Implementing Cost-optimal Methodology in Existing Public Buildings

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SUMMARY

- Project RePublic_ZEB
- Building applied concepts/methodologies: cost-optimal
- Cost-optimal framework
- Results and conclusions

RePublic_ZEB

REfurbishment of the PUBLIC building stock towards nZEB

March 2014 – August 2016

Coordination:

CTI (Italian Thermotechnical Committee Energy and Environment)

Partners

PROJECT STRUCTURE

WP1 Mangement
(Lead by CTI)

WP2 Analysis of the public building stock and definition of reference buildings
(Lead: BSERC)

WP3 Assessment of the status quo and analysis of opportunities for refurbishing public buildings towards nZEB
(Lead: BME)

WP4 Costs/benefits analysis of the “packages of measures” for the refurbishment towards nZEB
(Lead: POLITO)

WP5 Strategies and guidelines towards nZEBs
(Lead: LNEG)

WP6 Communication and dissemination
(Lead: BRE)

PROJECT WEBPAGE

http://www.republiczeb.org/

APPLIED CONCEPTS

Nearly zero energy buildings: achieving the EU 2020 target

DIRECTIVE 2010/31/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
of 19 May 2010
on the energy performance of buildings
(recast)

EPBD Recast

THE EUROPEAN PARLIAMENT AND THE COUNCIL OF THE EUROPEAN UNION,

Having regard to the Treaty on the Functioning of the European Union, and in particular Article 194(2) thereof,

Having regard to the proposal from the European Commission,

Having regard to the opinion of the European Economic and Social Committee (1),

Having regard to the opinion of the Committee of the Regions (2),

Acting in accordance with the ordinary legislative procedure (3),

Whereas:

(1) Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings (4) has been amended (5). Since further substantive amendments are to be made, it should be recast in the interests of clarity.

(2) An efficient, prudent, rational and sustainable utilisation of energy applies, inter alia, to oil products, natural gas and solid fuels, which are essential sources of energy, but also the leading sources of carbon dioxide emissions.

(3) Buildings account for 40 % of total energy consumption in the Union. The sector is expanding, which is bound to increase its energy consumption. Therefore, reduction of energy consumption and the use of energy from renewable sources in the buildings sector constitute important measures needed to reduce the Union's energy dependency and greenhouse gas emissions.

Together with an increased use of energy from renewable sources, measures taken to reduce energy consumption in the Union would allow the Union to comply with the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC), and to honour its long term commitment to maintain the global temperature rise below 2 °C, and its commitment to make, by 2020, overall greenhouse gas emissions by at least 20 % below 1990 levels, and by 30 % in the event of an international agreement being reached. Reduced energy consumption and an increased use of energy from renewable sources also have an important part to play in promoting security of energy supply, technological development and in creating opportunities for employment and regional development, in particular in rural areas.

(4) Management of energy demand is an important tool enabling the Union to influence the global energy market and hence the security of energy supply in the medium and long term.

(5) The European Council of March 2007 emphasised the need to increase energy efficiency in the Union so as to achieve the objective of reducing by 20 % the Union's energy consumption by 2020 and called for a thorough and rapid implementation of the priorities established in the Commission Communication entitled 'Action plan for energy efficiency: realising the potential'. That action plan identified the significant potential for cost-effective energy savings in the buildings sector. The European Parliament, in its resolution of 31 January 2008, called for the strengthening of the provisions of Directive 2002/91/EC, and has called at various times, on the latest occasion in its resolution of 3 February 2009 on the Second Strategic Energy Review, for the 20 % energy efficiency target in 2020 to be made binding. Moreover, Decision No 406/2009/EC of the European Parliament and of the Council of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020 (6), sets national binding targets for CO_2 reduction for which energy efficiency in the building sector will be crucial, and Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources (7) provides for the promotion of energy efficiency in the context of a binding target for energy from renewable sources accounting for 20 % of total Union energy consumption by 2020.

(1) OJ C 277, 17.11.2005, p. 75.
(2) OJ C 200, 25.8.2005, p. 41.
(3) Position of the European Parliament of 23 April 2009 (not yet published in the Official Journal), position of the Council at first reading of 14 April 2010 (not yet published in the Official Journal), position of the European Parliament of 18 May 2010 (not yet published in the Official Journal).
(4) OJ L 1, 4.1.2003, p. 65.
(5) OJ L 140, 5.6.2009, p. 16.

