



INNOVATIVE EDUCATIONAL INTEGRATION OF URBAN
PLANNING BASED ON BIM-GIS TECHNOLOGIES AND
FOCUSED ON CIRCULAR ECONOMY CHALLENGES

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TASK 02/A.1.1 REPORT ON COMPILATION ON LEGISLATION OF LCA AND ITS APPLICATION IN CONSTRUCTION SECTOR IN POLAND

Task O2/A1.1

REPORT ON COMPILATION ON LEGISLATION OF LCA AND ITS APPLICATION IN CONSTRUCTION SECTOR IN POLAND



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1. Introduction - Ecological (Environmental) Life Cycle Assessment

According to the Polish standard PN-EN ISO 14044 from 2009, is defining as "Collecting and evaluating inputs, outputs and potential environmental influences product system during its life cycle ". The inputs are quantitative and qualitative data on the resources and energy used to carry out the process being analyzed. The effect of this process, i.e. both desirable products, services as well as emissions and waste are the outputs. The product system is understood as a set of material and energetically connected processes unitary or its smallest parts. The product system has of course, the boundaries set by the designer within which LCA study is making, where different production processes can be assessed or individual stages of technology. It is not possible to cut off impacts that are not significant for the study (those with a small contribution to the overall environmental impact). The boundaries the product system is shown in the below diagram below.

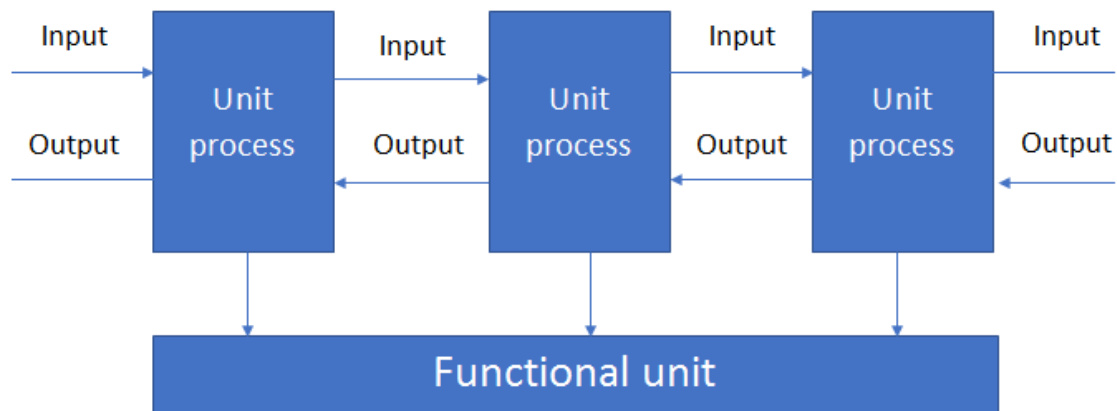


Diagram: The limits of the product system, source Kulczycka 2011.

Another important concept is the functional unit, determined also by the researcher. The functional unit according to the ISO standard is the quantitative effect of the product system used as a reference unit in life cycle research. Three types of units can be distinguished. First, the simplest is physical units, such as meters, kilograms or kelvins. The second is a specific product and its function, i.e. cleaning 1,000 m³ of sewage or a certain area in the field and the way it is used. The last, third type is a combination of units of the first type.¹

¹https://www.google.pl/url?sa=t&rct=j&q=&esrc=s&source=web&cd=6&cad=rja&uact=8&ved=2ahUKEwiO_KqAyY7iAhXNtYsKHQgNCjUQFjAFegQIABAC&url=http%3A%2F%2Fwww.poznan.pl%2Fmim%2Fpublic%2Fwos%2Fattachments.html%3Fco%3Dshow%26instance%3D1000%26parent%3D62706%26lang%3Dpl%26id%3D143644&usg=AOvVaw0dgiTjwNLNsiGhdUHoxIYd



