Nordic view

- data needs and scenario settings for building LCA

Helle Redder Momsen
18 02 2025

Nordic Sustainable Construction

It began with a Vision

Our vision 2030

A **competitive** Nordic region

Together, we will promote green growth in the Nordic region based on knowledge, innovation, mobility and digital integration.

A **green** Nordic region

Together, we will promote a green transition of our societies and work towards carbon neutrality and a sustainable circular and bio-based economy.

The Nordic region will become the most sustainable and integrated region in the world

A **socially sustainable** Nordic region

Together, we will promote an inclusive, equal and interconnected region with shared values and strengthened cultural exchange and welfare.

Nordic collaboration on Building Regulations

Nordic Vision 2030

2019
Nordic Vision 2030
Nordic Prime Ministers

2019
Nordic Ministerial Declaration Housing and Construction

2021
Nordic Sustainable Construction Programme

2023
Nordic Ministerial Declaration Housing and Construction

Nordic Ministerial Declaration, 2023

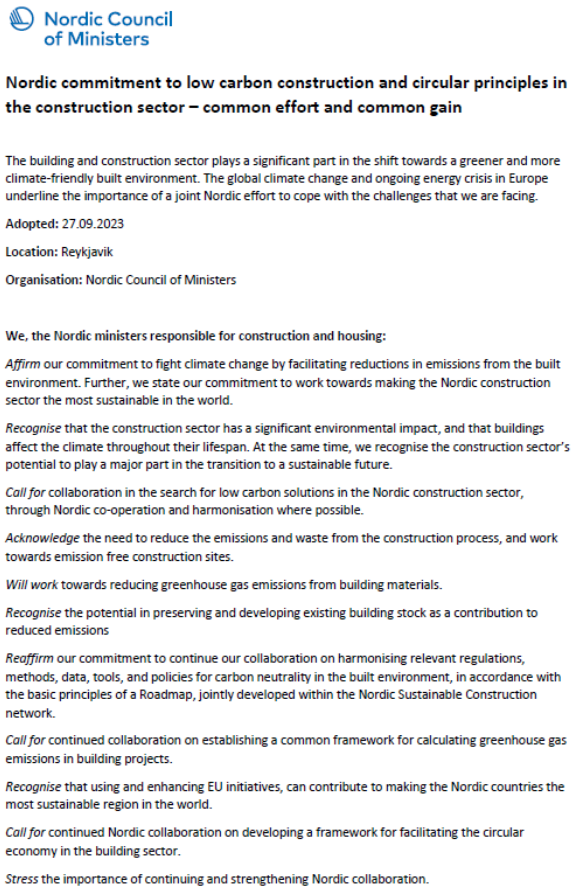
Nordic Ministers responsible for construction and housing

"We reaffirm our commitment to the ongoing work towards **low carbon solutions** and the integration of **circular principles** in the **Nordic construction and building sector**"

"… reaffirm our commitment to continue our collaboration on **harmonising relevant regulations, methods, data, tools, and policies for carbon neutrality in the built environment**, in accordance with the **basic principles of a Roadmap**, jointly developed within the Nordic Sustainable Construction network.

"Acknowledge the need to reduce the **emissions and waste** from the construction process, and **work towards emission free construction sites**"

"Recognise the potential in **preserving** and **developing existing building stock** as a contribution to reduced emissions"



Nordic Council of Ministers

Nordic commitment to low carbon construction and circular principles in the construction sector – common effort and common gain

The building and construction sector plays a significant part in the shift towards a greener and more climate-friendly built environment. The global climate change and ongoing energy crisis in Europe underline the importance of a joint Nordic effort to cope with the challenges that we are facing.

Adopted: 27.09.2023

Location: Reykjavik

Organisation: Nordic Council of Ministers

We, the Nordic ministers responsible for construction and housing:

Affirm our commitment to fight climate change by facilitating reductions in emissions from the built environment. Further, we state our commitment to work towards making the Nordic construction sector the most sustainable in the world.

Recognise that the construction sector has a significant environmental impact, and that buildings affect the climate throughout their lifespan. At the same time, we recognise the construction sector's potential to play a major part in the transition to a sustainable future.

Call for collaboration in the search for low carbon solutions in the Nordic construction sector, through Nordic co-operation and harmonisation where possible.

Acknowledge the need to reduce the emissions and waste from the construction process, and work towards emission free construction sites.

Will work towards reducing greenhouse gas emissions from building materials.

Recognise the potential in preserving and developing existing building stock as a contribution to reduced emissions

Reaffirm our commitment to continue our collaboration on harmonising relevant regulations, methods, data, tools, and policies for carbon neutrality in the built environment, in accordance with the basic principles of a Roadmap, jointly developed within the Nordic Sustainable Construction network.

Call for continued collaboration on establishing a common framework for calculating greenhouse gas emissions in building projects.

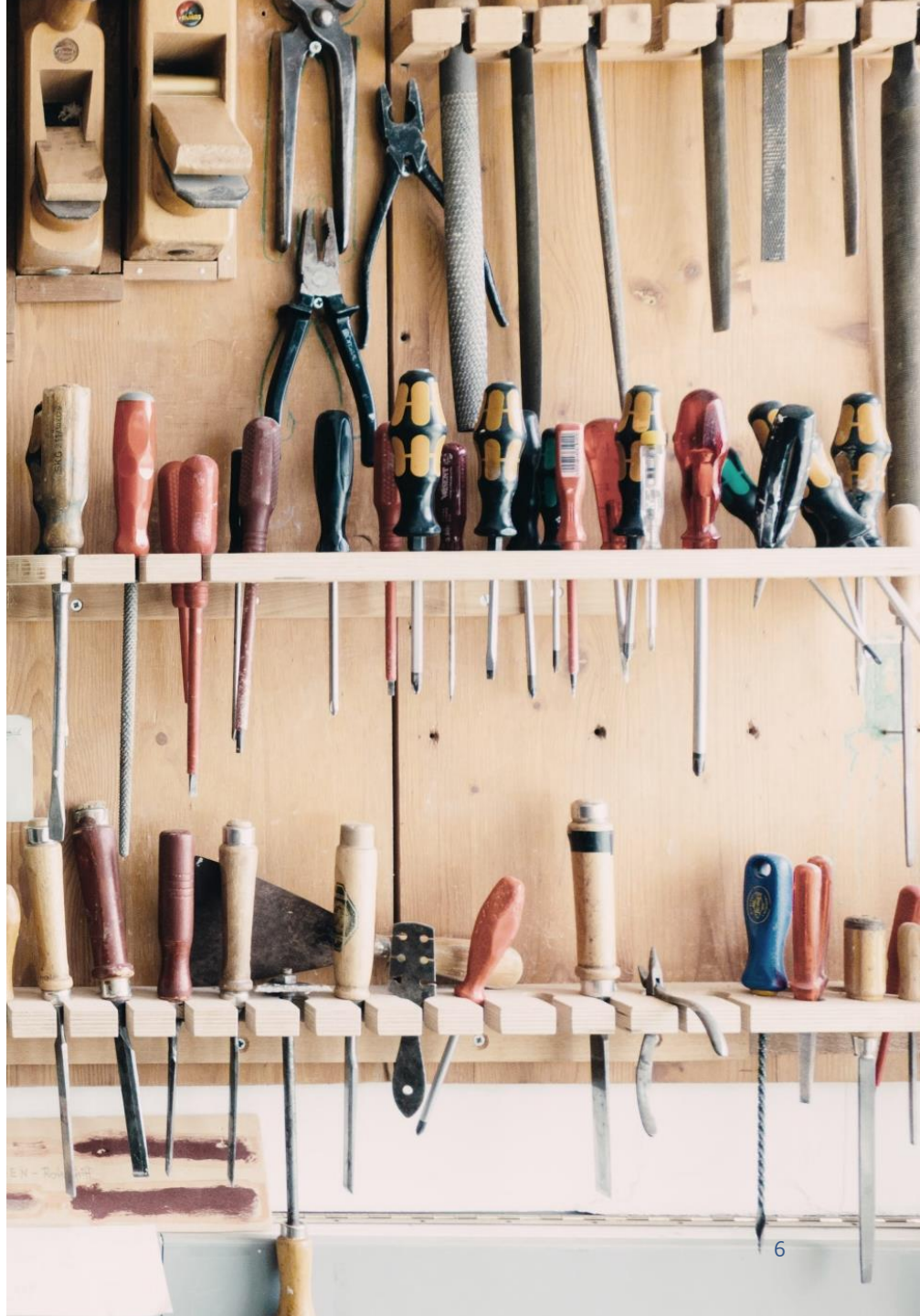
Recognise that using and enhancing EU initiatives, can contribute to making the Nordic countries the most sustainable region in the world.

Call for continued Nordic collaboration on developing a framework for facilitating the circular economy in the building sector.

