Tackling the potential from below: Italian Municipal Building Codes as concrete implementation tools for the EPB Directive

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Abstract

In Italy there are more than 500,000 building companies, employing on average three workers each. The companies face difficulties to keep up to date with legal provisions, due to their small size. European, national and regional legislation need a number of accompanying measures in order to be implemented effectively. Municipal administrations are over 8000 and have frequent contacts with the building companies. Furthermore the municipalities have the responsibility on town planning schemes and on building codes that for example regulate aesthetics and hygiene standards, and more recently may include specific energy efficiency standards and norms.

Starting in 2003 a number of successful local experiences have been implemented, especially in Lombardia and in the Milano Province, where the practices of the building companies have been permanently modified. The pilot experience of some early adopter municipalities has spread, currently involving around 100 municipalities.

Best practices show the effectiveness of monitoring activities in the construction sites and of incisive accompanying measures (training and information, technical support, focused economic incentives). In this perspective, the successful establishment of improved building codes is not intended as a mere approval of a new piece of legislation. All success stories may be described as a continuous process involving citizens, entrepreneurs, designers, companies, suppliers.

Introduction

In 1987, through a public referendum, Italy decided to stop the development of nuclear power plants. Consequently, in 1989 a new National Energy Plan (Piano Energetico Nazionale, PEN) was approved by the Parliament. In 1991 two twin laws were approved aiming to implement the National Energy Plan: Law 9 concerning the generation, transmission and distribution of electricity and hydrocarbons regulation ("Norme per l'attuazione del nuovo Piano energetico nazionale: aspetti istituzionali, centrali idroelettriche ed elettrodotti, idrocarburi e geotermia, autoproduzione e disposizioni fiscali"); Law 10-1991 concerning rational use of energy, energy efficiency and renewable sources of energy ("Norme per l'attuazione del Piano energetico nazionale in materia di uso razionale dell'energia, di risparmio energetico e di sviluppo delle fonti rinnovabili di energia"). Law 10-1991 included a number of different provisions, including for example minimum standards for new buildings heating system efficiency, building heat loss and overall specific energy consumption.

In the Italian legal order, laws are approved by the Parliament and establish general principles, while the technical specification are included in Governmental Acts that do not need to be approved by the Parliament. Therefore a number of Governmental Acts were needed to put in practice the principles set by Law 10. In the following years a number of acts were actually developed, particularly those concerning use and maintenance of heating systems, and those concerning minimum standards for new buildings. But the technical regulations concerning energy performance certification of buildings have never been developed. In addition to this, the calculation of the heating requirement for new buildings was performed by the building designer, and the inspection on the building site do not take

place: in these conditions those professionals that do not observe the obligation are not subject to any consequence.

Law 10-1991 was an important instrument that failed to be fully implemented. While a number of bureaucratic fulfilments were introduced, the actual practice of the building enterprises was only partially modified: buildings completed in the late nineties have only slightly better energy performance than those completed in the eighties.

When in 2002 the European Parliament and the European Council approved the Directive 91 concerning the energy performance of buildings (EPBD), they gave a new opportunity to complete the transition towards more sustainable building practices. In 2005 the National Government approved a first important piece of legislation that was amended in 2006. Currently the implementation of Directive 2002/91/EC is ruled by Legislative Decree n.192/2005 (as modified by Legislative Decree n.311/2006). Once again the Decree introduces general criteria, and postpones most of the technical issues to following decrees that still (end of 2008) have not been published.

But the EPBD implementation process in Italy is complicated by the fact that energy is one of the subjects delegated to the regional governments by the constitutional reform approved in 2001. The regional Governments (19 regions plus 2 autonomous provinces) are responsible for the actual implementation of the Directive (in particular the provisions concerning methodology of calculation of the energy performance of buildings and energy certification). The current situation in Italy varies depending on the region:

- Some regions (e.g. Lombardia, Liguria, Piemonte, Emilia Romagna) have already adopted a methodology and have completed the implementation: all the provisions included in Directive 2002/91/EC are now effective in these regions;
- Some regions have started the implementation process, but the mechanism is still not effective;
- Some regions have not yet started the implementation process.

Municipalities for Energy Efficiency

Municipal administrations have the responsibility on town planning schemes and on building codes that for example regulate aesthetics and hygiene standards, and may include specific energy efficiency standards and norms. In this regard it must be noted that Italian municipalities are 8101, the largest being Rome (2,700,000 inhabitants on 1,285 km^2) while the least populated is Morterone (34 inhabitants).

Italian building companies operate in this rather complicated legislative framework. More than 500,000 building companies employ on average three workers each. The companies face difficulties to be up to date with legal provisions, due to their small size. But building companies have frequent contacts with the municipal offices, that represent the closest level of the administration. In most cases building designers and building companies have no relationship with regional or national governments and their technical staff, while they have continuous relationships with municipal governments and their technical staff. For example most of the mandatory communications must be directly handed to the Municipal Technical Offices. For these reasons, since 2003, some municipalities have started actions aimed at helping the implementation of the legislation, acting on three levels:

- **Municipal building code**, to enact some mandatory provisions regarding energy efficiency and integration of renewable energy sources;
- **Financial or volumetric incentives** to stimulate voluntary action to increase energy efficiency (compared to the mandatory provisions);
- **Inspecting and monitoring** the projects and the building site, to ensure that the process is having an impact.

