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A proposition to extend CityGML and ADE Energy standards for exchanging information for LCA simulation at urban scale.

LCM at the urban scale: BIM and Nature Based solutions

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Introduction

The construction industry in transition(s):

DIGITAL TRANSITION

Since 2017, for public works contracts and design contests, EU Member States may require the use of specific electronic tools, such as of building information electronic modelling tools or similar.

ENERGY AND ENVIRONMENTAL TRANSITION

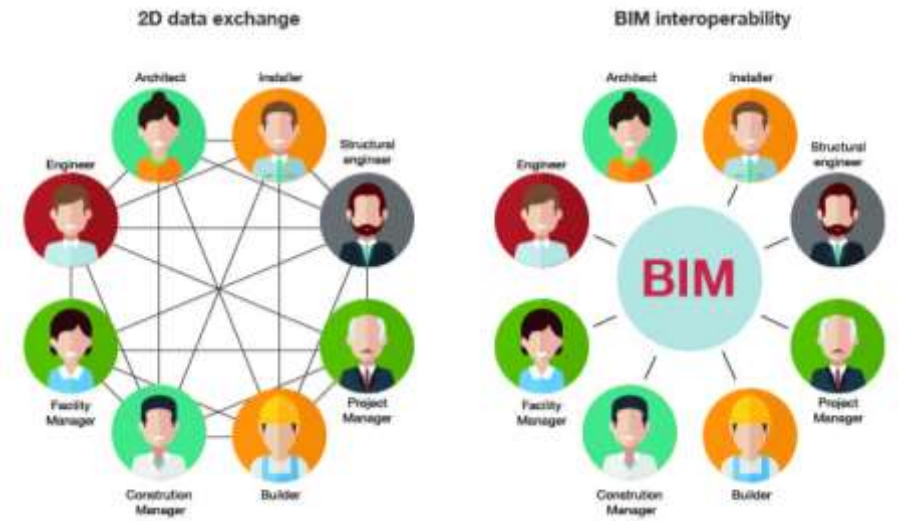
> Buildings account for 40% of the EU's total final energy consumption.
> Generalization of constructions complying with high environmental quality standards is needed to achieve the environmental transition

CAN DIGITAL TECHNOLOGY SUPPORT THE ENVIRONMENTAL TRANSITION?

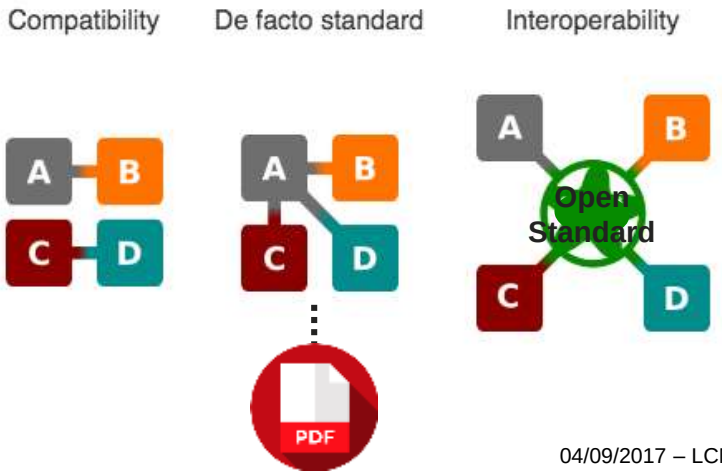
> Integration of Building information Model (BIM) to LCA could reduce efforts during data collection

Definitions

BUILDING INFORMATION MODELS :
Files containing building information regarding objects, geo-localization, geometry and semantic data



