

# Webinar: BIM-Based Building LCA (Task 3)

WP<sub>1</sub> Nordic Harmonisation of  
Life Cycle Assessment

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12.12.2023

Nordic Sustainable  
Construction



# Agenda

## Presentations (~40 min)

- The Operating Environment of Building LCA and BIM in the Nordics and Estonia
- Proposal: BIM-based building LCA process

## Discussion and cooperative work (~50 min)

- Your insights on the proposed process

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# Main goals

- Generic process for BIM-based building LCA
- Architectural, structural and HVAC models and their IFCs
- Online learning material guiding the calculation of BIM-based building LCA



# 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



**gravicon**



# The Operating Environment of Building LCA and BIM in the Nordics and Estonia

- [Report](#) on the current building LCA and BIM practices
  - Constraints and enablers for Nordic harmonization of building LCA
  - Enablers and hindrances for BIM-based building LCA
  - The basis for further project work providing guidance for BIM-based LCA and material declaration



# Focus on normative building LCA

## Proposal design



**LCA aim:** Comparing LCA of alternatives

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

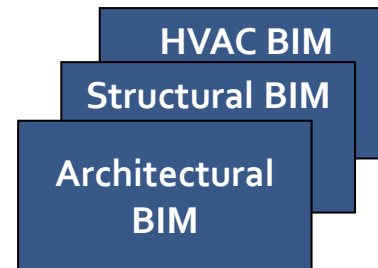
## General design (building permit)



**LCA aim:** *Proposed* normative LCA (*Estonia, Finland, Iceland*)

**Data:** Mainly general emission data

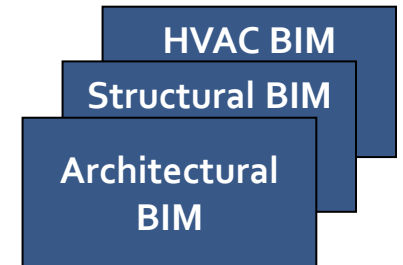
## Detailed design



**LCA aim:** Quantity take-off provides detailed information for more accurate LCA

**Data:** General and specific (EPD) emission data

## As-built



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

**Data:** General and specific (EPD) emission data



# The status of normative building LCA

Country	Normative building LCA	Limit values
Denmark	Since January 2023	Since January 2023
Estonia	Will be in force in 2025	Under discussion
Finland	Will be in force January 2025	Will be in force January 2025
Iceland	Coming soon	Maybe in 2026
Norway	Since July 2023	Maybe in +5 years
Sweden	Since January 2022	Proposed July 2025



# Modules in the normative building LCA

X = included in the regulation, O = planned but not in force yet

Module	Denmark	Estonia	Finland	Iceland	Norway	Sweden
A1-A3 Product phase	X	O	O	O	X	X
A4 Transport	O	O	O	O	X	X
A5 Construction process	O	O	O	O	X*	X
B1 Use	-	-	-	-	-	-
B2 Maintenance	-	-	-	-	X	O
B3 Repair	-	-	-	-	-	-
B4 Replacement	X	O	O	O	X	O
B5 Refurbishment	-	-	-	-	-	-
B6 Operational energy use	X	O	O	O	-	O
C1 Deconstruction, demolition	-	O	O	O	-	O
C2 Transport	-	O	O	O	-	O
C3 Waste processing	X	O	O	O	-	O
C4 Disposal	X	O	O	O	-	O
D Re-use, recovery, recycling potential	X	-	O	O	-	-



# The phase of normative LCA reporting and accepted data sources

Country	Building life-cycle phase of the mandatory LCA	Floor area definition	Accepted emission data sources	Conservative emission factor for general data
Denmark	As-built	Reference area (embodied part), heated gross floor area (operational part)	Generic data from BR18 §297, EPDs	-
Estonia (Proposed)	Building permit	Heated net floor area	Estonian database, EPDs	1,2
Finland (Proposed)	Building permit and as-built	Heated net floor area	National emission database (CO2data.fi), EPDs	1,2
Iceland (Proposed)	Building permit and as-built	Gross floor area, possibly later net floor area	Emission database, EPDs	1,25
Norway	Finished before the certificate of completion is issued	Gross floor area	EPDs	1,25
Sweden	As built	Gross floor area	Boverket database, EPDs	1,25

