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On the Integration of Leadership in Energy and Environmental Design (LEED)[®] ND Protocol with the Energy Planning and Management Tools in Italy: Strengths and Weaknesses

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Abstract: Owners and municipalities face the choice to renovate or rebuild buildings in order to improve energy efficiency and sustainability. The process of upgrading the existing building stock can be supported by land management tools, *i.e.*, municipal energy plans (MEP) or sustainable building codes (BC), that municipalities use to plan, check and monitor actions taken. Many local and regional authorities are involved in the Covenant of Mayors supported by the European Union (EU): the sustainable energy action plan (SEAP) is the key document in which the Covenant signatory outlines how it intends to reach CO₂ reduction target by 2020. Sustainability at the urban scale is also supported by voluntary certification schemes such as Leadership in Energy and Environmental Design (LEED)[®] for neighbourhood development proposed by the United States Green Building Council (USGBC), Building Research Establishment Environmental Assessment Method (BREEAM) Communities proposed by UK Building Research Establishment (BRE) and Comprehensive Assessment System for Built Environment Efficiency (CASBEE) for Urban Development proposed by the Japan GreenBuild Council. The fact that there are so many tools to manage urban sustainability is positive, but what happens when multiple tools are applied to the same territory? Overlap, redundancy, and conflicts in management may be critical elements. The purpose of this article is to analyze these critical issues,

highlighting the elements of integration and possible synergies for effective management of sustainability at the local level.

Keywords: urban sustainability; energy efficiency; leadership in energy and environmental design (LEED) ND; green house gases (GHG) emission reduction; energy planning; sustainable energy action plan (SEAP); sustainable building code (BC)

Acronyms:

BC	Building Code
BRE	Building Research Establishment
BREEAM	BRE Environmental Assessment Method
CASBEE	Comprehensive Assessment System for Built Environment Efficiency
DHW	Domestic Hot Water
DDH	Winter Degree Days
EPBD	Energy Performance Building Directive, 2002/91/EC
EU	European Union
GCT	Green Construction and Technology
GHG	Green House Gases
HVAC	Heating Ventilation and Air-Conditioning
IASDO	Integrated Assessment of Supply and Demand-Side Options
IDP	Innovation & Design Process
IEA	International Energy Agency
IEP	Integrated Energy Planning
IPA	Integrated Plan of Action
IRP	Integrated Resource Planning
JRC	Joint Research Center
LCP	Least-Cost Planning
LEED	Leadership in Energy and Environmental Design
MEP	Municipal Energy Plan
NEP	National Energy Plan
NPD	Neighbourhood Pattern and Design
REP	Regional Energy Plan
RPC	Regional Priority Credits
SEAP	Sustainable Energy Action Plan
SEN	National Energy Strategy
SLL	Smart Location & Linkage
TPS	Town Planning Scheme
UTP	Urban Traffic Plan
UNCED	United Nations Conference on Environment and Development
USGBC	United States Green Building Council

1. Introduction

The environmental quality of urban spaces is a necessity and at the same time, a great opportunity. In recent decades, the state of the environment has become a dominant theme, and many nations have signed international commitments to reducing green house gas (GHG) emissions, starting with the Kyoto Protocol [1]. Human-induced environmental change is not only a global issue but also a local issue; environmental problems become more critical in cities, as those spaces hold the greatest concentration of population. The latest edition of Demographia World Urban Areas [2] estimated that urban areas account for approximately 48% of the world's population. In some countries, as in the U.S., population density in city cores are decreasing [3], but the higher concentration of population in suburban areas brings about its own set of issues.

The major causes of environmental impacts in urban areas can be linked to local traffic patterns (especially private transport) and building energy consumption related to heating ventilation and air-conditioning (HVAC) systems, domestic hot water (DHW) systems and electrical purposes. With regards to the European Union (EU), the Green Paper [4] estimated that the residential and tertiary sectors, the major part of which are buildings, account for more than 40% of final energy consumption in the EU and are expanding, a trend which is bound to increase energy consumption and hence carbon dioxide emissions.

In the EU, energy policies cover both new buildings and existing buildings. The European Directive 2002/91/EC [5], named Energy Performance Building Directive (EPBD), highlights the fact that buildings will have an impact on long-term energy consumption and new buildings should therefore meet minimum energy performance requirements, tailored to the local climate. The transposition of the above mentioned Directive in the Member States generated new regulations and laws aimed to significantly increase the energy performances of new construction. The more recent Directive 2010/31/EC [6] goes further, in terms of energy performances for buildings; by 31 December 2020, all new buildings must be nearly zero energy buildings, and after 31 December 2018, new buildings occupied and owned by Public Authorities must be nearly zero energy buildings.

A critical issue concerns the existing building stock. The energy performance of existing buildings is very low and an energy policy that focuses on turn-over (*i.e.*, replacement of existing buildings with new buildings) is not always realistic since this process would take too many years. EPBD states that "Major renovations of existing buildings above a certain size should be regarded as an opportunity to take cost-effective measures to enhance energy performance". A new effective strategy for improving the sustainability of urban areas should include actions aimed at retrofits on existing buildings and new rules for the design and construction of new buildings that should be, according to the above mentioned Directive 2010/31/EC nearly zero energy and, in the near future, zero energy. Actions to improve the environmental sustainability at the urban scale not only affect the buildings but also the urban context. The most appropriate means to act in a rational way are planning policies and programming.

Following the first energy crisis of 1973, many countries have adopted energy planning tools to support more traditional urban planning. At that time, energy issues were primarily concerns about energy security. Countries that have approved an energy strategy, through national energy plans (NEP) and regional energy plans (REP), are in most cases characterized by a reliance on imported energy

from fossil fuels. The oil embargo thus had an undeniably positive effect of promoting energy efficiency and the use of renewable energy sources.

Since 1992, when the United Nations Conference on Environment and Development (UNCED) was held in Rio de Janeiro (Brazil), and up to the above-mentioned Kyoto Protocol, the environmental issue has become better defined. Countries are faced with both energy and environmental issues; the need to reduce energy consumption, and in many cases the import of fossil fuels, and the need to counter the effects of climate-change generated by the inefficient use of energy. Energy and environmental planning, starting with national and regional strategies such as the NEP and the REP, in many cases also concern the urban or municipal scale.

The municipal energy plans (MEP) are the tools that, supporting the more traditional town planning schemes (TPS), ensure that the development of urban areas contributes to improving the quality of urban life through a planned reduction of energy consumption. In many cases, energy planning is also supported by two important tools: the integrated plan of action (IPA), required managing land at the neighborhood level; and building codes (BC), tools that, among other things, define the rules for building activities and the minimum energy and environmental performance of new buildings and those subject to renovation. These instruments reflect the Italian situation, however many countries, not only European, adopt a similar structure.

The above mentioned energy planning instruments are managed by the public administration (the state, the regions, and the municipalities); rules and strategies, once approved and adopted, must be complied with by stakeholders (planners, designers, builders and citizens). Energy sustainability at the local level (e.g., municipal level), however, can be encouraged by initiatives that promote and stimulate a market that values the energy and environmental quality not only of buildings, but also of neighborhoods.

The paradigm in this case changes; the new rules are not followed because there is a law or regulation governed by the public authority, but as a voluntary choice, knowing that a building or neighborhood with greater energy and environmental quality has a higher market value. The rules of these voluntary approaches are defined by reference protocols developed by associations or non-governmental bodies. At the international level, the most diffused protocols are the Leadership in Energy and Environmental Design (LEED)[®] for Neighborhood Development rating system, or LEED[®] ND, proposed by the United States Green Building Council (USGBC) [7], the Building Research Establishment Environmental Assessment Method (BREEAM)[®] Communities rating system proposed by the Building Research Establishment (BRE) [8,9] and Comprehensive Assessment System for Built Environment Efficiency (CASBEE)[®] for Urban Development [10] proposed by the Japan GreenBuild Council.

The municipal framework for promoting sustainability in the EU is enriched by an important initiative, the Covenant of Mayors, adopted by many municipalities. The Covenant of Mayors is a voluntary commitment, made by local and regional authorities, to increasing energy efficiency and use of renewable energy sources within their territories. Through their commitment, Covenant signatories aim to meet and exceed the EU's objective to reduce CO₂ by 20% by 2020.

A sustainable energy action plan (SEAP) is the key document in which the Covenant signatory outlines how they intend to reach their CO₂ reduction target by 2020. The document defines the activities and measures set up to achieve the targets, together with time frames and assigned responsibilities.

The direction of development is moving towards an improvement in environmental sustainability. This change, almost unanimously considered necessary, covers all areas responsible for energy consumption, and more generally speaking, resources; the main areas being transport, industry and construction (residential and tertiary sectors) [11].

Energy and environmental planning tools were developed in order to provide concrete responses and approaches to issues related to the use of energy from fossil fuels and the reduction in GHG. The intent of the latest tools, such as LEED[®] ND and BREEAM[®] Communities, is to encourage a change in the housing market by stimulating an economic interest in the value of choices that lead to greater energy efficiency and improved sustainability.