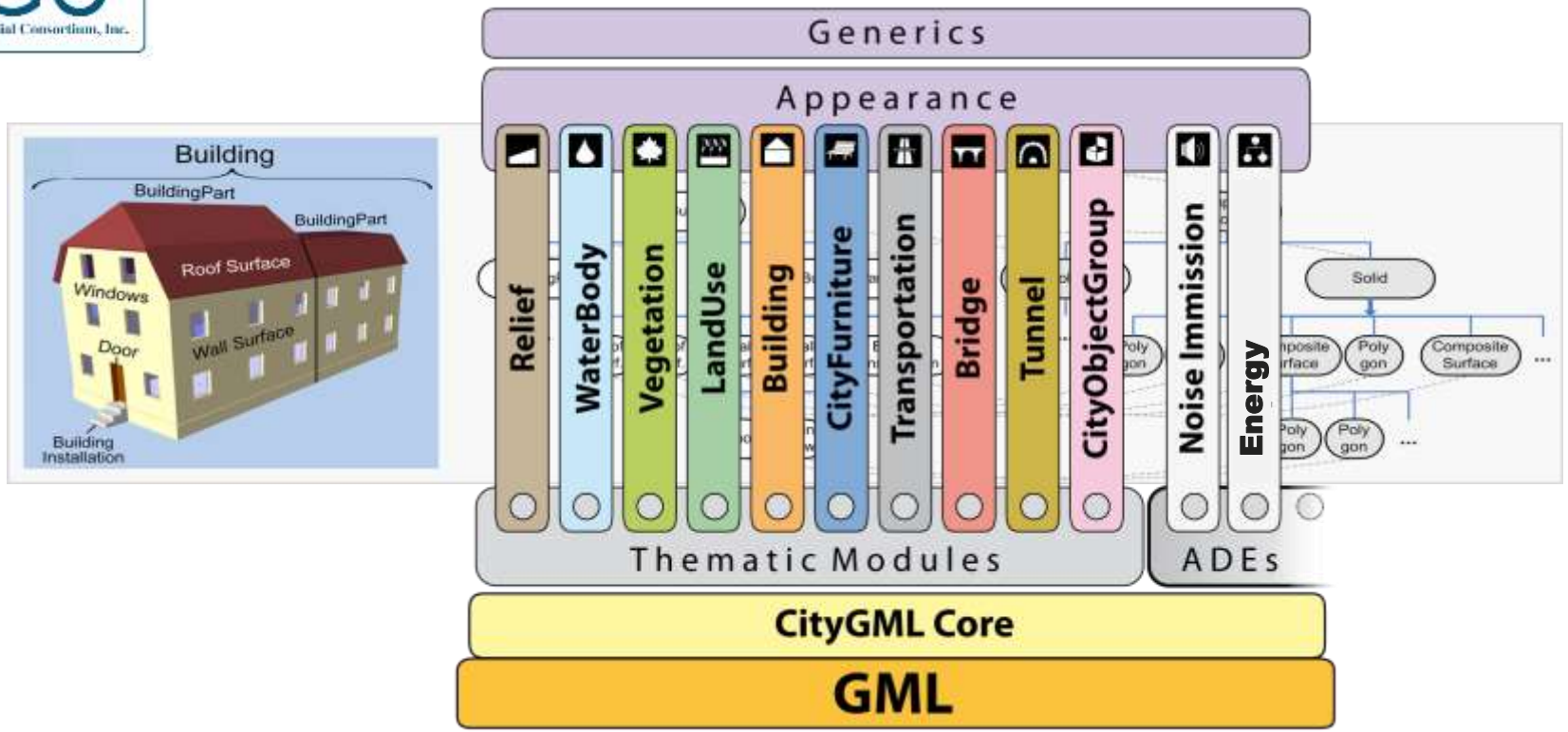
In order to ensure interoperability with different software (e.g. with energy simulation tools), digital mock-up using an open information standard must be preferred.



The CityGML standard

The international open standard CityGML is an XML-based data model that defines classes and relations for 3D object in cities (e.g. buildings, roads, water bodies etc.).