# Constraints and Enablers for Nordic Harmonisation of Building LCA

## — Constraints

- Differences in what is included (modules, building parts)
- Differences in handling biogenic carbon
- Differences in accepted data sources and use of conservative values

## — Enablers

- Common standards as a starting point (EN15978 and EU Level(s))
- Process for
  - unified calculation of the building parts
  - handling of the BIM material inventory lists
  - tracking of assumptions



# BIM maturity

- All countries use BIM authoring tools for architectural and structural modelling
  - Allow the export of IFC (EN ISO 16739-1)
- Many countries have BIM guidelines and requirements, but rarely national or mandatory
  - Do not specifically support normative building LCA
- The naming conventions and classifications for materials and structures vary
  - They are also national, and their maturity and usage vary by country



# Constraints and needs for a BIM-based 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

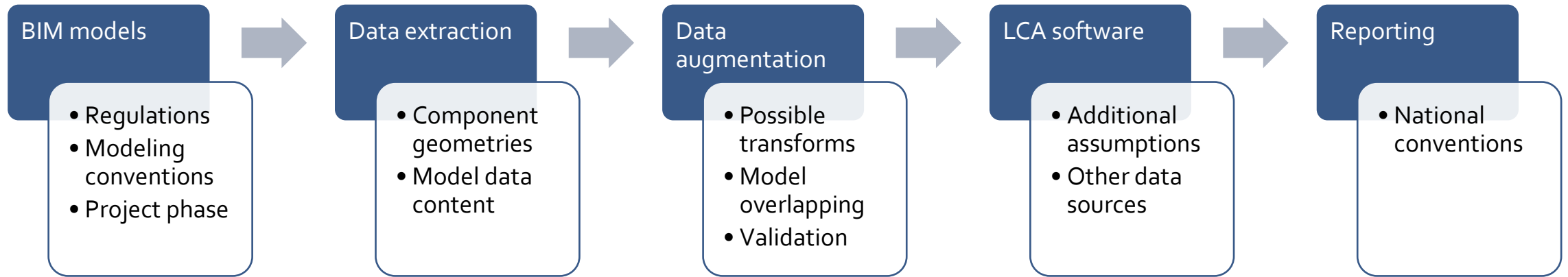


# BIM modelling for building LCA

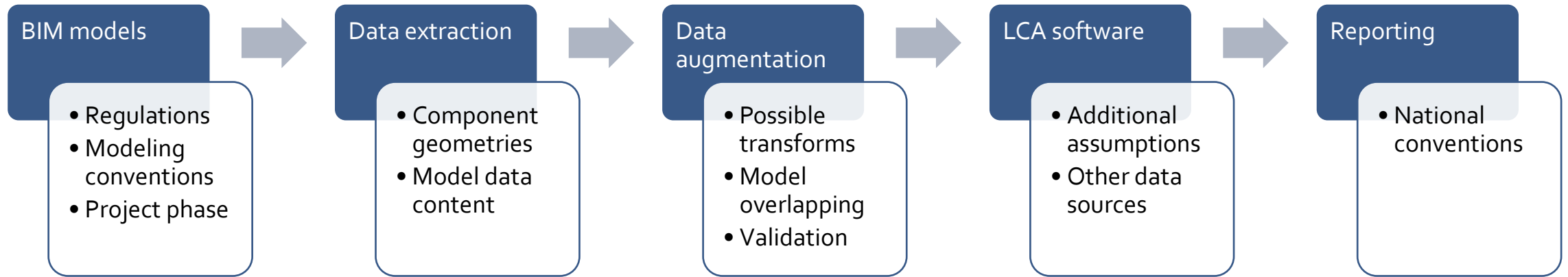
You have received a draft report for BIM-based LCA for commenting



