Critical Issues in Application of New European Standard EN15978 in building refurbishments

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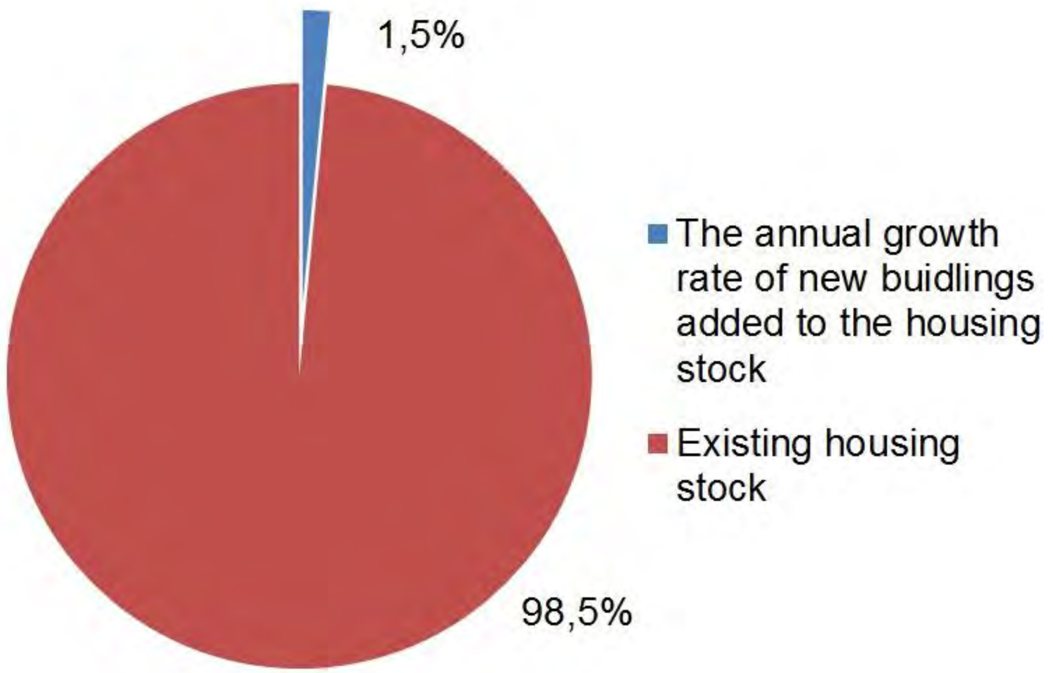
Introduction

Sustainability of building sector:

New buildings represent just a small portion from the existing building stock. If we want to achieve sustainability in building sector, we have to focus on existing buildings.



SOURCE: Ad-hoc Industrial Advisory Group: Energy-efficient Buildings (EeB) PPP, 2009