The fact that there are so many tools to manage urban sustainability is positive, but what happens when multiple tools are applied to the same territory? Overlap, redundancy, and conflicts in management between LEED and other tools may be critical elements. The purpose of this article is to analyze these critical issues, highlighting the elements of integration and possible synergies for effective management of sustainability at the local level.

In order to better emphasize the synergies and potential problems of use of LEED with the other methods that can arise from the application of several instruments in the same territory, a case study including an operational and practical approach will be used. The case study addresses Baranzate, a municipality of about 10,000 inhabitants, located on the outskirts of Milan (Italy), in which most of these tools have been applied or are in the implementation stage. This paper takes into account the framework of Italy, a nation where these environmental issues are beginning to emerge, the results and discussions of this work, however, have international value. The movement of the Covenant of Mayors, which generates the SEAP tool, is a movement promoted by the European Commission. The LEED[®] ND protocol, considered as reference point to evaluate the possible integration of the energy and sustainability planning tools, is an international rating system. The decision to analyze this instrument, instead of on BREEAM[®] Communities, is due to its greater flexibility for application outside the UK and due to the fact that the Italian GBC has developed GBC Neighborhoods, a version of LEED[®] ND tailored for a local application [12]. This paper provides an important contribution as it investigates the integration of instruments contributing to a new approach to energy and environmental management of the land at the urban scale.

2. Energy Planning, Sustainable and Certification Protocols for Districts: State of the Art

2.1. Energy Planning Tools at the Regional and Municipal Level

The topic dealt with in this paper is current and therefore, an object of study, research and analysis. Many of the considerations in this paper are inspired by works of several authors that, although within specific sectors, have contributed to the advancement of state of the art tools and methods for energy planning, as well as the role of protocols for the sustainable certification of neighborhoods.

A very detailed analysis of integrated planning in cities and territories is offered by the work of review published in the article by Mirakyan and De Guio [13]. The authors state that “although the integrated energy and environmental planning processes of cities and territories with more than 50,000 inhabitants differ, previous studies suggest that long-term, model-based energy planning

processes have a common scheme that can also be used as a framework for reviewing the methods and the tools that are used in The Integrated Energy Planning (IEP) of these cities and territories”.

The concept of IEP was proposed, during the 1970s by the International Energy Agency (IEA) in response to the oil crisis, to increase energy diversity and decrease dependence on foreign oil. Different IEP methodologies, including integrated resource planning (IRP), integrated assessment of supply and demand-side options (IASDO) and least-cost planning (LCP), have typically been practiced at the national level. The implementation of the IEP at a lower level (territory or city) in several countries has increased in conjunction with the liberalization of energy markets [14]. The European Commission has recognized the importance of using integrated approaches in the sustainable development of cities and territories [15]. From a methodological point of view, Mirakyan and De Guio [13] stated that the planning processes can be divided into four phases: preparation and orientations, model design and detailed analysis, prioritization and decision, implementation and monitoring. The authors analyzed other important aspects of the IEP, *i.e.*, participatory and governance levels, methods and tools, software resources, implementation and monitoring.

Climate change, urban energy and planning practices in the Italian context are the subjects of research carried out by Zanon and Venores [16]. Energy planning and spatial planning in many cases are managed separately despite a logical potential for integration: the authors deal with this problem in a paper that focuses on the Italian case and analyses the possibility of integrating energy planning with spatial planning, the effectiveness of plan implementation mechanisms, and the prospect of integrating public-led interventions with market tools. The thesis of the authors is that public authorities need to make use of all the policy tools at their disposal, because energy efficiency and GHG emissions abatement can be attained only when the market incorporates some of the benefits (which are short-term for energy savings but long-term for climate change) and when the behaviors of consumers and citizens change so as to reduce consumption and contain mobility (mainly connected with residential well-being and urban space quality). We agree with the authors when they argue that these goals can be pursued only partially “by regulation”. The results of the case studies presented, the MEPs of three cities located in northern Italy, highlight the partial inefficiency and ineffectiveness of the authoritative command-and-control instruments, as well as of the financial implementation strategies.

Brandoni and Polonara [17] investigated the role of MEP in the REP process with results derived from 12 MEP developed for urban areas located in Marche Region, in the centre of Italy. The results note that decentralized viewpoints, with respect to regional and municipal governments, are important in the energy planning process, contributing to the transition to a low-carbon society and increasing citizens’ awareness of feasible alternatives to the current fossil fuel based energy system. The study highlights the importance of consistency between the different levels of energy planning, in this case, regional and municipal.

The definitions of the strategies within the MEPs require knowledge of the energy and environmental quality of existing buildings stock. Several papers focus on this important aspect of energy planning, providing tools and methods of analysis. Dall’O’, Galante and Torri [18] propose a methodology for the energy performance classification of residential building stock on an urban scale. The method, which is based mainly on information that municipalities already own, is tested on a medium-sized municipality located in the Lombardy Region (Italy). Within a few years, the market for

high energy-performance buildings grew substantially; to date, nearly 7500 energy performance certificates for buildings of Class A and Class A+ have been issued [19].

The study developed by Caputo, Costa e Ferrari [20] describes a methodology able to characterize the energy performance of the built environment in a city or neighborhood and to evaluate the effects of different energy strategies. The methodology was designed to be a useful tool for energy policies at the urban level. More technical is the paper of Manfren, Caputo and Costa [21] that provides their contribution to the debate on urban-scale distributed power generation.

2.2. Planning for Sustainability and Certification Protocols for Neighborhoods

The topic of sustainability planning at the urban scale has been the subject of many works that highlight interest in an open debate. Most research addresses the issue of sustainability with reference to buildings and not the neighborhood scale (the issue of the sustainability of neighborhoods is more recent). Considerable interest in the topic of sustainability in buildings has generated many, perhaps too many, certification protocols and this can sometimes become a critical element. Haapio and Viitaniemi [22] present a review of building environmental assessment tools. The 16 assessment tools are analyzed as a group rather than as individuals considering all the possible aspects (*i.e.*, environmental, economic and social). The authors state that since the field of building environmental assessment tools is vast, the comparison of the tools and their results is difficult, if not impossible. The very detailed, accurate and complete work provides an interesting perspective for reflection. Insights and analysis of the environmental assessment tools, regarding buildings, are provided by other authors as Ding [23], Kyrkou and Karthaus [24], Alyami and Rezgui [25], Goldstein, Herbøl and Figueroa [26].

The issue of the classification systems of sustainability at the neighborhood scale is covered by Haapio [27]. The author makes a comparison between the international assessment tools for urban communities: LEED[®] for Neighborhood Development, BREEAM[®] Communities, and CASBEE[®] for Urban Communities. Table 1, taken from the author's paper, summarizes the categories of the three assessment tools. The author confirms that the interest in certification systems is increasing amongst authorities, and especially amongst global investors.

Sustainable Neighborhood Development is the theme of research work presented by Miller [28], a thesis for a Master in Urban Planning and Policy Design, comparing U.S. and European approaches. According to the author, the U.S. approaches urban sustainability issues with a different perspective than most European countries. Wherein European planners are tasked with adaptive reuse of previously developed, historic sites and a very limited opportunity for entirely new developments, planners in the U.S. face a temporal, cultural challenge where new development is valued, space is not limited, and buildings have a short lifespan. The research work analyses and compares the latest case studies of sustainable neighborhoods, made in recent years in the U.S. and Europe, in which the rating systems LEED[®] ND and BREEAM[®] Communities were applied.

In our work, the comparison between U.S. and European approaches is useful in order to understand some critical aspects of the U.S. LEED[®] ND protocol that has been designed for a local context sometimes very different from the European one, although the Italian version of the protocol [12], partly takes these differences into account and makes it more suitable for application in the Italian context.

Since GBC neighborhoods is perfectly compatible with LEED® ND, for convenience we will refer to it in the following as LEED® ND.

Table 1. Categories of the urban assessment tools (Haapio, [27]). LEED: Leadership in Energy and Environmental Design; BREEAM: Building Research Establishment Environmental Assessment Method; CASBEE: Comprehensive Assessment System for Built Environment Efficiency.

