Neapolis University

HEPHAESTUS Repository **http://hephaestus.nup.ac.cy**

Department of Real Estate MSc in Real Estate

2020-07

Towards Nearly Zero-Energy Buildings in Mediterranean Countries: Challenges for Real Estate Professionals from the Latest European Regulations

Ioannou, Costas

Real Estate Management Program, School of Architecture, Engineering, Land and Environment, Neapolis University Pafos

http://hdl.handle.net/11728/11864

Downloaded from HEPHAESTUS Repository, Neapolis University institutional repository

Neapolis University Pafos

MSc in Real Estate

Dissertation

Towards Nearly Zero-Energy Buildings in Mediterranean Countries: Challenges for Real Estate Professionals from the Latest European Regulations

Costas Ioannou

July 2020

Abstract

The Energy Performance of Buildings Directive 2010/31/EU demands that all new buildings are nearly zero-energy (NZEBs) by the end of 2020, thus requiring from European countries to draw up national plans and develop their first NZEBs.

According to the EU Directive, after December 31st, 2020, building projects that do not meet the requirement of "nearly zero (fossil) energy" consumption, will not be granted a construction permit. However, only a limited number of zero-energy consumption buildings do exist nowadays, while their design, construction and operation constitute a great challenge for a variety of reasons.

The purpose of this study is to examine the Cyprus case study. More specifically to identify the most critical sustainability design and construction parameters for NZEBs, through a thorough analysis of the European Directives, National legislation and international scientific resources, to highlight the main differences between conventional and NZEB developments in Mediterranean countries such as Cyprus and evaluate the principles and techniques for a more sustainable construction industry in Cyprus. The main focus is to investigate and highlight the barriers faced by various construction industry practitioners and professionals, in the application of the underlying legal and technical framework for NZEBs.

Through this process, several conclusions were drawn, which were also affirmed by the findings of the empirical quantitative research conducted via an online questionnaire addressed to construction and real estate professionals across Cyprus. First, the necessity of applying the principles of sustainability and NZEBs to maximize energy efficiency is undeniable and unanimously recognized by industry professionals. In terms of compliance to the European Directives on Energy Efficiency, the current policy framework in Cyprus and other countries has made relatively little progress towards providing effective and efficient solutions to existing barriers because little focus has been drawn on solving them.

The government does not offer sufficient incentives to citizens for home upgrades although refurbishing costs are significant. The state has also failed to meet its own targets on bringing government buildings up to speed with the EU directive.

There are also challenges in the research and development of NZEBs, as well as technical, financial, social, environmental/health-related and organizational/legal barriers to the implementation of new NZEB developments and NZEBs retrofit. From the limited range of technical solutions that can be used because of existing building structure and technical systems, the excessive investment costs, the lack of knowledge and interest for energy efficiency among residents and building owners to the sensitive balance between comfort and efficiency as criteria for selection of materials and waste management and the necessity of communication and consensus in NZEB refurbishments involving multiple homeowners, these challenges must be addressed for sustainable NZEB developments to be the new norm. To this end, industry professionals can and should play a key role in raising awareness and promoting the principles of sustainability and NZEBs, although this entails their own adequate training to remain up to date with the latest technical and regulatory requirements.

Acknowledgments

I am deeply grateful to Neapolis University Paphos for providing me with the necessary knowledge and skills to pursue my professional aspirations.

I would also like to thank Dr. Martha Katafygiotou, Lecturer in Real Estate, in particular for guiding me through the process of conducting the present research.

Finally, there are no words to describe my endless gratitude to my family, who has always supported and encouraged me to follow my goals and dreams.

Table of Contents

Abstract 1

List of Tables 5

List of Figures 5

Chapter 1: Introduction 8

1.1. Research Problem 8

1.2. Research Aim & Objectives 9

1.3. Research Methodology 10

1.4. Dissertation Structure 10

Chapter 2: Literature Review 12

2.1. Key Concepts & Definitions 12

2.2. Key Features & Characteristics of NZEBs 13

2.3. European Regulation & National Legislation on NZEBs 17

2.3.1. Climate Energy Package & EU Directive 2012/27/EU 17

2.3.2. Energy Performance of Buildings Directive (EPBD) Recast 2010/31/EU 20

2.3.3. National Legislation in Cyprus 22

2.4. International Experience on NZEB Developments 23

2.5. Challenges & Barriers in the Application of Sustainability Principles & Techniques in the International Construction Industry 32

Chapter 3: NZEBs – The Case of Cyprus 36

3.1. Legal and Regulatory Framework in Cyprus 36

3.2. NZEB Developments in Cyprus 41

3.3. Challenges & Barriers in the Application of Sustainability Principles & Techniques in the Construction Industry in Cyprus 44