Questions

Regarding refurbishemt

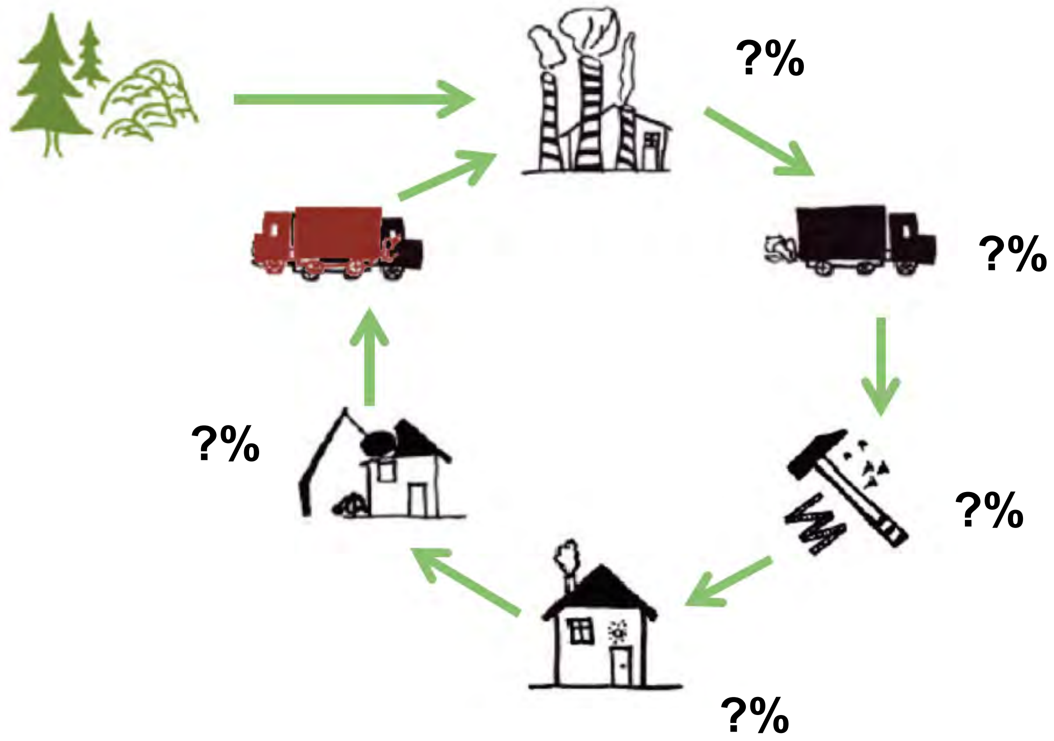
- Is it better to refurbish an old building or demolish it and construct a new one?

- What is the influence of buildings operation life to its overall environmental sustainability?

Questions

Regarding LCA of a building

- What is the influence rate of particular buildings life cycle stages to its sustainability profile (construction stage, operation stage, maintenance, refurbishment etc.)?



PICTURE: *J. Hodkova*

Questions

Regarding LCA of a building

- What is the difference between symplified and complex LCA analysis?

- Is symplified LCA (like in SBToolCZ) accurate enough for building assessment?

simplyfied LCA **vs.** **Detailed LCA**

Methods

Case study – building model

- family house in Pilsen (Czech Republic)
- refurbishment finished in 2010
- Original floor space: 81,7 m^2
- New floor space: 142,8 m^2

The basic constructional principals of the refurbishment were:

- Keeping the original built-up area;
- Using parts of the original foundations;
- Deconstruction of the walls;

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- Using the original bricks for the new construction of the walls (hand cleaned);
- Rising up the roof to create new rooms;
- HVAC DUPLEX unit used for ventilation and heating (runs on gas boiler) ;
- Fire place with heat accumulation reservoir;
- Solar collectors;

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Methods

Purpose of the assessment

The purpose of the assessment is defined by the goal, the scope and the intended use of the assessment. In our case, the intended use of the assessment is according to the norm [EN 15978] following:

- Assistance in decision making process (for example comparison of the environmental performance of different design options);
- Documenting the environmental performance of the building;

Methods

Specification of the object of assessment

Functional equivalent and reference unit:

- family house for 4 persons; meeting the requirement of the heat transfer coefficient for low energy house (the same coefficient as will be defined for other scenarios/designs), and all fire protection and structural requirements of Czech building laws

Required service life (life span):

- The required service life of the building will be the same for all scenarios (50 years)

In case of comparison of different building design assessments (e.g. new building will have larger floor surface than the refurbished one), the reference unit per m^2 or per 1 person will be used.

Methods

Specification of the object of assessment

Reference study period:
- Required service life

SERVICE LIFE - CRITICAL ISSUE:

