



Evaluation of the energy performance strategies in competition tenders to achieve Nearly Zero Energy Buildings: two case studies in Barcelona and Merano.

Speakers:

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***Abstract:** This paper shows the experiences of two typologies of tender competition to achieve Nearly Zero Energy Buildings (nZEB) target, realized in 2013 in two cities: Barcelona (Catalunya) Spain and Merano (Bolzano) Italy. This work was carried out in the framework of AIDA Project assisting Municipalities in the Integrated Energy Design (IED) process by IREC and EURAC, as partners of the European project consortium. In particular, this paper shows the approach used during the evaluation of proposals in submission phase, from the analysis of the design solutions presented to achieve the energy target and the energy performance (demand and generation on site), as well also the score assignment (energy efficiency item). Moreover, the total score is the sum of different points from different criteria achieved (urban integration, architectural and functional quality, aesthetic, etc.). This means, that presently, the nZEB target is an important aspect, but not necessary, to reach to win the competition. In conclusion, this paper highlights the importance of the definition of tender and specification documents related to the Energy efficiency, from the early stages of the architectural design, to achieve a nZEB and integrated the IED process.*

IED process, nZEB, NZEB, submissions evaluation, energy efficiency.

1. Introduction

According to the European Directive 2010/31/EU, by 2020 all new buildings in Europe should be nZEB [1]. This ambitious target has originated, at international level, many research activities and intense scientific and political debates to clarify the Net Zero Energy Buildings - NZEB definition. Defining NZEB, developing design tools and procedures and seeking optimum design solutions for NZEB are items which were widely under discussion, as an example, the IEA Task 40 [2]. Currently, the low adoption of the EPBD at National and Regional levels and lack of definition about nZEB in many countries, has led to very low adoption of NZEB and nZEB in public and private sectors.

The AIDA Project – IEE [3] aims to accelerate the market entry of NZEB and nZEB, increasing the knowledge about these buildings among public local administrations (municipalities) and building professional and master builders (private sector). For this purpose, one objective of AIDA is to develop a method to introduce energy performance requirements into public design tenders with an IED process [4]. The IED is a multidisciplinary and collaborative process, where the work team comprises different actors with various knowledge and experiences. This

team works together to define, analyse and evaluate different solutions and possible interactions [5]. This work describes the approach used for the evaluation of the proposals submitted, from the analysis of the energy strategy of the proposals, to the score assignment.

2. Nearly and Net Zero Energy Buildings, context and definition

Due to the missing implementation of the EPBD [1] at national level, into the AIDA project, a common nZEB definition has fixed, in order to use the same method for the energy balance calculation in all the case studies involved. The starting points are been the results obtained within the international project of the IEA SHC Task 40/ECBCS Annex 52¹ “Towards Net Zero Energy Solar Buildings”, AIDA suggests to focusing at least on the results of *Net ZEB primary* or *Net ZEB limited* and *Net ZEB carbon* definition. Furthermore, within AIDA project, have been proposed some minimum energy performance indexes (see Table 1), in order to achieve the nZEB targets, summary on a high-energy efficient building able to produce, on site, as much energy as needed (by Renewable Energy Systems - RES).

3. Tenders

At European level, the Directive 2004/18/EC and updates, define technical, legislative and economics aspects and rule the process and the relations between public and private sector. The tender is the vehicle able to contain needs, requirements and information for bids. Contracting authorities shall treat economic operators equally and non-discriminatory and shall act in a transparent way (Directive 2004/18/EC, art.2).