We present shortly some examples, having in mind that only a threefold strategy may generate success stories.

MUNICIPAL BUILDING CODES: MIX OF OBLIGATION AND PROMOTION STRATEGIES

In 1999 the municipality of Barcelona adopted the Municipality Solar Thermal Ordinance, being the first EU administration to make the installation of thermal solar panels compulsory. Based on this experience, that quickly proved to be successful, in 2002, the Municipal Councillor for the urban planning of the Carugate Municipality decided to update the Municipal Building Code (MBC), asking for the support of the Director of "Rete di Punti Energia", as technical expert. In 2003 **Carugate** was the first municipality that adopted a Municipal Building Code (MBC) aimed at reducing energy consumption and CO_2 emissions in the building sector, so contributing to comply with Italian commitments under the Kyoto Protocol. This small Municipality located in Lombardia region in the outskirts of Milano has therefore played a pioneering role in Italy adopting a building regulation that has a comprehensive approach to energy saving, to the use of renewable energy sources and to the application of bioclimatic strategies. Throughout Italy several energy saving initiatives were inspired by Carugate MBC adoption.

In 2004 the Municipality of **Corbetta** (Lombardia Region) approved a MBC imposing the same obligations as Carugate, but making a step forward obliging also to install centralized heating systems with individual heat counters and abolishing the use of individual boilers.

On July 2005, **Milano Province** (Lombardia Region) published the "Guidelines for Standard Building Codes" (PROVINCIA DI MILANO, 2005). The aim of this action was to standardize the mandatory measures and to make operators' work simpler and public action more transparent. Guidelines met the approval of several Lombardia municipalities, ten of which started adopting on their territory the rules of the proposed MBC just after their publication. On January 2006, the Milano Province, in collaboration with Building Environment Science and Technology Department (BEST) of Politecnico di Milano, edited a procedure for Energy certification of buildings called BESTClass. On April 2006, such Province constituted together with the Municipalities of Carugate and Melzo, the first building energy label accreditation corporation for city council members based on BESTClass scheme that could be adopted on a voluntary basis. This experience was inspired by Bolzano Province initiative called "Casa Clima" building certification. The voluntary labelling schemes were important as a stimulus

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to implement the EPBD. Currently they are surpassed at least in those regions were a mandatory certification scheme was adopted.

But the experience in small municipalities, helped also as a stimulus to bigger ones. In 2006, the Municipal Council of **Rome** (Lazio Region) has given the permission for the deliberation already approved in December 2005, partially modifying the Building Regulation, introducing 48/bis article on "Energy saving and renewable energy sources". Such article establishes the obligation to use renewable sources in new buildings. Renewable energy sources must provide at least 30% of total energy needs and 50% of the energy needed for hot water production. As from December 2007, new and refurbished public and private buildings must cover 15% of the energy needs by photovoltaic panels and another 15% by energy saving measures such as wall and roof insulation, installation of timed ignition systems, installation of energy efficient boilers.

The practical experience demonstrated that change processes might benefit starting at the local level and adopting a bottom-up approach. Building Regulation allows Local Authorities to be more rapid than other higher level planning bodies in carrying into effect the provisions because Local Authorities have the mandate to verify directly the constructions.

FINANCIAL OR VOLUMETRIC INCENTIVES TO PROMOTE ENERGY EFFICIENCY

A number of Municipalities and Provincial Administrations foresees incentives for the promotion of sustainable actions in the national territory or in the building system. Some of them have already adopted Building Codes that promote energy efficiency, others have published guidelines to put into effect best practices and others have relied on the realization of "excellent" cases. We propose some explicative cases to show the different experiences.

At a time when budget restrictions prevent in most cases direct contribution Municipalities have two main instruments to promote energy efficiency in new and existing buildings:

- Building companies must pay urbanization costs to the municipality when they are carrying out new projects: the municipality can decide rebates depending on the energy performance of the building;
- New projects must fulfil volumetric limits, depending on the municipal land use plan (e.g. 1 m^3 of built space for each 1 m^2 of available land): the volumetric ratios may be increased depending on the energy performance of the building; a different approach may also be adopted: all the extra building volume needed to fulfil insulation requirements will not be counted in the calculation of volumetric standards.

For existing buildings, where urbanisation costs are not due, municipalities can decide rebates on other taxes, such as the tax on municipal wastes. When providing an incentive, the municipality can adopt two different approaches:

- A methodology is adopted to calculate the energy performance of buildings (generally in kWh/m^2 year or in kWh/m^3 year): incentives are given to buildings whose performance is lower than defined thresholds;
- A list of measures that reduce the environmental impact of the building (not including only energy consumption but for example water use or waste management) is adopted: each measure has a score and the incentives are given to those building whose total score is higher than defined thresholds;

Municipalities can also promote agreement with local financial institutions to provide financing scheme for energy efficiency measures (e.g. Milano province, Parma province). We provide a short list of examples of incentive schemes.

