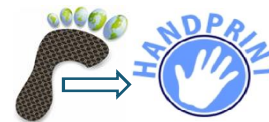


Press release | 4 March 2019 | Brussels



VTT

Closing the loop: Commission delivers on Circular Economy Action Plan



PRIORITY

A European Green Deal

Striving to be the first climate-neutral continent

GHG emission reduction target for all EU economy:

80% by 2050 compared to 1990 (all industries need to contribute) => After 2035, carbon capture & storage technology would be applied to emissions from industries unable to make substantial cuts (e.g. steel, cement).

EU ETS reduction target:

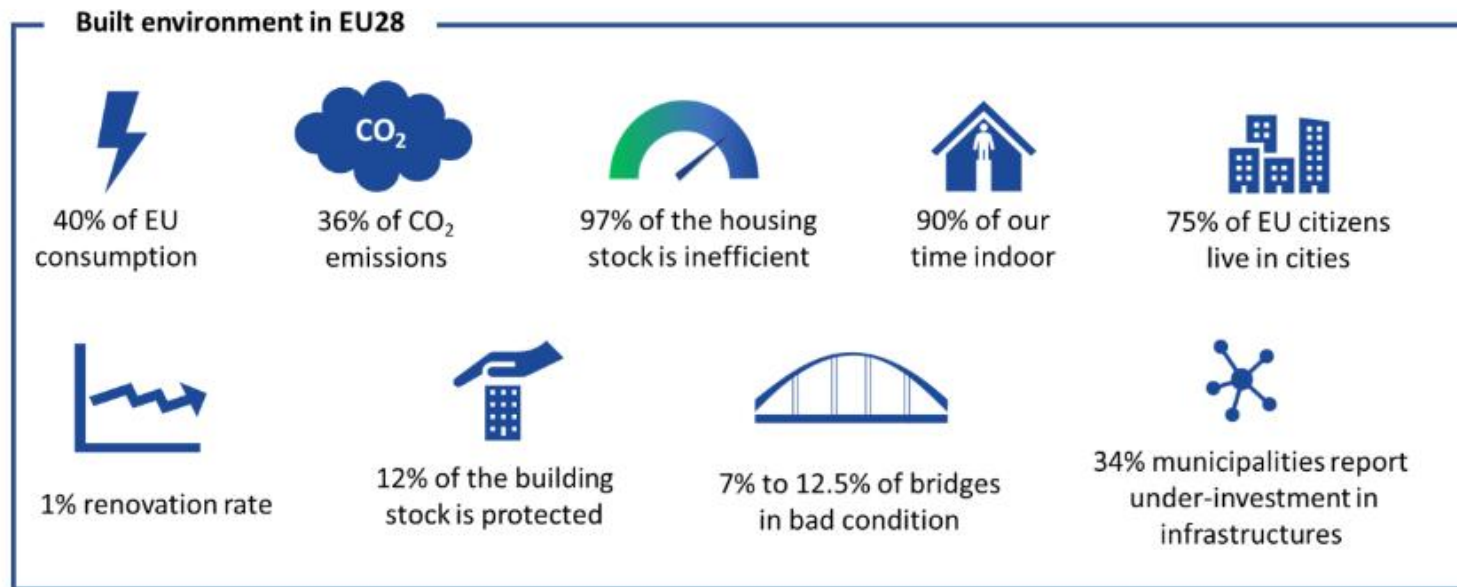
43% by 2030 compared to 2005

CO2
Governance

Societal challenges and the impact of the construction sector



§ climate change, population ageing and urbanisation



Source: Based on data from BPiE, EC, EIB, Member States

ECTP Strategic Research & Innovation Agenda, 2021-2027



EU Construction and Demolition Waste Protocol and Guidelines

Published on: 18/09/2018

Author: European Commission

EU Member States agree on promoting the recycling of construction products – Council adopts conclusions on the circular economy in the construction sector

Press release 2019-11-28 at 14:37

“It is essential to take into account the circular economy perspective in the reform of the EU Construction Products Regulation. In addition to responding to the climate challenge, the recycling of construction products opens up a major new product market and, at best, can create millions of jobs in Europe,” Minister of Employment

Timo Harakka emphasises.

- Considerable amounts of natural resources are embodied in the building stock and infrastructure.
- Need to focus the sustainability criteria in national building codes on designing resource-efficient buildings and not only on improving energy efficiency and waste recovery.



ADVANCING NET
ZERO

Resource Efficient Built Environment

- § Preserve natural resources
- § Better understanding of the end-of-life scenarios of building structures.
- § Waste prevention - Support C&D waste reduction,
- § Reduce overall the environmental impacts of buildings by encouraging the re-use of the building components.



REDUCE: Space resourcing and Low-carbon materials

Reduction of construction volumes

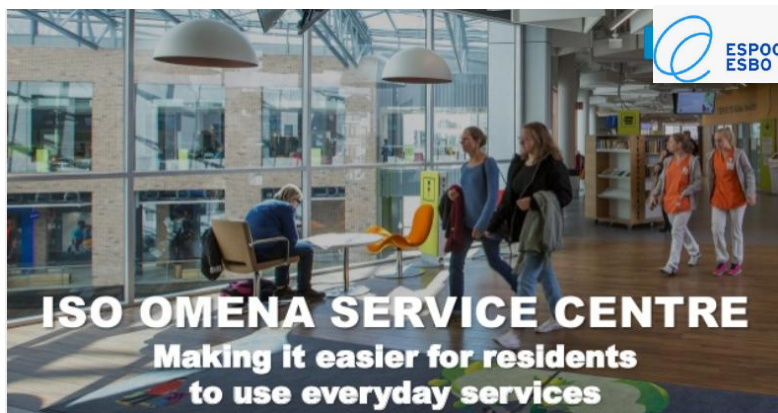
Increase in the use ratio of unused or poorly used premises

VTT

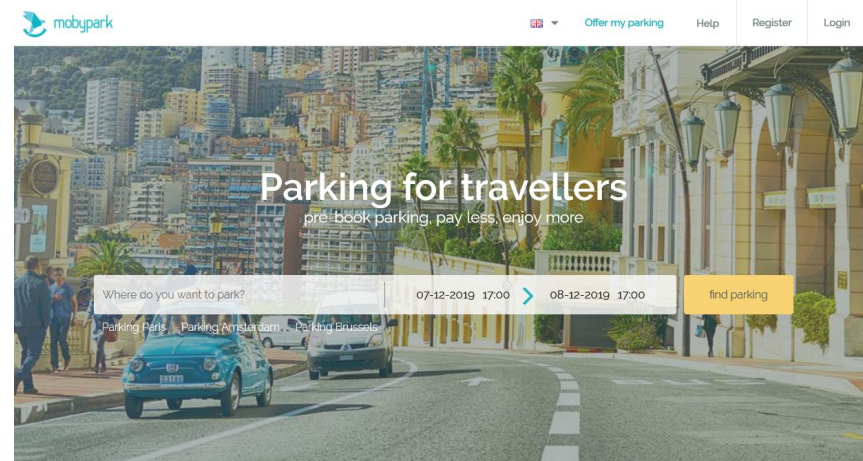


<https://www.archdaily.com/907675/oodi-helsinki-central-library-ala-architects>

- § Space as a service
- § School as a service
- § Everyday services
- § City as a service



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Urban densification

Infill development and building extensions with timber based solutions

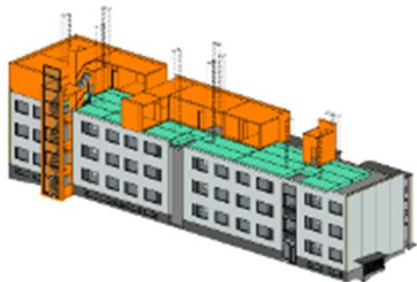
Case-studies

Added values of using timber based solutions:

- In the majority of the plans timber was allowed **visual presence in the townscape**
- **Light weight timber constructions** make the suggested building extensions designed using prefabricated spatial modules and parasite volumes attached to old structures feasible

Infill construction is one of the **Finnish national goals in regional and land-use development** and studied cases show environmental, economic and social benefits of the solution.