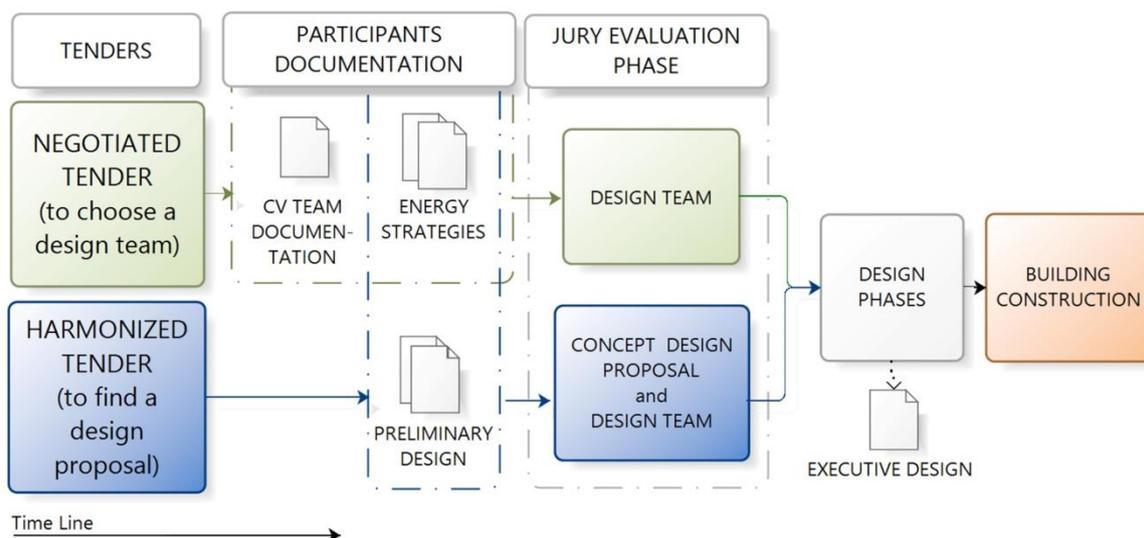


Figure 1: Tender procedures of the case studies (Source: Deliverable 3.1, IEE-AIDA²)

All European member states have implemented this Directive and its updates at national level. The building tender's choice is closely linked to the final objectives, needs, available budget

¹ IEA, International Energy Agency (<http://task40.iea-shc.org/>)

²IEE-AIDA project: <http://www.aidaproject.eu/downloads.php>

and involved professional figures. In these case studies are been chosen two different tender procedures, but in both the nZEB target is been introduced like a necessary requirement:

New equipment in Plaça Sarrià, Barcelona: Ideas competition tender (harmonized tender) organized by BIMSA - *Barcelona d' Infraestructures Municipals, Barcelona Municipality*, to find the design team through a design competition for the new Public library, Civic Centre - District Head Office and City archive (total net floor area= 4.640 m²).

New Elementary School of Signio, Merano: Design competition tender (negotiated tender) organized by Merano Municipality to choose the design team who will design the preliminary, definitive and executive project (total gross volume 17.300 m³).

3.1. Energy specifications parts

In both tenders, is been introduced a specific part, guidelines for the energy concept, about energy specification requirements, clarification of the nZEB definition (energy target), procedure and methodology to calculate the energy balance, physical boundary of the building (generation on site), integration of the energy generation systems and weighting factors, (Deliverable 3.1, IEE-AIDA)³. Moreover, *Minimum energy performance indexes*, such as defined in IEE-AIDA project, are been introduced in this part of tenders. Being their more restrictively respect to the national/local laws the two Municipalities have decided to increase this minimum or achieve the mandatory limits (see Table 1).

Table 1: Minimum energy performance indexes

| Minimum requirements | AIDA project | Merano | Barcelona |
|---|--|---|--|
| National/local energy performance classification of the building: | Standard A of National/Regional Energy Performance Certification | Standard ClimaHouse A: heating demand <30kWh/(m ² .year) | CTE Energy Certification (mandatory): level A |
| Primary energy- PE : | < 60 kWh/(m ² .year) | | Result of PE Balance: <90 kWh/(m ² .year) * |
| PE % produced from RES: | At minimum the 50% | At minimum the 40% | *No specified |
| CO2 emissions: | < 8 kg/(m ² .year) | < 100 ⁴ kg/(m ² .year) | No specified |
| Others: | | 60% of the DHW load covered by RES; Electricity produced from RES: minimum of 20W (for each square meter covered) | Limit of Electricity demand: <75-80 kWh/(m ² .year) |

*The nZEB objective will be realized by Energy balance in PE, using the conversion factors or weighting factors for different energy carriers, where energy demand includes: heating, cooling, domestic hot water - DHW, ventilation, lighting and equipment (affecting by the conversion factors to obtain the final electrical energy). The energy balance is performed on an annual basis, considering the type and efficiency of the energy systems and production of renewable energies systems (RES > 100 kWh /m².year).

³IEE-AIDA project: <http://www.aidaproject.eu/downloads.php>

⁴When the public tender of Merano was been published, AIDA's minimum energy performance criteria were underdevelopment.

3.2. Energy criteria and awarding points:

Within the tenders were introduced awarding energy performance criteria in order to assign as many points as the results achieved by the proposals. Both tenders required two energy criteria: a) Energy strategy to achieve the nZEB target; b) Composition of the design team with, at least, an Energy expert in the design team. Moreover, in Merano's tender, was required an expert able to calculate the energy balance through static and dynamic simulation tools.

New equipment in Plaça Sarrià, Barcelona: award criteria (with a maximum of 100 points), included in the Annex 6 of the Specifications document “*Global Architectonic Quality*”, were divided in 80 points for Architectonic quality, Compliance of Architectonic Program, Technical and structure consistency, Maxim costs and 20 points for Energy Efficiency (max. 15 points) and LCA- Life Cycle Assessment of materials.