Guidelines for bio-architecture of the Municipality of **Calenzano** (Toscana Region) define some rules for environmental sustainability. Those new buildings that fulfil the guidelines, may have a reduction up to 70% of the taxes paid to the municipality for urbanization costs. Furthermore they may benefit a volumetric increase up to 10% compared to standard values.

In 2004 the Municipality of **Carugate**, after the adoption of MBC, has introduced, besides the obligation for new buildings, some financial incentives. Urbanization costs are reduced between 25% and 50% depending on the energy performance of the building. Higher reductions are provided if the project includes Photovoltaic plant to provide at least 50% of the annual electrical needs.

The Municipality of **Corbetta** (Lombardia Region), after approving the Building Regulation on 2004, has adopted financial measures for new buildings. The financial incentive consists in 20% of the cost of the thermal solar plant for the production of sanitary hot water, up to a maximum of 2,000 Euro for each plant.

Municipality of **Limena** (Veneto Region) approved a new guideline for environmental protection and energy saving. The aim of this program is to reduce the environmental impact of the buildings and to enhance the health of the citizens, identifying financial contributions for new and retrofitting buildings.

In December 2006 **Regione Lombardia** set a regional framework for these kind of financial incentives: municipalities may increase volumetric standards up to 15%, and can reduce urbanisation costs for projects with better energy performance than the standard or fulfilling bioclimatic guidelines.

MONITORING AND EVALUATION

The past experience in Italy concerning building energy performance regulation can be seen as a failure. Although standard were set at a national level, the practical experience showed that:

- The building designers normally considered the written declaration concerning energy consumption of new buildings as a bureaucratic loss of time, in most cases they just cut-and-paste from previous projects: they deliver it to the Municipal Technical Office just because they were obliged to;
- In some cases, when the standard was not fulfilled, they just change some numbers in the declaration: the numbers now are right, the building remains the same;
- In most cases, the project was different from what was actually built and typically has a worse energy performance than expected looking at the layout.

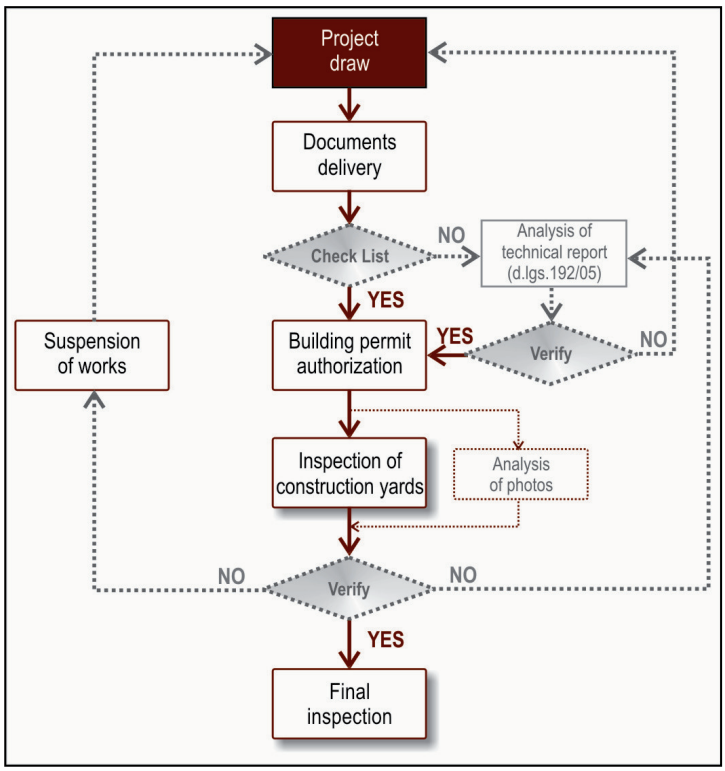

Figure 1. Management and control scheme of activity and projects. Procedures already applied and validated inside the Municipalities of Carugate and Corbetta (Lombardia Region).

The result was more paper in the offices, same buildings on the site. When the municipalities started to implement the provisions of new and upgraded MBC they had in mind this past experience, and decided to organise monitoring activities, so as to be sure that the process would be working. The Municipal Technical Offices are in charge to control the work of designers and builders. The verification procedures must be identified following a simple and linear scheme, so that they can be managed also by small municipalities of little dimensions.

The scheme highlighted in Figure 1, was adopted from the Municipalities of Carugate and Corbetta (both around 15,000 inhabitants), after having introduced the new Building Regulation. The proposed procedure foresees two kinds of verification: one on the basis of the project documentation (Check List) and one in the construction yard. The Check List which will be compiled by the planner is a useful support to the Municipal Technical Office: all the elements which characterize the project under the energy point of view are summed up in one document. Two additional columns are filled out by the Municipal Technical Office: the first during the project verification and the second during construction yard inspections. The Check List constitutes a first filter of consistency that the planner is called to respect. Some municipalities (e.g. Lodi) supply an electronic checklist, were part of the verification is performed automatically. The introduction of the checklist has made planners and builders more responsible because they understood that the Municipality would make verifications and controls on the projects and the building sites, contrary to previous practice.

