



Innovating to zero the building sector in Europe: Minimising the energy consumption, eradication of the energy poverty and mitigating the local climate change

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Abstract

The present paper discusses issues related to the three major problems of the built environment in Europe and in particular, the energy consumption of buildings, the energy poverty and the local climate change. The article introduces the idea of a zero concept world where the global impact of the three specific sectors will be diminished. The paper analyses the actual status of each sector and identifies the main problems. It discusses and sets a road map to satisfy this objective, involving future quantitative and qualitative targets for the three considered sectors while it investigates the major technological, economic and social forces and policies that have to be employed in order to minimize the energy consumption of buildings, eradicate the energy poverty and mitigate the local climate change. The links, synergies and impacts between them are analysed in a comprehensive way and the interrelated nature and characteristics of the three sectors is highlighted. The mechanisms to transform the actual problems into opportunities and appropriate drivers for future development are identified and analysed. A road map involving a full estimation of the necessary investments to fulfil the defined targets is presented. The major medium and long term benefits for the society, including the impact on the economy, employment, the environment and health are fully quantified and analysed.

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1. Introduction

Construction is a complex and dynamic sector. It has the potential to protect and ensure the human quality of life, offers income and employment, consumes enormous resources and energy, produces pollution and waste, affects significantly the global and local climate, and is directly linked to the poverty and vulnerability of a large part of the population. At the same time, it presents an intrinsic

dynamism acting as the main catalyst and promoter of future technological and social mega trends able to improve the quality of lives and transforming our societies.

Construction is a sector of major importance in the global economy. It is related to financial and commercial activities dealing with the development, renovation and extension of different types of fixed assets like buildings, open spaces and other types of infrastructures. The overall budget spent by the construction industry in 2013 including residential, non-residential and infrastructure construction was close to 8.2 Trillion dollars (IHS Economics, 2013), while it is foreseen that this will grow up to \$15 trillion

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worldwide by 2025 ([Global Construction Perspectives and Oxford Economics, 2013](#)). Among them, almost \$3 trillions are spent for residential buildings, \$2.5 trillions for non-residential buildings and the rest for infrastructures ([IHS Economics, 2013](#)). 70% of the investments are made by the public sector, while the private sector is responsible for 26% of the spending and the rest 4% is due to the Official development assistance ([BWI, 2006a,b](#)).

Construction generates a serious income for the world population. It represents almost 13% of the world GDP and it is expected to increase to 15% by 2020 ([Global Construction Perspectives and Oxford Economics, 2013](#)). Most of the future activities are expected in the emerging economies and mainly China, India and Brazil. Actually, developing nations represent almost 35% of the global construction output, but it is expected to increase up to 55% by 2020 as a result of the very rapid increase of the population, increased urbanization and rising of the local living standards ([Global Construction Perspectives and Oxford Economics, 2013](#)).

Besides the direct economic impact, construction has a serious indirect economic input as it is related and is strongly influencing numerous industrial sectors through important forward and backward growth linkages. Construction activities present a very high multiplier factor for the global economy through various relationships, fuelling sectors such as the manufacturing of components and materials, the exploration and use of energy, the development and use of machinery, and other building related activities.

Construction is a labour intensive activity, creating a relatively high number of jobs per unit of investment. Actually, the impact of construction on employment is very important and the sector counts as the second source of employment worldwide after agriculture ([WIEGO, 2015](#)). Officially, it employs more than 110 million people and almost three quarters of this figure is in the developing countries. Given that a high part of the construction related jobs in the developing world is undeclared, the final number of construction workers is estimated much higher. During the last decades, almost 89% of men and 97% of women working in the construction sector in India were considered as employees under informal conditions ([Pais, 2002](#)). The Building and Wood Workers International ([BWI, 2006b](#)), estimates that the total number of the construction workers exceeds 180 million worldwide. In parallel, the construction industry presents a high employment multiplier factor. For each new direct job created in the construction sector, many other new works are generated in the global economy. As mentioned by [Emrath \(2015\)](#), for each new single family house in USA almost 2.97 new jobs are created. Out of this, 1.76 jobs are directly related to the specific construction project, while the rest is the indirect impact, a multiplying effect of the construction sector in the global employment. In particular, construction helps to generate new employment in the manufacturing sector, wholesale and retail trade, transportation and ware-

housing, finance and insurance, real estate, various services, etc. The National Association of Home Builders ([NAHB, 2015](#)), estimated the impact of building 100 single-family homes in a typical local area of USA because of the construction activity, (phase A), the induced effect of spending income and tax revenue generated by the construction, (phase B) and the ongoing, annual effect that occurs because units are occupied, (Phase C). It is found, that during the three phases about 463 new jobs are generated out of which 185 are directly related to the construction.

Although construction is strongly fuelling the global economy and contributes highly to improve the quality of life of human beings, it presents a high potential to create negative impacts. In fact, construction is associated with major human crises, problems and challenges related to energy, environment, climate change, poverty and vulnerability issues. In particular:

- (a) The building sector is the major consumer of energy, accounting for around 30–40% of the worldwide consumption ([UNEP, 2012](#)). When the energy required for construction and demolition is also considered, the global demand by the construction sector estimates around 50% of the total energy use ([WBCSD, 2009](#)). The absolute figure of the delivered energy consumption of the building sector was in 2010 around to 23.7 PW h, and according to the reference scenario of the International Energy Agency it may increase up to 38.4 PW h in 2040, mainly because of the increased demand from the non OECD countries ([IEA, 2013](#)).
- (b) It affects the environment in multiple ways by consuming resources and producing waste and pollution. The building sector is responsible for the use of a large part of the worldwide resources of raw materials. Manufacturing of building components and products requires almost three billion tones of raw materials per year, which is equivalent to 40–50% of the global annual material use ([Hultgren, 2011](#)). In parallel, construction is responsible for consuming 12% of the global potable water and almost 70% of the global timber products. In addition, it is responsible for almost 20–25% of the air pollutants, about 70% of halocarbon, and almost 25–33% of black carbon emissions, 40% of the pollution of drinking water and finally 50% of the landfill waste ([UNEP, 2012](#); [BIMHow, 2015](#); [IASA, 2015](#)).
- (c) Buildings are highly responsible for the global and local climate change. The construction sector emits almost 38% of the greenhouse gases ([UNEP, 2012](#)), while the intense urbanization favors the development of the urban heat island phenomenon in densely packed cities, resulting in higher local urban temperatures, increased energy consumption for cooling, lower indoor and outdoor thermal comfort levels

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