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# SMART AND RESILIENT CITIES

## IDEAS AND PRACTICES FROM THE SOUTH OF EUROPE

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# UNDERSTANDING HOW AND WHY CITIES ENGAGE WITH CLIMATE POLICY

## AN ANALYSIS OF LOCAL CLIMATE ACTION IN SPAIN AND ITALY

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ABSTRACT

Cities significantly contribute to climate change and at the same time have governance capacity to act efficiently in the fields of mitigation and adaptation. Their capacity is being increasingly recognized by international institutions and has been pointed out as crucial in the multi-level government scenario of the European Union (EU). Addressing the challenges of climate change at urban level is a complex issue which requires a holistic approach to strategic urban planning. Understanding why and how cities start action can help to identify the barriers they face when addressing climate change, and how national governments, regions and international bodies can support local authorities in their climate fight. This work aims to contribute to the provision of the knowledge needed to gain a better and deeper insight into urban climate action. The study investigates the state-of-the-art of urban climate plans in Spain and Italy, two countries which share similarities on many levels (i.e. cultural, geographical, climate vulnerabilities, urban configurations and institutional framework). The research analyses cities that are included in the Eurostat Urban Audit (UA), 26 in Spain and 32 in Italy, focusing on the actions taken by large and medium municipalities in reducing their contribution to climate change and becoming more resilient to changing weather patterns. The results of the analysis show a trend towards increasing awareness of climate mitigation (highly focused on energy efficiency and the promotion of cleaner energy sources), while adaptation remains a local policy area in its infancy in both countries. The study also identifies the beneficial influence of national and international climate city networks.

KEYWORDS:
Urban climate policy, mitigation plan, adaptation plan, Spain, Italy

# 1 INTRODUCTION

Cities are increasingly being recognized as important actors in the efforts towards climate change mitigation and adaptation (UN-Habitat, 2014; OECD, 2014; UNEP and UN-Habitat, 2009; C40, 2015). Urban areas are major contributors to climate change, although they cover less than 2% of the earth's surface (UN Habitat, 2012). Indeed, they account for between 71% and 76% of CO2 emissions from global final energy use and between 67 – 76% of global energy use (Seto et al., 2014). At the same time, because more than half of the world's population is urban, cities are highly vulnerable to climate change, as they represent concentrations not only of people but also of assets and infrastructures. Being drivers of climate change and vulnerable to it cities see the need and the responsibility to take action. Moreover, cities and larger urban areas are to a large degree (ranging across countries) self-governed administrative units assumed to be able to act more independently and potentially more quickly than international consortia, such as the United Nations Framework Convention on Climate Change (NFCCC) (Kousky and Schneider, 2003).

High-level and large-scale international events and processes bear witness to the increasing importance of cities in the fight against climate change. For example, the Open Working Group of the UN Sustainable Development Goals (SDGs) explicitly suggests "*Mak[ing] cities and human settlements inclusive, safe, resilient and sustainable*" as SDG #11 and "*Tak[ing] urgent action to combat climate change and its impacts*" as SDG#13 (UN DESA, 2014). The Sustainable Development Solutions Network (an independent advisory body to the SDGs) calls to "*empower inclusive, productive and resilient cities*" and to "*curb human induced climate change and ensure clean energy*" (SDSN, 2013). Furthermore, the UN-Habitat's Cities and Climate Change Initiative (CCCI) is preparing Guidelines for City Climate Action Plans (UN-Habitat, 2015) to be launched at the Conference of the Parties (COP21) in Paris.

Recognizing this key role, local governments have taken on more responsibility to mitigate and adapt to climate change. In December 2009, for the first time, during COP15 in Copenhagen, a large group of mayors took part in a Climate Summit for Mayors jointly organized by the city of Copenhagen, C40, and ICLEI. Subsequently, many cities have begun to undertake a path of effective action that is bringing in innovative interventions and policy strategies. These actions frequently open up new fields of economic activity and opportunities for community participation at local level, and show that cities are at the forefront of climate change mitigation and adaptation actions. However, and despite the risks and cost of taking no action, many more cities are struggling to introduce climate issues in their policy agenda on a sustained and sound basis.

Understanding why, and how, cities start action can help to identify the barriers they face when addressing climate change, and what kind of initiative has to be undertaken by upper tiers of government and international bodies to support local authorities in their climate fight. Though research has increasingly been focussing on responding to this necessity in recent years (Heidrich et al.n 2013; Reckien et al., 2014b; Reckien et al. 2015), efforts need to be increased in order to be able to fully answer these questions.