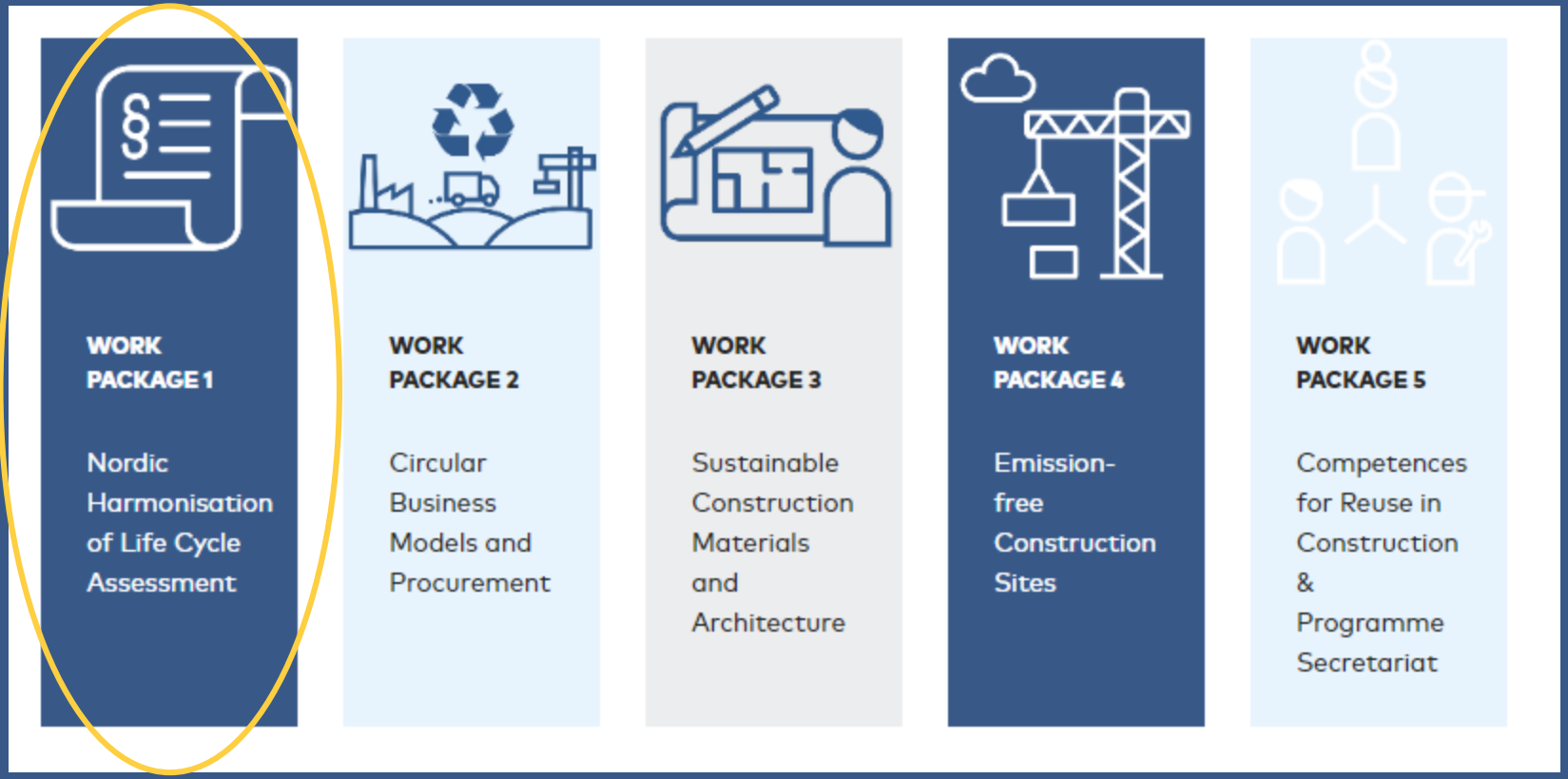
Stress the importance of continuing and strengthening Nordic collaboration.

Our purpose

The Nordic Sustainable Construction programme aims to support the ambition in the Nordic Vision 2030 of establishing the Nordics as a leading region in sustainable and competitive construction and housing – with minimised environmental and climate impact.



Nordic collaboration to Nordic vision



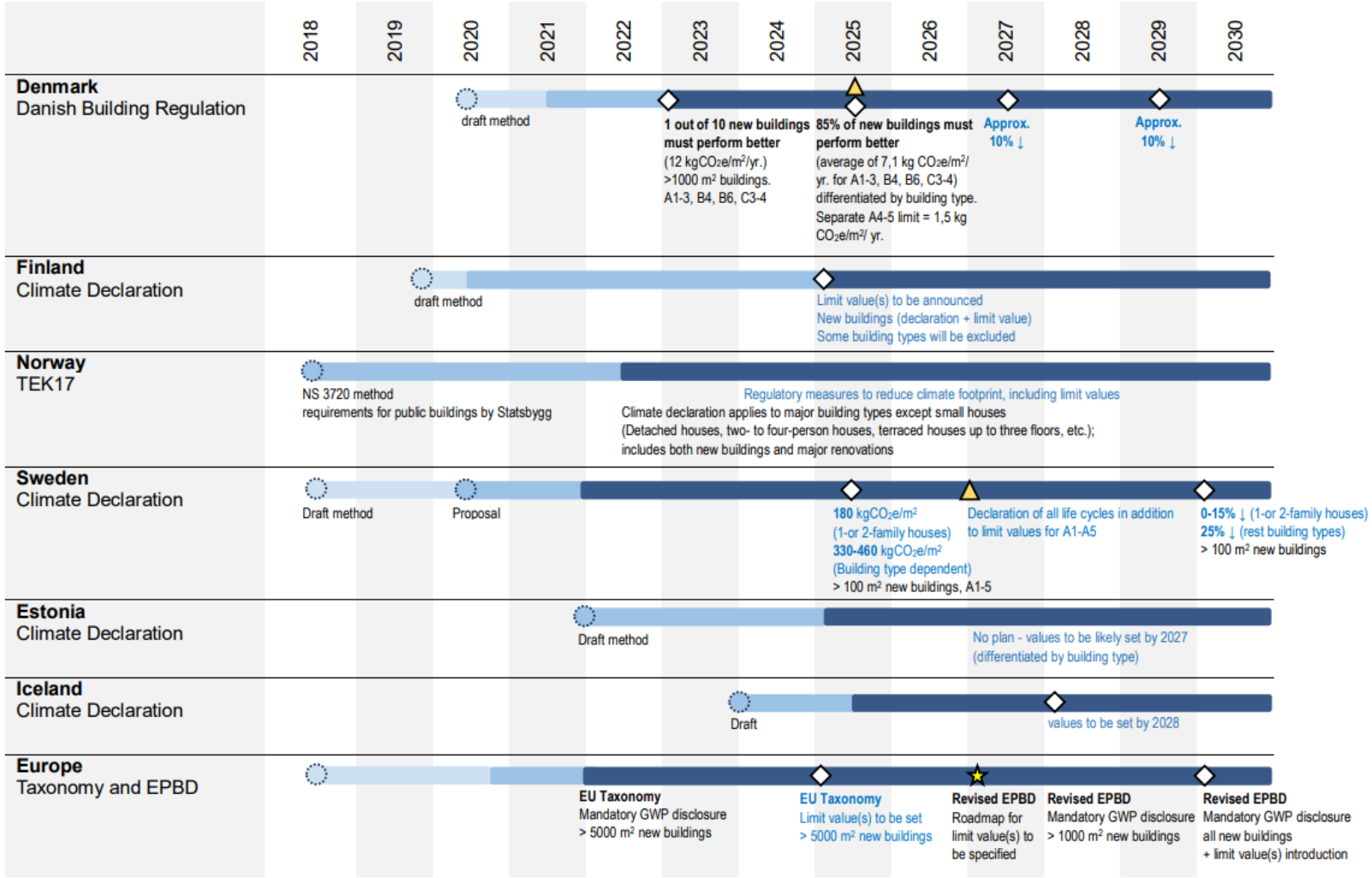
Ympäristöministeriö
Miljöministeriet
Ministry of the Environment

