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1.3.2. REPORT ON METHODOLOGIES FOR CALCULATION OF CO_2 EMISSIONS IN CONSTRUCTION PROCESSES IN PORTUGAL

OERCO2
ONLINE EDUCATIONAL RESOURCE FOR INNOVATIVE STUDY OF CONSTRUCTION MATERIALS LIFE CYCLE

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The goal of this report is to provide a survey of the different methodologies that can be used to analyse the CO_2 emissions of building systems in Portugal, focusing mainly on building construction materials.

Effectively, the estimate of CO_2 emissions is included in the various parameters or categories of environmental impact used in various systems of environmental certification or sustainability in construction applicable to edification or standards of the field.

These methodologies are used to assess the environmental performance of building systems, based on pre-existing tools or international renowned methodologies that can be applied worldwide.

a) Sustainable building certification systems

The development of environmental evaluation systems, specifically for buildings, has enabled a technological challenge and consequently a revolution in terms of design and project management, allowing for the increase of research and development for construction materials with improved environmental performance. For example, the World Green Building Council (WorldGBC) is a global network divided per councils worldwide, promoting "green buildings" with the goal to reduce the environmental impacts generated by the construction sector. Each council helps to develop and administer many of the existing evaluation tools and allows to select which tool is most suited for their country's market needs when analysing a project.

One other example is the Leadership in Energy and Environmental Design (LEED), created by the US Green Building Council. Being already in its 4th version, this tool can be applied in every kind of building project, in any life cycle phase, and it has been adapted and used worldwide to assess the environmental performance of buildings, analysing the manufacture of construction materials, the generated emissions, energy consumption and waste management. LEED system divides the analysed projects in five different categories: building design and construction, interior design and construction, building operations and maintenance, neighbourhood development and homes. It considers seven evaluation areas: energy and atmosphere, sustainable sites, energy and atmosphere, materials and resources, indoor environmental quality, innovation in design and regional priority. The classification system provides a final score, with rating levels which are divided in four categories per gained points: Certified, Silver, Gold and Platinum.

Another evaluation system used in Portugal is Building Research Establishment Environmental Assessment Method (BREEAM), that was the first sustainability assessment method for buildings. This system considers ten environmental categories for construction activities: energy, health and well-being, innovation, land use, materials, management, pollution, transport, waste and water, measuring the sustainable value in each category by credits. The final credit score

determines their rating level: Acceptable (In-Use scheme only), Pass, Good, Very Good, Excellent or Outstanding. BREEAM has been driving reductions in building energy consumption and associated CO_2 emissions since the first scheme was launched in 1990.

Besides the WorldGBC, there is also the International Initiative for a Sustainable Built Environment (iiSBE), that developed an international and voluntary environmental certification system called SBTool that is used for the environmental and energetic evaluation of existing buildings, building projects or buildings in restoration. This system was adapted in 2007 for the Portuguese situation, a work developed by University of Minho and iiSBE Portugal, to analyse the sustainable behaviour of Portuguese residential buildings in three domains: environmental, social and economic. The building materials and products embodied environmental impacts are assessed in the Life-cycle environmental impacts indicator of SBToolPT. In this indicator, the impacts of the building under assessment are calculated using the EPD (Environmental Product Declaration) methodology and evaluators are encouraged to use specific environmental information for the building materials and products. A bottom-up approach is used, i.e. the whole building embodied impact is assessed summing up the contribution of each building element (floors, roofs, walls, etc.). Whenever specific LCIA information is not found, evaluators are advised to use the generic LCIA (Life Cycle Impact Assessment) database about construction technologies that is provided with the SBToolPT. A list of conventional building materials and products is provided with the SBTool, accordingly to the Portuguese context.

SBToolPT contemplates nine sustainability categories in the building evaluation:

- Environment: climate change and out-door air quality, biodiversity, energy efficiency, materials use and solid waste, water efficiency;
- Social: occupant's health and comfort, accessibility;
- Economical: costs, adaptability and building flexibility.