Chapter 4: Methodology 48

4.1. Theoretical Context 48

4.2. Research Methodology 50

4.3. The Questionnaire 50

4.3.1. The Questionnaire 50

4.3.2. Research Sample 52

4.3.3. Data Processing & Analysis 55

Chapter 5: Statistical Analysis & Discussion 56

5.1. Results of Statistical Analysis 56

5.1.1. Distribution of Responses 56

5.1.2. Investigation of Statistically Significant Relationships 70

5.2. Discussion of Findings 77

Chapter 6: Conclusions, Limitations & Recommendations 85

6.1. Conclusions 85

6.2. Limitations of Present Study 88

6.3. Recommendations for Future Research 88

Bibliography 89

Appendix A: The Questionnaire 95

List of Tables

Table 1: Potential Energy Savings to Achieve -20% by 2020 (energy measured in Megatons of Oil Equivalent) (Tzortzaki, 2017) 18
Table 2: NZEB Targets in Cyprus (Tzortzaki, 2017)..... 38
Table 3: Statistically significant associations between demographic variables and other questions..... 71
Table 4: Statistically significant associations between pairs of question variables.... 75
Table 5: Most Critical Sustainability Design and Construction Parameters for NZEBs 85
Table 6: Main Benefits of NZEB Against Conventional Developments 86
Table 7: Primary Barriers & Challenges Faced by Construction Industry Professionals in the Implementation of NZEB Projects 86

List of Figures

Figure 1: Gender of Respondents 53
Figure 2: Age of Respondents 53
Figure 3: Professional Experience of Respondents 54
Figure 4: Profession – Area of Expertise of Respondents 54
Figure 5: Location of Work of Respondents 55
Figure 6: Responses to Question B1a: Are you familiar with the term "Sustainability"? 56
Figure 7: Responses to Question B1b: To what extent do you apply the principles of Sustainability in your work?..... 57
Figure 8: Responses to Question B2a: Have you employed any sustainable materials in any of your projects?..... 57
Figure 9: Responses to Question B3a: Are you familiar with the term "(Nearly) Zero Energy Buildings - (N)ZEBs"?..... 58
Figure 10: Responses to Question B3b: To what extent do you apply the principles of (N)ZEBs in your work? 58

Figure 11: Responses to Question B5: Are you familiar with the current and imminent EU Directives on Energy Performance of Buildings? 59
Figure 12: Responses to Question B6: Are you ready to hire sustainability professionals to pursue more sustainable development and NZBEs projects? 60
Figure 13: Responses to Question B7: Do you believe that in Cyprus the current experience of the construction industry on sustainable development and NZBEs can ensure the smooth communication and collaboration between all stakeholders and at all project stages? 61
Figure 14: Responses to Question B8: Do you believe that professionals that take on projects for sustainable and NZE buildings should charge higher prices? 61
Figure 15: Responses to Question B9: Do you believe that contractors, developers, construction companies have the required know-how and expertise to undertake sustainable and NZEB projects? (for both new and existing buildings) 62
Figure 16: Responses to Question B11: Do you believe that there are enough economic and financial incentives (sponsorships, tax deduction etc.) granted to potential buyers from the Cypriot state for the promotion of sustainable and NZE buildings? 63
Figure 17: Responses to Question B12: Do you believe that in Cyprus the required assessment tools for successful comparison between sustainable and NZE buildings do exist? 64
Figure 18: Responses to Question B13: Do you believe that in Cyprus the volume and quality of available information, building codes and material/system prototypes is sufficient for the successful development of a sustainable NZE building? For instance, are there enough resources to facilitate LEED certification? 65
Figure 19: Responses to Question B14: Would you employ certified materials and systems in your projects in order to achieve better energy efficiency performance? 65
Figure 20: Responses to Question B15a: Would you employ renewable energy systems in your projects in order to achieve better energy efficiency performance? 66
Figure 21: Responses to Question B16: Do you believe that investors would invest in energy conservation systems for buildings destined for sale or renting? 67
Figure 22: Responses to Question B17: Do you believe that potential building owners in Cyprus would accept higher initial costs for the establishment of new sustainable,

energy efficient systems under the assumption that those would lessen the buildings' environmental impact in the long-run? 67
Figure 23: Responses to Question C1: Evaluate the levels of your clients' willingness to pay for innovative materials and systems that have not been sufficiently tested in Cyprus, so that their building is energy efficient 68
Figure 24: Responses to Question C2: Evaluate the levels of your clients' willingness to pay for innovative materials and systems that have not been sufficiently tested in Cyprus, so that their building is environment friendly 69
Figure 25: Responses to Question C3: Evaluate the possibility of being asked to undertake the design and development of an energy efficient, environment friendly, sustainable building within the next 5 years 69
Figure 26: Responses to Question C4: Evaluate the degree of your interest in receiving additional training in areas related to the design, development etc. of sustainable, energy efficient buildings 70
Figure 27: Summary of Empirical Survey Findings 80