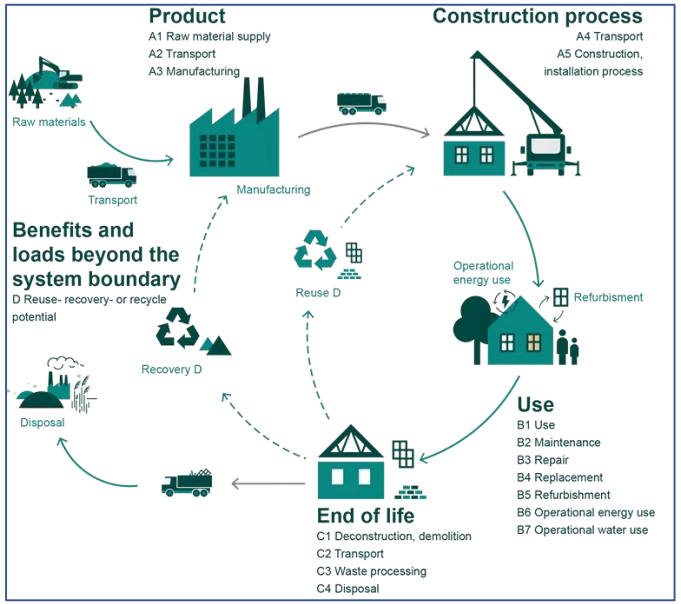
Work Package 1

Nordic Harmonisation of Life Cycle Assessments

Task 1	Task 2	Task 3	Task 4	Task 5
Analysis of Nordic LCA Practices	**Data for LCA**	**BIM for LCA - Calculating the Climate Impact of Buildings Through Digitalisation**	**Limit Values and Monitoring the Decarbonisation of the Nordic Building Stock**	**Acceleration Programme: Knowledge Sharing Clinics and Best Practice Catalogues**
2 reports: • Nordic feasibility study on harmonisation of building LCA (June 2022- internal) • Roadmap for Harmonising Nordic LCA regulation (Sep. 2023)	1 big report: Nordic view on data needs and scenarios settings for full life cycle building environmental assessment (June 2024) Strengthen collaboration between Nordic data LCA experts 2 webinars 5 workshops	2 reports: • The operating environment of building LCA and BIM in the Nordics and Estonia (Dec. 2023) • BIM-based building LCA - instructions for material inventory for climate declarations (Sep 2024) 2 webinars (one coming) +30 BIM models (Sep 2024) 8 short e-learning videos on how to use the BIM models (Sep 2024)	3 reports: • Process for Monitoring the Decarbonization of the Building Stock (Jan. 2024) • Harmonising limit values for buildings across the Nordics (March 2024) • Decarbonization of the building stock (*Sep 2024*) 2 webinars	The acceleration programme to speed up decarbonisation of the building and construction sector 1 launch webinar 1 workshop and tailor made consultancy (Sep. 2024) Report: Nordic Low Carbon Building Catalogue (Dec 2024).

Timeline of carbon declaration and limit values integration

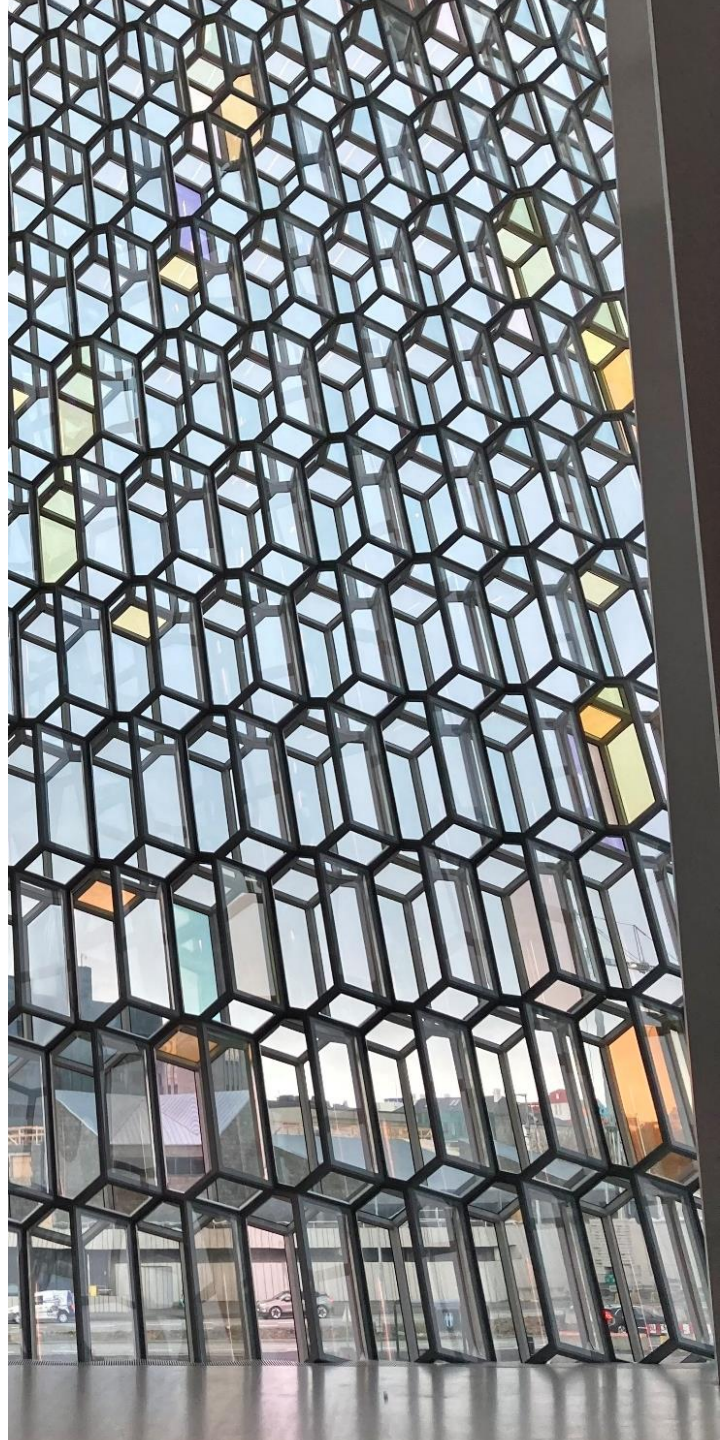




Overview of Nordic Climate Declarations and Limit Values integration | Nordic Sustainable Construction

Can digitalisation help?

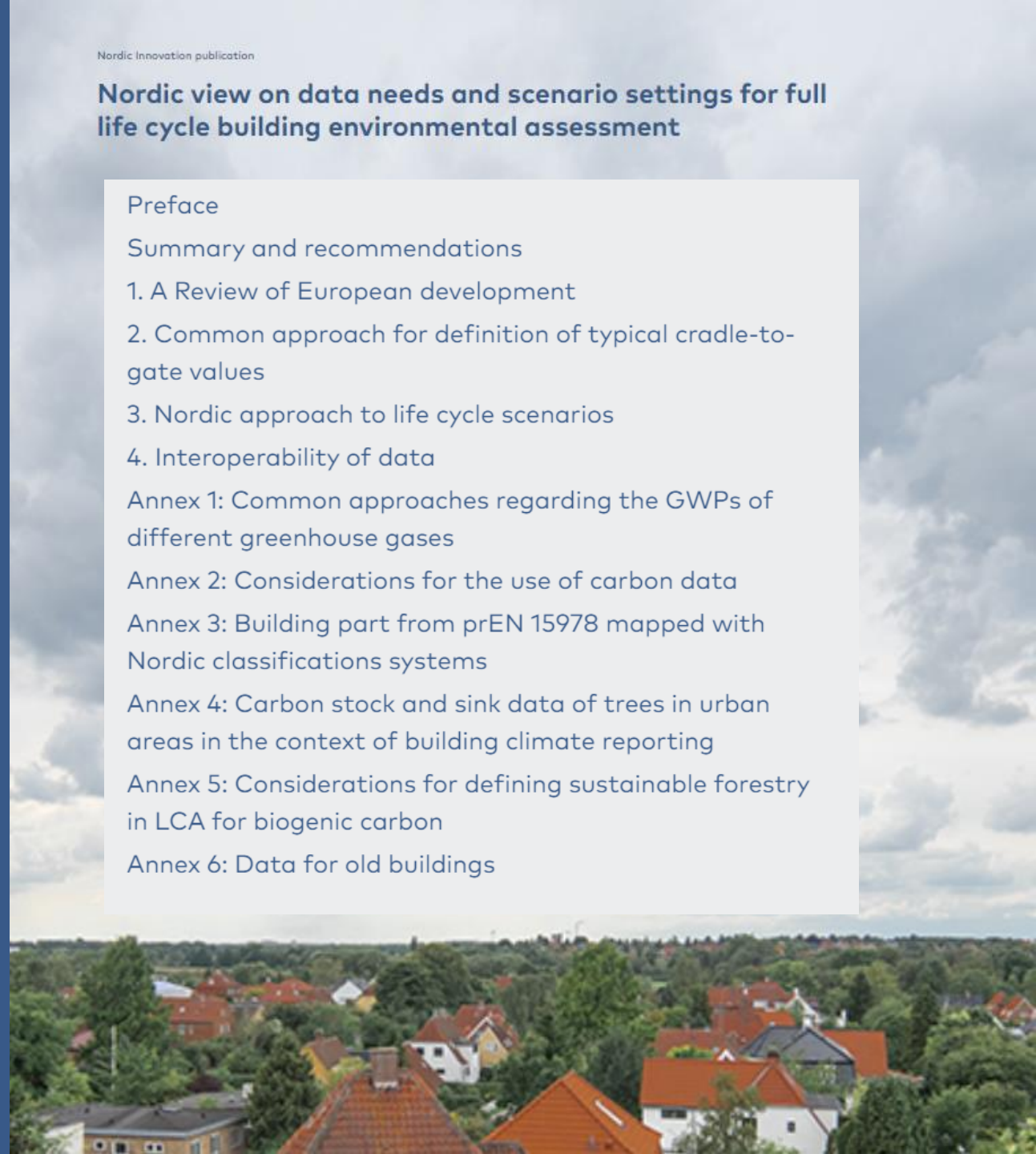
- Regulation of embodied carbon = more data to handle
- Tightened limit value = need for improved building designs
- Mapping between building classification systems
- Machine readable templates for out put data
- Databases and product specific data
- …



Data, data, data

— Strong focus on data quality, machine readable data and how to make data talk together so it can also be used in BIM.