The final evaluation is based on normalised values obtained from the several indicators that exist in each category. In the end, this values are converted into a scale from A+ to E. This scale is only relative to the national context, where D corresponds to the conventional practice, and the A or A+ to the best practice. The best practice is a building which environmental impact is only 25% of the conventional practice environmental impact.

The Portuguese system, LiderA (*Liderar pelo Ambiente*), was developed in 2005 at IST (*Instituto Superior Técnico*). It is a voluntary system of recognition (phase design) and certification (operation phase) of sustainability. The system, through its principles and criteria, supports the development of projects that seek sustainability and certify the demand for sustainability of products in the built environment, from the design phase, construction to operation. The system considers six domains: local integration, environmental load, environmental comfort, socio-economic living and sustainable use. The environmental performance is evaluated with a range

from A to E, where E are the existing practices. If the performance verified by the LiderA verification reaches a final evaluation of the sustainability from C to A++ classes, the building or the built environment are certifiable as a good level of sustainability.

DomusNatura is also a Portuguese sustainability certification system, created by SGS (*Société Generale de Surveillance) in 2005. This system, in conjunction with DomusQual, cares about quality and sustainability* of a building, acting on 4 levels: design, construction, demolition or rehabilitation and resource management. DomusNatura combines the quality factor with environmental factors and efficient management of resources, with the objective of increasing comfort and reduce usage costs. The buildings that comply with the good social, economic and environmental practices recommended in the evaluation system, are certificated with the level of sustainability obtained according to the score in the following categories: sustainable site and safety; rational water use; energy and atmospheric pollution; materials and resources; comfort and quality and innovation and ecology. The classification is obtained through the total points gained in each category, where the final value has assigned a certification level, being the lowest level rated by I and the highest level by IV.

All the methodologies that are applied in Portugal can evaluate all the life cycle phases of the building. Beyond the environmental aspects, these systems also address others, such as social and economic indicators. Within the environmental domain, the systems evaluate not just the CO_2 emissions, but also other environmental impact categories.

b) Calculation of CO_2 emissions - CELE companies

The calculation of CO_2 emissions is based on the methodologies and emission factors defined by the Intergovernmental Panel on Climate Change (IPCC), which was established in 1988 by the World Meteorological Organization (WMO) and the UNEP (United Nations Environment Programme), with a directive to assess and compile scientific information on climate change; assess the environmental and socio-economic consequences of climate change; and formulate realistic response strategies.

Since then the IPCC reports have continued one of the main references, informing the political debate and the responses to be implemented around the world.

Companies covered by the European Emissions Trading System, in accordance with the criteria set out in Directive 2003/87/EC of 13 October and successive amendments, transposed into Portuguese law by Decree-Law no. 38/2013, of March 15 and Decree-Law no. 93/2010, of July 27, have specific methodologies for calculating CO_2. The CO_2 calculation encompasses the production process only at the place of production (factory), including combustion sources and process sources (including carbonated raw materials). The calculation methodology follows the

provided in EC Regulation no. 601/2012, with the emission factors according to the last inventory submitted to the IPCC.

c) Calculation of CO_2 emissions throughout the life cycle

The calculation of CO_2 emissions in building materials, constructive solutions and building throughout the various stages of the life cycle, from the extraction, transport, production, transport/distribution of the product, construction on site, stage of use and end stage, is supported by field software (e.g. SimaPro, or Gabi or equivalent), using databases such as Ecoinvent or the International Reference Life Cycle Data System (ILCD) or equivalent.

The calculation factors are supported by IPCC, across the various stages of the life cycle.

They can follow NP EN 15804 + A1:2013 on Sustainability of construction works – Environmental product declarations - Basic rules for construction product categories and NP EN 15643-2, on Sustainability of construction works - Assessment of Sustainability of buildings - Part 2: Framework for the assessment of environmental performance.

In fact, and as already mentioned, the estimation of CO_2 emissions is included in the various parameters or categories of environmental impact used. For more and additional information on the subject, including carbon footprint, see document REPORT 1.3.3. STUDY OF THE EVALUATION OF THE CARBON FOOTPRINT IN CONSTRUCTION IN PORTUGAL.

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