2.1. Applied standards in Poland regarding LCA

One of the first publications that was a typical life cycle assessment, in this case the energy consumption in production systems, was the report presented by Harold Smith at the World Energy Conference in 1963. In the following years, global research was launched to forecast changes in the supply of fossil fuel resources for the coming years by estimating changes in the demand for natural resources and energy. In the United States, the REPA (Resource and Environmental Profile Analysis) model was developed, which made it possible to make comparisons of used amounts of materials, energy and waste generated on the basis of their quantitative statement. The proper beginnings of work on LCA are connected with the establishment of a non-governmental association called SETAC (The Society of Environmental Sciences and Chemistry) in 1978. In the following years, two LCA, American and European schools were distinguished, which had a huge impact on conducting research in this subject for many years. In 2004, a branch of SETAC organization was established, operating in the countries of Central and Eastern Europe (SETAC CEE). As of today, its members are mainly representatives of science. The tasks of SETAC CEE are, inter alia, to promote and popularize LCA. The first, widely accepted technical structure (procedure) of LCA was published in 1993 in the document "A Code of Practice". The ISO International Organization for Standardization in the mid-1990s started work on the normalization of the LCA area and as a result a group of ISO 1404x standards was created. Based on them, Polish language versions of documents have been prepared. Currently, the following standards are in force in Poland²:

- PN-EN ISO 14040: 2009, Environmental management - Life cycle assessment - Principles and structure,
- PN-EN ISO 14044: 2009, Environmental management - Life cycle assessment - Requirements and guidelines.

These standards describe the principles and structure of the life cycle assessment (LCA) and provide the requirements and procedures necessary to assess the life cycle. Studies on the life cycle assessment are also carried out under UNEP (The United Nations Environment Program), but the work called the Life Cycle Initiative deserves the most attention, being the result of the work of both SETAC and UNEP.

² http://www.ztch.umcs.lublin.pl/materialy/rozdzial_25.pdf

2.2. Environmental declaration and ECO labelling construction sector in Poland

In Poland (as of March 1, 2017) there are four international multi-criteria certification schemes (in alphabetical order): BREEAM, DGNB, HQE and LEED. The fifth, the latest WELL Building Standard, focusing solely on the evaluation of the impact of a building on a human being, has the first registration of the project³.

3. Conclusions

LCA identifies environmental issues related to products and materials and establishes the benchmark for measurement of improvements. LCA is also more and more commonly used in new product research and development, when the future marketing or cost structure of a new product has to be related to the environment. LCA's growing significance is evident for more and more popular eco-labeling: environmental product declarations (EPDs). EPDs are often forced by the market demand, for example LEED (Leadership in Energy and Environmental Design) in construction. The benefit to LCA are vita: reliable, transparent data for both manufacturers and consumers, enabling better decisions how to produce and use materials and products.

4. References

https://www.google.pl/url?sa=t&rct=j&q=&esrc=s&source=web&cd=6&cad=rja&uact=8&ved=2ahUKewiO_KqAyY7iAhXNtYsKHQgNCjUQFjAFegQIABAC&url=http%3A%2F%2Fwww.poznan.pl%2Fmim%2Fpublic%2Fwos%2Fattachments.html%3Fco%3Dshow%26instance%3D1000%26parent%3D62706%26lang%3Dpl%26id%3D143644&usg=AOvVaw0dgiTjwNLNsiGhdUHoxlYd

Article about LCA using in wastewater treatment.

<https://sourceable.net/life-cycle-assessment-for-buildings-is-taking-off-globally/>

Information about LCA methodology use worldwide. Needs for use of LCA, and positive trends. Improvement of projects performance.

<http://e-czytelnia.abrys.pl/ecomanager/2009-2-431/zarzadzanie-4341/lca-elementem-zarzadzania-srodowiskiem-10303>

Ways of LCA use in macro, mezo and micro scale. Related standards. LCA advantages and disadvantages. Available only in Polish.

<https://www.eebguide.eu/>

³ https://g4e.pl/?gclid=EAlaIqobChMI2dSkgMiO4gIVDMKyCh132QOzEAAYASAAEgLIDPD_BwE and <https://plgbc.org.pl/wp-content/uploads/2017/05/Polish-Certified-Green-Buildings-2017.pdf>



Guidance, reporting templates, training materials and policy notes about LCA using in energy efficient buildings and building products. Many of materials are available in French, English and Spanish.

http://zbc.uz.zgora.pl/Content/3256/PDF/adamczyk_doktorat.pdf

PhD thesis on the use of LCA for environmental assessment of buildings. Available only in Polish.