LEED for Neighbourhood Development	BREEAM Communities	CASBEE for Urban Communities
USA	UK	Japan
<p>Smart location and linkage—favours development of cities and suburban areas. Development, revitalisation and services are important aspects. Protects areas, populations and water bodies. Neighbourhood pattern and design—emphasizes public transportation and reduction of auto dependency. Reaches for rich neighbourhood by increasing social interaction. Green infrastructure and buildings—devotes to decreasing environmental impact caused by construction and maintenance of buildings and infrastructure. Energy and water efficiency are emphasised. Additional categories: Innovation and design process; Regional priority (LEED, 2009); Criteria: 53 criteria. They are evaluated differently—some are worth 10 points, some only 1 point. From the main categories, the total is 100 points, and from additional categories it is possible to earn 10 extra points.</p>	<p>Climate and energy—focuses on reducing the project’s contribution to climate change; Community—supports vibrant communities and encourages to integrate with surrounding areas; Place shaping—provides a framework for the design and layout of the local area; Ecology and biodiversity—aims at conserving the ecological value of the site; Transportation—focuses on sustainable transportation options, and encouraging walking and cycling; Resources—emphasize sustainable and efficient use of resources; Business—aims at providing opportunities for local businesses and creating jobs in the region; Buildings—focus on the overall sustainability performance of buildings. (BREEAM, 2009); Criteria: 51 criteria. All credits are equal. Values criteria from 1 to 3 points.</p>	<p>Q_{UD}1—Natural environment (microclimates and ecosystems); Q_{UD}2—Service functions for the designated area; Q_{UD}3—Contribution to the local community (history, culture, scenery and revitalization); LR_{UD}1—Environmental impact on microclimates, façades and landscape; LR_{UD}2—Social infrastructure; LR_{UD}3—Management of the local environment (CASBEE, 2007); Criteria: 80 criteria. All credits are equal. Uses five-step scale based on the ratio of achieved and maximum points.</p>

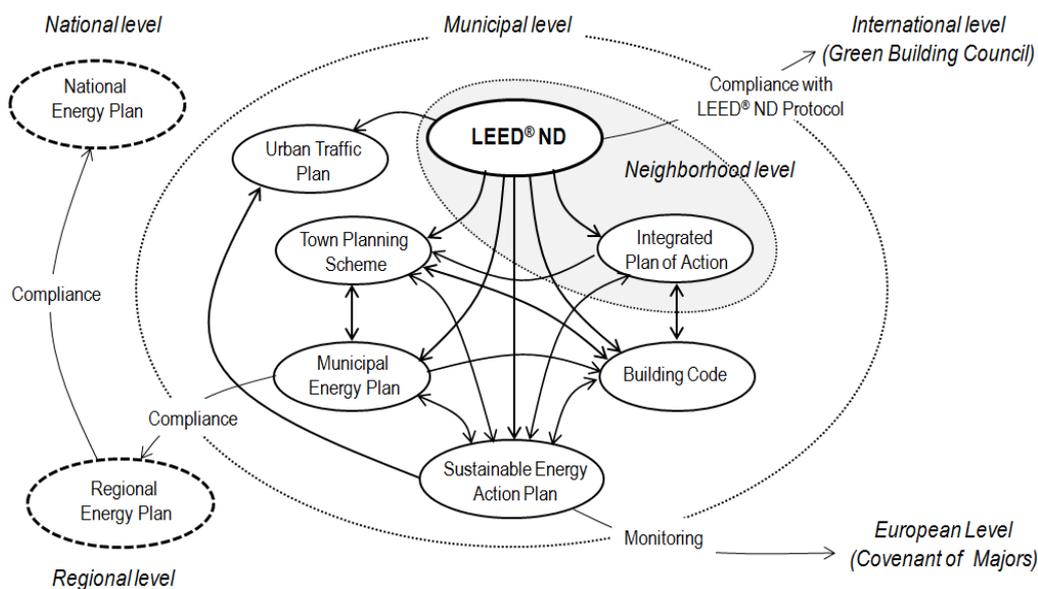
3. Energy Planning at an Urban and Neighbourhood Level in Italy

3.1. General Framework

In this section, we analyze the energy planning tools at an urban and neighborhood level in the Italian context. The purpose of the analysis is to verify understand how these tools interact with each other, both on a technical level and on the level of governance. Through this comparison, we can verify the synergy, the potential but also the weaknesses of the LEED® ND protocol when placed into

a comprehensive framework for energy planning and sustainability. The diagram in Figure 1 shows the relationship between LEED® ND Protocol and other tools for energy and urban planning, and summarizes the concepts that we want to express through our analysis.

Figure 1. Relationship between LEED ND protocol and other tools for energy and urban planning. Arrows indicate the direction of the interaction.



Italian National energy and environmental policies are closely linked to strategies fostered through the EU directives to be transposed by the Member States and of course international agreements (e.g., the Kyoto Protocol). This general premise is very important in understanding the interactions between the various instruments of energy planning and programming.

Energy planning in Italy follows a top-down logic. Article 7 of Decree-law 112 Article 7 of Decree-Law No. 112 [29] introduces the concept of a “National Energy Strategy (SEN)” as a means of orientation and programming of national energy policy. The most recent document approved by the Italian Parliament is the SEN [30]. General objectives of the plan are to reduce energy costs, fully achieve and surpass all the European objectives for the environment, and promote a greater security of supply and industrial development of the energy sector.

The Italian Constitution considers energy as a competing matter between State and Regions: Regions, therefore, have autonomy in transposing European directives on energy issues; however, regional strategies must ensure compliance with the general principles established at national level. The REP have been introduced by law 10/91 [31], and are therefore mandatory. The same law requires municipalities with populations over 50,000 to develop a MEP, providing that there should be consistency between the MEP and the TPS.

At the Municipal level, in addition to MEP and TPS, there are other planning tools: the IPA, implementation tools that municipalities use to manage the development of suburban areas (neighborhood level), and the BC, rules defined and approved by the municipality for the construct buildings and urban infrastructure. Municipalities are allowed to propose BC more restrictive than those set by national or regional laws with regards to energy and sustainability issues. Some municipalities approved (by the town council) and adopted the SEAP within the European Covenant of Majors project:

the SEAP must be consistent with other tools, in particular with the MEP and the BC. Since LEED[®] ND also considers aspects of the sustainability of traffic, it is important to compare the protocol with the planning tool for traffic management at the urban scale, in this case, the Urban Traffic Plan (UTP).

The scheme of Figure 1 shows that the LEED[®] ND Protocol cannot be considered an independent planning tool, since the choices made to obtain the desired level of sustainability interact with other energy planning and urban planning tools. As for the governance of the processes, Figure 1 highlights the many public institutions and organizations that are involved: the State for NEP, the Region for MEP, the Municipality for MEP, TPS, IPA, BC and SEAP, the European Commission with the technical support of the Joint Research Center (JRC) of The Institute for Environmental Protection and Research (ISPRA—Istituto Superiore per la Protezione e la Ricerca Ambientale) for SEAP and Green Building Council (GBC) for LEED[®] ND.

In the following section, we explore aspects of the tools of energy and environmental planning at the municipal scale, leaving LEED[®] ND for a more detailed discussion in the next section.

3.2. Municipal Energy Plans (MEP)

Article 5 of the Italian Law 10/91 [31] states that the TPS of municipalities with a population greater than 50,000 must include a specific plan at the municipal level concerning the use of renewable sources of energy, namely a Municipality Energy Plan. It is interesting to note that the legislature does not consider a MEP as independent tools but elements that are tightly integrated with urban planning (TPS). The typical objectives of a MEP are summarized as follows:

- acquire systematic data on the flows of energy within the municipal area, considered a snapshot of the energy situation to highlight any critical elements;
- define and plan actions for energy efficiency on the basis of a clear framework for evaluating each action, as economic resources but also as benefits for energy saving and reduction of environmental impact;
- monitoring, by means of dynamic indicators, the impact of the introduced measures through benefits: monitoring allows one to change the strategies in the event that the expected benefits are not achieved.

In Italy, there are 136 municipalities with a population greater than 50,000 inhabitants, constituting a population of about 21 million inhabitants, corresponding to 36% of the Italian population. The Italian municipalities that have approved a MEP, however, are many more. According to Cittalia [32], 3318 municipalities have approved a MEP, or about 41% of the 8093 Italian municipalities [33]. This demonstrates that other small municipalities that are not obligated by law also use the instrument.

3.3. Building Codes (BC)

The first genuine “sustainable” Italian BC was endorsed by the City of Carugate, a municipality near Milan (Italy), on 2003 [34,35]. The BC of Carugate introduced mandatory rules in order to guarantee high energy performance for new buildings and buildings subject to major renovation works for the first time. Among the new rules for energy and environmental performance of buildings,

innovative at that time (the EPBD Directive had just been approved and not yet implemented in Italy), the most advanced were the following:

- optimization of the orientation of buildings in neighborhoods in order to take advantage of solar radiation for heating and lighting;
- maximum level of U-values for the building envelope (*i.e.*, external walls, windows, roofs and basement) were very low if compared with the standard used at that time;
- mandatory use of solar thermal for DHW (minimum integration of 50% on consumption required);
- mandatory efficient technologies for HVAC and DHW systems (e.g., condensing boiler, local thermal controls, *etc.*);
- recovery and reuse of stormwater.

The mandatory use of solar thermal systems for DHW, within the BC of Carugate, was inspired by the first European regulation, the Solar Ordinance of Barcelona (Spain) that came into force in 2000 [36]. Following the example of Carugate, many other municipalities in the Province of Milan adopted a “sustainable” BC. In order to define a similar standard, the Province of Milan published guidelines for sustainable building regulations [37]. In order to promote the implementation of the sustainable BC at national level, Dall’O’ and Galante [38] defined a guideline taking into account the results of the most interesting case studies.