In this context, this paper aims to contribute to shedding light on the efforts undertaken by Spanish and Italian cities in tackling climate change throughout the last decade. The specific objective is to understand whether large and medium cities have acted in the field of climate policy in Spain and Italy, and what kind of action they have developed. This objective is relevant in the current scenario, in which the United Nations (UN) is preparing to negotiate a new international agreement in Paris (December 2015) to be implemented from 2020. Within that agreement the involvement of local governments is considered crucial.

Italy and Spain were chosen because they share important similarities in terms of climate vulnerability and urban configurations. These conditions make it plausible to assume that cities in both countries face similar climate change challenges and risks and, therefore, need to develop similar efforts (financial, administrative, political, technical, etc.) in order to implement efficient policies. Spain and Italy also share political and

historical conditions resulting in similar contemporary governance structures, and both are integrated in the climate change policy of the European Union (EU).

This paper is structured as follows: Section 2 explains the data and method, while Section 3 addresses the EU's climate framework and the action developed by the central governments and regions in both Spain and Italy. This section aims to establish the context for the policy and the governance systems in which the analysed cities have been acting. It builds on the work developed in De Gregorio et al. (2014). Section 4 examines the mitigation plans developed by Spanish and Italian cities, while Section 5 develops the study of the adaptation plans. These two sections further develop the work undertaken in Olazabal et al. (2014). Section 6 discusses the outputs of the analysis while Section 7 contains the conclusions.

## 2 DATA AND METHODS

This work analyses the current state of climate action (mitigation and adaptation) of large and medium-sized cities in Italy and Spain. Large and medium-sized cities are assumed to have the technical expertise within their administrative structures (or can have easy access to technical expertise) and the relevant financial resources needed to undertake action in these two fields. They are also the municipalities with greater capacity to mobilize other relevant stakeholders and engage them in local mitigation and adaptation.

To develop this study, we took the sample of 26 Spanish[1] and 32 Italian[2] cities that are included in the Urban Audit (UA)[3]. UA cities are assumed to be a regionally and population balanced sample of cities within European countries, and thus also of Italian and Spanish cities. The cities were originally selected in the context of a wider research work by Reckien et al. (2014a) studying urban Climate Change Mitigation (CCM) and Adaptation (CCA) plans and actions across 200 cities in 11 European countries. This study goes further by additionally analysing Climate Change Mitigation-Related (CCMR) and Adaptation-Related (CCAR) plans, and in providing an update to the original dataset, accounting for the latest development from January 2013 to June 2015.

The database used in the context of this work (Reckien et al., 2014a, updated as of January 2013) includes different types of indicators including: i) the plans active in the cities (year of approval, topics covered and emission reduction targets[4], etc.), and ii) membership of relevant networks (Covenant of Mayors –CoM-, Spanish Network of Cities for Climate –RECC-, and Climate Alliance). In addition, results were also analysed using cluster analysis. This is a technique of multivariate statistical analysis that makes it possible to analyse

1 Alicante (AL), Badajoz (BD), Barcelona (BA), Bilbao (BI), Córdoba (CO), A Coruña (CR), Gijón (GI), Las Palmas (LP), L'Hospitalet de Llobregat (LH), Logroño (LO), Madrid (MD), Málaga (MA), Murcia (MU), Oviedo (OV), Palma de Mallorca (PL), Pamplona/Iruña (PA), Santa Cruz de Tenerife (SC), Santander (SA), Santiago de Compostela (SC), Sevilla (SE), Toledo (TO), Valencia (VA), Valladolid (VL), Vigo (VG), Vitoria-Gasteiz (VI), Zaragoza (ZA).

2 Ancona (AN), Bari (BA), Bologna (BO), Brescia (BS), Cagliari (CA), Campobasso (CB), Caserta (CE), Catania (CT), Catanzaro (CZ), Cremona (CR), Firenze (FI), Foggia (FG), Genova (GE), L'Aquila (AQ), Milano (MI), Modena (MO), Napoli (NA), Palermo (PA), Padova (PD), Perugia (PG), Pescara (PE), Potenza (PZ), Reggio Calabria (RC), Roma (RO), Sassari (SS), Salerno (SA), Taranto (TA), Trento (TN), Torino (TO), Trieste (TS), Venezia (VE), Verona (VR).

3 The UA database was developed and is maintained by the European Commission, Eurostat and the national statistical offices.

