Chapter 9

Chosen Case Studies of nZEB Retrofit Buildings

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ABSTRACT

The reasons why the buildings are named intelligent and the cities are called smart arise from the requirement to achieve effective use of natural resources while maintaining at least current standard of living when faced with global climatic changes and growing scarcity of resources. Now, energy efficient and environmentally friendly urban solutions tend to concentrate on the possibilities of upgrade of already existing buildings that form the majority of the contemporary urbanized landscape. Due to the increasing human population, our world is undergoing rapid urban development. This state overlaps with climate changes and growing scarcity of resources, which has a high impact on the ongoing transformation of our built environment. Many of those issues are mirrored by European legislation, especially in Energy Performance of Buildings Directive, which makes nearly zero-energy buildings a standard by 2020. Many of the technologies are already available. nZEB renovation process will be a challenge for parties involved in the design and construction process.

INTRODUCTION

Sustainable policy is directed towards initiatives which aim for energy efficiency and sustain existence of public sector solutions which aid construction of all new buildings as nZEB by 2019. It also supports measures towards implementation process of low and zero energy buildings characterized with optimum cost coefficients.

Construction sector is responsible for at least one third of world’s total energy use. Low technical conditions of the majority of existing buildings and often inefficient energy solutions found in the newly constructed ones have direct impact on the high energy use. This state varies from one country to another, but for example energy performance of a single family house heated with a low temperature gas boiler in Poland is 30% higher than in Sweden (KodnZEB, 2015-2017). This chapter will be dedicated to the

DOI: 10.4018/978-1-5225-4105-9.ch009
pilot projects both on urban as well as individual building scales which allow for the provision of zero emission urban environments. Presented cases are located in Norway, as having one of the best nZEB standards already in place, even if currently accepted as a voluntary option.

BACKGROUND

Recast of EBPD Directive has been welcomed by the members as it defines various issues which for some time were interpreted rather freely depending on the local policies and culture. This includes the definition of an nZEB building and optimum costs. According to some experts (Sartori, et al. 2014), it is not possible to construct a nearly zero energy building without high rise in construction costs. On the other hand, German market prices prove that such buildings may be provided at only 2% of higher investment input (Sartori, et al. 2014). Still even the recast Directive lacks certain precision. Neither calculation methods for the energy characteristics have been included. Applicable in this case Article 7 of the EPBD states that

*Member States shall take the necessary measures to ensure that when buildings undergo major renovation, the energy performance of the building or the renovated part thereof is upgraded in order to meet minimum energy performance requirements set in accordance with Article 4 so far as this is technically, functionally and economically feasible*”. Major renovations, as defined in Article 2 of the EPBD recast, include the renovation of a building where: “(a) the total cost of the renovation relating to the building envelope or the technical building systems is higher than 25% of the value of the building, excluding the value of the land upon which the building is situated; or (b) more than 25% of the surface of the building envelope undergoes renovation.

Member States can follow either or both of those options. Since the definition of major renovations – associated with retrofit procedures differ from country to country, it is currently very difficult to compare the outcome of various renovation choices. Hence, in 2016, the outcomes on observatory of market studies and various data tools used for nZEBs were published (Zebra2020). Due to lack of an official European definition, authors’ of Zebra 2020 developed an indicator described as major renovation equivalent and defined three renovation levels: *low*, *medium*, and *deep*. It should nevertheless be noted, that any case studies on nZEB buildings new or retrofit, located in different countries and therefore subjected to different legal requirements, do not correspond to the same level of energy savings. Therefore any comparisons should be made to analogous processes rather than uniform outcomes.

Zebra2020 team assumed that with major renovations, building’s final heating energy demand can be reduced by 50-80% depending on a country, undertaken measures and current energy efficiency of local building stock (ZEBRA 2020). In general monitoring process of the nZEB market which took place in 17 European countries showed that the annual share of building stock representing major renovations is very low; circa 0.5% in Spain or Poland and only slightly above 1.5% in Germany, France or Austria. It was also found that the heating demand in nZEBs is generally lower for new built than for renovated buildings, but no consistent patterns were found within particular climate zones. It was confirmed that the most common insulation material for the residential building’s envelope is expanded polystyrene and stone wool for the non residential ones. The thickness depending on the climatic zones and local building codes, as well as building height and prevailing fire laws. The use of triple glass windows in