To obtain the Permission of Build (needed for new buildings) or for the Declaration of Beginning Activity (needed for refurbishments), the building designer delivers to the Municipal Technical Office the Check List together with the project of the building and the technical report created following the ministerial scheme with supporting technical drawings and certifications on the energy performances of the used materials (foreseen by Law 10/1991).

The Building surveyor is guarantor and also responsible of the correspondence between project and actual implementation. Every modification to the project or every change of the used materials, in particular those that could affect the energy performance (thermal isolations or windows for example) involve an updating of the energy calculation and therefore, forces the elaboration of a new project report attesting that the produced changes do not affect the fulfilment of the legal requirements. The Municipal Administration is not asked a verification of the results of the energy calculation that would require a parallel analysis: technical officer should however perform a check of the general consistency of the documentation as well as an onsite verification.

ONRE National Observatory on Municipal Building Codes

In 2008, Legambiente and CRESME have promoted a National Observatory on Municipal Building Code (ON-RE Osservatorio Nazionale Regolamenti Edilizi per il Risparmio Energetico), that published its first report in October 2008. The report includes an in-depth analysis of Municipal building codes and other policy instruments implemented by the Italian Municipalities to increase the building energy performance.

This first report (ON-RE, 2008) presents the result of a research that has involved 1000 municipalities. 188 municipali-

Table 1. Number of municipalities adopting different approaches for energy efficiency promotion (Source ON-RE, 2008)

Approach	Number of municipalities
Obligation	56
Obligation and promotion	17
Obligation and incentive	30
Incentives	23
Incentives and promotion	20
Promotion	31

ties are active in energy efficiency promotion through the MBC. In 103 municipalities the MBC includes at least one mandatory provision concerning energy efficiency, while in 85 municipalities the MBC includes only incentives. The 103 municipalities with mandatory provisions host 7.6 million inhabitants, 40 000 new unit annually, around 13% of the Italian total (around 300,000 in 2008).

The MBC provisions may be addressed only to new buildings or also when an existing building undergoes a renovation. Energy efficiency is promoted in different ways:

- **Obligation**: the licence for new buildings' construction (or for the renovation works) is given only if a list of criteria is complied with;
- **Obligation and promotion**: besides the obligation, the MBC contains also a list of advices that may increase the energy performance of the new or existing building;
- **Obligation and incentive**: besides the obligation, some kind of incentive is provided;
- **Incentives**, when only incentives are provided;
- **Incentives and promotion**, but no obligation;
- Only **promotion** activities.

Among the possible obligations, the most popular measure is the solar thermal obligation. In new buildings (66 municipalities) or in new buildings and refurbishments (38 municipalities), a solar thermal plant must provide at least 50% of the primary energy needed for sanitary hot water production. An obligation to install photovoltaic plants (at least 0.2 kW for each apartment or unit) is in force in 81 municipalities. In seven municipalities the obligation is defined in terms of total primary energy needs: a defined percentage of the energy needs for heating and hot water must be produced by renewable energy sources (solar, geothermal, biomass).

Success story: Municipality of Carugate, Milano Province

After having presented the overall institutional framework, we analyse in the following the experience in two municipalities that can be seen as success story. In particular we present in detail the experience in the first municipality that adopted an energy efficient MBC. Carugate may be seen as a pioneer experience and in a way it offered an important stimulus to other municipalities, to the Milano Province and to the Lombardia regional government to develop new policies. While the second municipality we present is Lodi, where the new MBC was developed after the implementation of the new regional regulation. In this second experience we can see how the MBC can integrate existing policy tools and serve as an implementation tool to transform in real practice the provisions included in national or regional regulation.

The town of Carugate has a population of 13,423 inhabitants. Totally the building stock includes around 1,500 buildings, of which 1,300 for residential use. The Municipality of Carugate represents an excellent experience in the field of environmental sustainability (i.e. in the waste management). Enlarging this perspective also to the building sector, in 2002 the Municipal Councillor for the urban planning of the Carugate Municipality decided to update the MBC. Between 2002 and 2003, a draft of the MBC was outlined during some meetings among the Councillor at the Urban Planning, the person in charge of the Technical Office for "Private Building" and the Director of "Rete di Punti Energia".

THE PROCESS FOR THE DEVELOPMENT OF THE NEW MBC

The development of the MBC and its adoption was carried out having in mind the suggestion from BETTIOL, 2005 and WATES N., 2000 concerning community planning. The first phase of the process was dedicated to the analysis of the status quo: information was gathered concerning the energy and environmental situation of the territory. Criticalities were highlighted organising discussions with local stakeholders (especially building designers and building companies).

Then a second phase of the process included all technical offices inside the municipality. In this phase all technical experts of the different departments were involved to define the new MBC layout. The importance of this phase lays in the fact that the technical experts knew the other municipal instruments in force and they worked for a global harmonisation. Furthermore they will be the persons in charge for the practical implementation of the MBC, and they should feel that the MBC is their own, and not something that someone else is imposing on them. This approach derives from the studies on the working teams (see for example FISHER et al. 1997).