4 Regarding the "emission reduction targets indicator" in the plans, it is important to clarify that all Spanish cities express their emission targets as % of CO2 equivalent (henceforth, CO2e). All Italian cities, in contrast (except Rome), express emission targets as % of CO2. Figures in CO2e account for the mix of greenhouse gases taking the Global Warming Potential (GWP) of the CO2 as reference (see Forster et al. 2007). According to Eurostat (Eurostat, 2013), "*carbon dioxide accounted for 82.4% of EU-27 greenhouse gas emissions in 2010, followed by methane (8.5%), nitrous oxide (7.1%) and fluorinated gases (2.0%)*" (http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Climate_change_statistics; Last accessed June 30, 2015). Cerutti et al. (2013) argue that this can be used to justify a reliable comparison of both measurements, nevertheless bearing in mind that other gas emissions are underestimated if only CO2 is considered. Assuming that no emission abatement measure can reduce only CO2, in this work we consider these figures to be comparable in order to reduce the scope and ambitiousness of the Italian and Spanish local mitigation projects. Eurostat Climate Change Statistics. URL: http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Climate_change_statistics (Last accessed June 30, 2015).

homogeneous groups within a data set. Depending on the type of data (qualitative or quantitative), different indices of similarity or distance can be applied to the data being analysed, which is organised in a matrix consisting of objects and descriptors. The initial matrix constitutes of binary data, characterizing the presence (1) or absence (0) of topics. The Sokal and Michener index (Sokal and Michener, 1958) is used to measure the similarity between the objects whereas the "complete linkage" algorithm is used for the clustering.

# 3 GENERAL CONTEXT OF CLIMATE ACTION IN SPAIN AND ITALY

## 3.1 THE COMMON FRAMEWORK: EU CLIMATE POLICY

EU commitment to climate change stems from international concern for, and the negotiations that resulted in, the adoption of the UNFCCC in 1992. In fact, it was in the early 1990's that the EU and most of its Member States started to develop "serious" climate change action (Oberthür and Dupont, 2011), adopting a position that has been described as that of a major stakeholder and even of a major leader in international climate policy.

In order to sustain international commitment, the EU continues in its efforts to underpin that through the development of a climate change policy for its territory. From the entry into force of the Kyoto Protocol[5] (ibid.) the EU has implemented an emission-trading scheme in which all EU Member States must participate, has developed a comprehensive package of policy measures to reduce greenhouse gases (GHG) emissions under the European Climate Change Programme (ECCP)[6], and has made efforts to set up an EU adaptation policy. The evolution of the action taken resulted in the reaffirmation of the EU's leadership ambitions, when in March 2007 the European Council announced a unilateral GHG emissions reduction programme that set EU targets for 2020. Through this programme, EU leaders committed themselves to a highly energy-efficient, low carbon economy. This set of targets was enacted through the climate and energy package in 2009 and aims for a 20% reduction of overall GHG emissions by its 27 Member States compared to the 1990 levels. The EU has offered to increase this emissions reduction to 30% if other major economies agree to contribute to a global emissions reduction effort (European Commission, 2012a). Today, the EU is driving a transition towards a low carbon economy, and strict targets have been set for the EU as a whole and for all the Member States. In particular, with the Energy roadmap 2050, the EU commits itself to reducing GHG emissions to 80-95% below 1990 levels by 2050[7].

EU efforts have also been made regarding adaptation action. The Green Paper on Climate Change Adaptation (COM(2007) 354 final) and later the White Paper on Adapting to Climate Change: Towards a European Framework for Action (COM(2009) 147 final), laid the basis for a common framework on adaptation, identifying its vulnerability to the impact of climate change and setting out a number of measures to enhance the EU's resilience. As a key deliverable of the White Paper, in March 2012, a web-based European Climate Adaptation Platform (Climate-ADAPT) was launched, providing, and making available to citizens, policy makers and professionals, the latest data on adaptation actions in the EU, alongside several useful policy support tools.

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5 It is worth observing that "neither the Kyoto Protocol (KP) nor the UNFCCC contain specific references to local government or city level actions to meet the Protocol commitments. There are only a few references to local level involvement; for example, Article 10 in the KP recognizes that regional programmes may have a role in improving the quality of local emission factors" (Sassen, 2013, p. 241).

6 The first ECCP was launched in June 2000 and went on until 2004 aiming to implement the Kyoto Protocol on EU territory (European Commission, 2012b). The Second European Climate Change Programme (ECCP II) explored further cost-effective options for reducing greenhouse gas emissions as well as adaptation to the effects of climate change in synergy with the EU's Lisbon strategy for increasing economic growth and job creation (European Commission, 2011).

7 http://www.roadmap2050.eu/ (Last accessed June 30, 2015)

The European adaptation framework was completed with the launch of the Strategy on Adaptation to Climate Change (April 2013) that provides EU policy makers with comprehensive guidelines on the process of developing, implementing and reviewing adaptation strategies for facing climate change.

In order to be implemented, the approaches developed and the decisions taken by the EU institutions have to be introduced in the national frameworks of the Member States.