# 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



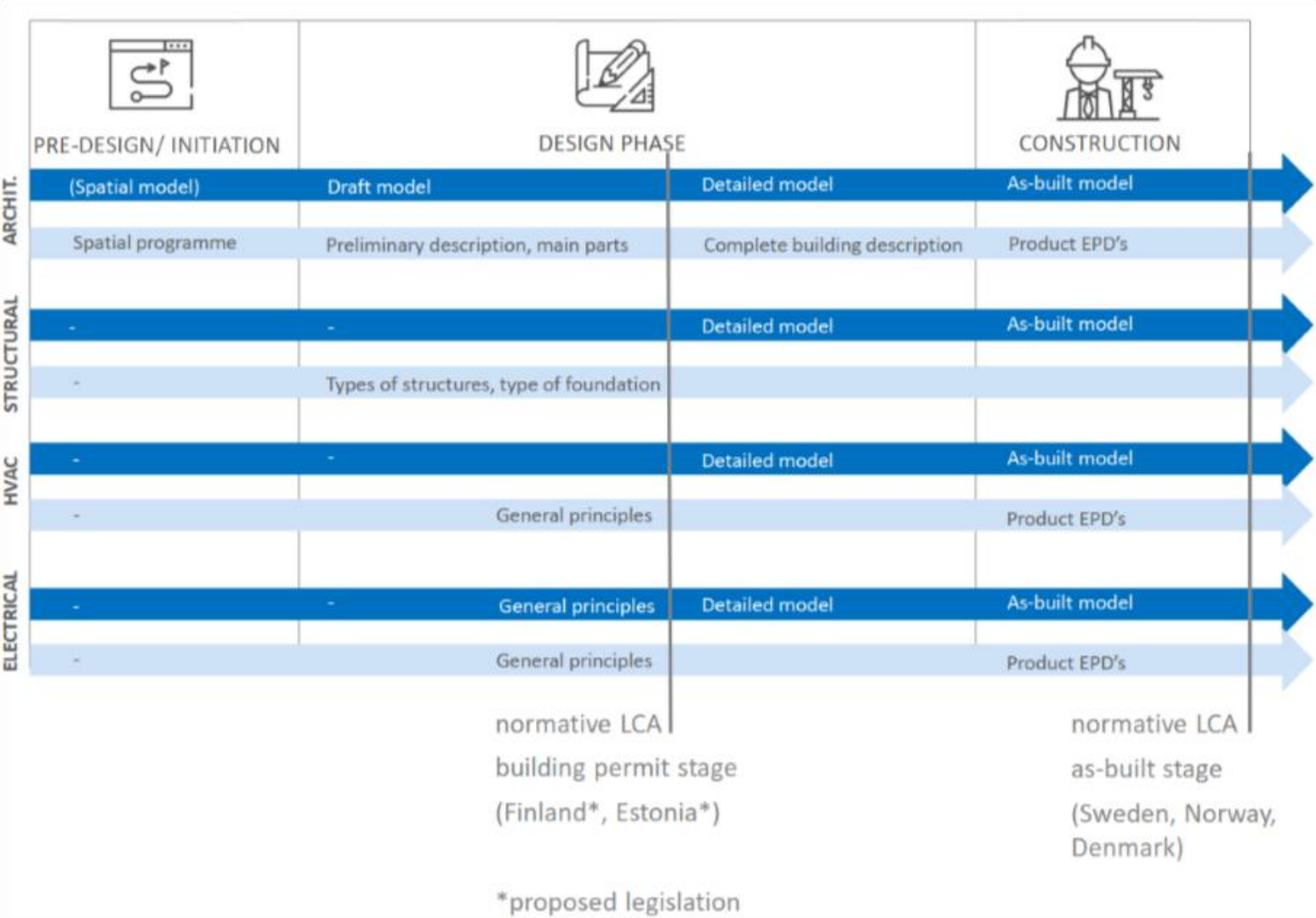
# Status of LCA automation

- Some manual input from the LCA expert is always required for normative LCA
  - The extent of additional input from the LCA expert depends on project phase
  - Less estimates in the as-built phase, but still some on non-material related modules
- In certain design fields, there is already working automation
  - Example in structural analysis: Tekla → OneClick LCA
  - Does not extend to complete building LCA
  - Always requires adherence to strict modelling principles
- In this task, we intend to specify general modelling principles and data requirements for architectural, structural and HVAC modelling, so that the material inventory lists can be processed more effectively
- Information required for calculation of non-material related LCA modules will not be likely to be contained in BIM models