Infill development can serve as **a financing instrument for building refurbishments.**



Aalto University
School of Arts, Design
and Architecture

Sara Pietilä, University of Oulu
Lähiön uudet kasvot
Lisä- ja täydennysrakentamissuunnitelma Porvoon Gammelbackaan
Master thesis 20.11.2013 p 31

Low carbon materials supporting circular economy

Urban Timber Buildings

§ From the circular economy perspective, wood as a construction material is renewable, largely recyclable and may provide closed-loop manufacturing and utilization processes. Wooden buildings and furniture with long life cycles are also carbon storages.

Project Wood Circus, Underpinning the vital role of the forest-based sector in the Circular Bioeconomy: <https://woodcircus.eu/>
Low2now, SITRA, <http://www.low2no.org/>



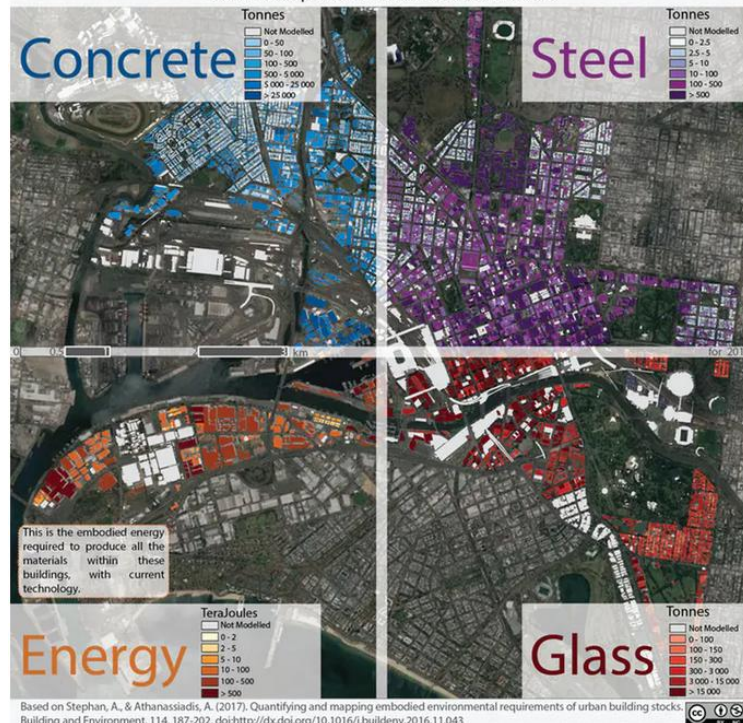
RECOVER: Demolitions and construction waste

An urban mining resource

Construction and Demolition waste make up one-third of all waste generated in Europe

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The Material Stock and Embodied Energy of the City of Melbourne, Australia
Dr André Stephan and Dr Aristide Athanassiadis

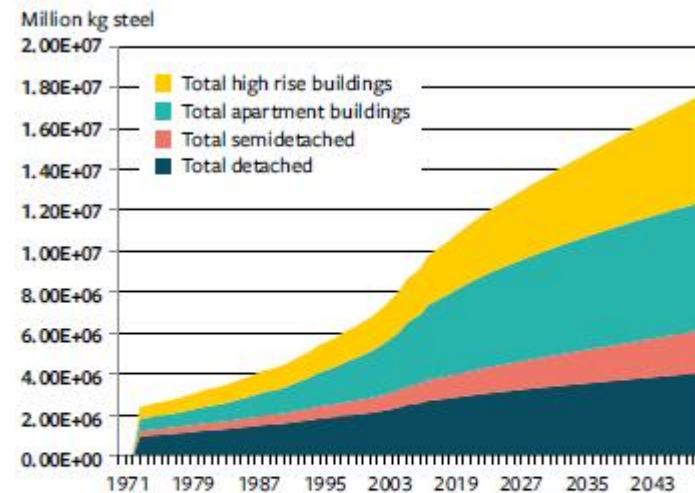


Selected material stock (2015) and embodied energy of the City of Melbourne. André Stephan & Aristide Athanassiadis

<http://theconversation.com/with-the-right-tools-we-can-mine-cities-87672>

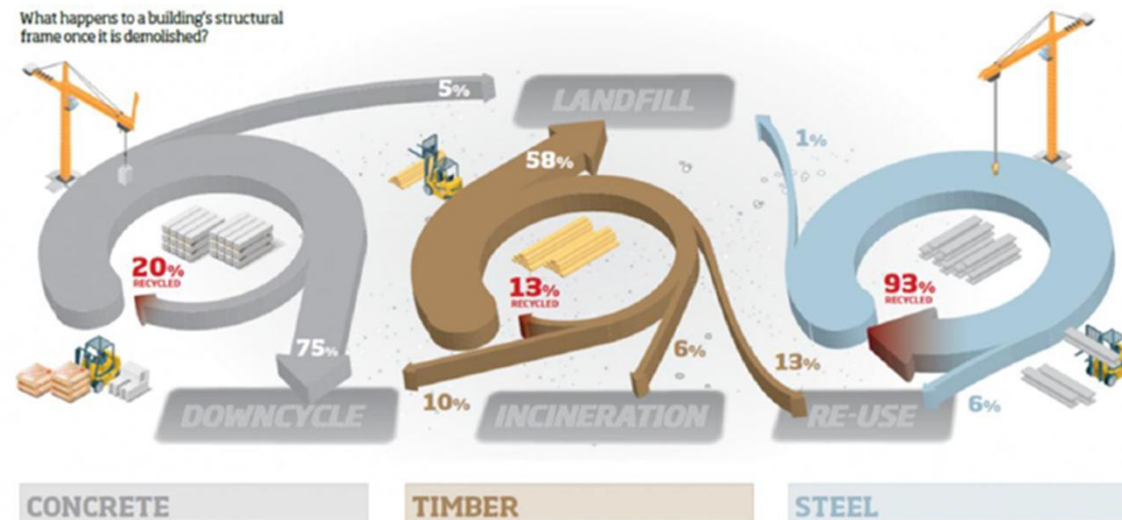
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Steel stock in residential buildings 1970–2050, global level



Stocks in the cities are expected to grow as well as the material flows. At a certain level of welfare, the stocks saturate.¹

¹ Source: Sylvia Marinova, Sebastiaan Deetman, Ester van der Voet, Vassilis Dalgoglou (2019). Global construction materials database and stock analysis of residential buildings between 1970–2050. Journal of Cleaner Production, in review



An example of end-of-life scenarios for concrete, timber and steel from buildings from steel construction info

- § Utilization of waste requires careful management and a lot of knowledge of the materials:
- § In demolition work it is important to ensure safe waste materials (non-contaminated) for recycling them into new products.
- § Safe demolition includes removal of hazardous material from material loop and controlled management of waste containing hazardous materials.

CE2019_Hihglights-by-FEI

Pre-demolition audits a new, voluntary measure for mapping out the materials and hazardous substances in buildings to be demolished.