The BC, strongly oriented to the implementation of energy efficiency, renewable energy and, generally, the sustainability of the urban spaces, have found much success in Italy; the National Observatory Building Regulations Energy Saving in the recent report [39] estimated that in Italy, 1003 municipalities (about 10% of the total municipalities) have changed their BC in order to insert new energy and environmental criteria and objectives for improving the energy performance of buildings and the sustainability of the urban landscapes.

3.4. Sustainable Energy Action Plans (SEAP)

A SEAP is the key document in which the Covenant signatory (of the Covenant of Mayors) outlines how it intends to reach its CO₂ reduction target by 2020. It defines the activities and measures set up to achieve the targets, together with timeframes and assigned responsibilities. Covenant signatories are free to choose the format of their SEAP, as long as it is in line with the general principles set out in the Covenant SEAP guidelines. There are 4628 committed signatory cities involving a population of 167,145,782 citizens, there are 2861 currently adopted SEAP. The level of involvement of Italian municipalities and Italian communities is very high; 2446 committed signatory cities (representing 29,910,055 citizens), which corresponds to 51% of the Italian population. Italian submitted SEAPs are 63% of the whole project [40]. While the SEAP refers to a European dimension, and the MEP refers to the national dimension, the objectives of the two planning tools are similar: the reduction of GHG emissions through an action plan focused on the reduction of the use of energy from fossil fuels. The political approach however is different: it is worth remembering that in Italy, the MEP is mandatory for municipalities with a population higher of 50,000 inhabitants, while joining the Covenant of Mayors is voluntary. After more than twenty years from the publication of law 10/91 [31], 3318 municipalities have adopted a MEP, after only five years, 2446 cities are committed signatories

of the Covenant of Mayors and that number is increasing significantly. The Covenant of Mayors project is a demonstration that actions from below, even on a voluntary basis, can sometimes be more successful than top-down actions.

From the technical point of view, there may be significant overlapping elements between the MEP and the SEAP and the two instruments and the planned actions should be carefully assessed, to avoid redundancy or contradictions.

4. LEED ND[®] Certification Scheme

4.1. Structure of the Certification Scheme

The USGBC defines their vision of neighborhoods as “In basic terms, a neighborhood is an area of dwellings, employment, retail, and civic places and their immediate environment that residents and/or employees identify with in terms of social and economic attitudes, lifestyles, and institutions. By itself the neighborhood is a village, but combined with other neighborhoods it becomes a town or a city. Similarly, several neighborhoods with their centers at transit stops can constitute a transit corridor. The neighborhood, as laid out in LEED[®] ND, is in contrast to sprawl development patterns, which create pod-like clusters that are disconnected from surrounding areas” [7].

LEED[®] ND emphasizes the creation of compact, walkable, vibrant, mixed-use neighborhoods with good connections to nearby communities. In addition to neighborhood morphology, pedestrian scale, and mix of uses, the rating system also emphasizes the location of the neighborhood and the performance of the infrastructure and buildings within it. Together, well-located and well-designed green neighborhood developments will play an integral role in reducing GHG emissions and improving quality of life.

GBC Italia in 2013 has defined a certification protocol named GBC Neighborhoods [12]. The effort of GBC Italia was to verify the compatibility of the regulatory and legislative of the protocol which is strongly inspired by LEED[®] ND, in the Italian context. The structure of GBC Neighborhoods is basically identical to that of LEED[®] ND.

GBC neighborhoods considers a certifiable area an area that possesses a minimum of two buildings which constitutes a set of relationships that will contribute to creating a functional and social mix, and the characteristics of a permanent settlement. Sustainable neighborhoods are places where there are buildings, infrastructure and residents, where the service functions and workplaces are walkable. The projects being evaluated may also be single-purpose small interventions to complement existing neighborhoods that integrate relationships and quality of services to the residents.

GBC Neighborhoods is broken down into the three categories of Smart Location & Linkage (SLL), Neighborhood Pattern and Design (NPD), and Green Infrastructure & Buildings (GIB), plus additional points for Innovation & Design Process (IDP) and Regional Priority Credits (RPC).

The following sections analyses the Prerequisites and Credits provided by GBC Neighborhoods and related to their possible applicability to existing planning instruments. Specifically, we identified, based on the experience of the authors, the following types of interactions:

- “Binding Rule—Direct influence” or the Prerequisite or Credit can be entered as a binding rule, therefore directly affecting the planning instrument;

- “Binding Rule—Indirect influence” or the Prerequisite or Credit cannot be inserted into the planning instrument, having an indirect impact on it;
- “Optional potentially incentivized rule—Direct influence”, Credit can be entered as an optional rule, therefore having a direct bearing on the planning instrument, municipalities to decide whether to apply an incentive scheme, e.g., the acquisition of more points for the effective achievement of the objectives laid down by specific Credit;
- “Optional potentially incentivized rule—Indirect influence”, Credit is not entered directly into the planning instrument, but its application affects it indirectly.

To better explain, let’s take an example of the Credit “Location with Reduced Automobile Dependence”. This can certainly be entered as a binding rule with direct influence on IPA, as it can be required by municipalities for a given neighborhood. For the TPS, the optional rule can be applied, since it can be extended to the whole territory, but if it is applied (for example with an incentive scheme related to the acquisition of one to seven points) it has a direct influence on everything within the TPS from the urban point of view. Similarly, it can be considered an optional rule for both the UTP and the SEAP since it has direct influence on both transport and the built environment. When applied to the MEP, it becomes an Optional Rule indirect influence because the criteria cannot be inserted in the Plan, but it is possible application has an indirect influence on the instrument, through the positive effects on the reduction of emissions.

4.2. Smart Location & Linkage (SLL): Where to Build

SLL is characterized by five prerequisites and nine additional credits—the prerequisites include Smart Location, Imperiled Species and Ecological Communities, Wetland and Water Body Conservation, Agricultural Land Conservation, and Floodplain Avoidance. The credits in this category are generally based on smart growth design principles, focusing on site selection. Emphasis within the credits is placed on Preferred Locations and Locations with Reduced Automobile Dependence [28].

4.3. Neighborhood Pattern and Design (NPD): What to Build

Neighborhood Pattern and Design is highly influenced by New Urbanist principles, with the credits of Walkable Streets, Mixed-Income Diverse Communities, and Compact Development being given the highest point allotment and also being prerequisites for the category [28].

4.4. Green Construction and Technology (GCT): How to Manage Environmental Impacts

GCT is the last standard LEED® ND category. The prerequisites in this category are a Certified Green Building, Minimum Building Energy Efficiency, Minimum Building Water Efficiency and Construction Activity Pollution Prevention. Credits in this category most closely align with the other LEED® programs, emphasizing especially, Certified Green Buildings, Stormwater Management, and On-site Renewable Energy Sources [28].

4.5. Innovation & Design Process (IDP) and Regional Priority Credits (RPC)

Additional points can be achieved for both IDP and RPC. Innovation & Design (I&D) points are awarded to projects implementing a sustainable practice that doesn't fall under the three primary categories, for example, one point of I&D is designated for the inclusion of a LEED[®] Accredited Professional on the project design team. The RPC are defined by regional committees to place emphasis on particular credits falling under the three primary categories that are particularly relevant to that region. A project will get additional points for choosing to implement a credit that has been selected for regional importance in the project area [28].

5. Analysis of the Case Study

5.1. Description of the Urban Context

The case study analysed is the town of Baranzate, a medium-small municipality located north-east of the Province of Milan (Italy) (Lat. 45°31'37" Nord, Long. 9°06'51" East). Baranzate has a population of 11,448 inhabitants [41], the average population of a typical Italian municipality, and a total area of 2.78 km², with a population density of 4117.99 4 inhabitant/km², about twice the density of the Province of Milan that is 2023.84 inhabitants/km². The climate is temperate [2404 Winter Degree Days (DDH)], sub-continental, is characterized during the year as follows: six months temperate (from March to June and from September to October), four months cold and wet (from November to February) and two hot and humid months (July and August). The average annual air temperature is equal to 13.2 °C with an average temperature range (difference between the mean temperature of the warmest month, July, and the most cold-January) of 21.3 °C. The design air temperature for the heating systems is −5 °C while the average value of the external air temperature during the winter season is 8.4 °C.