The third phase is the intervention of the councillors, which can suggest some modification. In February 2003 the MBC was adopted by the city council, meaning that it was published for a public review giving the possibility to all stakeholders to deliver observations and suggestions. During the spring a part of the accompanying measures were carried out. Meetings were organised with building designer associations and with building companies association. During the meetings it was identified a typical construction and calculation were carried out evaluating the extra costs and the energy savings incurred due to the introduction of the new MBC (see following paragraphs). The evaluation was developed with the participation of the building companies that helped to define the real extra costs. Both the designers and the companies were surprised by the results, since the extra costs were estimated as less than 3% of the total costs. The building companies typically tend to overestimate the extra cost needed to achieve energy savings, especially for new construction. Results from a survey which involved 1400 experts worldwide were striking: additional costs were generally estimated at 17% for new buildings when actual additional costs generally amount to about 5% of total building costs (WBCSD, 2007).

Table 2. Analysis of technical and economical costs of interventions.

Typology	Dwelling cost [€]	Gas consumption [m^3 year]	Cost [€/year]	Energy saving [%]	Additional Costs [€]	Saving [€/year]
Law 10/91 building	126 000	1 410	705	43	3 000	300
Carugate building	129 000	810	405			

During this period, observations were gathered and minor changes were introduced. Finally in May 2003 the municipality approved the MBC. The structure of this planning tool, is divided in mandatory measures, and recommended measures that encompass both new and existing buildings. Later some update were needed: in July 2004 the "Energy Labelling" was introduced and a scheme of incentives for buildings with levels of energy performance higher than the minimum required. In 2008 after the adoption of new standards at a regional level, the MBC was modified.

MANDATORY AND SUGGESTED ENERGY EFFICIENCY MEASURES

The mandatory measures included in the Carugate MBC are:

- More restrictive envelope U-values than those required by the national law;
- Solar thermal systems for domestic hot water production;
- Application of thermostatic valves to radiators or individual regulation systems;
- Individual heating metering systems and gas-fired condensation boilers installation;
- Low-energy electricity devices (e.g. standard digital lighting control systems) and high efficiency lamps;
- Collection and storage system for gathering rain water.

Major retrofits on existing buildings must comply with these standards as well. MBC text distinguishes among measures related to renewable energy promotion and energy saving measures related to winter heating. As far as existing building renovation is concerned, mandatory measures addressing renewable energy have to be implemented in case of heating system renovation or non residential building volume extension, whilst mandatory heating measures (mostly related to building surface U-values) have to be applied in case any kind of intervention is undertaken on existing building walls, roof, windows, etc. If building renovation covers more than 50% of floor area, renovated building energy performances must be certified according to certification system adopted in the regulation.

MBC also obliges to install solar thermal systems for domestic hot water system (DHW) in new residential and public buildings, whilst photovoltaic panels are only suggested. The importance of building integration of these technologies is duly stressed in the regulation. Other recommended measures are:

- Green roofs;
- Low temperature radiant panels;
- Natural materials and bio-compatible furniture;
- Centralized heating systems;
- Solar greenhouses.

Mandatory measures allow to achieve considerable energy savings as shown in the following paragraph.

EX-ANTE EVALUATION OF THE LONG TERM SAVINGS

Between the adoption and the approval of the new MBC, the municipality organised meetings with building designer associations and with building companies association. During the meetings it was identified a typical construction and calculation were carried out evaluating the extra costs and the energy savings incurred due to the introduction of the new MBC. The energy analysis was conducted on a linear building having 16 dwelling distributed on 4 storeys, see Table 2.

A comparison has been conducted between the new regulation and the one that was in force at the time (Law 10/1991). Only mandatory measures were considered. In the sample building energy savings were achieved for the heating system (36% compared to the standard case), and for the DHW (67% compared to the standard case). The estimated total saving is about 43% compared to traditional building (applying Law 10/1991). During 2003-2008, 95 building concessions have been active, 32 of them for new buildings. The application of the MBC on territory in 2004-2010 is expected to guarantee energy saving in the range of 12-24% within 2010.

The total amount of expected energy saving on the whole building stock, calculated on the basis of an ex ante evaluation of the mix of measures implemented and retrofit action on existing buildings, was of 23.7% (100,885 MWh/year), see Table 3. The economical convenience becomes much more advantageous in retrofitting of existing buildings that, as known, have poor energy quality and a great energy potential.

When considering new construction or rehabilitation, the extra-costs that are necessary to transform a standard building in a energy efficient building is about 2-4% of the total costs, depending on building typology. The energy saving potential is particularly high in the retrofitting of buildings where it is estimated that every year 1-2% of the building stock is renovated. It is more practical and economic to realize potential energy efficiency increase when a building is renovated. If this opportunity passes without the implementation of appropriate measures, then the opportunity is "lost" for a decade or more due to the long lifecycle of buildings.