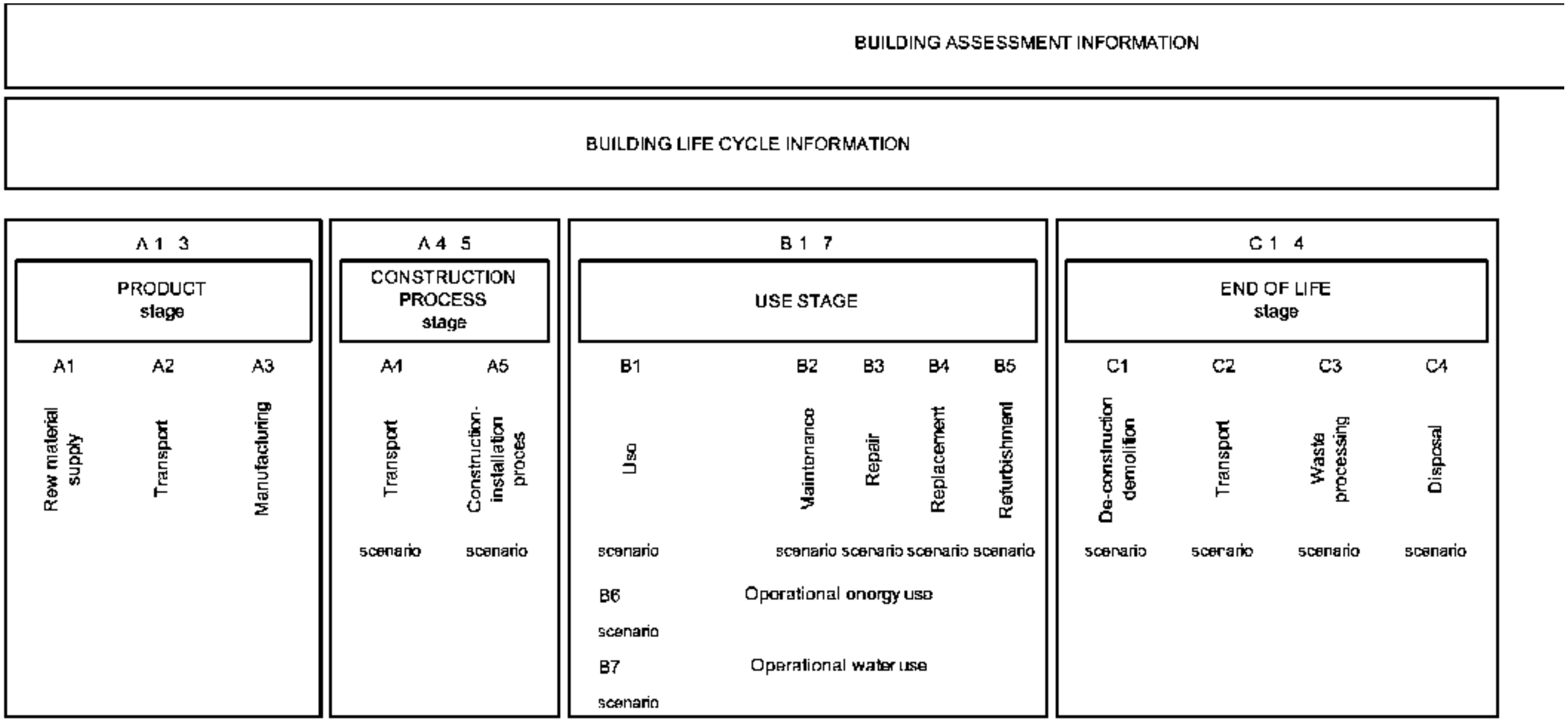
MORAL SERVICE LIFE

TECHNICAL SERVICE LIFE

Moral service life is not usually identical with the technical service life. It is common that buildings reach their moral service life limit before reaching the real technical service life limit. Such buildings do not fulfil the needs of building operation and they are being demolished although the technical condition of their construction is good.

Building Assessment

The building refurbishment assessment process according to the modules A-D given in [EN 15978] and [EN 15804] was studied.