The urban context is characterized by the presence of many industrial and service sectors areas, some of which, partly because of the economic crisis, are no longer used. From the social point of view, the Municipality of Baranzate is an interesting and unique case, considering the Italian context. The population is characterized by a strong presence of foreign nationals, average to lower-middle class workers, who have created communities through which integration and social cohesion are sought. The municipal government has proposed, in recent years, a policy strongly oriented towards social cohesion but also to the improvement of energy and environmental sustainability. All the tools of sustainable planning have been activated:

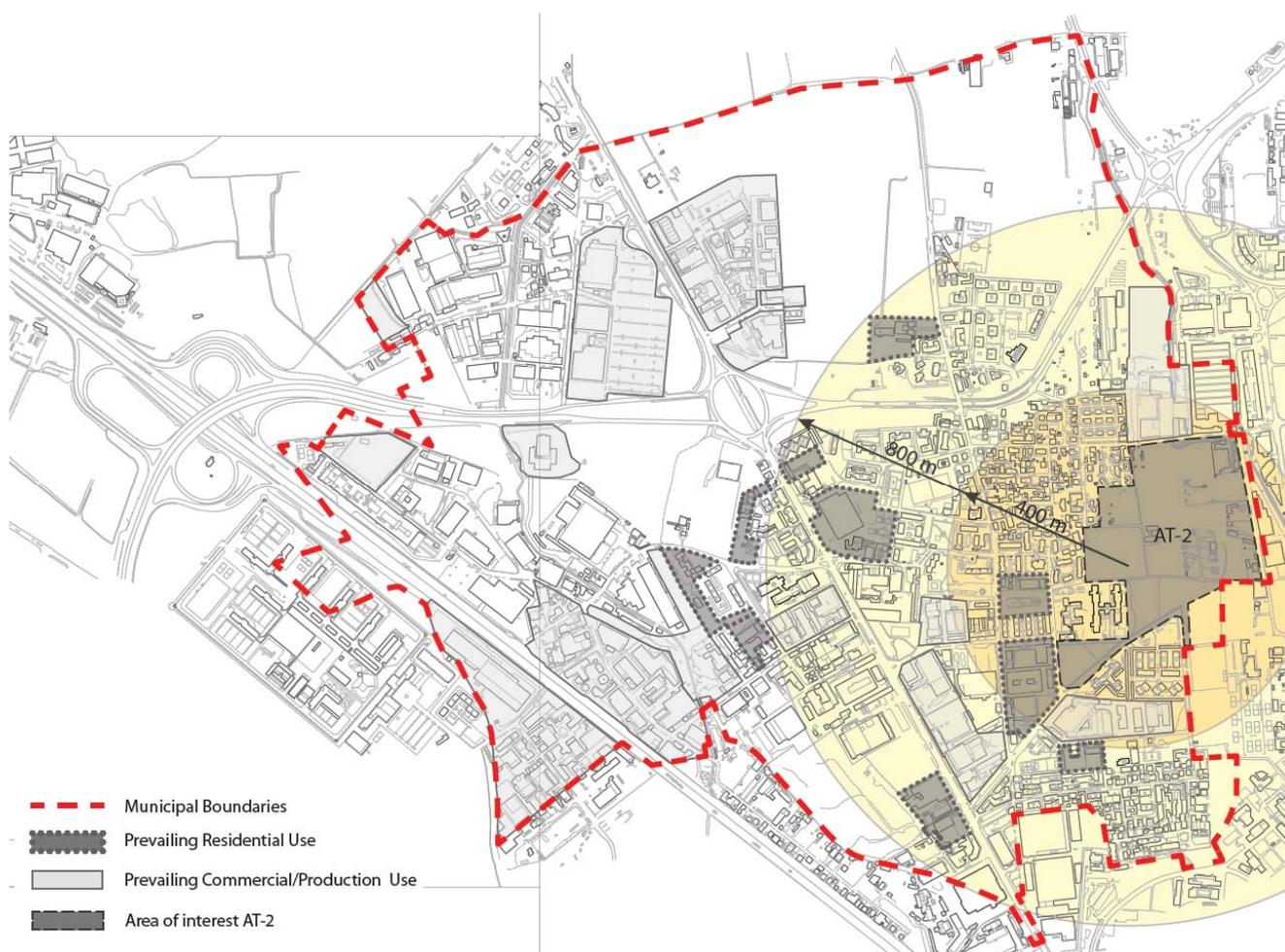
- the approval of a TPS that aims to recover and enhance unused urban areas;
- the approval of a BC which requires high energy quality standards for new buildings (energy class A) and for buildings subject to major renovation;
- the implementation of a UTP that addresses sustainable mobility;
- signatory to the Covenant of Mayors and the approval of an SEAP;
- the implementation of a MEP in order to reduce energy consumption and GHG emissions.

The political and administrative context of Baranzate seemed ideal to test a possible implementation of the LEED Protocol and its integration with the energy planning and management tools approved or in the approval process.

5.2. Possible Implementation of LEED[®] ND Protocol

Figure 2 shows the general layout of the town highlighting the areas in which urban redevelopment is scheduled within the TPS. The first analysis step is to identify areas that may be certified using the LEED[®] ND Protocol.

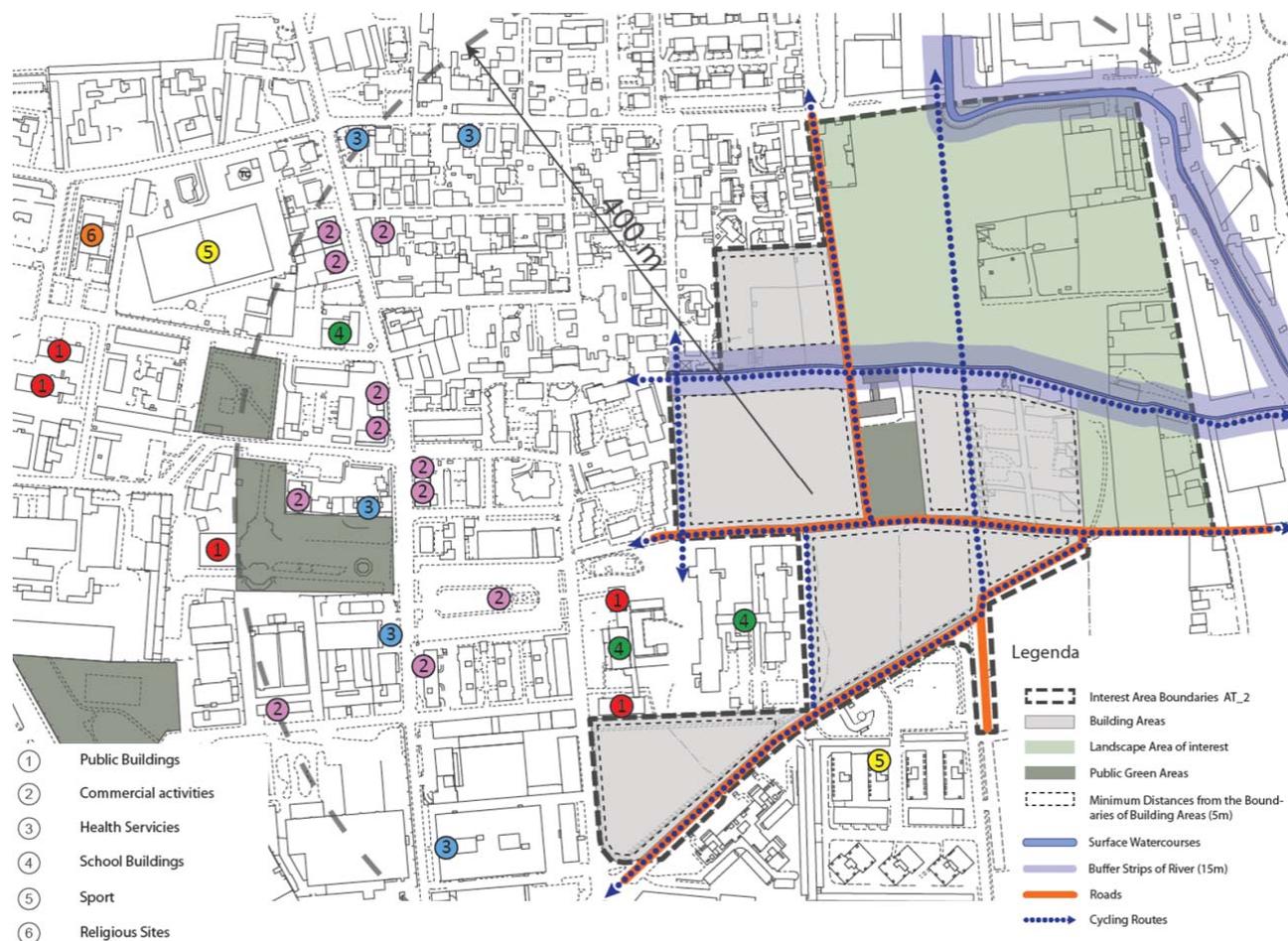
Figure 2. General layout of the town highlighting the areas in which the urban redevelopment is scheduled within the Town Planning Scheme (TPS).



Within the TPS, that is the framework for the urban programming and development, it is possible to define particular areas in which to apply the IPA. Figure 2 highlights the IPA of Baranzate by means of grayscale areas.

The areas highlighted in light gray are characterized by the presence of industries and commercial areas; these areas are not compatible for LEED[®] ND certification. The areas highlighted in dark gray, however, have a strong presence of residential and therefore could be considered. An area located to the East of the city was chosen for the test of a possible application of the LEED[®] ND Protocol, shown in larger scale in Figure 3.

Figure 3. Characteristics of the urban area covered by the application of the LEED® ND Protocol.