Table 3. Energy performances of the Carugate MBC

Energy performances		Standard case	Rehabilitation strategies			
			10% of existing buildings	20% of existing buildings	30% of existing buildings	30% of existing buildings (higher standards)
Heating	MWh/year	78 175	68 794	65 667	63 321	59 942
	kWh/m^2 year	149	131	125	121	114
Domestic hot Water	MWh/year	18 529	15 791	15 066	14 340	13 334
	kWh/m^2 year	35	30	29	27	25
Electrical Use	MWh/year	35 593	31 385	30 270	29 156	27 609
	kWh/m^2 year	68	60	58	56	53
Total	MWh/year	132 297	115 969	111 003	106 818	100 885
	kWh/m^2 year	237	207	199	191	180
Savings compared to the standard case	%	–	12.30%	16.10%	19.30%	23.70%

ACCOMPANYING MEASURES

The Municipality, after the adoption of the MBC, has introduced in 2004 some financial incentives. Urbanization costs are reduced:

- 25% for building with heating energy performance ≤ 40 kWh/m^2 per year (A–B class);
- 50% for building with heating energy performance ≤ 30 kWh/m^2 per year (A class);
- 25% for building with heating energy performance ≤ 50 kWh/m^2 per year (C class) but provided with Photovoltaic plant proportioned to provide at least 50% of the annual electrical needs;
- 50% for building with heating energy performance ≤ 40 kWh/m^2 per year (A–B class) but provided with Photovoltaic plant proportioned to provide at least 50% of the annual electrical needs;
- 75% for building with heating energy performance ≤ 30 kWh/m^2 per year (A class) but provided with Photovoltaic plant proportioned to provide at least 50% of the annual electrical needs.

Energy saving measures were promoted through a number of other accompanying measures, such as:

- public meetings to explain the new MBC rules;
- partnerships with building companies' associations;
- partnerships with manufacturers and builders;
- links with other Government programs.

RESULTS OBTAINED AFTER THE IMPLEMENTATION

The analysis consider the first two years of implementation of the new MBC, before the new Regional regulation. Between 2004-2006, 57 checklists were completed and delivered to the Municipal Technical Offices: 35 concerning existing buildings, while 22 concerning new buildings. An analysis of the checklists shows how the practice of the building companies changed. As shown in figure 2, the wall insulation was finally taken seriously and U-values fulfil the MBC requirements (e.g. 0.35 W/m^2 K for walls, 0.30 W/m^2 K for roofs, 2.30 for doors and windows).

The solar heating obligation may be seen as a success, since 26 new plants were developed, for a total 456 m^2 (330 m^2 on new buildings and 126 m^2 on existing buildings). The average additional installed surface is 34 m^2 per 1000 inhabitants, more than sixfold the Italian average in the same period (5.2 m^2 per 1000 inhabitants).

The MBC contained no obligation to install photovoltaic systems, but the incentive scheme achieved some good results as well: 111 m^2 additional installation around 1 m^2 per 1000 inhabitants, almost fivefold the Italian average in the same period (0.21 m^2 per 1000 inhabitants).

Furthermore two new buildings were certified as Class B performance, following the voluntary certification scheme. One building was pre-certified in order to obtain a rebate in the urbanisation costs.

But what probably constitutes the most important achievement of the new MBC is the on-site inspection phase. In the first two years of implementation a total of eleven construction site were inspected. During the inspection the municipal engineers were able to check that what was written in the checklists was also observed in the concrete practice. On site verification is the only way to be sure that all the MBC provisions have obtained real results and are not just an increase in the bureaucratic burden of building designers and companies.

Figure 2. On site inspection in Carugate. Thick insulation layers may be seen in the surrounding walls in new constructions.

Success story: Municipality of Lodi

In 2007 Regione Lombardia was the first to adopt a regional law that included mandatory minimum standards as well as a methodology for energy certification. Energy Certification in Lombardia is currently mandatory when buildings are sold. It will be mandatory when single apartments are rented, starting from July 2010. The regional legislation has also strengthened provisions, compared to national law:

- Minimum energy efficiency standards have been defined for winter space heating in new buildings (or in buildings undergoing major renovations), defined in terms of primary energy: the designer is free to choose any measure involving the building envelope or the heating system, given that the primary energy standard limit is achieved;
- If in an existing building a part of the heating system is substituted, the whole system must comply with minimum energy efficiency standards;
- If in an existing building doors and windows are substituted, they must comply with minimum U-value standards;
- If an existing building is enlarged, the additional part of building envelope must comply with minimum U-value standards;
- In case of a new installation or a major renovation of an heating system, the new layout must be designed so that at least 50% of the primary energy needed for DHW must be provided by renewable energy sources (solar thermal, biomass or geothermal heat pump).

During 2008 new provisions have been introduced concerning cooling needs during summer season, regulating thermal mass and the heat transfer coefficient (also known as thermal admittance).

This paper will not present the details of the new Regional regulation, but it appears clearly that most of the provisions included in the innovative MBCs are now mandatory on a regional level. Furthermore, we would run the risk of having more than 8000 completely different regulations, one for each municipality. In this perspective one may think that in this new framework, the innovative MBCs are currently already outdated. Do we still need MBCs to promote energy efficiency?