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The decision comes before demolition



EU Guidelines
Published in 2018

National Guidelines

Electronic reporting

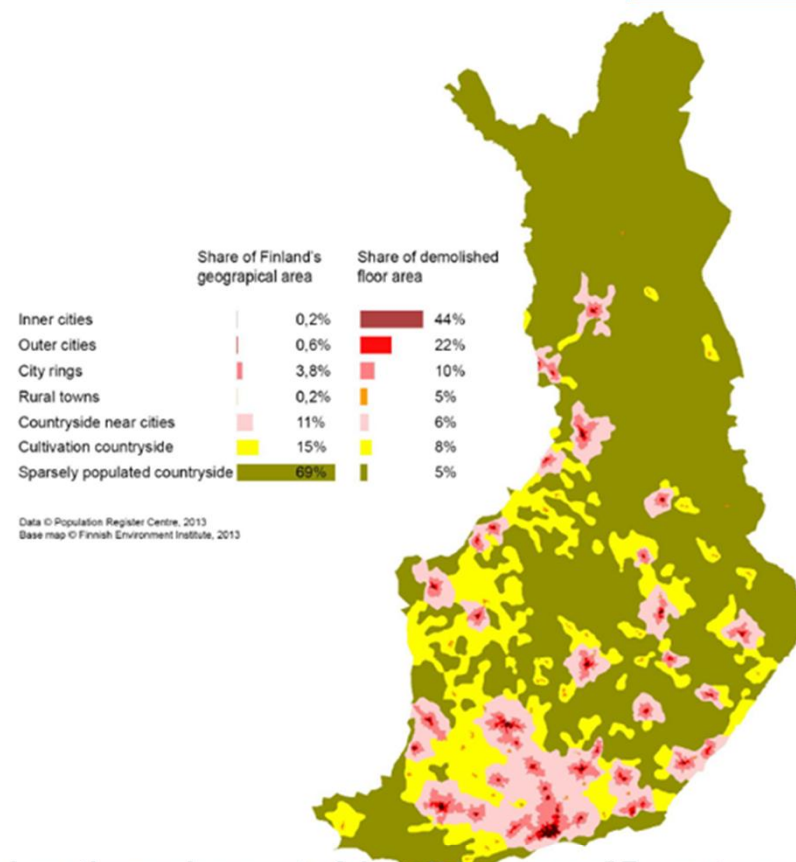
A screenshot of the LUPAPISTE electronic reporting system. The header shows 'LUPAPISTE' and a user icon. The main section is titled 'RAKENNUS- JA PURKUKARTESUUNNITELMA'. Below this, there is a link to 'Lisätietoa kiertäyksestä löydät osoitteesta www.kiertäys.fi'. The form is titled 'Rakennus- ja purkujätte' and has a table with columns 'Aines' (Material) and 'Arvioitu määrä' (Estimated quantity). The table contains a list of materials: 'Vaihte aines', 'Vaihte aines', 'Beton-, tiili-, kivenhajalla- ja kerämisjätteet', 'Kipsipohjaiset jätteet', 'Kyläkköiset jätteet', 'Metallijätteet', 'Lasijätteet', 'Muorijätteet', 'Paperi- ja kartonkijätteet', and 'Maan- ja kivijätteet'. There are also buttons for '+ Lisää rivi' (Add row) and '+ Kopioi viimeinen rivi' (Copy last row). The footer shows 'PÄÄTÖKSEN TOIMITUS'.

Pre-demolition Audit – A Guide for Authors

VTT

- § Finland's objective is to reach the **target of 70 per cent material utilisation set for construction and demolition waste in the EU Waste Directive by next year (2020)**.
- § More emphasis should be placed on the role of demolition as a project preceding new builds.
- § The purpose of the surveys is to create good conditions for the appropriate use of demolition materials while preventing environmental and health risks and ensuring a high-quality demolition process in all demolition projects.
- § Finnish pre-demolition audit is based on EU initiated audit procedure. This guide is part of a series of three guides aimed at improving the quality of demolition projects. The other two guides deal with the **procurement of demolition work** and the implementation of the **demolition process as a whole**.

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Location and amount of demolition: map of 7 area types and diagrams of their shares of Finland's geographical area and demolished floor area. REUSE project



RawMaterials
Connecting matters



vito
vision on technology



TECHNICAL UNIVERSITY OF KOŠICE
Faculty of Civil Engineering



Vlaamse
Confederatie Bouw
Bouw, energie & milieu

PARADE - Best practices for Pre-demolition Audits ensuring high quality Raw materials

Building owners

- § A correct material inventory at the start of the tender process, so that a correct and detailed cost estimation can be made
- § High-grade material outputs and a legal and sustainable end market for the material streams

Demolition companies

- § A correct material inventory at the start so that a realistic price can be offered.
- § Health security in waste handling when hazardous materials are identified and treated properly.
- § Lower unexpected works
- § A higher quality of the material streams
- § Avoiding penalties and landfilling costs.

Recycling companies

- § High-grade material streams allow a more cost-effective recycling process and more high-grade recycling applications.

REUSE: Reusable buildings and components

Demolition or deconstruction?

Supply chain, new roles, place for new players



Photo credits: Paul Kamrath

What is reuse?

Products designed to survive harsh conditions in several lifecycles



Picture credits: Arianne Group Holding

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or management of industrial waste ?

February 27, 2014

Construction-waste recycling gets a boost

TECHNOLOGY · CLEANTECH & ENERGY · RECYCLING



The purpose of VTT's project is to look at how used building components and construction waste can be utilised more extensively.

LEHTIKUVA / MATTI BJÖRKMAN

Vision for the future reusable buildings



High end-of-life value

Future owners aware of the value of their property at its end of life. Supply chain actors actively offering reusable components for sale before the deconstruction.



Reusable BIM

BIM objects for the new building design equally sourced from the product manufacturers and second-hand material dealers.



Reversible and scalable design

Buildings will be designed for deconstruction and reuse. The evolution of future building requirements (e.g. relocation loads, thermal insulation) will be anticipated.



2017-2020 PROGRESS

PROVISIONS FOR GREATER REUSE OF STEEL STRUCTURES

Focus on single-storey steel buildings

Broad applicability (industrial, commercial, sports, exhibition, warehouses), suitable for reuse and viable for circular-economy business models. The results will be extendable to other materials and building typologies.

Existing and future buildings

Reuse of existing building stock is challenging and only marginally profitable.



Buildings from reused components



Steel reuse

- § Reusing is the (environmentally) best solution
- § Carbon footprint of steel can be further reduced, waste can be prevented
- § **Steel has existing supply chain from recycling activities**
- § Steel is reusable multiple times
- § Facility owners already know that metals have end-of-life value and should be collected
- § Although steel is being reused, systemic solution is missing
- § Business models need to be developed for the whole value chain
- § The whole sector will benefit from implementation of steel reuse. Once the circular economy is established in constructional steel, it is easy to extend it to the other materials and products

Documented case studies

Drivers and facilitators of reuse cases

VTT



Reuse of Steel Case Study no. 1

NTS building, Thirsk, UK



Figure 1 Erection of the NTS building primary structure (summer 2017)

Project summary

Client:	National Tube Stockholders (NTS)
Original designer/fabricator:	Severfield plc/Fisher Engineering
Project manager and fabricator:	Cleveland Steel and Tubes (CST)
Structural engineer:	BHD partnership
Fabrication drawings:	Rapid consulting
Steelwork erector:	WHL Building Services Ltd

Project description

CST's main business involves buying surplus steel pipe from the offshore oil and gas sector and supplying structural steel tube and piling into the UK construction market. CST holds approximately 65,000 tonnes of pipe stock at their facility in Thirsk, UK. In addition to stock holding, CST offers steelwork fabrication services. CST project managed this reuse project on behalf of NTS. CST has good experience of procuring previously used steelwork and is keen to promote the reuse of structural steel. CST was responsible for the overall management and coordination of this project.