— Details in REPORT: Recommendations for a Common Nordic Approach to Combat New Buildings Life Cycle Climate Impact | Nordic Sustainable Construction



Aims

- Develop a generic process for BIM-based building LCA
- Create architectural, structural, HVAC and electrical BIM designs and their IFCs
- Create learning material guiding the calculation of BIM-based building LCA

Focus on building LCA

Conceptual design

LCA aim: Comparing LCA of alternatives

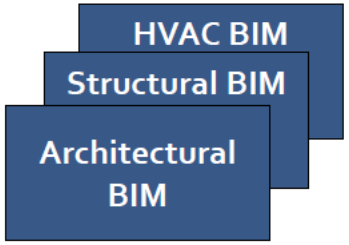
Data: emission data for structures and systems at rough estimate level of detail

Developed design (building permit LCA)

LCA aim: First estimation (*Proposed* normative LCA in *Estonia and Iceland*)

Data: Mainly general emission data

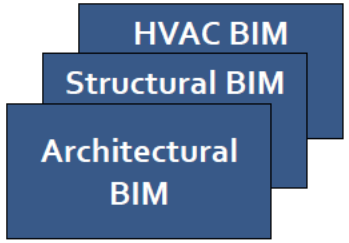
Technical design



LCA aim: More accurate LCA based on the quantity take-off

Data: General and specific (EPD) emission data

Construction and handover (as-built LCA)



LCA aim: As-built normative LCA (Denmark, *Finland*, *Iceland*, Norway, Sweden)

Data: General and specific (EPD) emission data

Constraints and needs for using BIM for the building LCA

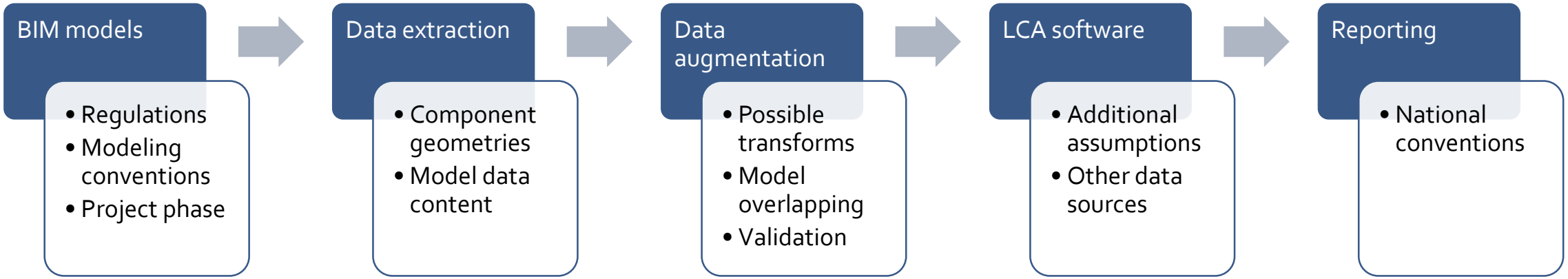
Constraints:

- The information content and identification of objects and materials in BIMs are not standardized
- Inaccuracy in quantity take-off
- The lack of interoperability between BIM and LCA software
- Modelling conventions regarding spaces in BIM are not harmonized
- Not all data comes from BIM (e.g. B6 and energy sources)

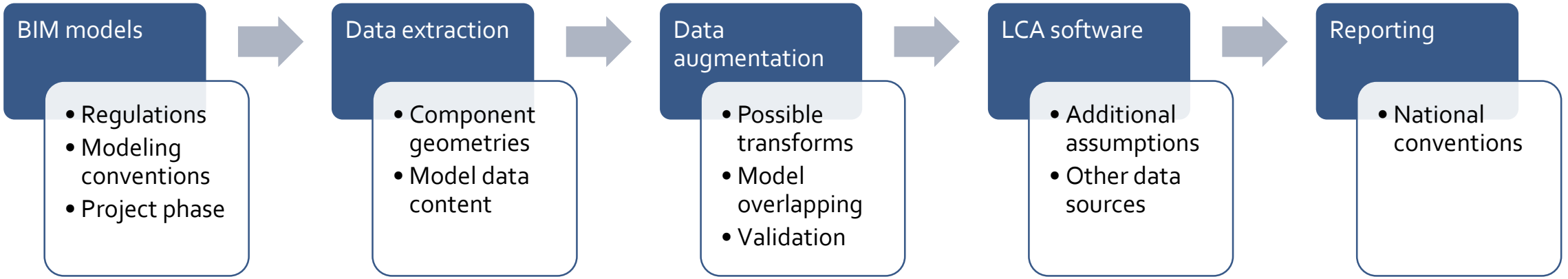
Needs:

- The general calculation rules for building LCA set requirements for the BIM modelling process
- The information content and identification of materials and structures in BIM should be standardized

Current state: steps from BIM to LCA



Possible issues in the data flow



- Objects modelled incorrectly
- All objects not modeled
- Data may be recorded in different properties
- Varying naming and typing conventions

- LCA system boundary may differ from modeled content
- Take-off units not corresponding to LCA databases
- Data in nonstandard locations
- Reliability of quantities?
- Manual extraction work, error-prone

- No knowledge on missing information
- Difficult to solve overlapping between modeled domains
- Object types in BIM models not easily mappable with other documents

- Lacking coordination from BIM modeler to LCA analyst
- Not sure of materials and products

- Not clear, to which LCA reporting category a BIM object belongs
- Low automation in previous steps leads to repeated work