We think that there are still important factors of importance for MBC promoting energy efficiency:

- **The link with municipal financial (or volumetric) incentives**: the MBC can be designed in order to take account that the incentive scheme may differ from one municipality to the other (one may prefer not to loose money, introducing volumetric incentive, another may prefer not to increase the volume of the buildings, introducing financial incentives);
- **The role of the accompanying measures**: when a MBC is implemented, the accompanying measures (information campaign, training, public debate, incentives…) constitute a learning process that promotes a positive framework helping technical officers, designers and building companies in the adoption of what is already stated in the national law; without the implementation phase of the MBC and the accompanying measures the local context miss an important chance to start a fruitful collaboration;
- **The chance to adapt the national or regional legislation to local conditions** (climate, or historical architectural heritage): now that a regional harmonisation is assured and we don't run the risk that each municipality his own MBC, still there is some room left to introduce adaptation to local condition, thanks to the participative phase;
- Last but not least, even if the provisions are the same as those applicable at national level, including them in the MBC, makes them stronger: **actually national legislation de facto provides no sanctions, while if a professional does not respect the MBC provisions, he commits a criminal offence.** In a context where rules are changing rapidly, it must be clear that it cannot be accepted that some market actors act as if nothing has changed, to provide fair market conditions.

For all this reasons, a number of municipalities are undergoing a revision of their MBC, seen as a part of a learning process. We will present the experience in the Lodi municipality, around 45 000 inhabitants.

THE PROCESS FOR THE DEVELOPMENT OF THE NEW MBC

During autumn 2007, just after the new regional regulation was approved, the Lodi municipality started to review its MBC. All the municipal departments dealing with energy were involved, profiting of the consultancy of the Milano technical University. The local associations of architects, engineers and surveyors were also involved in this phase.

In November 2007 the municipal council adopted the text of the new MBC and published it in order to collect observations. The revision consisted in a preparation of an annex to the existing MBC: the annex is focused on energy efficiency, renewable sources integration and water management. Some professionals highlighted problems concerning the dimensioning of mandatory rainwater collectors. A solar thermal company also asked to change a provision that obliged to put the solar heater water storage under the roof: this provision in practice was forbidding natural circulation systems. The rule was changed and now it applies only in the historic centre were there are some concerns on the aesthetic impact of the water storage above the roofs.

In February 2008 the final text, accepting the observation was approved. It includes all the regional provisions, plus some additional requirements regarding:

- In all residential buildings including 4 or more apartments, a centralised heating system is mandatory;
- A dual water system is mandatory, with a collector for rainwater that must be utilised for irrigation and other uses;
- Stricter requirements are defined for the summer comfort such as higher values of thermal mass (especially of the roof) and the heat transfer coefficient, and solar protection measures;
- Active cooling systems installation is possible only when passive or low energy measures are already in place (heat gains reduction, free cooling);

An electronic checklist, based on a spreadsheet, was prepared by the Municipal Technical Offices. In the electronic checklist part of the verification is performed automatically: in this way the designer undergoes an auto-verification before sending the project to the Municipal Technical Office. Although some critical reactions have emerged, especially from older professionals, the municipal officer in charge of the MBC implementation highlights that a number of professional was happy about the change "they were looking forward this new approach" (ZANCHI, 2009).

RESULTS OBTAINED AFTER THE IMPLEMENTATION

One architect expert in bioclimatic strategies and general energy efficiency measures is in charge of the verification process, this paragraph is based on his personal experience (FEDELI, 2009). When a new project is prepared, a meeting is organised with the designer, in order to help him to fulfil the obligations: in most cases the meeting ends up to be a real consultancy. There is a double check: first the internal coherence of the project is checked, before the start of the construction site. If any problem arises (as in most cases) the designer is asked to change the project, and a second meeting is organised. In this case the construction site is stopped, or does not begin at all. The second check is performed directly onsite to verify if the buildings are erected according to the checklist and the project layouts that have been delivered to the Municipal Technical Office. All the verification process is conceived more as a help-desk to the designer and the building company, rather then an inquisitorial activity. The aim is to change the habits, not to prosecute people.

In some cases designers don't even know the regional law or the Municipal Building Code, they don't know the standards they are supposed to respect. In this perspective the electronic checklist is a useful tool and helps the designers to get into the new approach. The municipality is also preparing a technical guide in order to clarify which standard must be fulfilled in which cases. In the first month of implementation a total of 50 new projects were delivered and were checked (in most cases modification were asked to the design). Only 5 onsite inspections were performed ("more resources are needed to perform the inspections in all the building sites, but even with only 10% of buildings inspected, the companies know that there is someone that may check them and tend to be more careful in their work").

Analyzing the checklist it emerges clearly that changes are undergoing and a new approach in building construction is arising: for example, roofing tile thickness was typically around 30 cm, while now it is increased up to 46, 50 or 52 cm. Furthermore, solar thermal collectors are widespread as well as condensing boilers. In most cases, however, the changes are implemented because of the obligation, and most of the projects is quite similar to the existing ones, only some pieces of the puzzle change, not the general design. In any case some designers try also more ambitious strategies, such as the introduction of geothermal heat pumps integrated with a photovoltaic system: in this case the building is energetically self sufficient, if we consider the annual energy balance.