For the area under consideration, all the provisions contained in the planning and sustainable tools already approved or in the approval phase (TPS, IPA, MEP, UTP and SEAP) were carefully analyzed in order to verify the compatibility and compliance with the prerequisites and credits of the LEED® ND certification scheme. This analysis and comparison, based on a concrete case, was very useful for processing Tables 2–4.

Table 2. Relationship between prerequisites and credits of “Smart Location & Linkage (SLL)” category and tools for energy and urban planning. Legend: ■ Binding Rule—Direct Influence; □ Binding Rule—Indirect Influence; ● Optional potentially incentivized rule—Direct Influence; ○ Optional potentially incentivized rule—Indirect Influence. IPA: Integrated Plan of Action; MEP: Municipal Energy Plan; BC: Building Code; UTP: Urban Traffic Plan; SEAP: Sustainable Energy Action Plan.

SLL—Pre-Requisites and Credits	Tools for Energy and Urban Planning					
	TPS	IPA	MEP	BC	UTP	SEAP
PR01—Smart Location	■	■	-	□	□	-
PR02—Imperiled Species and Ecological Communities	■	■	-	-	■	-
PR03—Wetland and Water Body Conservation	■	■	-	□	-	-

Table 2. Cont.

SLL—Pre-Requisites and Credits	Tools for Energy and Urban Planning					
	TPS	IPA	MEP	BC	UTP	SEAP
PR04—Agricultural Land Conservation	■	□	-	-	□	-
PR05—Floodplain Avoidance	■	□	-	-	-	-
CR01—Preferred Location	●	●	-	-	○	-
CR02—Brownfield Redevelopment	●	■	-	-	-	○
CR03—Location with Reduced Automobile Dependence	●	■	○		●	●
CR04—Bicycle Network and Storage	□	■	-	■	■	□
CR05—Housing and Job Proximity	■	■	-	-	□	□
CR06—Steep Slope Protection	●	■	-	-	-	-
CR07—Site Design for Habitat or Wetland and Water Body Conservation	●	■	-	-	-	-
CR08—Restoration of Habitat or Wetlands and Water Bodies	■	■	-	□	-	□
CR09—Long-Term Conservation Management of Habitat or Wetlands and Water Bodies	■	□	-	■	-	□

Table 3. Relationship between prerequisites and credits of “Neighborhood Pattern and Design (NPD)” category and tools for energy and urban planning. Legend: ■ Binding Rule—Direct Influence; □ Binding Rule—Indirect Influence; ● Optional potentially incentivized rule—Direct Influence; ○ Optional potentially incentivized rule—Indirect Influence.

NPD—Pre-Requisites and Credits	Tools for Energy and Urban Planning					
	TPS	IPA	MEP	BC	UTP	SEAP
PR01—Walkable Streets	-	■	-	■	□	-
PR02—Compact Development	■	■	-	□	-	-
PR03—Connected and Open Community	■	■	-	□	■	□
CR01—Walkable Streets	□	■	-	■	■	-
CR02—Compact Development	●	■	-	-	○	○
CR03—Mixed-Use Neighborhood Centers	●	■	-	-	-	●
CR04—Mixed Income Diverse Communities	●	●	-	●	-	●
CR05—Reduced Parking Footprint	□	■	-	■	■	□
CR06—Street Network	●	■	-	-	■	-
CR07—Transit Facilities	■	■	-	■	■	□
CR08—Transportation Demand Management	○	○	○	-	●	○
CR09—Access to Civic and Public Spaces	●	●	-	○	○	-
CR10—Access to Recreation Facilities	●	●	-	○	○	-
CR11—Visitability and Universal Design	●	■	-	●	-	-
CR12—Community Outreach and involvement	-	●	-	-	-	●
CR13—Local Food production	●	■	-	-	○	●
CR14—Tree-Lined and Shadowed Streets	●	●	-	●	●	-
CR15—Neighborhood Schools	●	■	-	●	○	-
CR16—Acoustic Climate (Only GBC Neighborhood)	-	■	-	■	□	-

Table 4. Relationship between prerequisites and credits of “Green Construction and Technology (GCT)” category and tools for energy and urban planning. Legend: ■ Binding Rule—Direct Influence; □ Binding Rule—Indirect Influence; ● Optional potentially incentivized rule—Direct Influence; ○ Optional potentially incentivized rule—Indirect Influence.

GCT—Pre-Requisites and Credits	Tools for Energy and Urban Planning					
	TPS	IPA	MEP	BC	UTP	SEAP
PR01—Certified Green Buildings	□	■	■	■	-	□
PR02—Minimum Building Energy Efficiency	□	■	■	■	-	■
PR03—Minimum Building Water Efficiency	-	■	■	■	-	-
PR04—Construction Activity Pollution Prevention	□	■	-	■	□	-
CR01—Certified Green Buildings	○	●	○	○	-	○
CR02—Building energy Efficiency	○	●	●	●	-	●
CR03—Building Water Efficiency	-	●	●	●	-	-
CR04—Water-Efficient Landscaping	-	■	-	■	-	□
CR05—Existing Building Use	○	■	●	●	-	●
CR06—Historic Resource Preservation and Adaptive Reuse	■	■	-	■	-	-
CR07—Minimized Site Disturbance in Design Construction	□	■	-	■	-	□
CR08—Stormwater Management	-	■	-	■	-	-
CR09—Heat Island Reduction	□	■	■	■	-	□
CR10—Solar Orientation	-	●	●	●	-	-
CR11—On-Site Renewable Energy Sources	-	■	■	■	-	■
CR12—District Heating and Cooling	-	●	●	●	-	●
CR13—Infrastructure Energy Efficiency	-	■	■	-	■	■
CR14—Wastewater Management	-	●	●	●	-	-
CR15—Recycled Content in Infrastructure	-	●	-	●	●	●
CR16—Solid Waste Management Infrastructure	-	●	●	●	-	●
CR17—Light Pollution Reduction	□	■	■	■	□	□

In the area covered by the study, shown in Figure 2, three scenarios were considered:

- *Baseline scenario*: the prerequisites and credits in the LEED® ND were compared with the actions already provided for within the energy and environmental planning tools;
- *Silver scenario*: the energy and environmental planning tools already implemented were integrated with additional rules (prerequisites and credits) in order to achieve the Silver certification of the LEED® ND Protocol;
- *Gold scenario*: the energy and environmental planning tools already implemented were integrated with additional rules (prerequisites and credits) in order to achieve the Gold certification of LEED® ND Protocol.

The results of the three simulations are shown in Table 5, which highlights the scores achieved in the three areas of evaluation (SLL, NPD and GCT). The baseline scenario shows the impossibility of obtaining the LEED® ND certification, as the rules contained in the actual planning tools do not comply with the prerequisites that are mandatory in the Protocol. By implementing the existing planning tools with a few additional rules, and limited effort for the public administration, it is possible

to aspire to the Silver certification. There is still a margin, and the need for other additional rules, to get certified Gold.

Table 5. Results of application of LEED ND to Baranzate municipality. SLL: Smart Location & Linkage; NPD: Neighbourhood Pattern and Design; GCT: Green Construction and Technology.

Rating scenario	Rating				Additional effort
	SLL	NPD	GCT	Total (*)	
Baseline	10	13	3	26	NA
Silver	11	32	9	52	low
Gold	13	34	15	62	medium

(*): The credits for Innovation & Design Process (IDP) and Regional Priority Credits (RPC) were not considered in this simulation.

6. Results and Discussion

The aim of the LEED[®] ND Protocol is to become an effective tool for the transition of a neighborhood or a part of the city towards an ideal situation in which the concept of sustainability becomes a fact and not a fascinating theory. Raimi + Associates and the Natural Resources Defense Council [42] defines a neighborhood as a place with its own unique character and function, where people can live, work, shop, and interact with their neighbors. The most sustainable neighborhoods tend to exhibit high levels of walkability, a sense of place, social cohesion and stability, and neighborhood resiliency amidst changing economic and sociopolitical conditions.

As the LEED-ND program is market driven, local governments have the opportunity to influence new development in a way that was only previously possible with zoning and permitting. Local governments can prepare themselves for the implementation of LEED[®] ND developments and shape the future growth of a city by considering a number of aspects related to the program [28].

An important added value of this protocol is guaranteed by GBCS governance, non-profit-association charged to promote the protocols in specific areas, so considering local specificities, but within a general framework of world reference (WGBC—World Green Building Council).

The role of GBC is a key point for the success of the strategy proposed. Sedlacek and Maier [43] discuss the role that such organizations can play in the respective construction and real estate industry and under what circumstances a GBC can contribute positively to the development of a “greener” or “more sustainable” stock of buildings.

The authors state that activities of GBC can broadly be categorized into three areas:

1. promotion of sustainable construction and building awareness of the issues of sustainability;
2. lobbying for BC and policies that support sustainable buildings and sustainable development in general;
3. identifying best practice examples through the application of sustainable building rating systems.

The first area targets the general public. The GBCs aim to alter behavior by providing information about issues of sustainability and about sustainable materials and construction techniques.