This standard and its extensions are developed by many international actors



BIM and Urban LCA

Many building specific LCA tools are already compatible with **IFC** and/or **gbXML** formats :

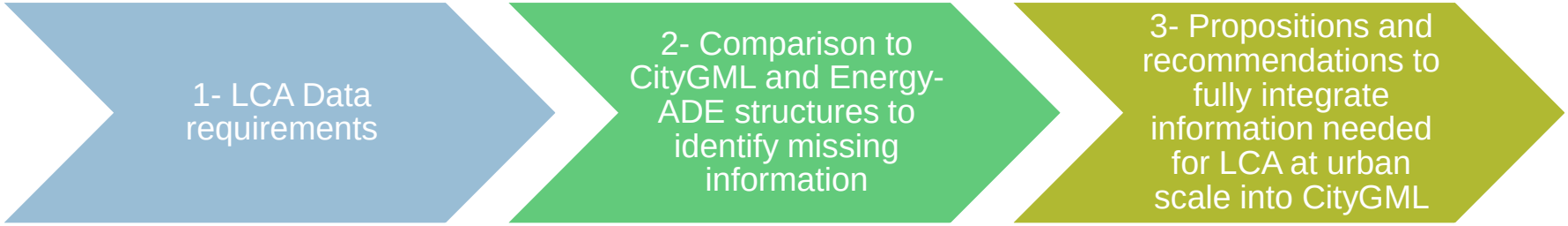
At urban scale, CityGML is an open standardized data model and exchange format to store digital 3D models of cities and landscapes and it is an official international standards of the OGC.

To our knowledge, **no** LCA tools exist that developed a link with the **CityGML** standard

Aim and approach

An important issue related to the integration of BIM and LCA at urban scale is that **LCA data requirements have not been fully integrated into the CityGML** format nor its ADE.

The aim of this paper is to propose extension of CityGML and Energy-ADE standards for exchanging information for LCA simulation at urban scale.



Identification of data needs for LCA at urban scale (scope limited to buildings)

Depending on the objective of the LCA study, and on data availability, a screening, simplified or detailed LCA approach can be applied. Data needs for environmental evaluation at urban scale of building objects can be structured into three categories :

1) Generic information, related to each building object

Data needs	Type and unit
Building typology	List
Floor area	Decimal
Geometry	Geometry
Construction year	Date
Number of storeys	Integer
Height	Decimal
Type of operation	List
Number of occupants	Integer
Housing units	Integer
Glazing ratio	Decimal
Renovation actions	String
Main structure type	List
Main structural material	List
Main filling material in facade	List
Foundation type	List