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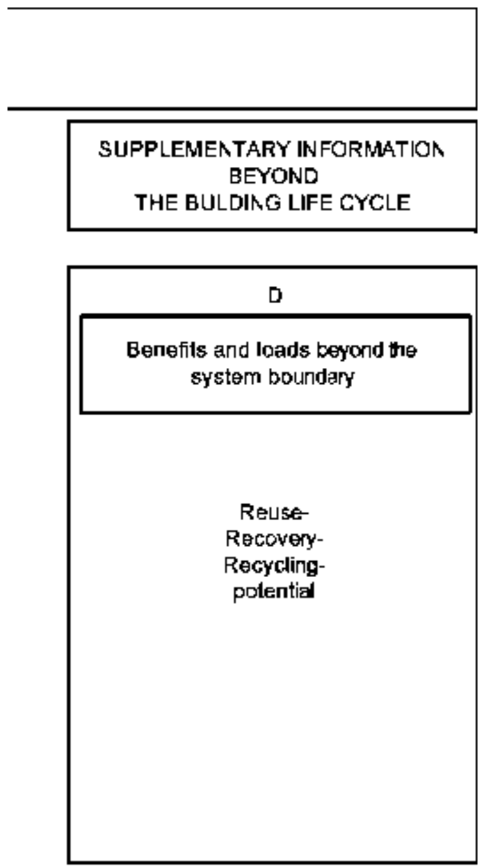


LCA methodology

Organization of LC stages and scenarios – building model

277 scenarios

		PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE					END OF LIFE STAGE			
		A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4
Description of the physical characteristics of the building according to EN 15978:2011 (E) part 7.5.2		**Raw materials supply**	**Transport**	**Manufacturing**	**Transport**	**Construction - instalation process**	**Use**	**Maintenance**	**Repair**	**Replacement**	**Refurbishment**	**De-construction demolition**	**Transport**	**Waste processing**	**Disposal**
Elements		***EPD***	***EPD***	***EPD***	***scenario***	***scenario***	***scenario***	***scenario***	***scenario***	***scenario***	***scenario***	***scenario***	***scenario***	***scenario***	***scenario***
1	– foundations;	EPD	EPD	EPD	1	1	1	1	1	1	1	1	1	1	1
2	– frame (beams, columns, slabs);	EPD	EPD	EPD	1	1	1	1	1	1	1	1	1	1	1
3	– non load-bearing elements;	EPD	EPD	EPD	1	1	1	1	1	1	1	1	1	1	1
4	– external walls;	EPD	EPD	EPD	1	1	1	1	1	1	1	1	1	1	1
5	– windows;	EPD	EPD	EPD	1	1	1	1	1	1	1	1	1	1	1
6	– roof;	EPD	EPD	EPD	1	1	1	1	1	1	1	1	1	1	1
7	– internal walls;	EPD	EPD	EPD	1	1	1	1	1	1	1	1	1	1	1
8	– doors and staircase(s);	EPD	EPD	EPD	1	1	1	1	1	1	1	1	1	1	1
9	– floor;	EPD	EPD	EPD	1	1	1	1	1	1	1	1	1	1	1
10	– ceiling;	EPD	EPD	EPD	1	1	1	1	1	1	1	1	1	1	1
11	– the technical systems;	EPD	EPD	EPD	1	1	1	1	1	1	1	1	1	1	1
12	– sanitary systems (water, waste water, piping, pump and fixed equipment);	EPD	EPD	EPD	1	1	1	1	1	1	1	1	1	1	1
13	– fixed fire-fighting systems;	EPD	EPD	EPD	1	1	1	1	1	1	1	1	1	1	1
14	– heating and hot water systems;	EPD	EPD	EPD	1	1	1	1	1	1	1	1	1	1	1
15	– mechanical ventilation and air conditioning;	EPD	EPD	EPD	1	1	1	1	1	1	1	1	1	1	1
16	– fixed lighting systems;	EPD	EPD	EPD	1	1	1	1	1	1	1	1	1	1	1
17	– communication and security systems;	EPD	EPD	EPD	1	1	1	1	1	1	1	1	1	1	1
18	– transportation inside the building (lifts, escalators);	EPD	EPD	EPD	1	1	1	1	1	1	1	1	1	1	1
19	– drainage system;	EPD	EPD	EPD	1	1	1	1	1	1	1	1	1	1	1
20	– the site construction;	EPD	EPD	EPD	1	1	1	1	1	1	1	1	1	1	1
21	– landscaping;	EPD	EPD	EPD	1	1	1	1	1	1	1	1	1	1	1
22	– external lighting;	EPD	EPD	EPD	1	1	1	1	1	1	1	1	1	1	1
23	– external parking;	EPD	EPD	EPD	1	1	1	1	1	1	1	1	1	1	1
24	– on-site drainage;	EPD	EPD	EPD	1	1	1	1	1	1	1	1	1	1	1
25	– water treatment systems.	EPD	EPD	EPD	1	1	1	1	1	1	1	1	1	1	1

