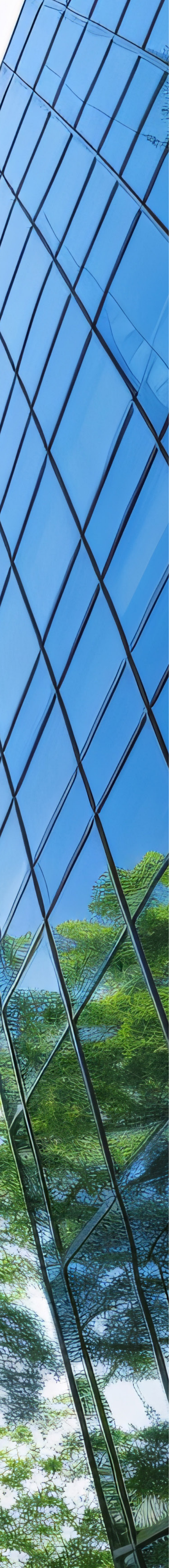
TRACTEBEL

ENGIE

The future of EU Building Design

Transitioninig from Low-Energy to Emissions-Free



Introduction

As the European Union gears up for the next critical revision of the Energy Performance of Buildings Directive (EPBD) in winter 2023, the stakes for sustainable building design have never been higher.

This article dives into Tractebel's pioneering role as a technical building designer in this evolving landscape. We will explore how our designs combine energy performance with financial feasibility, meet multifaceted challenges in urban settings, and navigate the intricacies of both operational and embodied greenhouse gas emissions.

We'll also examine the upcoming regulatory changes that will shape the future of the EU's building sector. Whether you're an industry professional, policymaker, or someone interested in the path to a carbon-neutral future, this article offers a comprehensive look into where we are and where we're headed.

Since 2002, the European Union has been promoting the energy performance of buildings, in particular through the Energy Performance of Buildings Directive (EPBD)[1].

Tractebel has since become a major player in the field of energy performant buildings, through its role as a technical building designer. In this field, our role is to design the structure and the technical elements of new buildings and major renovations to ensure the highest possible energy performance and therefore the lowest possible energy consumption.

[1] «Energy Performance of Buildings Directive», first issued in 2002 (2002/91/EC), then revised in 2010 (2010/31/EU), and a revision currently under review (2021/0426/COD)

Casablanca, Tour CFC - Casablanca Finance City (Fig. 1)

Tractebel is also deeply committed to elevating the energy efficiency of existing structures. Our holistic approach begins with detailed energy audits to identify inefficiencies, followed by customized action plans backed by performance measurement and verification protocols.

Through targeted renovations, set-point adjustments, and technical optimizations, we achieve substantial reductions in a building's energy consumption, generally achieving savings of 10-25%. This aligns with both environmental goals and operational cost-effectiveness.

Reducing energy consumption is a key strategy to mitigate greenhouse gas (GHG) emissions, especially in the building industry, which accounts for 40%[2] of the EU's energy consumption and 36% of its GHG emissions. While much of this comes from operational emissions, there is growing recognition of the significance of embodied emissions.

A comprehensive study[3] revealed a nuanced picture. While energy-efficient technologies and regulations have led to a decrease in operational emissions, embodied emissions are on the rise. In fact, the average share of embodied GHG emissions in buildings compliant with current energy performance regulations is 20-25% of the building's life cycle emissions.
This proportion can climb to 45-50% in highly energy-efficient buildings and exceed 90% in extreme cases.

Silver Tower project in Brussels, Belgium (Fig. 2)

[2] In focus: Energy efficiency in buildings (europa.eu) - *https://commission.europa.eu/news/focus-energy-efficiency-buildings-2020-02-17_en*
[3] By H. de Coninck, A. Revi, M. Babiker, P. Bertoldi, M. Buckeridge, A. Cartwright, et al., analyzed over 650 Life Cycle Assessment (LCA) case studies - Embodied GHG emissions of buildings – The hidden challenge for effective climate change mitigation - ScienceDirect - https://www.sciencedirect.com/science/article/pii/S0306261919317945?via%3Dihub

Operational emissions

Operational emissions refer to the greenhouse gas (GHG) emissions generated from a building's energy consumption throughout its entire lifespan, often quantified on an annual basis. For example, if a commercial building uses natural gas for heating and gas-powered electricity for lighting, the GHGs emitted from burning these fossil fuels would be categorized as operational emissions.

These emissions are typically measured in units of carbon dioxide equivalents (CO2e) per year to provide a standardized assessment of a building's environmental impact.

Embodied emissions

Embodied emissions represent the second category of greenhouse gas (GHG) emissions associated with buildings, and are often harder to define than operational emissions. These emissions stem mainly from the initial construction phase and include the GHGs released during the manufacturing and transportation of building materials.