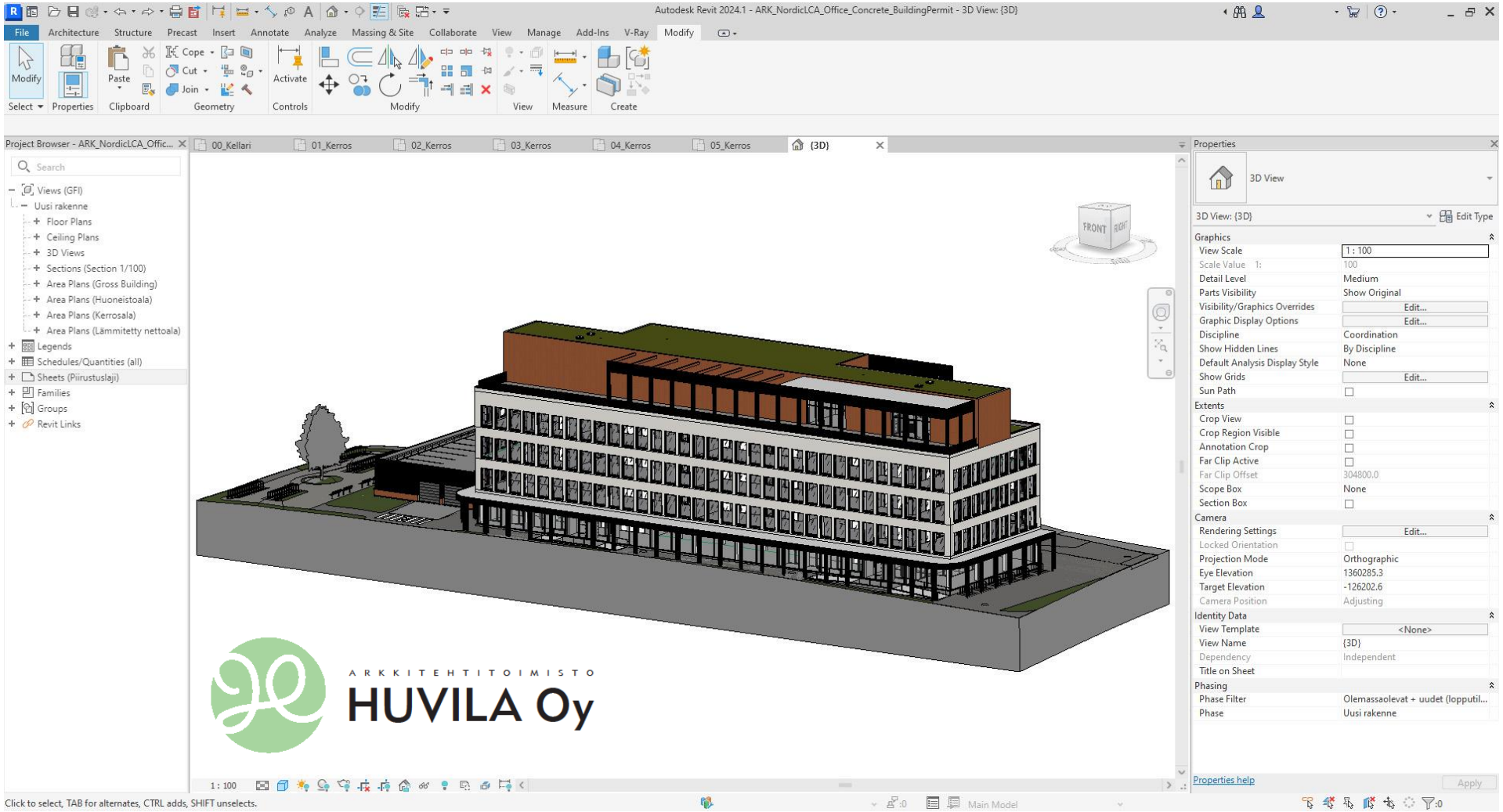
BIM-based building LCA process

Native

IFC

Processing

LCA



BIM-based building LCA process

- BIM provides adequate information on correct quantities
- This information is linked with the emission data in the LCA software.

Native

- Modelling in native software (Revit, ArchiCAD)
- Specifications for required properties for the objects, based on LCA requirements

IFC

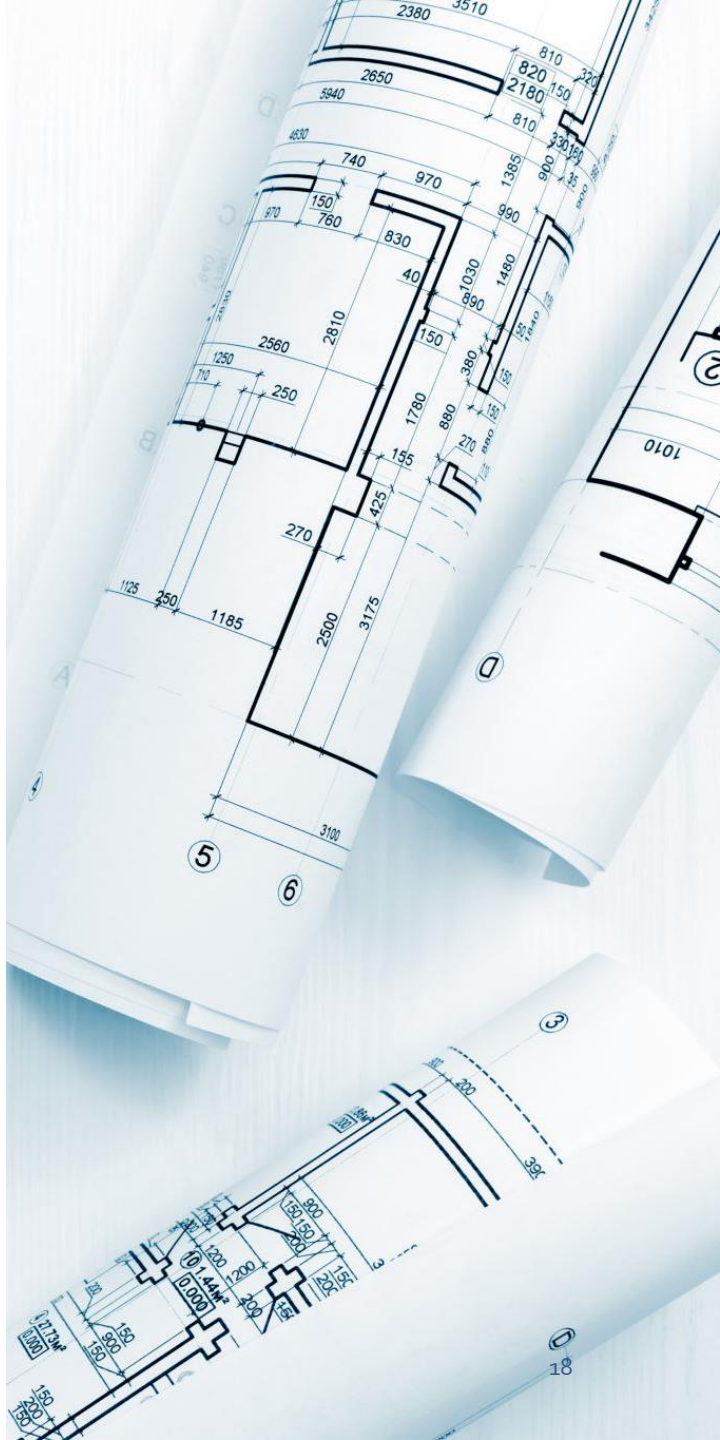
- IFC format as standardized exchange format
- Data specification in IFC property sets
- Export to material inventory lists with standardized fields

Processing

- Data augmentation and additional assumptions (manually, or later in the LCA software)
- Possible processing into format accepted by LCA software

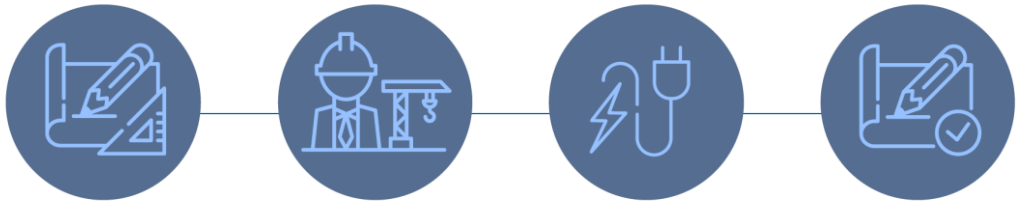
LCA

- Examples of importing material inventory lists into LCA software
- Reporting and calculation in LCA software, business-as-usual - creating national reports in LCA software is not included