Building operation level		scenario
B6	Operational energy use	1
B7	Operational water use	1

"The purpose of the building model is to enable the quantification of the mass and energy flows. This quantification should be organised in a structured way according to the norm" [EN 15978].

Module A – product stage

Critical issues

These data for building products should be gathered from EPDs [EN 15804]. However, in Czech Republic, there are only 10 EPDs for building products. Generic (Ecoinvent) data should be used in that case, but this could lead to incomparable and unreliable results.

CRITICAL ISSUES: Deviations can occure because of the use of generic data instead of EPDs.

Reasons:

- Technological – different machines used for concrete production;
- Geographical – different type of materials used for concrete production,
- Different energy mix;
- Temporal – some data from Ecoinvent are very old – new technologies are usually more environmentally friendly;
- Different LCA calculation rules – different characterisation factors can be used for EPDs and generic Ecoinvent data, different system boundary can be established.

Module B – use stages

Critical issues

B1 - **Boundary of the installed products in use**

- Defined by standard CEN/TC 351 - Assessment of release of dangerous substances
- **has not been published yet!**

B2 - **Boundary of maintenance**

- unceirtanty of:
  - **Transportation distance**
  - **Technolgy progress within the service life**
  - **Building adaptations**
  - **Building use**

Module B – product stage

Critical issues

B6 - Boundary of the operational energy use
Energy used by building-integrated technical systems during the operation of the building

- Critical issues:
  - Effectivity and technology progress
  - Recycling process
  - Legislative changes
  - Determination of operation life
  - Etc…

Module B – product stage

Critical issues

B7 - Boundary of the operational water use

- Critical issues:
  - Building use.
  - Difference between calculated and real water demand.

Module C – end of life

Critical issues

C1 – deconstruction, demolition

- Critical issues and questions:
  - What will be the use of the site at the end of life cycle of the building?
  - In what condition must be the site after removal of the building?
  - If the site will serve for construction of a new building, is it necessary to remove all the constructions, including the foundation?

  - We expect to reuse the waste, so we consider sorting of debris as an integral part of the deconstruction stage of life cycle.
    - But is there a sufficient market demand for sorted debris? If there is not, the technology of decomposition of foundation will be different.

Module C – end of life

Critical issues

C2 – Transport

- Critical issues and questions:
  - What will be the construction machines and trucks like in 50 years?
  - What will the transport distance be?

C3 – Waste processing

- Critical issues and questions:
  - Operation of recycling line?
  - Proportion of recycleable materials might change.
  - Recycling technology will be different.

Module C – end of life

Critical issues

C4 – Disposal

- Critical issues and questions:
  - Is the waste, generated during the recycling process, included in this module?

Conclusions

Critical issues

The common feature of the critical issues is their unpredictability in the future.

- Service life (moral and technical) of building and particular parts;
- Change of building use;
- Social and urban changes;
- Technological progress in transport methods, construction processes, ways of disposal, recycling etc.;
- Legal changes;
- Insufficient data on environmental performance of materials and building components.

The resulting LCA will always be accurate only within a certain **probability measure** which is hard to be determined as well because the number of possible development scenarios may be **infinite**.