S-Market Urjala



Photo credits: Ruukki

Deconstruction and reassembly of a steel structure in a new location

The owner of the retail stores chain decided to replace a building in Tampere with a larger one. At the same time, the need for a new grocery store emerged only 60 km away creating the opportunity for relocated reuse.

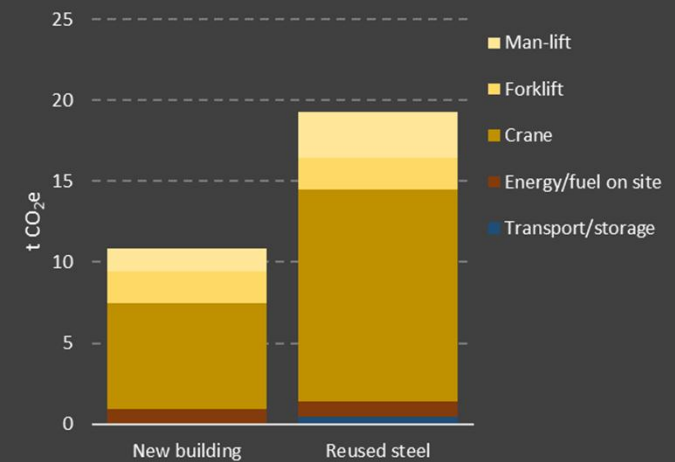
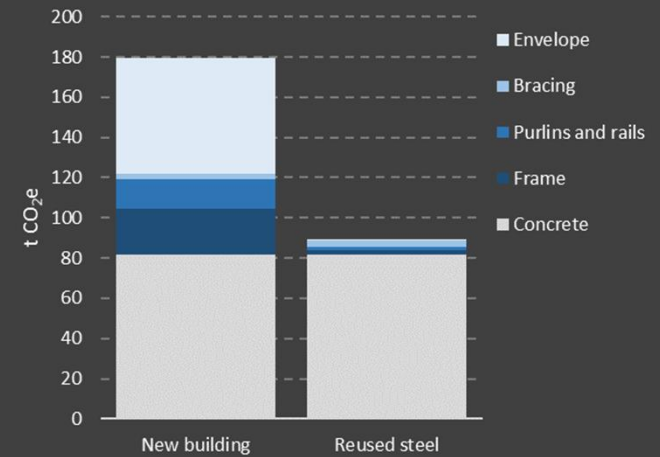
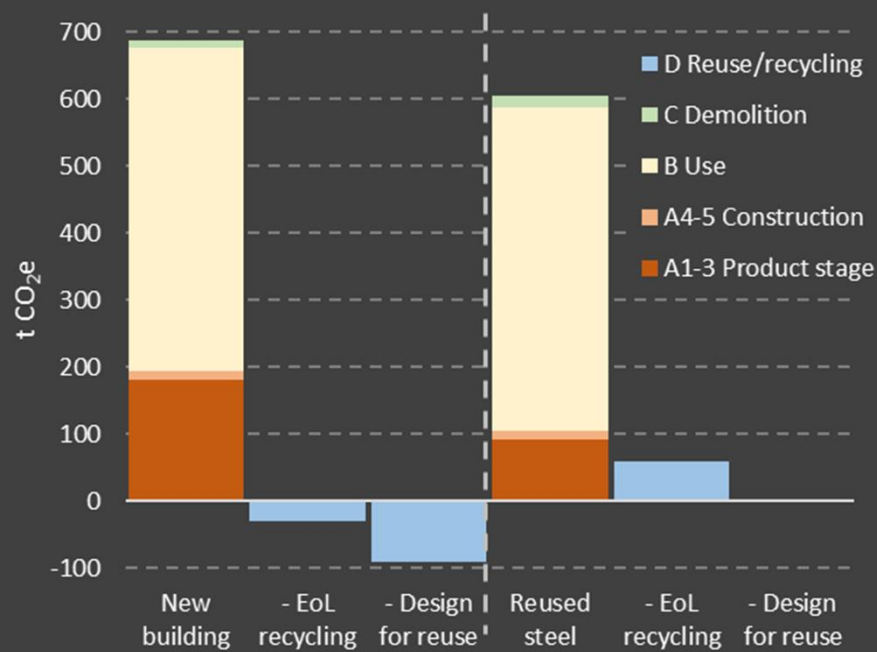
New design was based on available building frame

Main features

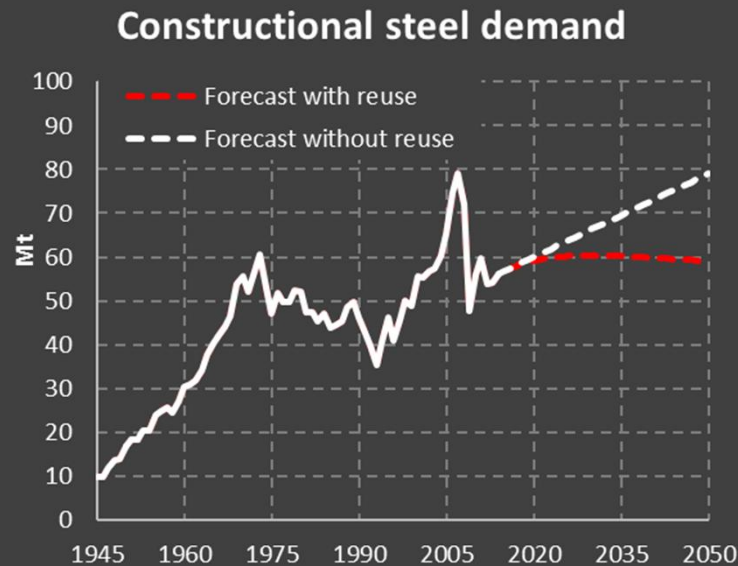
- Degree of reuse Ø steel frame (columns, main girders, cross girders) and roof profiles Ø **100% reused**.
- In-situ fire protection of frame with intumescent coating
- New plinth and wall structures, new bay for the small storage part.
- About **10% saving in total construction costs** due to reusing of steel structures

Realistic building case

2017-2020
PROGRESS
PROVISIONS FOR GREATER REUSE OF STEEL STRUCTURES



The effect of constructional steel reuse in EU



Implementing constructional steel reuse of **50% by 2050** may keep the new steel demand at the 2018 level.

However, new business opportunities will open in the supply chain of reused products (product manufacturers, re-certification, deconstruction, trading etc.).