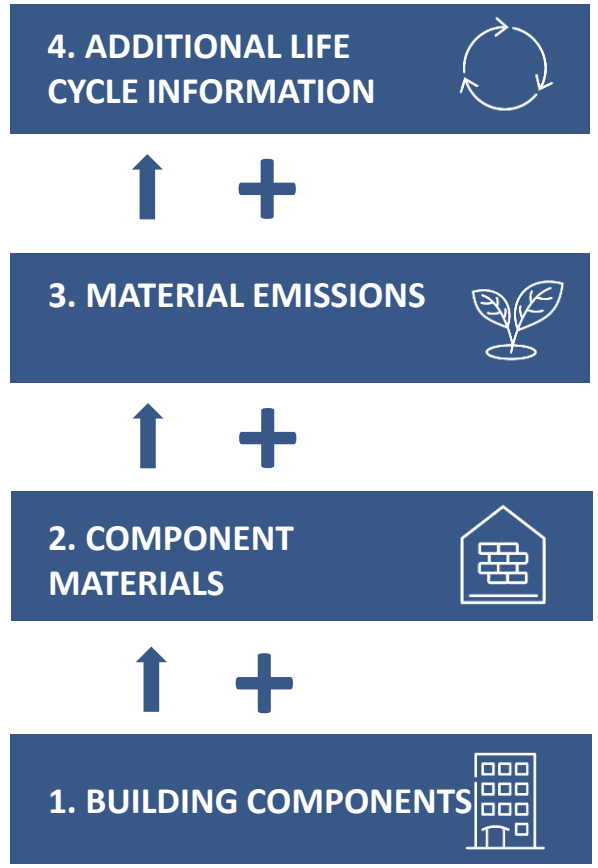
Whole life carbon assessment

Whole life carbon of a building, kg CO_2e



PRODUCT STAGE | CONSTRUCTION | USE STAGE | END OF LIFE

BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARY



Use of the IFC model to calculate the CO2 of a building

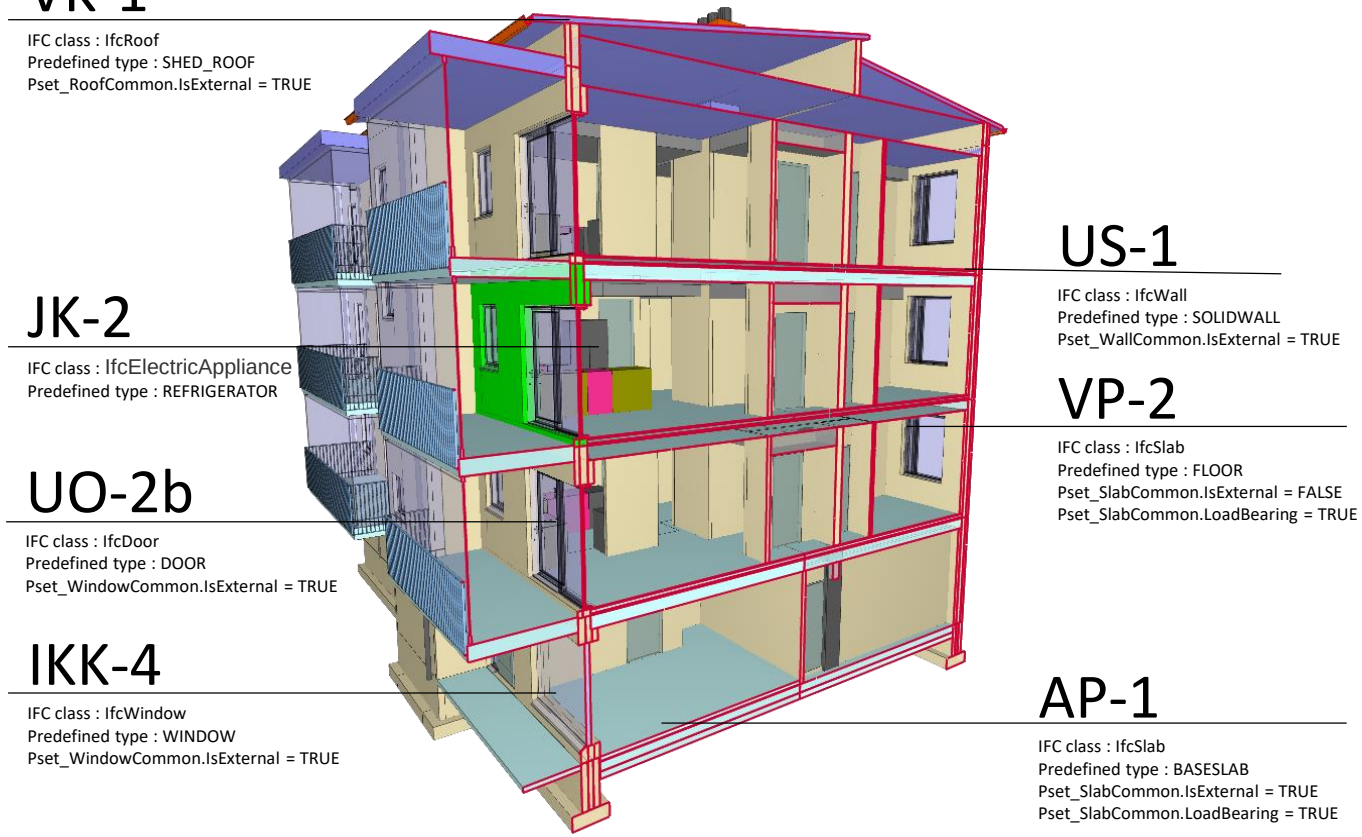
1. For each element in the design model, the correct IFC class, pre-defined type and required properties are defined. This information allows the IFC model to be filtered by element group.

2. In addition, in the IFC, each type of building element and product element is assigned a project-specific type designator (e.g. US-1). This allows the elements to be linked to external material and product data.

3. The IFC data model provides the quantity information for each element. Quantities can be read from the model as lengths, areas, volumes or number of items, depending on the elements.

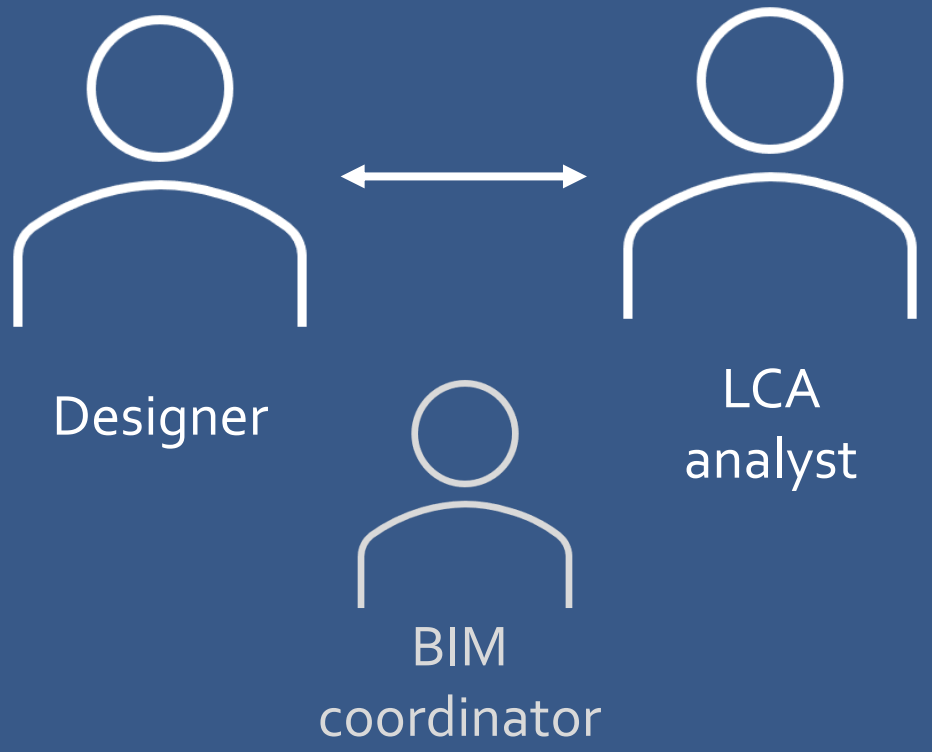
4. The IFC model data is transferred to the LCA calculation software. The IFC model contains quantitative data only for the elements to be implemented. Waste material, formwork, supports and other temporary structures must be considered separately. In addition, the LCA software must include quantitative estimates for elements not included in the design model.

5. The project-specific type designators in the IFC model can be used in the LCA calculation software to link the breakdown structure and product information for each element.