<https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=2ahUKEwjNuMuJ55zgAhWMISwKHayuDz0QFjAAegQICRAC&url=https%3A%2F%2Fatikteam.s3.amazonaws.com%2F552837c8166197f098d7918c63d14d%2F1323271252QA0RpXCZL5rhsVPIcVobC7nRmC4ZV2Fq8Hw572UxzGCWUxdYFQ%3FAWSAccessKeyId%3DAKIAJRRAGXI4N6PIQGVQ%26Expires%3D2147483647%26Signature%3DExk%252BvlfzX%252B7Cc5kLQOXDIZfHloQ%253D&usg=AOvVaw3l3vHHfTK8u5k7iK3W2fqQ>

LCA applied to urban settlements and urban morphology studies. Seven-page article for download in PDF format.

ftp://ftp.grenoble.cstb.fr/public/Fouquet/Proceedings-Avnir/divers/Sessions/6b_LCA%20as%20a%20decision%20making%20tool%20in%20building%20construction/257_Peuportier.pdf

Eco-design of urban settlements using LCA. Article in PDF ready to download.

https://www.researchgate.net/publication/304059699_LIFE_CYCLE_ASSESSMENT_AS_A_DESIGN_AID_TOOL_FOR_URBAN_PROJECTS

LCA as a design aid tool for urban projects.

http://www.lema.ulg.ac.be/research/suit/download/suit5.2f_ppaper.pdf

LCA and the conservation of the urban fabric. Reflections on the validity of the use of LCA in urban development.

<https://www.energy.ca.gov/2013publications/CEC-500-2013-129/CEC-500-2013-129.pdf>

LCA and urban sustainability. The report describes the effective development of energy also in construction sector.

<https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=7&cad=rja&uact=8&ved=2ahUKEwjNuMuJ55zgAhWMISwKHayuDz0QFjAGegQIAxAC&url=https%3A%2F%2Fwww.mdpi.com%2F2071-1050%2F8%2F3%2F287%2Fpdf&usg=AOvVaw3jIGXBhUEKASfUNnzzx2TO>

Article: LCA in Building: A Case Study on the Energy and Emissions Impact Related to the Choice of Housing Typologies and Construction Process in Spain. PDF ready to download.

http://www.irbnet.de/daten/iconda/CIB_DC28171.pdf



Impact Assessment and Life Cycle improving energy efficiency in urban areas.
Mathematical models able to integrate the different aspects of LCA.



<http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.918.7827&rep=rep1&type=pdf>

Expanding the use of LCA to capture induced impacts in the built environment. Illustration how LCA can be used to evaluate the environmental impacts from induced impacts – the impacts resulting from the interaction of a building and its surrounding urban context.

<https://iopscience.iop.org/article/10.1088/1748-9326/8/3/035024/meta>

Quantification of urban metabolism through coupling with the life cycle assessment framework: concept development and case study.

<https://www.cbcsd.cz/wp-content/uploads/2017/09/Mastrucci-Marvuglia-Benetto-and-Leopold-Spatially-and-temporally-explicit-Life-Cycle-Assessment-of-building-stock-retrofitting-actions-at-the-urban-scale.pdf>

This paper presents an approach for the LCA of housing stocks retrofitting based on GIS and explicitly considering both the spatial and temporal dimensions.

<https://www.sintef.no/globalassets/project/lore-lca/deliverables/lore-lca-wp3-d3.2-armines.pdf>

The work about Low Resource consumption buildings and constructions by use of LCA in design and decision making.

<http://www.bvsde.paho.org/bvsiaia/fulltext/lifecycle.pdf>

Life-cycle analysis of the built environment. The article discusses the purpose of LCA and application in built environment.

<https://cshub.mit.edu/sites/default/files/documents/LCAforResidentialBuildings.pdf>

Life Cycle Assessment for Residential Buildings: A Literature Review and Gap Analysis.

http://www.irishlandscapeinstitute.com/wp-content/uploads/2017/02/161117_LCA_LVIA_Linear_Infrastructure_Draft-3.compressed.pdf

LCA and LVIA as primary tools for the design and construction of Linear Infrastructure.

<https://core.ac.uk/download/pdf/82527681.pdf>

Environmental LCA of a residential building in Egypt: A case study

http://www.inive.org/members_area/medias/pdf/Inive%5CIAQVEC2007%5CZhang_4.pdf

Comparison of LCA on steel and concrete construction office buildings - a case study.

<http://www.ibpsa.org/proceedings/BS2015/p2645.pdf>

Material across scales: combining material flow analysis and LCA to promote efficiency in a neighborhood building stock.



http://sections.arcelormittal.com/fileadmin/redaction/6-Sustainability/CTBUH_LCAReport.pdf

LCA of tall buildings structural systems. Extensive document in PDF format.

http://www.ztch.umcs.lublin.pl/materialy/rozdzial_25.pdf

“Application of LCA technique in ecological evaluation of products, technology and waste management” Article available only in Polish.

<https://plgbc.org.pl/wp-content/uploads/2017/05/Polish-Certified-Green-Buildings-2017.pdf>

Article “Polish Certified Green Buildings In Numbers” in English.