Success and failures factors

At present, energy quality is not properly valued in the Italian building sector. It is not a technical issue: a number of technologies to increase energy efficiency are well established on the market. And it is not an economical issue because most technologies are cost effective. Probably is not even a legislative problem, since regulations concerning energy efficiency have been finally adopted. The major obstacles are "non-technological barriers" that were identified in a previous project (RUGGIERI et al. 2007, whose results are summarised in RUGGIERI et al. 2008). We consider non-technological barriers:

- Poor education and training in the field of energy efficiency: the qualification of human resources plays a central role to promote a real and effective energy efficiency policy;
- Strong dislike of changing, both by stakeholders and Municipal Technical Offices;

- Lack of information on energy efficiency, furthermore it is not common sense that good results can be achieved with few efforts: it is crucial to spread information on energy efficiency with policies for sensitizing the individual comprehension, awareness and responsibility;
- Lack of proper financial tools and policies for improving energy efficiency and for reducing air pollution and emissions, at national, regional and local level; the financial tools are very important because the major threats are first the high initial investment and second the long-time payback period; policy instruments, especially if connected with financial incentives and legal measures, are very important to implement energy efficiency and to widespread the awareness of sustainable behaviour in citizens;
- Hostility to verification procedures: the main problems are caused by lack of information of internal staff; this shortage does not allow to control the projects and the construction yards, reducing the validity of the planning instrument; furthermore, the building operators may trick ambiguous or unclear rules; in this field it is important to establish monitoring and feedback tools or control mechanisms, in order to increase effectiveness of existing and possible new supporting schemes.

All the existing barriers are concentrated in the last link of the chain: the link between citizens and municipality on one side and building designers and companies on the other. What should be carefully taken into account is then the relationship at local level between these actors: MBC can be used as a stimulating issue, provided some conditions. When undergoing the revision process of an existing MBC, in order to assure a successful implementation we must be sure that:

- The revision must be intended as a process, a continuous work in progress, that can be constantly updated if some implementation problem arises or if new requirements are introduced at regional or national level;
- The process must include all stakeholders and in particular building designers, building companies, technologies providers, associations;
- Provision must be defined according to the state of the art;
- An economic cost-benefit assessment is carried out in order to select cost effective measures that can be included as mandatory;
- A number of accompanying measures must be implemented (information and training, technical support, incentives);
- The implementation of the measures must be verified during the construction of the building.

The introduction of energy efficiency provisions in the MBC may be considered a successful action, when the building companies change their actual building practice. The main success factors are:

- First a consultation phase is needed to understand the market and professional local context;
- The MBC should be drafted by the Municipal Councillor and the Municipal Technical Offices and then adopted and presented to the stakeholders for a consultation period;
- The building sector lobbies should not have too much influence on the final decisions, otherwise they would "sweeten" all the requirements;
- A final approval is needed by the municipal council, the final text should take account of all the rational observation from all the stakeholders;
- After the final approval of the MBC, information and training activities must be organised: the stakeholders have to be involved in the process;
- Municipal Technical Officers must undergo some training to overcome the lack of information;
- The control and verification activities may be organised so as to provide a practical consultancy to designers and companies.

Local Authorities, operators and builders, may overcome barriers only by using technical and management operative instrument for controlling the history of the project. The approach of support instrument to MBC considers all aspects, and particularly management and technological, economic, financial, cultural and social frameworks.

Conclusions

It is possible to direct local development towards energy efficiency and valorisation of the building sector, aiming at a better environmental compatibility. A precondition is that all the local planning instruments (such as the Municipal Building Codes) must be seen as a support instrument, and not an additional restraint, towards innovative design strategy. The revision of an existing MBC is part of the management of territorial transformation processes that imply a multi-level interaction between actors. A systemic approach is needed to melt different levels of analysis: the environmental condition and energy issues at a global level, the territorial and urban system, the economic and social value of the individual building where the MBC will be implemented.

Aiming at a sustainable local development, the town planning activities must be addressed to the valorisation of the local architectural heritage. Municipalities should play a prominent role in order to be able to define new relations between the social and the institutional dimensions. Municipalities should seek a possible interaction between the land planning instruments (land use plan, municipal building codes, other technical standards) and the plurality of actors and of social behaviours. A prominent role will be played by the Municipal Technical Office: they will take part in the definition of the new MBC, they will perform the technical assistance to the building companies and they will undertake all the verifications on the design and on site.

New provisions, if the process does not involve local actors, may beget only an increase in the formalization of paper files: when provisions are defined only looking at the legal and administrative requirements, they may be completely separated from the real contest. In this case probably the market actors

will fulfil only procedural contents of the provision, but the wider objectives will not be achieved. For example, in one municipality during an inspection it was verified that in a new building the solar water heaters were actually installed (as provided by the MBC) but they were not attached to the DHW circuit…

Some of the existing MBC date back to the late eighties. An updating process is therefore needed: it should take account of the mutated social and economical needs. Promoting new MBC including new obligations might be a part of a winning strategy, provided that all the actors are involved in the process, rather then being only spectators of an increase of the countless impositions they must face.

Abbreviations

DHW Domestic Hot Water

EPBD Energy Performance of Building Directive (Directive 2002/91/CE)

MBC Municipal Building Codes (Regolamento edilizio comunale)

Toe Tonnes of oil equivalent

U-value Thermal transmittance, also known as U-value, is the rate of transfer of heat through one square meter of a structure divided by the difference in temperature across the structure. It is expressed in watts per square metre per kelvin ($W/m^2 \cdot K$).

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