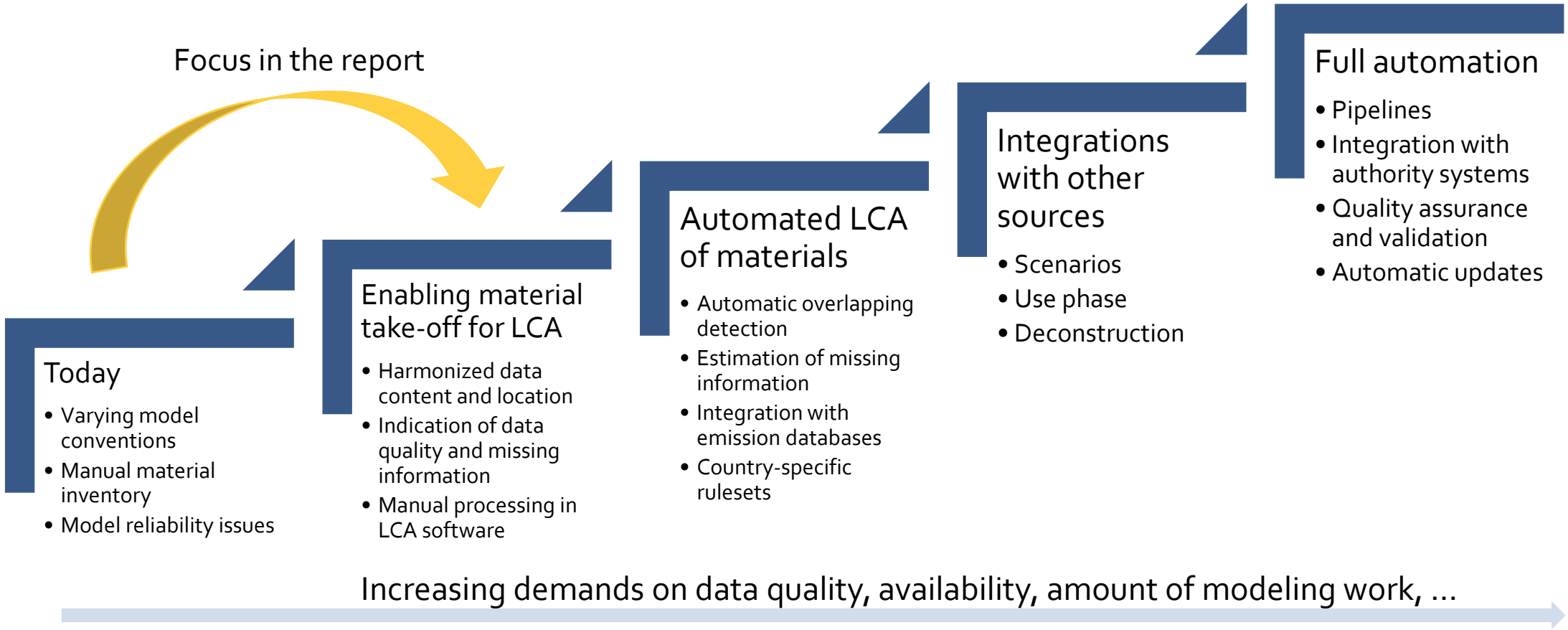


Communication as the key to success

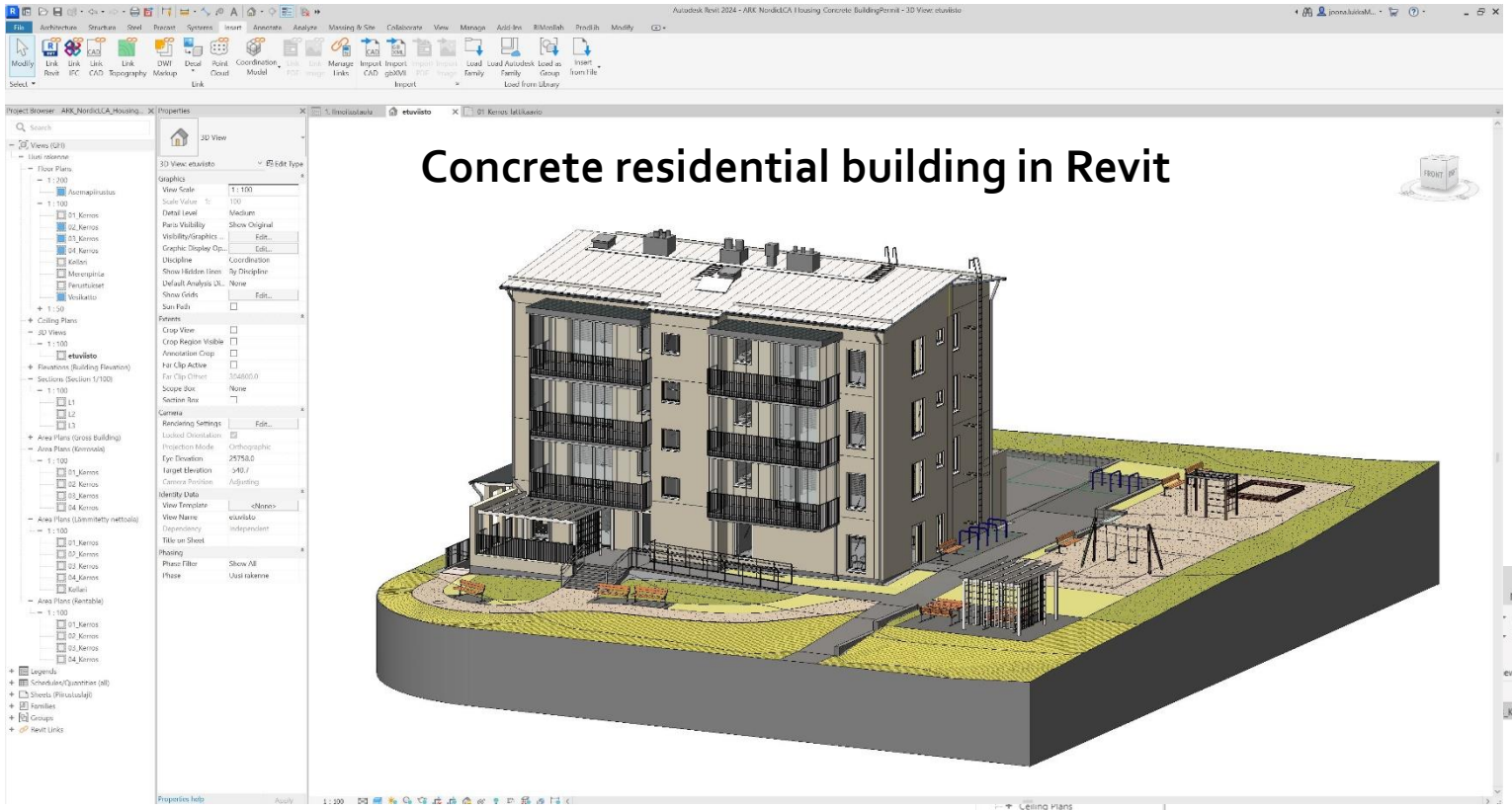
- Information requirements
  - Geometries and type designators
- Documentation of the models
  - What has been modelled, and the level of detail
  - What building parts or details are not modelled
  - Which IFC properties are employed to store data
  - Where can the LCA analyst find supplementary information