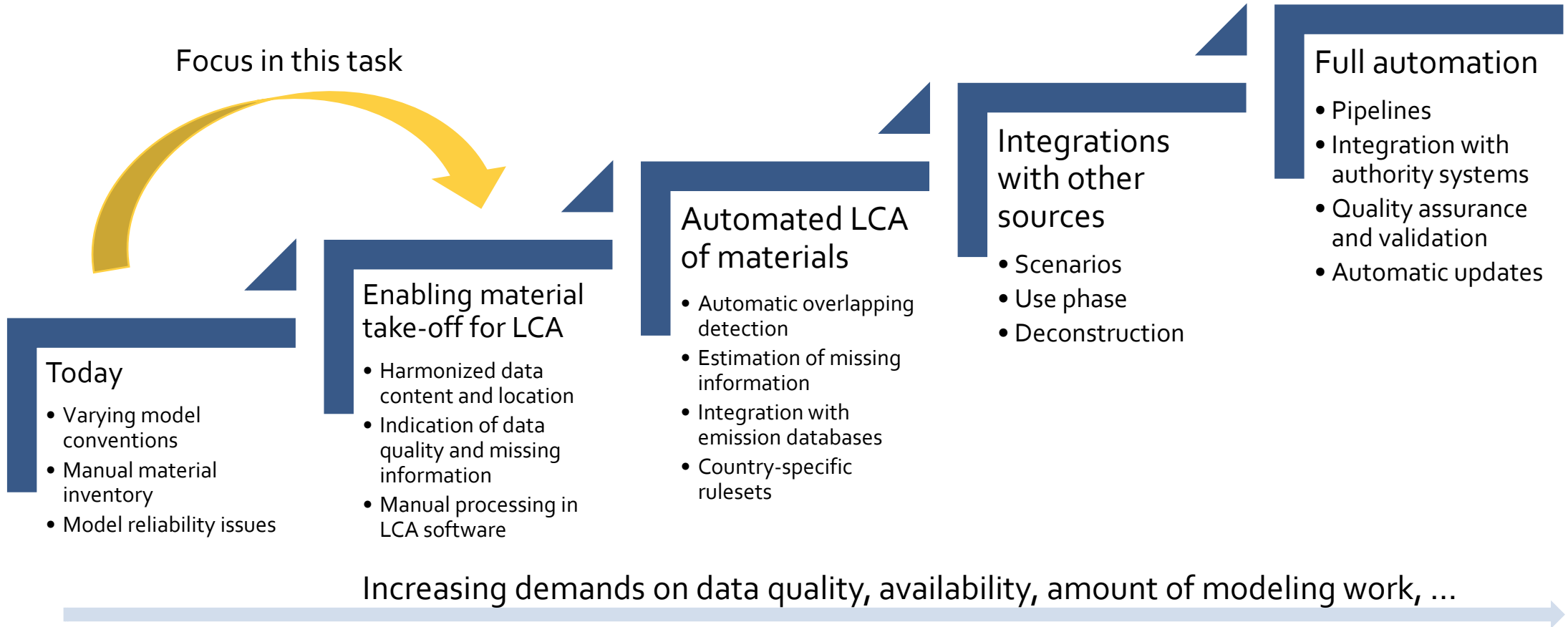




# General data content and LCA data sources in different stages



# Steps towards automated LCA from BIM



# Proposed solution

- Guidelines for how BIM models can be utilised more usefully in LCA calculations
  - Support existing BIM modelling conventions, state *minimum requirements* for additional information from an LCA point of view
- Define information content that is needed for LCA calculations and reporting
  - Based on requirements from LCA practice and LCA regulation
  - Creating guidance on how these elements shall be recorded *in IFC specification*
- Minimum requirement: object typing in models, with the same keys as in other documentation
  - Possibility to combine e.g. material information from other sources
- Give best practices on how the BIM information can be amended and overlapping handled
- The process must be applicable to all different national regulations, classifications and conventions



# 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



# Intended outcomes

- General process description (in current draft document)
- Instructions for BIM-based material inventory
  - Level of information need for modeled building components
- Guidance for transferring data from BIM tools to LCA tools
- Guidance for iterative design & analysis workflow between BIM and LCA tools
- Practical examples with example BIM models



# Workshop



# Discussion and co-operative work

- Questions and comments
  - What do you think about the proposed solution for the BIM-based building LCA process?
  - What needs to be instructed for BIM-based building LCA?
  - How should LCA methodologies be unified in the Nordics and Estonia? What are the hindrances and opportunities?
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# Thank you!