New Elementary School of Signio, Merano: award criteria consisted of Design architectural proposal (maximum 30 points) and law accomplishment construction (maximum 30 points), completed on ‘Criteria to achieve nZEB target’ (max. 6 points) and ‘Experience (CV) of the Energy Adviser/Certifier (maximum 4 points).

4. Evaluation phase

4.1. The evaluation of the Energy target.

The IREC and EURAC were collaborated with BIMSA and Merano Municipality respectively, as a part of the jury, to support them to assign the score in the energy efficiency item. The criteria changed with the typology of the tender design process used. Table 2 shows the difference between the energy criteria and awarding points of the two tender procedures and the characteristics analysed and investigated within the proposals.

Table 2: Difference between the energy criteria and awarding points of the two tender procedures.

| Criteria to assign points | Merano | Barcelona |
|--|-------------------------|--------------------------|
| Energy Efficiency target | 6 points maximum | 15 points maximum |
| a) the self-sufficiency (energy) | X | X |
| b) reduce the energy demand | X | X |
| c) the buildings that incorporate intelligent systems (load control by users) | X | X |
| d) proposed a final energy target higher then ClimaHouse A (such as Gold, Nature, Passive House, LEED, etc). | X | |
| e) Sketches and drawings to supporting the energy concept. | X | X |
| Experience of the Energy Adviser/Certifier qualification's assessment: | 4 points maximum | - |
| a) experience in energy performance building consultancy | X | |
| b) qualification of the Energy Adviser/Certifier and knowledge of energy performance simulation tools | X | |
| Total points | 10/60 | 15/100 |
| Perceptual of the total score | 16.66% | 15% |

The proposals were been composed by a written technical report and a design proposal (not necessary in Merano case). To evaluate the ‘Energy Efficiency’ criteria, and if the objective was been achieved by the participants, the proposals were analysed from different energy performance categories, based on the analysis realized in Spain for existing building [6]. The

parameters were organized in: a) *Building configuration* (Figure 2); b) *Lighting and HVAC systems* (Figure 3) and c) *Renewable energy systems generation* (Figure 4).

Within design competition (*New equipment in Plaça Sarrià, Barcelona*) there were 15 points (that represent the 15% of total score) for the Energy Efficiency target criteria, while in the Negotiated tender design (*New Elementary School of Signio, Merano*), there were a total of 10 points maximum available for the energy criteria (represent the 16.66% of total score). This means, the energy strategy of the design proposal within total score weighs 10% in Merano and 15% in Barcelona's design competition.

5. Results

5.1. Results of the analysis of proposals.

The number of the participants was fifty-eight (58) for Barcelona and fourteen (14) for Merano. The choices reflect the background experience and knowledge of the professionals 'experts and the construction market trend typically used in these two cities. All proposals, except a very few number, have explained their passive architecture strategies (see Figure 2) and combine them with active solutions (see Figure 3), and then some, with a RES generation (see Figure 4) probably to achieve the nZEB target.