Steel reuse model: gradual increase from 10% in 2018 to 50% in 2050

Documented business models



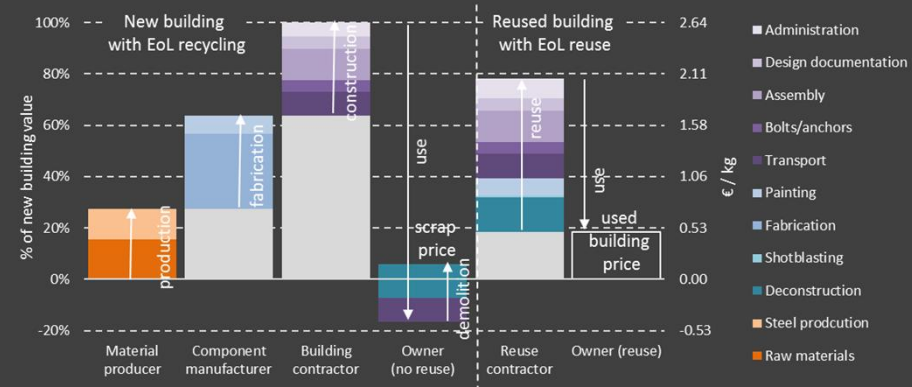
Photo credits: Arnošt Balcar



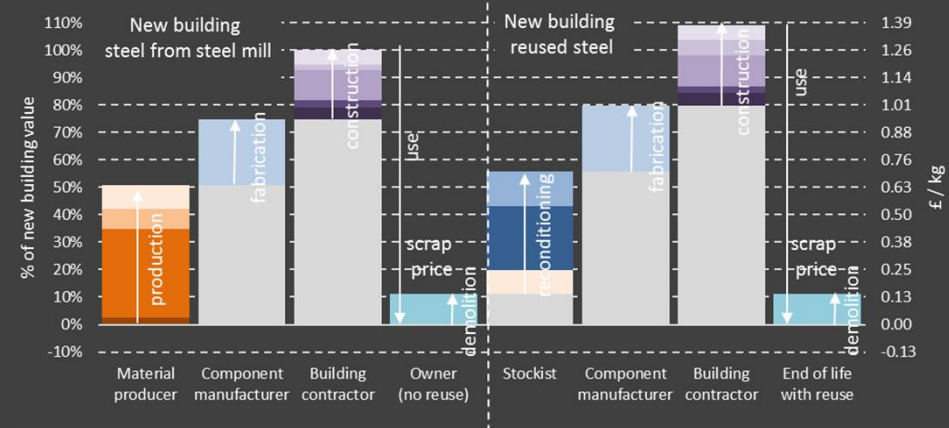
Photo credits: Arnošt Balcar



Reuse of the whole primary structure (CZ)



Reuse of the reconditioned steel sections (UK)



Testing protocol and re-certification

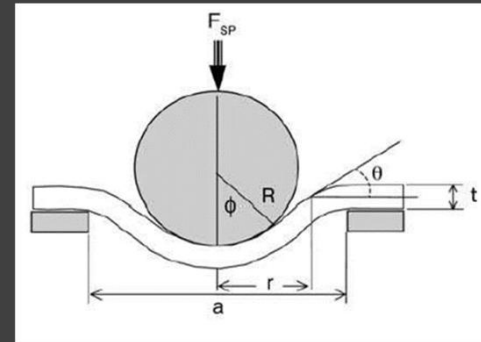
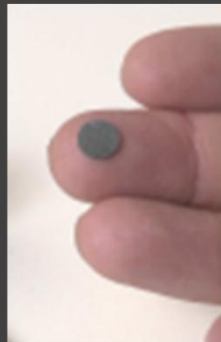
Non-destructive testing

- XRF spectrometer
- Hyperspectral camera
- Hardness testing



Minimum-invasive testing

- strength and ductility
- impact toughness
- weldability



Standard coupon tests



On-line trading platform

The screenshot shows the 'steel reuse' website interface. It features a 'Post details of reclaimed steel' section with a 'Sign in' button and a 'New user? Register' link. Below this are fields for 'Username' and 'Password'. To the right is a 'Find structural steel for reuse' section with a 'Search for a building due for demolition' button and a 'Inventory of reclaimed structural steel' button. Below these are search filters for 'Date needed', 'Location', 'Building type' (set to 'Commercial'), 'Structural form' (set to 'Portal frame'), and 'Weight of steel' (set to '100000'). A 'Search ID' button is at the bottom right.

Image credits: SCI

The screenshot shows the 'Search the inventory of sections from stockholders' page. It includes a heading 'This website is a portal for trading reclaimed UK structural steel sections.' and a circular arrow icon. Below this is a 'How to use this website' section with four icons: 'Find steel buildings scheduled for demolition', 'Find used steel sections', 'Sell structural steel', and 'Upload as-built BIM model'. The bottom of the page features four large green buttons with white text: 'Find steel buildings scheduled for demolition', 'Find used steel sections', 'Sell structural steel', and 'Upload as-built BIM model'.



Design for future reuse

Technical reusability (similar to BRE or DGNB Design for Deconstruction)

Component $r = \sum \rho_i w_i$ Building $R = \frac{\sum m_i r_i}{\sum m_i}$

Performance assessment result (%) \nearrow Weighting factor for each performance category (%) \nearrow Component mass (t)

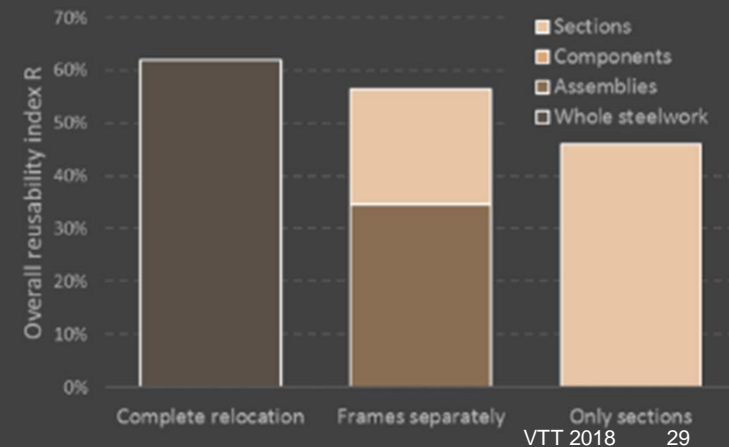
Economic prospect (complementary score)

Component $e = P(c_1 \cap c_2 \cap \dots) n$ Building $E = \frac{\sum m_i e_i}{\sum m_i}$