Conclusions

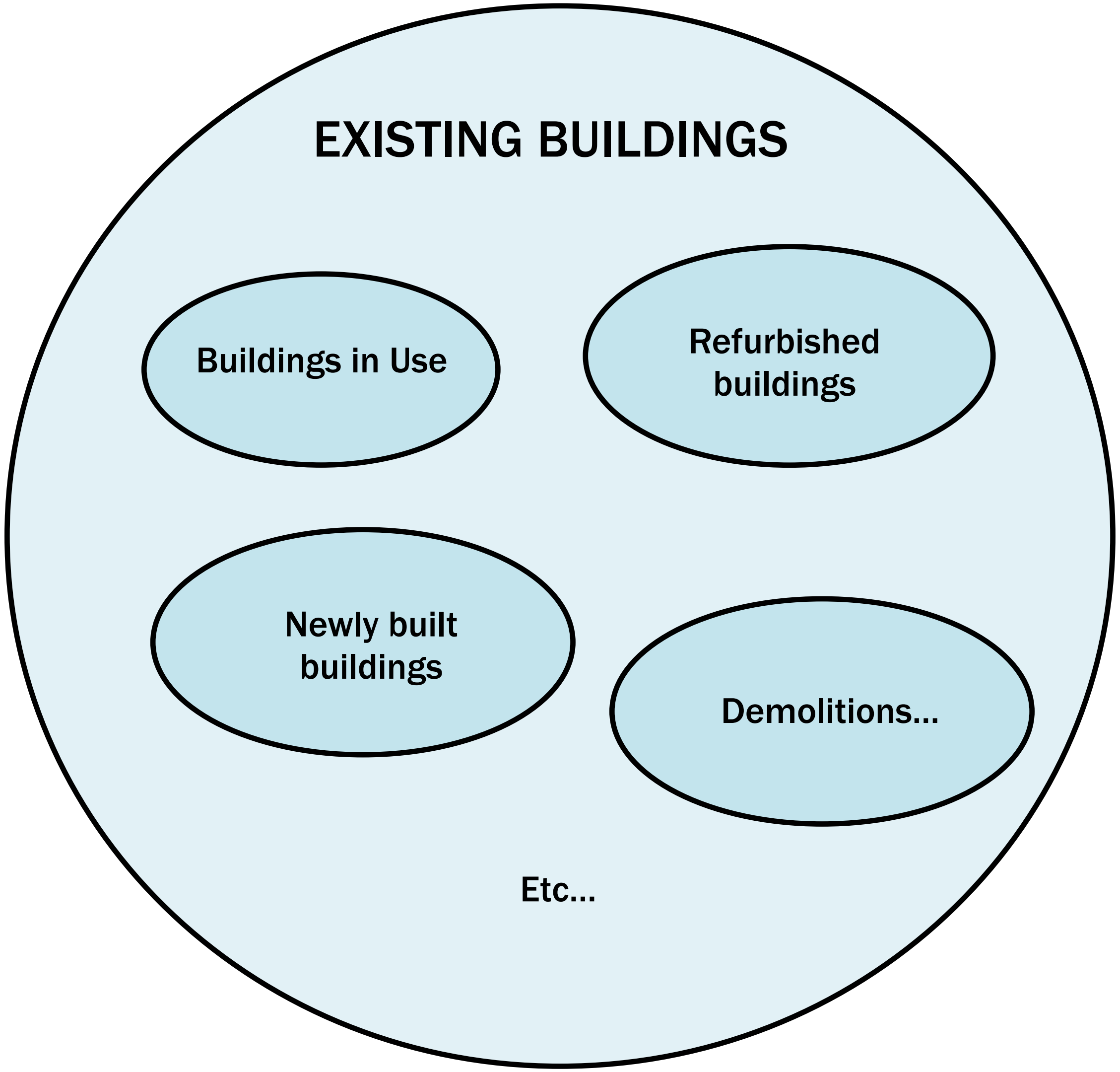
Prediction of the future acts and progress shoul be avoided.
LCA can be interpreted differently so it can keep the scientifc approach clear and the results of research credible.