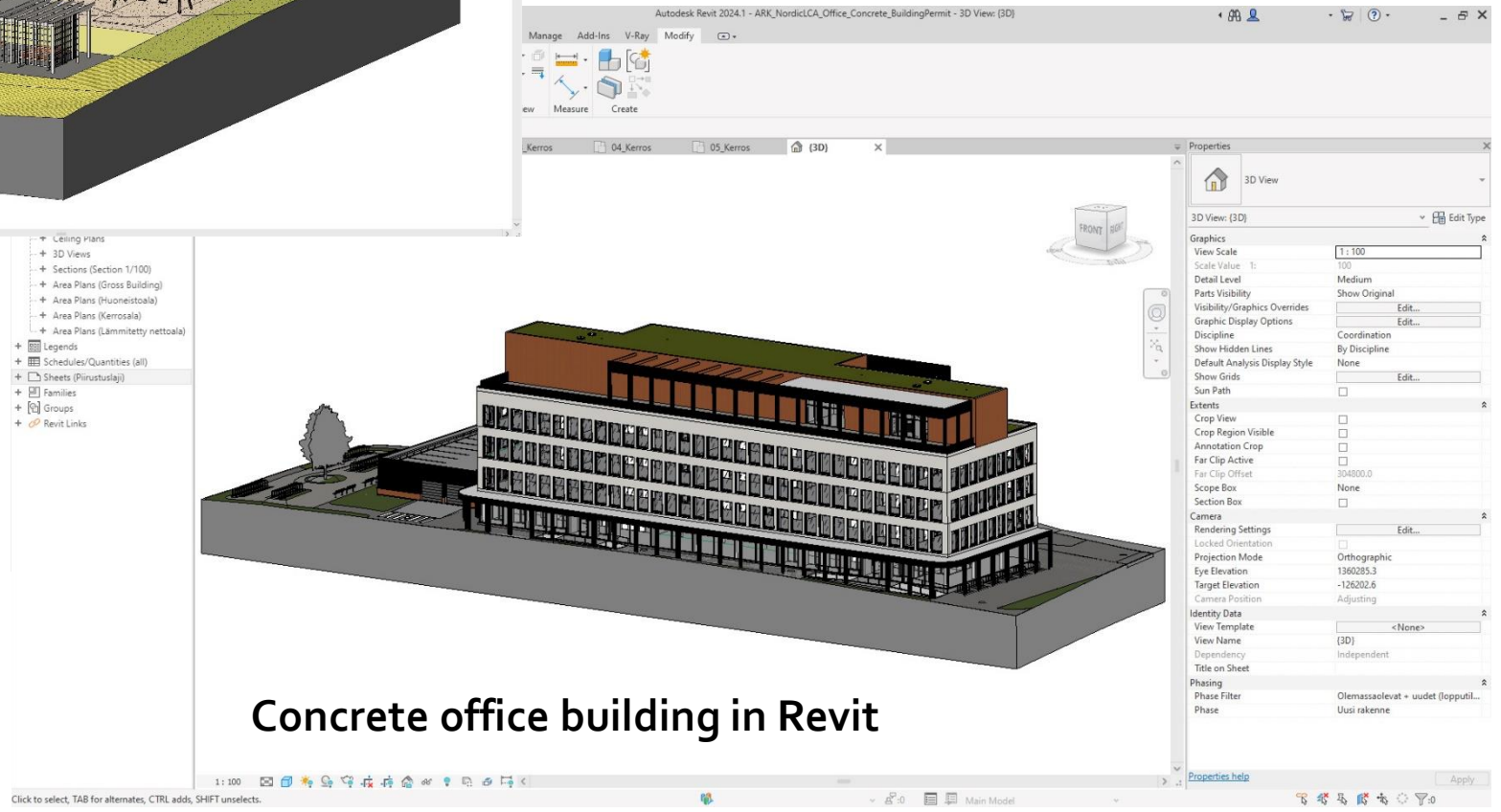


Steps towards automated LCA from BIM



Example buildings: residential & office building





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HUVILA Oy

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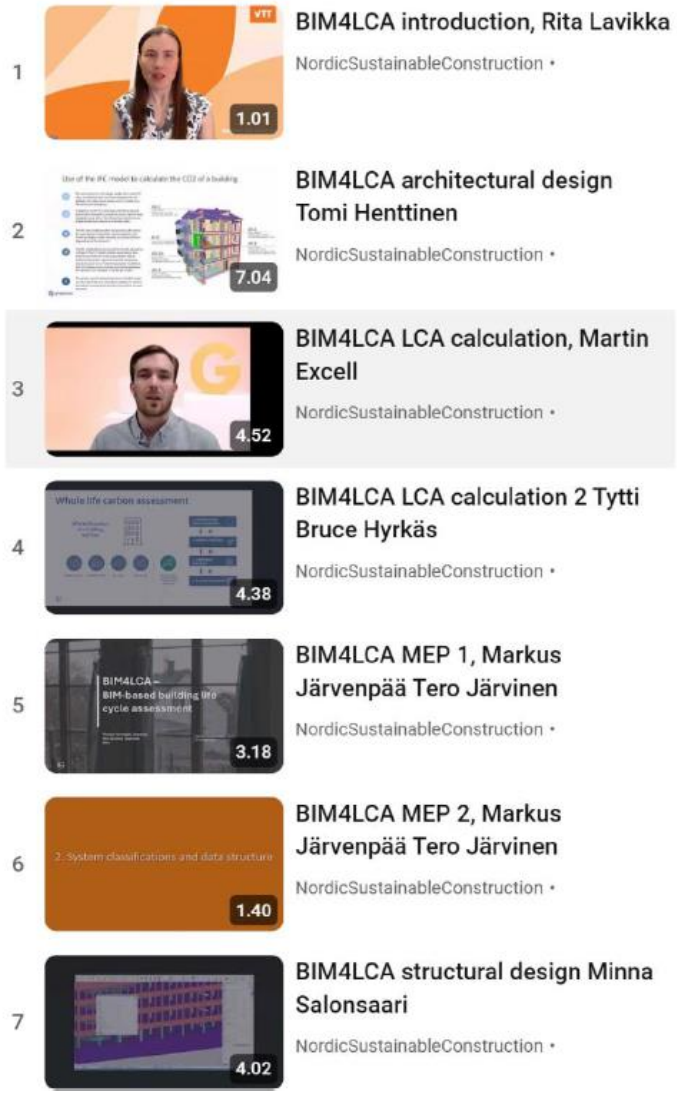
Design models (native BIM models and IFC)

Group	Wooden		Concrete		Site models	IFC files
Architectural **building permit** models	Residential building in Revit	Office building in Revit	Residential building in Revit	Office building in Revit	Residential and office building sites for Wooden and Concrete versions in Revit, Office building site in Archicad	As many as the native models = 10 IFC files
Architectural **as-built** models	Residential building in Revit and ArchiCAD	Office building in Revit	Residential building in Revit	Office building in Revit and ArchiCAD	Residential building site in Archicad	= 2 IFC files
Structural models	Residential building in Tekla Structures	Office building in Tekla Structures	Residential building in Tekla Structures	Office building in Tekla Structures		= 4 IFC files
HVAC models (Wood frame also includes sprinkler - systems)	Residential building in MagiCAD for Revit	Office building in MagiCAD for Revit	Residential building in MagiCAD for Revit	Office building in MagiCAD for Revit		= 4 IFC files
Electrical models	Residential building in MagiCAD for Revit	Office building in MagiCAD for Revit	Residential building in MagiCAD for Revit	Office building in MagiCAD for Revit		= 4 IFC files

YouTube training videos

1. Introduction to the BIM4LCA project
2. BIM-based building LCA process and building LCA calculation principles
3. Architect's building permit and as-built phases: information content, IFC export
4. Structural designer: information content, IFC export, Excel import
5. HVAC designer: information content
6. HVAC designer: IFC export
7. LCA expert: IFC export, LCA software import, example on calculating the CO_2 of a wall structure



Working group

- VTT Technical Research Centre of Finland (coordinator)
- Granlund
- Gravicon
- Insinööritoimisto Kallinen
- Nordic partners supporting R&D
  - Rangi Maja OÜ
  - Bengt Dahlgren
  - Asplan Viak AS
  - Gravicon DK
  - SBEResearch
  - Arkkitehtitoimisto Huvila

Summary of Results

1. A generic description of the **BIM to LCA process** supporting the calculation and reporting of normative LCA in building construction projects

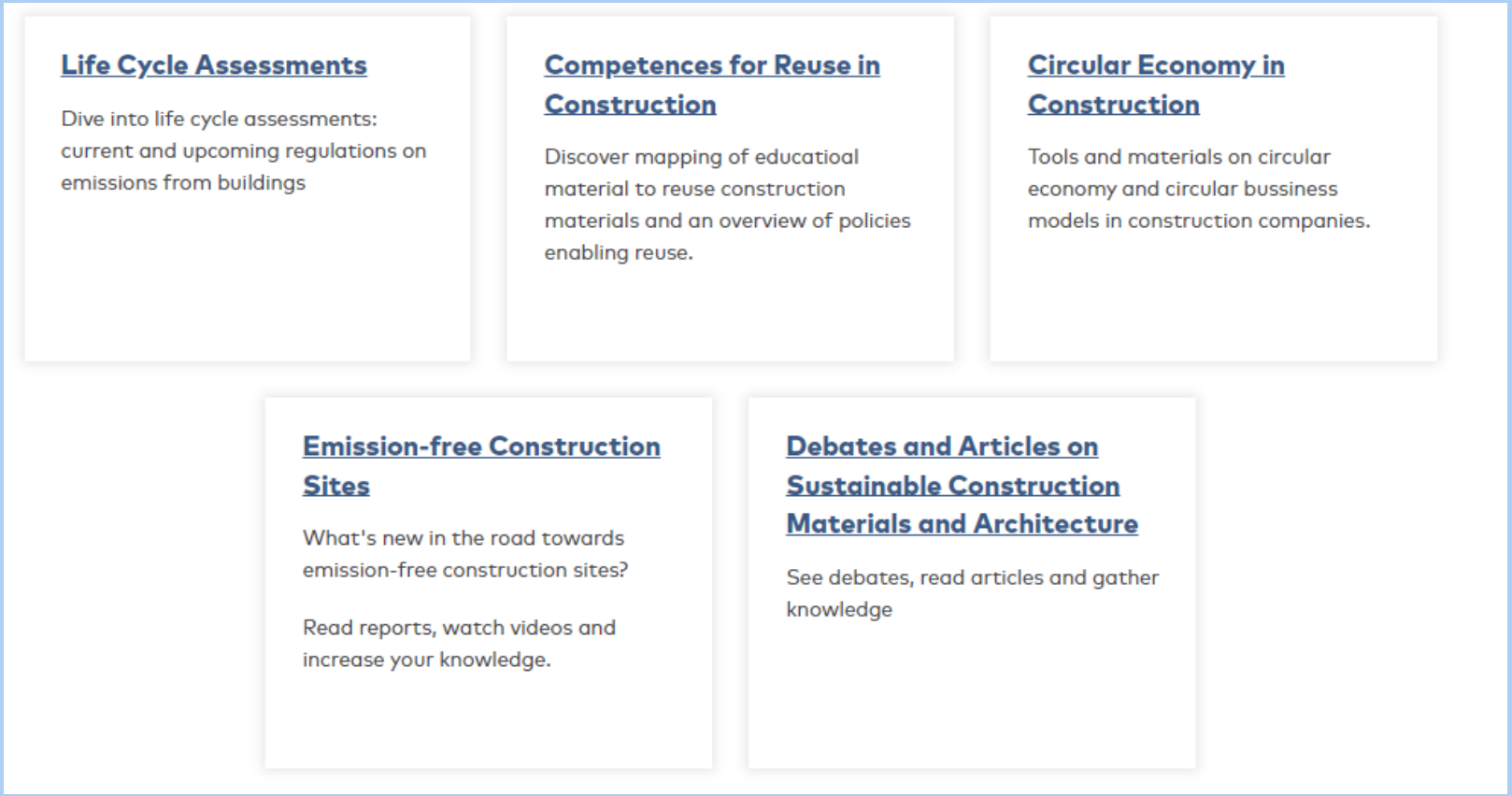
2. Generic **guidelines for reliable BIM-based material inventory** specifications for information needed for modelled building components, data transfer from BIM tools to LCA tools, and iterative design and analysis workflow between BIM and LCA tools

3. **A pathway towards automated BIM-based LCA** for instant feedback and low-carbon design solutions

4. **Two example buildings with BIM models** for practitioners to learn BIM-based building LCA

5. **Educational videos** on BIM-based LCA

Find details in Nordic knowledge centre



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