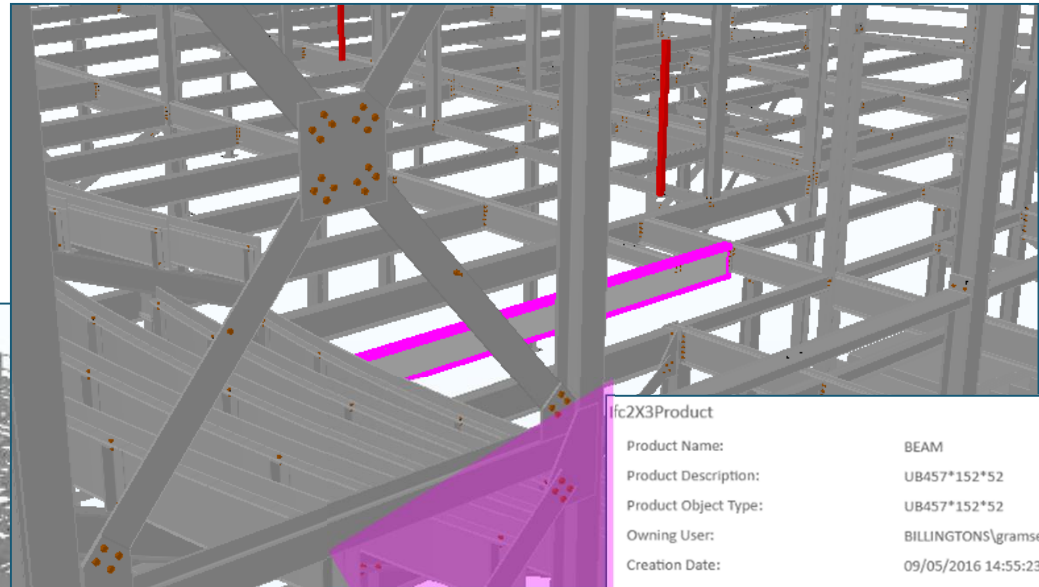
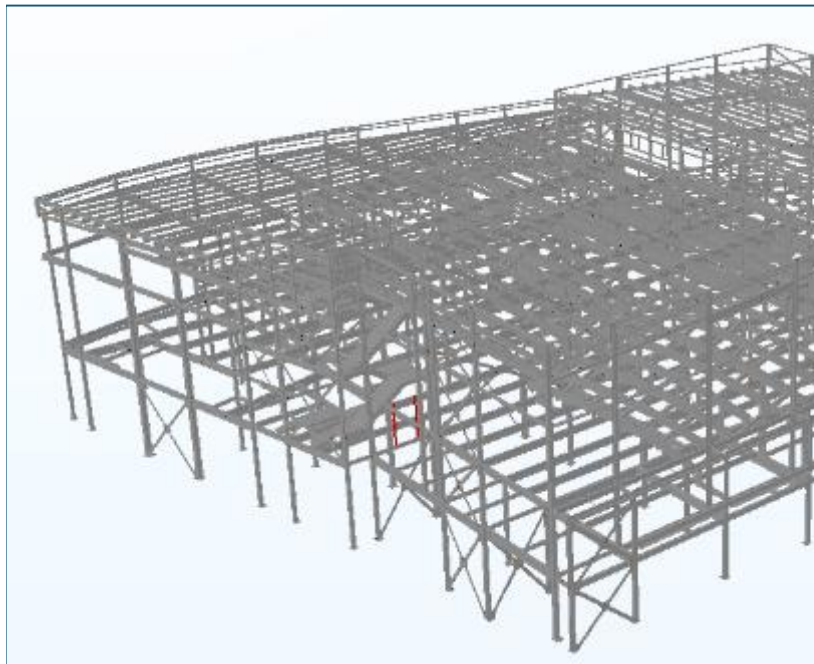
Criteria (e.g. span, height, floor area) \nearrow Number of new buildings in the selected area and time span \nearrow



Comparison of different scenarios



Good practice: Building information modelling



Ifc2X3Product	
Product Name:	BEAM
Product Description:	UB457*152*52
Product Object Type:	UB457*152*52
Owning User:	BILLINGTONS\gramsey@Tekla
Creation Date:	09/05/2016 14:55:23
Change Action:	NoChange
State:	Undefined
Application:	Tekla Structures (Multi materia
IfcMaterial	
Material:	STEEL/S355JR
BaseQuantities	
Length:	10062 mm
OuterSurfaceArea:	14.89 m2
NetVolume:	0.1 m3
NetWeight:	0.517 t
Tekla Quantity	

Good practice: BIM + augmented reality

Conversion of the former heat and power plant of RWTH Aachen University into a seminar building



Process of reusing concrete elements



Contemporary reuse of timber



Satu Huuhka, Tampere University of Technology

Photo 1 courtesy of General Architecture; Photo 2 © Mikael Olsson; Photo 3 courtesy of 3RW Architects; Photo 4 © diephotodesigner.de;
Photo 5 courtesy of Georg Grotenfelt; Photo 6 courtesy of PAVE Architects

VTT 2018

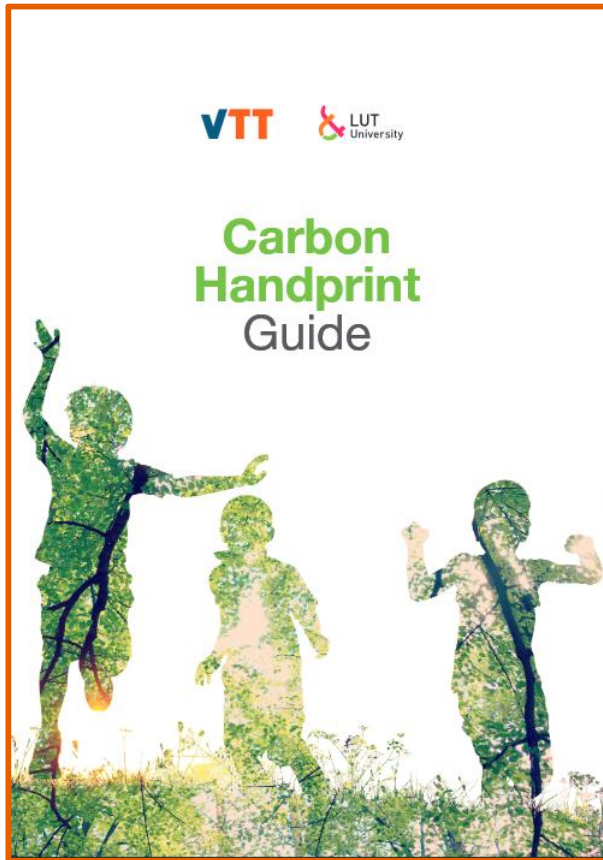
To do list ...

- Remove barriers in legislation & standardization, keep balance between demands for product safety and reusability (e.g. CE marking & CPRs, end-of-waste process, construction permit procedures etc.);
- Set targets for reuse (e.g. sectorial level, regional level, company goals, etc ...)
- Facilitate deconstruction over demolition by incentives and pre-demolition audits (e.g. request working out a reuse plan);
- Develop competences in the whole circular economy chain;
- Design for reuse (e.g. public projects);
- Assess the impact and maximize the residual value at end-of life of new construction;

Methods for the whole life carbon assessment of buildings

From Carbon footprint to Carbon handprint

VTT



19/12/2019 VTT – beyond the obvious

Carbon handprint

A Positive Indicator

An indicator of climate change mitigation potential. Describes the GHG emission reduction in a customer's activities that occurs when the customer replaces a baseline solution with a handprint solution.

Carbon footprint

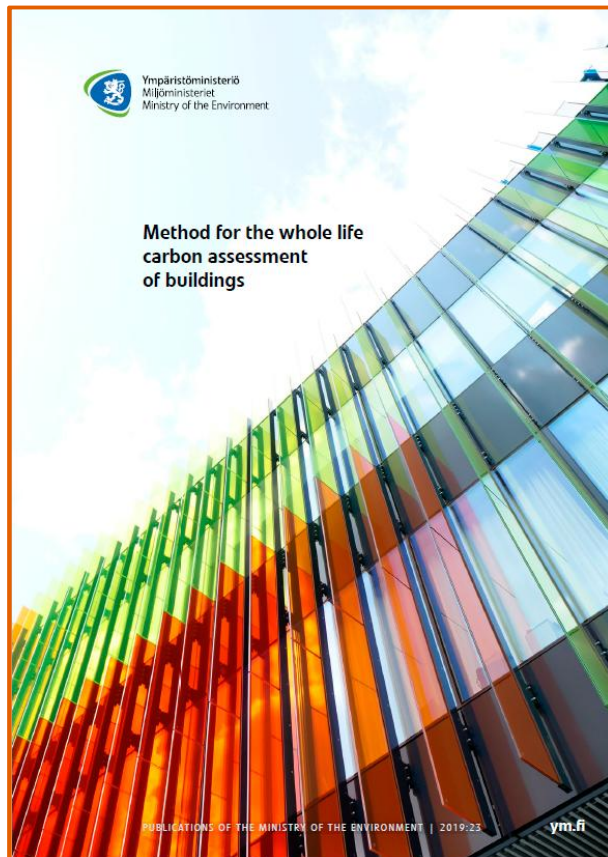
The sum of GHG emissions and removals in a product system expressed as CO₂ eq. and based on an LCA using the single impact category of climate change (ISO 14067: 2018).