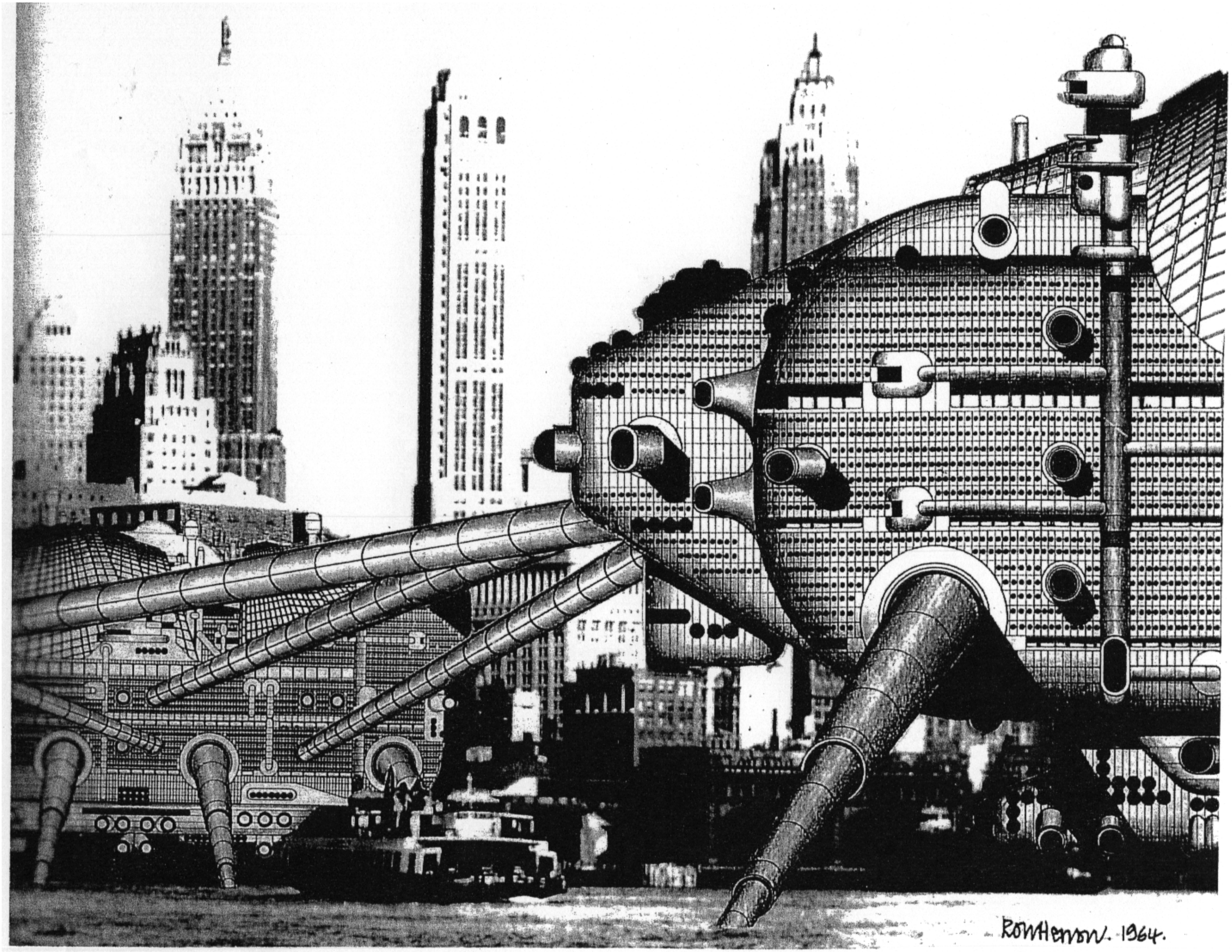
- LCA should be made only with known data with clear backgroung.

- It is possible to look at **building sector as one entity/system** and assess its impacts to the environment at certain point of time.
    - Nowadays, some buidlings are beeing built, some refurbished, some demolished etc. – data are more or less available.
    - We can assess the impacts of current processes that are beeing carried out and propose savings or reduction of the impacts according to the results.

Conclusions

Impacts assessment of building sector today





Walking city, Ron Herron, 1964

Ron Herron proposed building massive mobile robotic structures, with their own intelligence, that could freely roam the world, moving to wherever their resources or manufacturing abilities were needed.

Thank you

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