Article 5
Calculation of cost-optimal levels of minimum energy performance requirements

- The Commission shall establish a comparative methodology framework for calculating cost-optimal levels of minimum energy performance requirements for buildings and building elements
- Member States shall calculate cost-optimal levels of minimum energy performance requirements

COST-OPTIMAL METHODOLOGY FRAMEWORK

Guidelines accompanying Commission Delegated Regulation (EU) No 244/2012 of 16 January 2012 supplementing Directive 2010/31/EU

- define reference buildings (both residential and tertiary sectors, both existing and new), representative of the building stock in terms of function and climatic conditions;
- define the energy efficiency measures (EEMs) to be assessed for the reference buildings, extended to the whole building or to building elements;
- evaluate the final and primary energy need for the reference buildings before and after the realization of EEMs;
- calculate the costs of EEMs applied to the reference buildings in the expected economic life-cycle.

COST-OPTIMAL METHODOLOGY FRAMEWORK

Reference building

- Common for all target countries: Portugal, Italy, Spain, Romania, Greece
- Office public building
- Different climatic conditions: Lisbon, Milano, Barcelona, Bucharest, Athens

Main parameters of the case study-reference building

Geometrical data			Building construction data			System data (mean seasonal values)		
Vg	[m3]	7200	Uwl	[Wm-2K-1]	0,76	Convectors	ηH,e	0,93
Af,n	[m2]	2007	Uw	[Wm-2K-1]	3,20	Room temperature control	ηH,c	0,94
Aenv/Vg	[m-1]	0,32	ggl,n	[-]	0,75	Central distribution (horizontal pipes)	ηH,d	0,98
Aw	[m2]	488,47	Ufl,up	[Wm-2K-1]	0,85	Natural gas standard generator	ηH,gn	0,876
No. floors	[-]	5	Ufl,lw	[Wm-2K-1]	0,25	Electrical storage water heater	ηW,gn	0,75
						Indoor units split systems	ηC,e	0,97