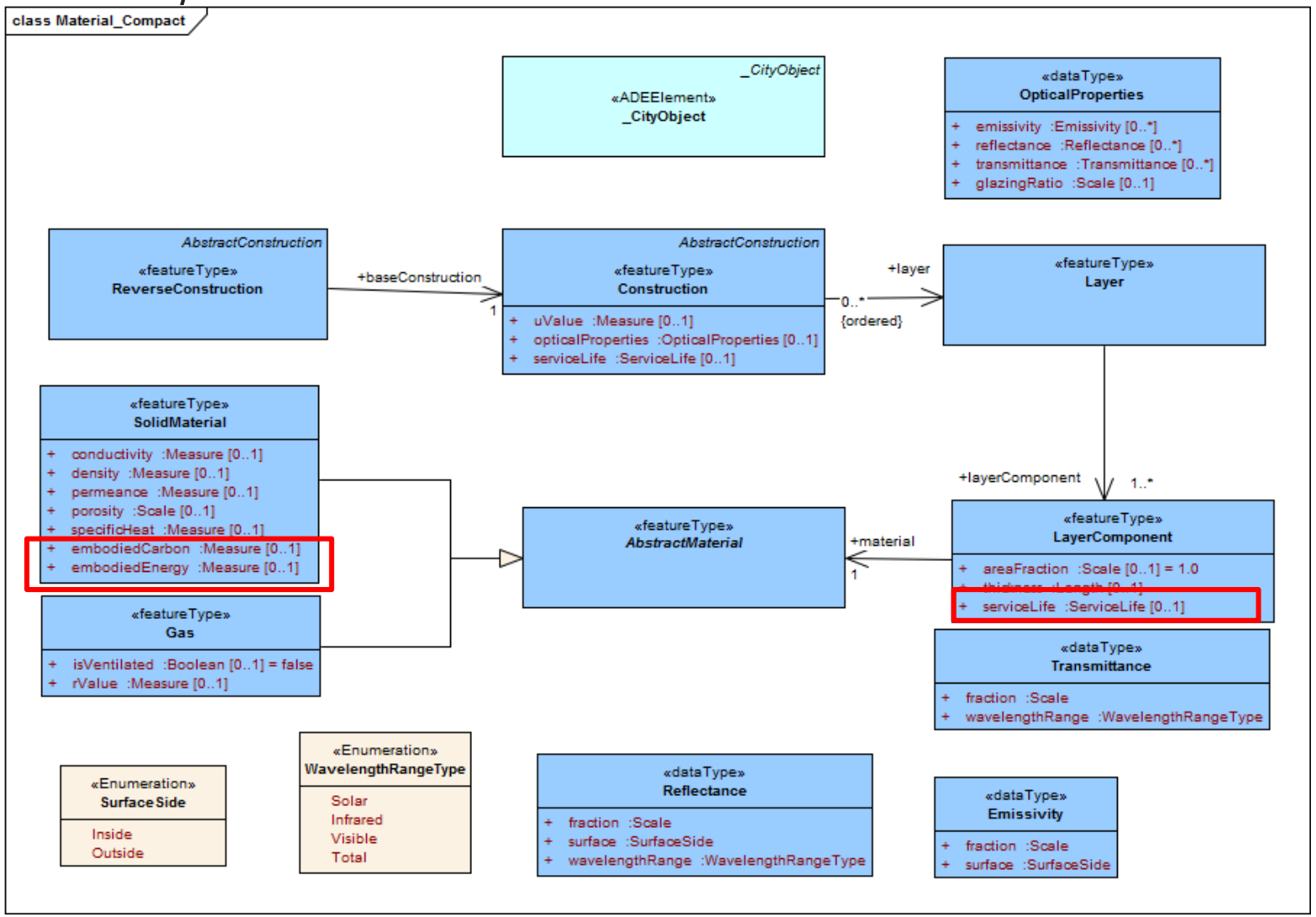
2) Information related to the walls, roofs floors and energy systems

Data needs	Type and unit
Construction package	List
Description field	String
Quantity	Decimal
Service life	Integer
Component type (wall, roof, floor…)	List
Construction system (framed construction, …)	List
Main Material (concrete, wood…)	List
U value (for thermal boundaries)	Decimal
Nominal power (for energy systems)	Decimal
Environmental Identifier	Database Name + Id