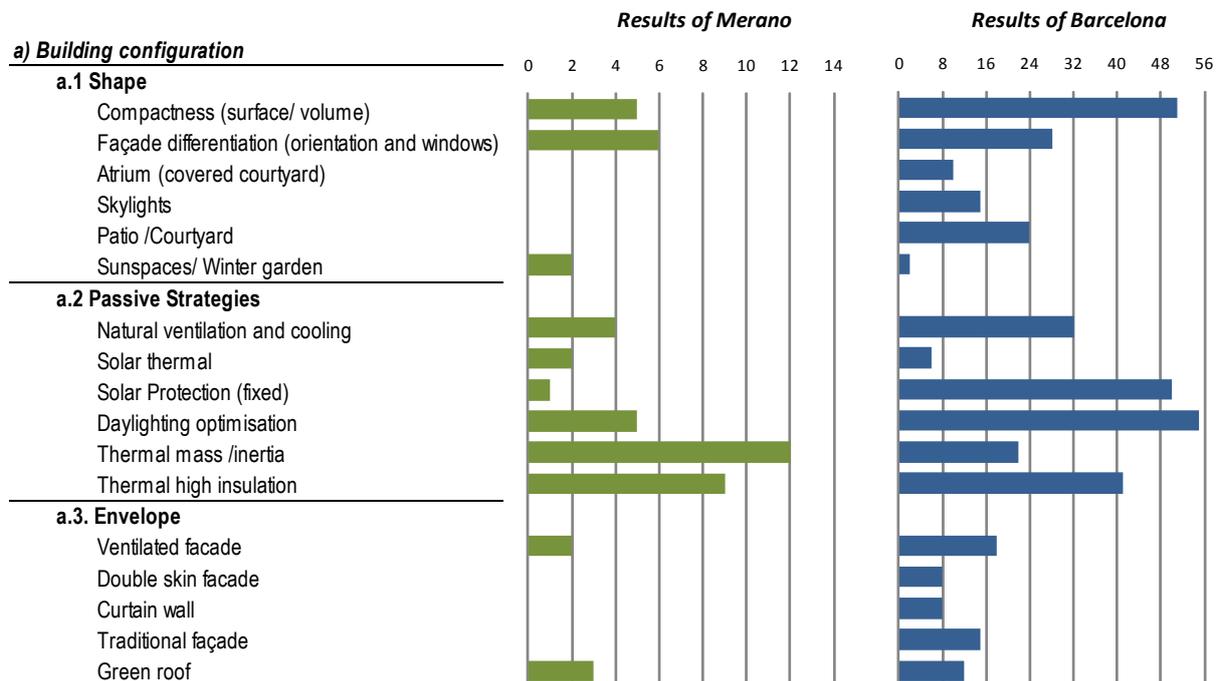


Figure 2: Analysis of Building configuration of the proposals results of Merano and Barcelona.

These results are strictly connected with the climate and the urban context. A building's compact shape is a necessary characteristic of the new building of Barcelona's city, development in height, due to the limit of the building construction area (plot). At the same time, the high number of façade differentiation (opaque/glass area of the façades) and thermal insulation are the most common solutions typically used in cold climate, like Merano's one.

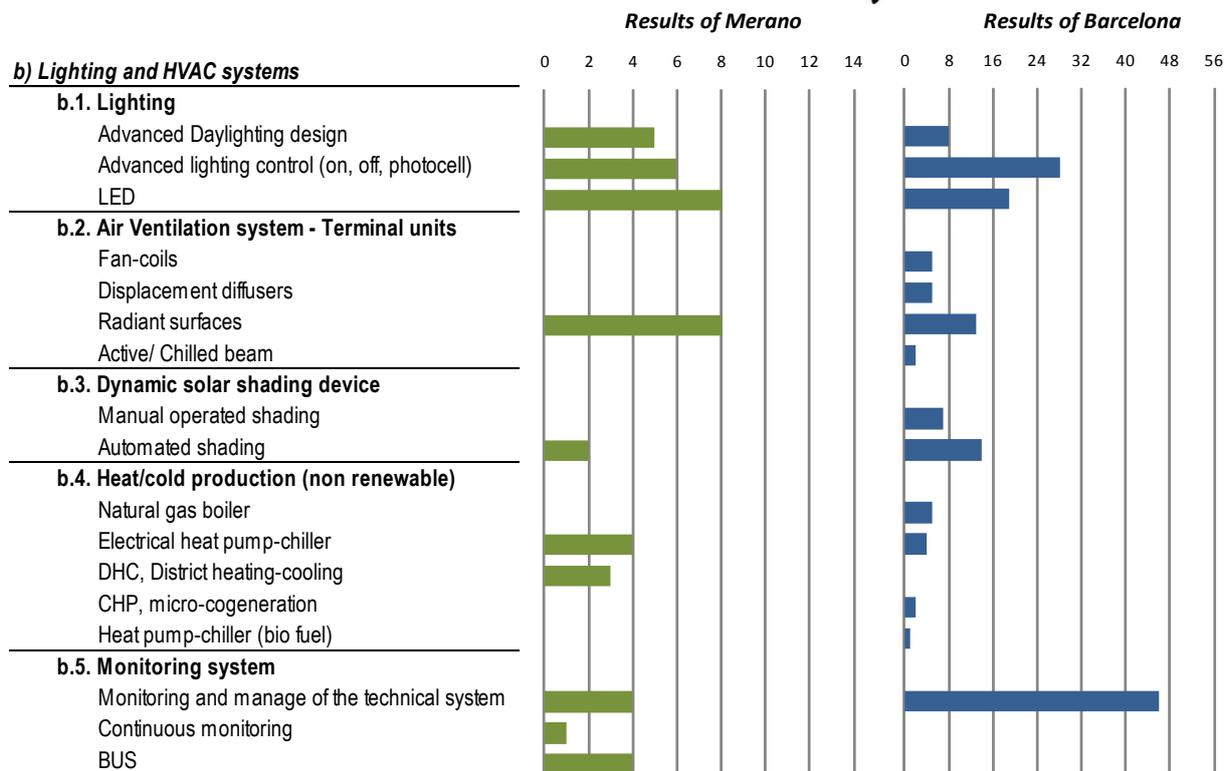


Figure 3: Analysis of Lighting and HVAC systems of the proposals results of Merano and Barcelona.