The second area takes on the opposite position. It assumes that sustainable buildings can only be implemented through governmental regulation. Unless a public policy body requests these standards in BC they will not be implemented.

The third area takes on an intermediate position. It encompasses more than just general information, but less than mandatory regulations for everyone. This area attempts to identify particularly good examples of sustainable buildings by measuring them against the yardstick of a sustainable building rating system. This measurement is voluntary and usually paid for by the building developer. This approach combines two policy elements: on the one hand it implicitly informs the general public about sustainable buildings and sustainable construction techniques, on the other hand it identifies individual buildings to be of particular quality with respect to sustainability [43].

To better understand the role and potential of tools such as LEED[®] ND, it is necessary to make a clarification.

LEED[®] ND is a voluntary tool that was created with the aim of breaking the “circle of blame”, so defined by David Cadman; constructors don’t build environmentally friendly buildings because developers don’t commission them; developers don’t commission them because investors don’t require them; investors don’t require them because they don’t believe that occupiers demand them; occupiers don’t demand them because they say that they are not offered to them, and round and round it goes [42].

This argument basically states that although there is a potential demand for “environmentally friendly buildings”, the market is either too complex for this potential demand to become visible or the market participants are too dumb to see it. If these were really the basic problem of sustainable building and construction, it would be easy to solve for GBCs [43].

The other energy and environmental planning tools (TPS, IPA, MP, UTP and SEAP), are defined and approved by the Public Administrations (State, Region, Municipality) in order to protect the environment and citizens against environmental, economic and social critical or as a concrete response to external demands (*i.e.*, Kyoto Protocol, European Directives, *etc.*). While LEED[®] ND is voluntary, the other tools are in most cases mandatory.

Analyzing Tables 2–4 it is possible to observe that the relationships between LEED[®] ND and the BC are very strong. The structure of the Protocol is very similar to that of the BC, both contain rules on how to make choices in the process of construction.

An Italian BC normally contains rules that are mandatory and in some cases, rules that are suggested in order to increase the energy performance and the sustainability of the buildings. The Protocol contains prerequisites and credits that allow individuals to obtain different levels of global certification, up to LEED[®] Platinum. In this case, it is possible to choose a strategy considering a cost-effective approach. The added value of this Protocol is that there is a single reference document, in other words, a unique standard that theoretically could be the same for the entire Country. BC are usually proposed by the Municipalities; so theoretically, but unfortunately also in practice, in Italy there could be 8092 (the number of municipalities in Italy) BC.

It is important to have a national reference that has an international matrix, a standard that could be periodically updated in order to integrate the advantages in technology innovation in the fields related to energy and sustainability.

This protocol could be the real driver for a policy strongly oriented to the sustainability of land use, for a “greening” of our neighborhoods and of our cities, and could be, a uniting element for all the other planning tools around energy and sustainability. Foreign investors, in addition, would be better ensured in the case where land planning references an international standard.

The application of a LEED[®] ND standard, however, presents a critical issue. A rating system for a building or multiple buildings can be considered a private matter, and easy to manage. When the subject of the certification is a neighborhood, inevitably public areas and public infrastructure must be considered, *i.e.*, spaces and objects related to planning choices operated by Public Authorities (primarily municipalities). For this reason the comparison with the existing planning tools and the involvement of the Public Authorities is crucial.

The case study of Baranzate, discussed in this paper, demonstrates that in some cases, in order to guarantee compliance with the prerequisites of the Protocol, it is necessary to modify some rules contained in the existing planning tools.

LEED[®] ND was born in a territorial context (U.S.) in which new construction operations and new urbanization are favored. As highlighted by Miller [28], the situation in Europe is quite different, many of the interventions of urban redevelopment are implemented inside the city and could consider new urbanization but with urban constraints that cannot be exceeded or that could be exceeded but in a process that could take several years.

The prerequisite that makes it mandatory to have at least a LEED[®]-certified building seems restrictive and too commercial, a protocol for a sustainable neighborhood might consider, alternatively, other recognized certification standards for sustainable buildings or green buildings although developed outside of the GBC.

Another critical aspect is the cost of the certification. Who has fiscal responsibility for the LEED certification, and who maintains the certification in following years?

Some remarks must be made about the procedure [28]. The first of these regards the definition of neighborhood characteristics and boundaries; LEED[®] ND doesn't define the size of neighborhoods. This can create issues such as larger projects experiencing difficulty in achieving some credits while smaller projects may not adequately represent the idea of a neighborhood.

Projects located in dense urban neighborhoods that consist of a single building, partial block or block have an advantage over larger stand-alone projects in that they can achieve rating without much effort. The location and access to public transportation are the main areas of benefit and given the emphasis on these areas, where the advantage is located. The problem with this advantage is that innovation may not be inspired if a project can succeed in an existing context [28].

In order to overcome the weaknesses of the integration of LEED[®] ND Protocol with the energy planning and management tools, we suggest a path of possible actions:

- municipal administration should take the lead in actively promoting LEED[®] ND certification protocol;
- the prerequisites of the LEED[®] ND Protocol should be carefully considered in the implementation phase of the energy and environmental tools, the simulation of the Baranzate case study shows that additional efforts to comply with the LEED[®] ND Protocol may be limited;

- once this decision has been made, municipalities should verify that there are no inconsistencies between the protocol and the existing planning tools, that is the guarantee that the environmental parameters applied in certified areas become standard parameters for the entire city;
- energy and sustainable planning tools should be consistent with the baseline LEED[®] ND certification; property developers could be encouraged to achieve higher ratings (silver, gold and platinum) by means of incentives (e.g., higher volumes or lower costs for the public infrastructure works);
- since the GBC are non-profit associations open to external contributions, municipalities should consider the possibility of being an active part in defining the criteria (for example by participating in working groups), in all cases an agreement protocol between the local GBC and the local municipalities is advisable;
- for municipalities, it is difficult and in some cases impossible, to assume the costs of certification; the costs should be paid by property developers of the area, the standard to be achieved should be included in the “development agreement” to be signed between the municipality and property developers.

7. Conclusions

The scope of this paper was to verify the relationship, and also the possible synergies between international and non-governmental environmental rating systems for neighborhoods (*i.e.*, LEED[®] ND, BREEAM[®] Communities and CASBEE[®] for Urban Development) and energy and environmental planning management tools in Italy. The Italian GBC recently proposed GBC Neighborhoods, the Italian version of LEED[®] ND, and for this reason, LEED[®] ND was considered the reference protocol in this paper even though many of considerations emerging from this study may also apply to other protocols.

The premise of GBC Neighborhoods states that “GBC Neighborhoods not born as an instrument of urban planning, but it can be a useful tool for municipalities that could adopt for promoting, encouraging and sustainable redevelopment of urban land, or for the preparation of guidelines for development”.

LEED[®] ND is an excellent rating system for sustainability at the urban scale and can fit well with existing tools if its use is limited to promote the sustainability market. However, we believe that LEED[®] ND is an instrument capable of expressing a greater potential to support planning strategies at the urban or neighborhood scale.

This paper is not intended as a criticism of LEED[®] ND but, on the contrary, a valuable contribution towards the implementation of this tool until it becomes effective for the planning of sustainable energy systems.

The great interest in energy planning and sustainable land use has stimulated a series of tools that often are likely to be inconsistent and redundant in certain aspects. In this paper we discussed the Italian context but in many countries, particularly European ones, the complexity of the situation is not different. There is a level of scale (national, regional, municipal, neighborhood), but there is also a level of governance. The supply chain management of these tools starts from the European level (EU is responsible for the directives), goes through the national and regional level and ends at the municipal level. Within this difficult and complex governance, LEED[®] ND is inserted, a rating system

that comes with a clear non-governmental connotation, a private initiative based on the involvement of stakeholders in the interest for the community.

The potential of LEED[®] ND is remarkable, first of all, we have an international rating system protocol that stimulates a real market of sustainability, no longer limited to the scale of individual buildings but extended to the neighborhood level, then an effective operational framework that can feed the need for a common growth comparison, compatible with international strategies. From the technical point of view, the tool is flexible enough to be adapted to local situations that can be very different.

Since LEED[®] ND does not apply to a single building but a neighborhood, we need to compare the compatibility of its rules with the rules contained in local planning instruments (see Figure 1) as the governance of these tools is charged to the Public Administration (*i.e.*, Central Government, Region, Municipality), one of the objectives of this paper was to verify this compatibility. Another important issue to be resolved is the governance of the tool. Who will be responsible for the application of LEED[®] ND? A private organization, such as a real estate developer, or a public body such as the municipality, or a private-public consortium.

In this paper, the LEED[®] ND Protocol has been tested on a real case. The potential, but also the weaknesses, were highlighted with suggestions in order to overcome these weaknesses. The study shows that, if the goal is to use LEED[®] ND not only as a tool to enhance the energy and environmental sustainability of small parts of the city (*i.e.*, neighborhoods), but also to lay the foundation for improving the sustainability of the whole city, the integration of LEED[®] ND Protocol with the energy planning and management tools must consider significant involvement of the Public Administration with the local GBC.