For instance, the cement used in concrete emits a significant amount of carbon dioxide during its production process. Other materials like insulation, tiles, paint, and electrical cables also contribute to embodied emissions. Commonly referred to as "grey energy," these emissions are an integral yet frequently overlooked aspect of a building's total carbon footprint.

New swimming pool complex in Sint-Niklaas (Fig. 3)

Life cycle analysis

Over the last two decades, the construction sector has been progressively reducing the operational emissions of buildings, mainly by increasing insulation, installing triple glazing and adding solar panels. Ironically, the result is therefore an increase in the embedded emissions of buildings. Then the challenge is how to calculate this effect and make informed, optimal emissions choices to prevent the additional embodied carbon needed for the building's energy performance from becoming greater than the carbon eliminated by its reduced consumption. To resolve this issue, calculation methods and tools have been developed. European regulations are set to evolve as a result, under the initiatives taken by various public authorities.

To assess a building's carbon footprint, including both operational and embodied carbon, it is necessary to use Life Cycle Assessment (LCA) calculations. An LCA for a construction project is a comprehensive evaluation of the environmental impacts associated with all stages of a building's life, from raw material extraction to construction, operation, maintenance, and eventual demolition or recycling. This assessment aims to identify and quantify the environmental footprint of a structure, considering factors such as energy consumption, water usage, waste generation, and greenhouse gas emissions. By understanding these impacts, stakeholders can make informed decisions to design and implement more sustainable construction practices, ultimately reducing the environmental impact of the built environment.

Energy performance vs energy bill

The energy performance of a building is the calculated quantity of energy needed for its use. This includes energy consumption for heating, cooling, ventilation, domestic hot water production, and lighting. Notably, HVAC systems alone can account for up to 38% of a building's total energy consumption. These are the types of energy use that can be optimized during the design phase and are therefore considered in energy regulations.

However, these are not the sole contributors to the overall energy bill. In residential settings, additional energy is consumed by household appliances, TVs, and PCs, among other electrical devices. In commercial buildings, energy is also used to operate PCs, printers, kitchens, vending machines, computer servers, elevators, and the like. And in both residential and commercial buildings, the arrival of electric vehicle charging stations has introduced yet another type of energy consumption to consider.

Project Marnix (Fig. 5)

Tighter regulations on the horizon

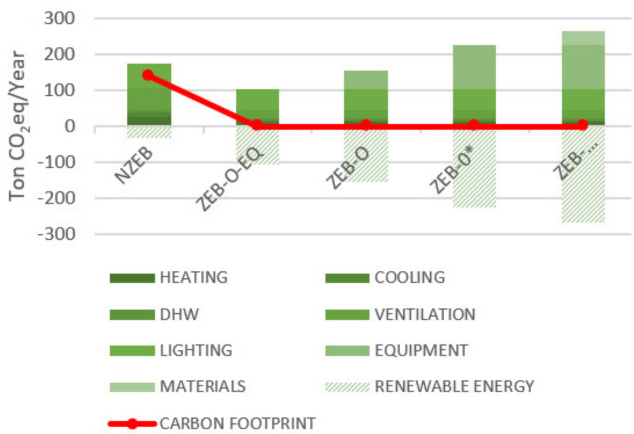
With growing awareness comes higher targets at the European level. This is reflected in successive revisions of the EPBD directive, the next of which is currently being prepared and is scheduled for winter 2023[4].

The main changes in this update are expected to be:

- **For existing buildings**: increase the speed of renovations, with minimum energy performance targets and specific thresholds for the most energy-intensive buildings (class F and G energy labels).
- **For new buildings** (or major renovations considered as new projects): shift the target from Nearly Zero-Energy Building (NZEB) to Zero-Emission Building (ZEB).
- In general, an overhaul of the Energy Performance Certificates (energy labels) to harmonize efforts between countries and raise overall standards.

From NZEB to ZEB

While the change to the acronym is minimal, its implications are significant. The are two changes: the «nearly» will disappear to show the increased threshold; and «energy» will be replaced by «emission» to illustrate the focus on greenhouse gas emissions and no longer on energy alone. This latter notion could lead to a fundamental change, which is still under discussion: taking into account GHG emissions over the entire life cycle of the building (operational carbon and embodied carbon), rather than emissions due to energy consumption only.



Carbon emissions by ZEB level[5] (Fig. 4)

The benefits of renovation

The art of renovation serves as a vital strategy for reducing waste, minimizing the land use footprint, and decreasing GHG emissions across a building's entire life cycle.

While the concept of renovation over demolition seems straightforward, the execution is far from simple. It demands careful planning, specialized skills, and a paradigm shift for architects – from "What can we build?" to "What can we keep?'"

At Tractebel, this represents a challenge that spans technical, methodological, environmental, and social dimensions. It's this very complexity that fuels our commitment to designing sustainable built environments, driving us towards a carbon-neutral future.

[4] The directive proposal has been voted in Plenary and needs to be discussed in Trilogue, then approved in Plenary and adopted.
[5] The ZEB level that could be adopted.

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