COST-OPTIMAL METHODOLOGY FRAMEWORK

Energy performance assessment

- EN 15603:2008
- EN ISO 13790:2008

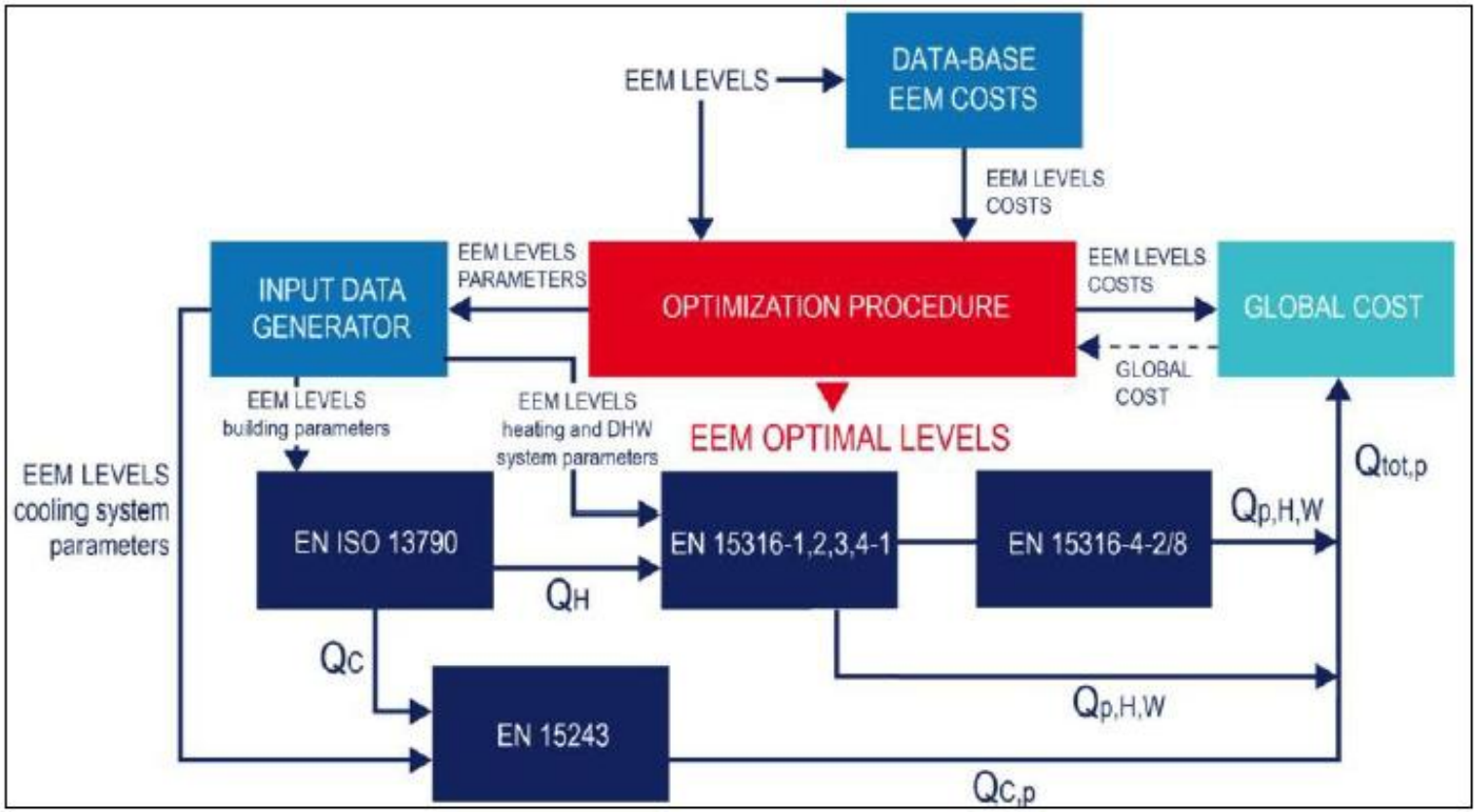
Global cost evaluation - EN 15459:2007

$$C_g(t) = C_I + \sum_j \left[\sum_{i=1}^{t} \left(C_{a,i}(j) \cdot R_{disc}(i) \right) - Val_{F,t}(j) \right]$$

global cost Cg(t) referred to the starting year t0 may be performed by a component or system approach,
initial investment CI, and for every component or system j,
the **annual costs Ca** and the discount rate **Rdisc(i)** for every year i (referred to the starting year), the **final value Val**

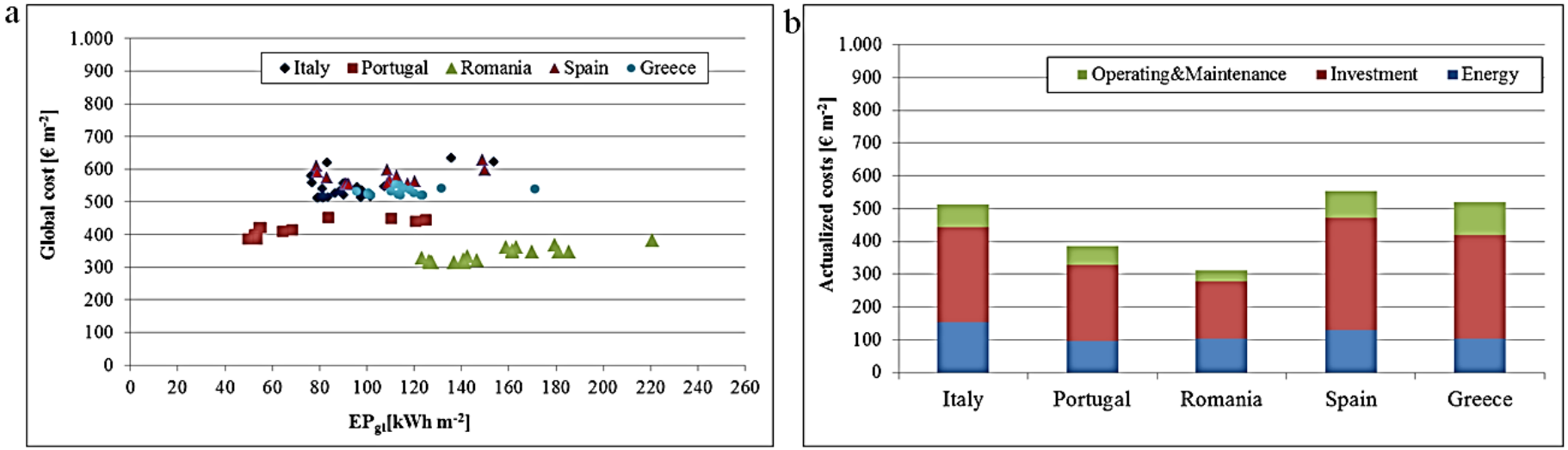
COST-OPTIMAL METHODOLOGY FRAMEWORK

The evaluation tool uses a new cost optimization procedure based on a sequential search-optimization technique considering discrete options is applied



RESULTS

The cost optimization was applied to the common reference case study considering the differences between the five countries in terms of: EEMs, weather data (Milano, Lisbon, Bucharest, Barcelona and Athens), energy price and primary energy indicators per energy carrier



(a) Optimization procedure application; (b) Cost optimal solution actualized costs

Results and Conclusions

- Concerning the global cost, for Italy, Spain and Greece the value is higher than 500 € m-2, while Romania shows the lowest value;
- Italy and Spain the energy costs are higher than the other countries; in Spain the EEMs costs are also high, while Romania obtains the lowest values in terms of energy, investments and maintenance costs;
- Global primary energy consumption ranges in between 54 kWh m-2 for Portugal and 137 kWh m-2 for Romania;
- Results show a relevant difference among the considered countries in the total primary energy consumption values, against a global cost deviation between 300 and 550 € m-2.

The study highlights the importance of a detailed definition of the energy efficiency measures and referred costs and of the energy costs, according to the building end use for each country.

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Thank you

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