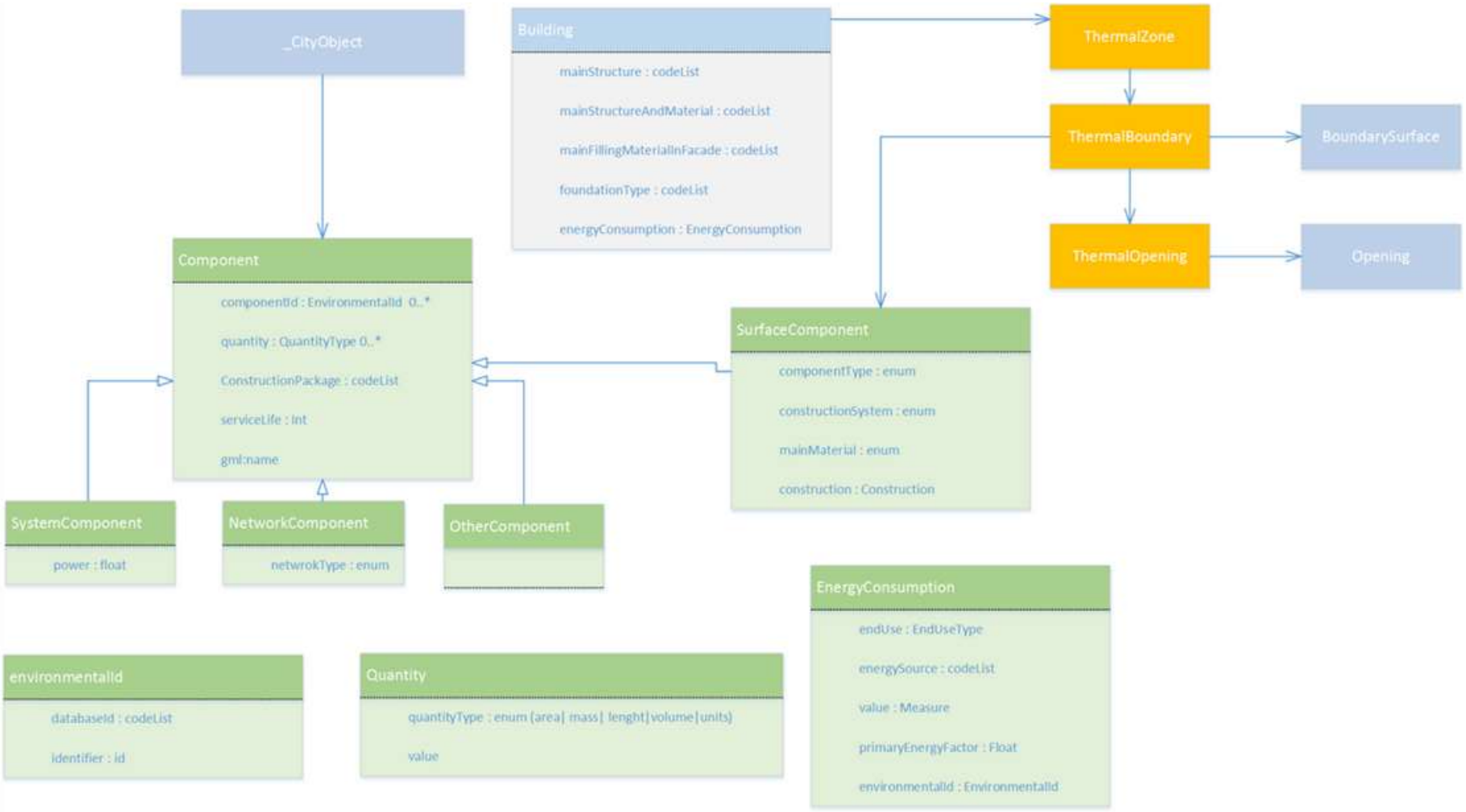
3) Information on energy consumptions of the building :

Data needs	Type
Type of energy (electricity, gas, biomass…)	List
End use (heating, air conditionning…)	List
Final energy consumption, for each energy type and end use type	Decimal (kWh)
Environmental ID	Database Name + Id
Primary Energy Factor	Decimal

The material Class from the Energy-ADE



Propositions



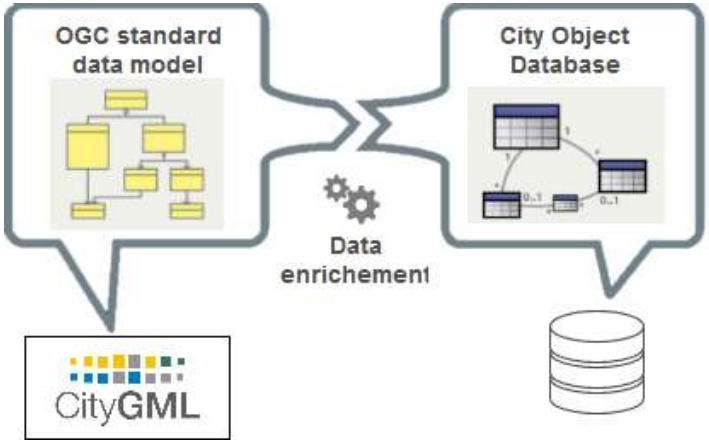
Conclusion

- The structure proposed is suitable for screening, simplified or detailed LCA of the building.
- Further work is required to integrate information and data structure on water consumption, waste production, mobility needs and worksite
- Get involved : All propositions should be discussed within LCA and CityGML communities

The issue of Data :

- Digital mock-up must

  be filled in with data!



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