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Conflicts of Interest

The authors declare no conflict of interest.

References

1. United Nations 1998. Kyoto Protocol to the United Nations Framework Convention on Climate Change. Available online: <http://unfccc.int/resource/docs/convkp/kpeng.pdf> (accessed on 30 September 2013).
2. Demographia World Urban Areas. World Urban Areas Population and Density: A 2012 Update. Available online: <http://www.newgeography.com/content/002808-world-urban-areas-population-and-density-a-2012-update> (accessed on 30 September 2013).

3. Fee, K.; Hartley, D.A. Urban Growth and Decline: The Role of Population Density at the City Core. Available online: <http://www.clevelandfed.org/research/commentary/2011/2011-27.cfm> (accessed on 30 September 2013).
4. Commission of the European Communities. *Green Paper: A European Strategy for Sustainable, Competitive and Secure Energy*; COM 105 Final; European Commission: Brussels, Belgium, 2006.
5. European Community. Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings. *Off. J. Eur. Commun.* **2003**, *L1*, 65–71.
6. European Parliament. Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings (recast). *Off. J. Eur. Union* **2010**, *L153*, 13–35.
7. United States Green Building Council (USGBC). LEED for Neighborhood Development. Available online: <http://www.usgbc.org/neighborhoods> (accessed on 30 September 2013).
8. BREEAM for Communities. *BREEAM Communities Assessor Manual: Development Planning Application Stage*; Building Research Establishment Ltd.: Watford, UK, 2009.
9. BREEAM Communities 2012—An Introduction for International Use. Available online: http://www.breeam.org/filelibrary/BREEAM%20Communities/BREEAM_Communities_-_An_introduction_for_international_use_%28KN5260%29.pdf (accessed on 30 September 2013).
10. CASBEE. *CASBEE for Urban Development (2007 Edition)*; Institute for Building Environment and Energy Conservation (IBEC): Tokyo, Japan, 2007.
11. Dall’O’, G. *Green Energy Audit of Buildings—A Guide for a Sustainable Energy Audit of Buildings*; Springer-Verlag: London, UK, 2013.
12. Green Building Council (GBC) Italia. GBC Quartieri. Available online: <http://www.gbcitalia.org/page/show/gbc-quartieri> (accessed on 30 September 2013).
13. Mirakyan, A.; de Guio, R. Integrated energy planning in cities and territories: A review of methods and tools. *Renew. Sustain. Energy Rev.* **2013**, *22*, 289–297.
14. Cormio, C.; Dicorato, M.; Minoia, A.; Trovato, M. A regional energy planning methodology including renewable energy sources and environmental constraints. *Renew. Sustain. Energy Rev.* **2003**, *7*, 99–130.
15. *Thematic Strategy on the Urban Environment—Interim Communication*; COM 60; European Commission: Brussels, Belgium, 2004.
16. Zanon, B.; Verones, S. Climate change, urban energy and planning practices: Italian experiences of innovation in land management tools. *Land Use Policy* **2013**, *32*, 343–355.
17. Brandoni, C.; Polonara, F. The role of municipal energy planning in the regional energy-planning process. *Energy* **2012**, *48*, 323–338.
18. Dall’O’, G.; Galante, A.; Torri, M. A methodology for the energy performance classification of residential building stock on an urban scale. *Energy Build.* **2011**, *48*, 211–219.
19. Dall’O’, G.; Belli, V.; Brolis, M.; Mozzi, I.; Fasano, M. Nearly zero-energy buildings of the Lombardy region (Italy), a case study of high-energy performance buildings. *Energies* **2013**, *6*, 3506–3527.
20. Caputo, P.; Costa, G.; Ferrari, S. A supporting method for defining energy strategies in the building sector at urban scale. *Energy Policy* **2013**, *55*, 261–270.
21. Manfren, M.; Caputo, P.; Costa, G. Paradigm shift in urban energy systems through distributed generation: Methods and models. *Appl. Energy* **2011**, *88*, 1032–1048.

22. Haapio, A.; Viitaniemi, P. A critical review of building environmental assessment tools. *Environ. Impact Assess. Rev.* **2008**, *28*, 469–482.
23. Ding, G.K.C. Sustainable construction—The role of environmental assessment tools. *J. Environ. Manag.* **2008**, *86*, 451–464.
24. Kyrkou, D.; Karthaus, R. Urban sustainability standards: Predetermined checklists or adaptable frameworks? *Procedia Eng.* **2011**, *21*, 204–211.
25. Alyami, D.H.; Rezgui, Y. Sustainable building assessment tool development approach. *Sustain. Cities Soc.* **2012**, *5*, 52–62.
26. Goldstein, B.P.; Herbøl, M.; Figueroa, M.J. Gaps in tools assessing the energy implications of renovation versus rebuilding decisions. *Curr. Opin. Environ. Sustain.* **2013**, *5*, 244–250.
27. Haapio, A. Towards sustainable urban communities. *Environ. Impact Assess. Rev.* **2012**, *32*, 165–169.
28. Miller, K. Sustainable Neighborhood Development 2010. A Toolkit for Understanding US and European Approaches. Master's Thesis, Polytechnic University of Milan: Milan, Italy, October 2010.
29. Italian Parliament. Conversione in Legge, con Modificazioni, del Decreto-Legge 25 Giugno 2008, n. 112, Recante Disposizioni Urgenti per lo Sviluppo Economico, la Semplificazione, la Competitività, la Stabilizzazione della Finanza Pubblica e la Perequazione Tributaria (in Italian). Available online: <http://www.parlamento.it/parlam/leggi/081331.htm> (accessed on 30 September 2013).
30. Italian Parliament 2013. Strategia Energetica Nazionale: Per Un'energia più Competitiva e Sostenibile (in Italian). Available online: http://www.mise.gov.it/images/stories/normativa/20130314_Strategia_Energetica_Nazionale.pdf (accessed on 30 September 2013).
31. Italian Parliament 1991. 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. Available online: http://www.autorita.energia.it/it/docs/riferimenti/legge_10_91.htm (accessed on 30 September 2013).
32. Cittalia, Fondazione ANCI Ricerche 2013. Politiche di Rispetto Ambientale, Il Piano Energetico dei Comuni. Available online: http://www.cittalia.it/index.php?option=com_content&view=article&id=4796:politiche-di-rispetto-ambientale-il-piano-energetico-dei-comuni&catid=3:notizie&Itemid=14 (accessed on 30 September 2013).
33. ISTAT 2013. Strumenti di Pianificazione per L'energia per i Comuni Capoluogo di Provincial. Available online: http://dati.istat.it/Index.aspx?DataSetCode=DCCV_STPIANEN&Lang= (accessed on 30 September 2013).
34. Dall'O', G.; Galante, A.; Scansani, S. *Valutazione del Potenziale di Risparmio Energetico nel Controllo del Processo di Riqualificazione Edilizia: Simulazione di un Caso*, (in Italian); Congresso Nazionale ATI: Padova, Italy, 2003.
35. Dall'O', G.; Solaini, G.; Galante, A. *Il Regolamento Edilizio come Strumento di Integrazione delle Scelte Progettuali per la Sostenibilità: Il Caso di Carugate*, (in Italian); 44° Convegno Internazionale AICARR: Milano, Italy, 2004.
36. European Solar Thermal Industry Federation (ESTIF) 2007. Best Practice Regulation for Solar Thermal. Available online: http://www.estif.org/fileadmin/estif/content/policies/STAP/Best_practice_solar_regulations.pdf (accessed on 30 September 2013).

37. *Linee Guida per la Definizione di un Regolamento Edilizio Tipo Provinciali, Assessorato all'Ambiente, Settore Energia*, (in Italian); Provincia di Milano: Milan, Italy, 2005.
38. Dall'O', G.; Galante, A. *Efficienza Energetica e Rinnovabili nel Regolamento Edilizio Comunale*, (in Italian); Edizioni Ambiente: Milano, Italy, 2009.
39. CRESME Ricerche; Legambiente. Rapporto Onre 2013, Edilizia Sostenibile in Crescita (in Italian). Available online: <http://www.legambiente.it/contenuti/dossier/rapporto-onre-2013-edilizia-sostenibile-crescita> (accessed on 30 September 2013).
40. European Commission, 2013. Covenant of Mayors—Sustainable Energy Action Plans. Available online: http://www.eumayors.eu/actions/sustainable-energy-action-plans_en.html (accessed on 30 September 2013).
41. ISTAT. Censimento ISTAT 2011. Available online: <http://censimentopopolazione.istat.it/> (accessed on 30 September 2013).
42. Raimi + Associates and the Natural Resources Defense Council (NRDC), 2013. A Citizen's Guide to LEED for Neighborhood Development: How to Tell if Development is Smart and Green. Available online: https://www.nrdc.org/cities/smartgrowth/files/citizens_guide_LEED-ND.pdf (accessed on 30 September 2013).
43. Sedlacek, S.; Maier, G. Can green building councils serve as third party governance institutions? An economic and institutional analysis. *Energy Policy* **2012**, *49*, 479–487.

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