Download in:

https://www.vtt.fi/sites/handprint/PublishingImages/Carbon_Handprint_Guide.pdf

A low-carbon building has a low carbon footprint and a big carbon handprint

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Carbon handprint

A Positive Indicator

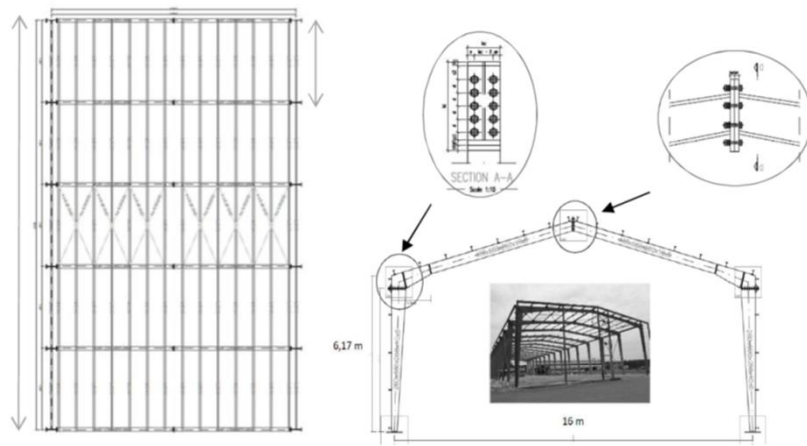
The carbon handprint analysis incorporates the net benefits of climate impact that would not arise if there were no construction project. These might be the building's carbon storages and sinks, the extra renewable energy produced during the building's life cycle, and the benefits gained from the reuse and recycling of the construction products.

Carbon footprint

A carbon footprint analysis covers a building's entire life cycle. It includes the manufacture and transportation of the products used in a construction project, the worksite, the use and maintenance of the building, its demolition, and recycling.

Download in:
<https://julkaisut.valtioneuvosto.fi/handle/10024/161796>

Example of a single industrial hall

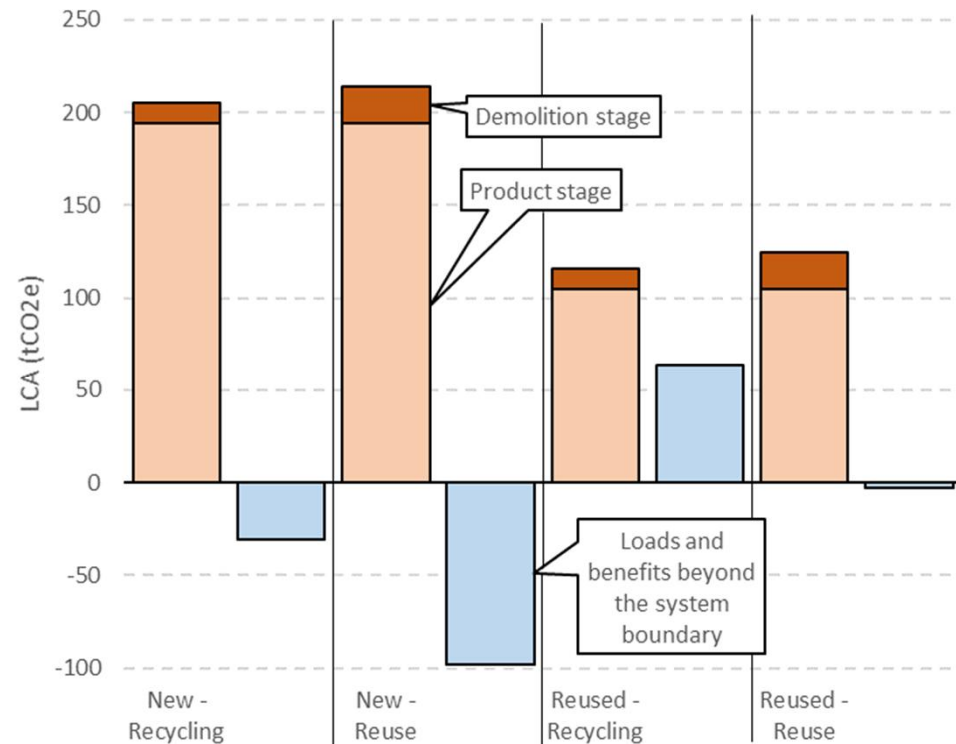


- § Pre-designed steel hall from PRECASTEEL¹
- § EPD data from Ruukki Construction²
- § LCA includes steelwork, concrete slab and foundations, envelope, windows and doors³

¹ <http://www.unav.es/Precastel/>

² <https://cdn.ruukki.com/docs/>

³ S. Vares, P. Hradil, M. Sansom, V. Ungureanu, Economic potential and environmental impacts of reused steel structures, Structure and Infrastructure Engineering, September 2019



Smart and Sustainable Cities

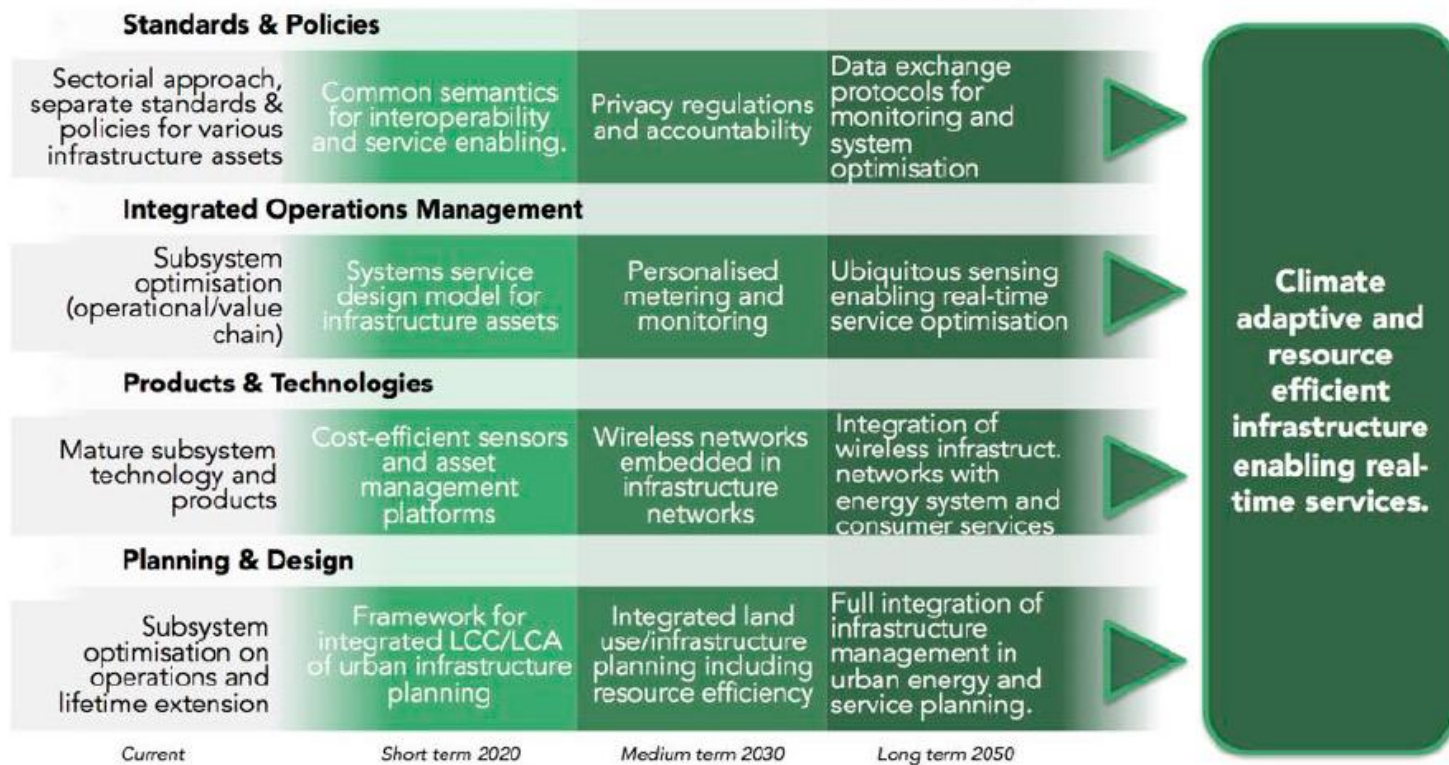
Perspectives from the Construction Sector