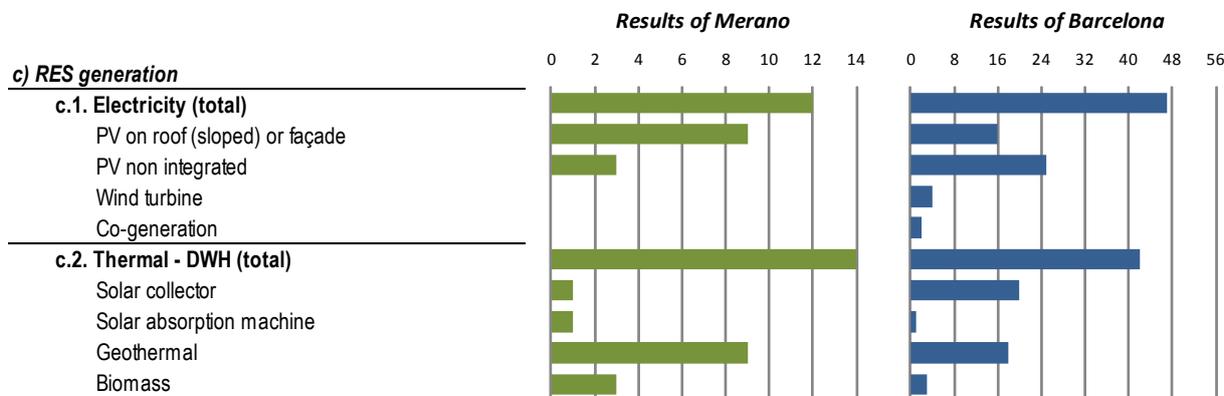


Figure 4: Analysis of RES generation of the proposals results of Merano and Barcelona.

6. Conclusions

This work suggests for future experiences a method for the analysis of the energy performance strategies of the design proposals, if the energy criteria are been introduced within the tender. This energy examination assigns as much points as the energy strategy achieves the nZEB target.

In both case studies, some misunderstandings were found. Sometimes, the participants were so determined to achieve the nZEB target, that they lost sight of the integration of the energy generation plants, like solar panels (thermal and PV ones), proposed unrealistic technical solutions for the specific urban context, or suggested contradicting solutions between technical reports and design proposals.



However, the introduction of the nZEB target requirement within public design tenders is an innovative strategy that allows increasing the energy performance knowledge and awareness in the professional expert (designers, architects, engineers and constructors) and improves the interactions between them. In addition, the complexity of the energy efficiency evaluation process of submitted proposals is highlighted, even if it is only a small part of the total score. This means that, presently, the nZEB target is an important aspect, but not necessary, to win the competition, and good proposals from this point have been discarded due to other factors (costs, architectural quality, urban context, functionality, etc.).

For the future, the energy efficiency aspects and nZEB target should drive the architectural design development, being part of architectonic language and strongly affecting the whole building configuration. In the case of the Barcelona's ideas competition the great number of design proposals submitted depict innovative approaches with similar architectural solutions. Both, Barcelona and Merano experiences, show that the energy performance-based tendering approach allow supporting this challenging achievement.

7. Acknowledgement

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8. References

- [1] European Parliament (2010). Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the Energy Performance of Buildings. Available: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:153:0013:0035:en:pdf>
- [2] AIDA Project (Affirmative Integrated Energy Design Action), co-funded by the Intelligent Energy Europe Program – IEE of the European Union. www.aidaproject.eu.
- [3] IEA SHC Task 40 / ECBCS Annex 52: Towards Net Zero Energy Solar Buildings. Available: <http://www.iea-shc.org/task40/index.html>.
- [4] Paoletti, G., Belleri, A., Mahlkenecht, H., Lollini, R. (2013) “Nearly zero energy target integration in public design tenders”. *SB13 Graz, SUSTAINABLE BUILDING CONFERENCE 2013*, Graz, Austria, 25–28 September 2013.
- [5] Larsson, N. and Poel, B. (2003). “Solar Low Energy Buildings and the Integrated Design Process – An Introduction”. IEA-International Energy Agency.
- [6] Sanchez, A., Salom, J., Cubí, E. (2012). Towards net zero energy office buildings in Spain: a review of 12 case studies. *EuroSun 2012 (ID 116)*, Rijeka, Croatia, 18-20 September 2012.