Cross-cutting domains and sector synergies

- § Digitalization in enabling new services and innovation as well as more efficient systems
- § Integrated and cross-sectoral planning and management is essential
- § Cities have many stakeholders; value-chains and changing and new eco-systems are emerging
- § Importance of energy management at building and district level increases as well as the increased
- § use of low carbon energies
- § New services, e.g. mobility as a service, building as a service, energy as-a-service, X-as-a-service .
- § Importance of resiliency, safety and security is highlighted
- § Upgrading existing infrastructure asks for new business concepts including new models for ownership



New and existing **infrastructures**





Existing and new buildings



Final words

Approach all aspects of sustainability equally as well as all aspects of the major building materials

- § REDUCE – REUSE – RECOVER
- § From footprint to carbon Hand-Print
- § Pre-demolition audits and re-certification
- § Digitalization as catalyzer
- § “Fridays 4 future” are the future customers
- § Investments in Research, development and innovation, including in research infrastructures are critical.



VTT's R&D infrastructure – an essential part of the national research infrastructure

VTT's research environments are world-class. They enable product development from basic research to piloting and even small-scale production.



Bioruukki
The largest bioeconomy pilot and research facility in the Nordic countries.



Biotechnology and food research piloting environment
offers unique facilities for the development and customisation of bio and food industry technologies.



Micronova
World-class cleanroom facility, fully equipped for the fabrication of silicon, glass and thin film-based microsystems.



VTT MIKES Metrology
is the National Metrology Institute of Finland and performs high-level metrological research and develops measuring applications in partnership with industry.



Engine and vehicle laboratory
enables research on passenger cars as well as heavy-duty vehicles up to 60 metric tons to develop energy efficiency, emissions reduction and use of 2nd generation biofuels.



PrintoCent
World's first pilot factory for printed intelligence industrialisation.



ROVIR
Remote Operations and Virtual Reality Centre for the development of remote operations and virtual reality technology in industry.



A pilot-scale research environment for fibre processes
enables the development of novel products and supports the renewal of the pulp and paper industry.



Centre for Nuclear Safety
for nuclear technology safety research.

Further Information



Design for Reuse:

Petr Hradil : Petr.Hradil@vtt.fi

<https://www.vtt.fi/sites/reuse/en>

<https://www.vtt.fi/sites/progress/project-consortium>

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

<https://www.vtt.fi/inf/pdf/technology/2014/T200.pdf>

Economic potential and environmental impacts of reused steel structures:

<https://cris.vtt.fi/en/publications/economic-potential-and-environmental-impacts-of-reused-steel-stru-2>

ECTP Strategic Research and Innovation Agenda 2021-2027

<http://www.ectp.org/news-events-newsletters/news/news-detail/ectp-has-issued-it-strategic-research-innovation-agenda-sria-for-2021-2027/>

Pre-demolition audits and Construction Waste:

Margareta Wahlström: Margareta.Wahlstrom@vtt.fi

https://ec.europa.eu/growth/content/eu-construction-and-demolition-waste-protocol-0_en

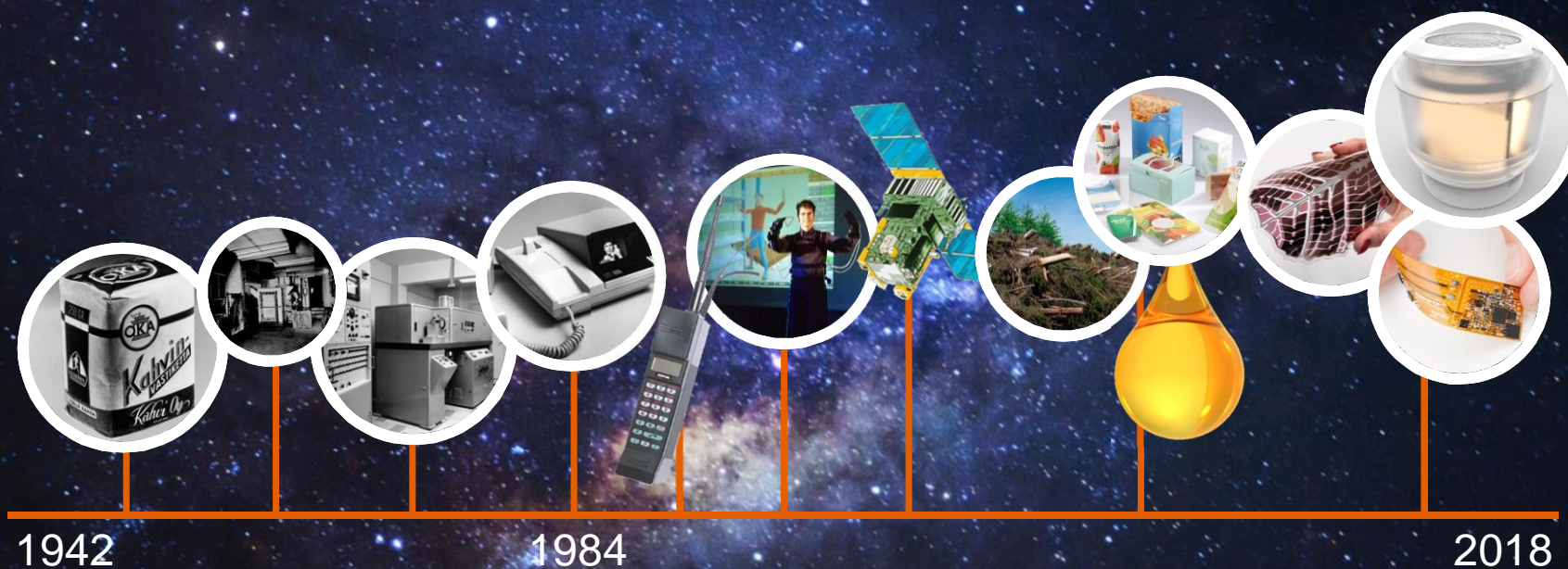
<https://www.vtt.fi/sites/PARADE>

Method for the whole life assessment of buildings

<https://julkaisut.valtioneuvosto.fi/handle/10024/161796>

76 years of innovations

Read more:
www.vttresearch.com



bey⁰nd

the obvious

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