In the framework of the climate change policy developed by the EU over the years, cities have to play a significant role, since "*cities are key players in the reduction of CO2 emissions and the fight against climate change*" (EC, 2011, p. 5). The European Commission envisages climate action at urban level as an important aspect that has to be included and mainstreamed in the concept of integrated urban development and integrated urban regeneration provided by the Toledo Declaration[8] (ibid.). In fact, the development of the climate policy of the EU has been constructed according to a multi-level vision that aims to enhance the collaboration of all the levels of government to tackle and adapt to climate change, e.g. underlined by the European Commissioner for Climate Action, Connie Hedegaard, in April 2013, at the Conference held around the launch of the EU Strategy on Adaptation to climate change. She said: "*we have to act, and we have to act together*" highlighting that climate change requires actions at all levels of government (EC, 2013c, p. 6).

## 3.2 GENERAL CONTEXT OF CLIMATE ACTION IN SPAIN

Spain has an institutional multi-level fragmented framework in which climate change policy seems to be an exception (De Gregorio et al, 2014). The main reason for this particular situation is that the Central Government has to rely on the involvement of regional governments and municipalities in order to fulfil its international commitments. This fact is even more evident as regions and cities have jurisdiction over housing, mobility, urban planning and spatial planning, etc.

Spain ratified the Kyoto Protocol in 2002, making a commitment to limit emissions growth over the period 2008-2012 by 15% compared with 1990. Since then the Central Government has started to develop the country's climate change policy, implementing as of 2004 a collaborative vision through the creation of four arenas of negotiation and collaboration in order to assure the involvement of all relevant tiers of government in the fulfilment of Spanish Climate Change objectives. It also created the Spanish Office for Climate Change (OECC) with the main role of creating synergies between the activities and tasks of these arenas for vertical and horizontal collaboration and climate action mainstreaming. All these entities develop a relevant role in supporting Central Government in climate decision-making.

The Central Government also developed a number of documents and strategies that contributed to laying the foundations of the institutional approach to climate change in the country. In 2007 it passed the Spanish Strategy on Climate Change and Clean Energy (SSCCCE) as part of the Spanish Sustainable Development Strategy. The SSCCCE includes a broad range of measures that contribute to sustainable development within the scope of climate change and clean energy. It aims to set the framework to give coherence to national, regional and local policies on climate change in the medium to long term (2007-2012-2020) and particularly to the implementation of a number of planning instruments among which it is worth mentioning the National Plan for Adaptation to Climate Change (2006), the National Allocation Plans 2005-2007 and 2008-2012 (2005 and 2008), and the Strategic Lines to Fight Climate Change (2008), and Climate Plans and Strategies of the Autonomous Communities.

The National Plan for Adaptation to Climate Change (MARM, 2006) is the tool that set the approach and guidelines to undertake adaptive action. It aims to face the large vulnerability of the Spanish territory to the adverse effects of climate change by providing a reference framework for the coordination of different public

[8] http://www.eukn.org/ (Last accessed June 30, 2015)

administrations in their activities towards climate impact assessments, vulnerability studies and adaptation to climate change.

Through the development of the above-mentioned collaborative bodies, plans and initiatives, the Central Government has been able to develop a number of measures that, respecting the competences of the regions, have influenced local action to a relevant extent. These initiatives have mainly consisted of: (i) calls based on national funds in return for performance criteria; (ii) the promotion of information and knowledge exchange and the dissemination of best practices; and (iii) the creation of the Spanish Network of Cities for Climate (RECC). The latter can be seen as the most explicit line of action launched by the Central government to promote the engagement of Spanish cities in the development of a climate policy. The Network was constituted in 2004 with the aim of fostering the development of local policies to fight climate change through the adoption of 5 main axes of action, i.e., mobility, building, urban planning, energy and waste. The Autonomous Communities have implemented a relevant number of mitigation measures. Almost all of them have also developed Energy Plans. As in many other policy areas, relevant differences can be identified in the way the 17 Autonomous Communities have developed their action, though in general the regions understood their role as a government task that they have to necessarily share with the Central Government in order to meet the national goals (De Gregorio et al, 2014).

As a result of this overall scenario, a multi-level collaborative framework has been created on a national scale, without the effective integration of the local level. In fact, a review of the regional climate plans shows that there has been no reflection on how cities should address climate change in the different territories, while it is possible to identify a general trend towards promoting sectorial action on an urban scale (particularly in the field of energy saving and efficiency) (ibid.).

## 3.3 GENERAL CONTEXT OF CLIMATE ACTION IN ITALY

The first explicit step Italy undertook at the national level was the 1994 National Plan for the Containment of $CO_2$ Emissions, approved immediately after the ratification of the UN Framework Convention on Climate Change. In 1997, Italy signed the Kyoto Protocol. The Italian commitment under the Kyoto Protocol was not agreed with the regions, hence there are no specific legislative arrangements and enforcement procedures to meet the national commitment at the regional level. However, a number of policies relating to GHG reduction (e.g., in transport and energy sectors) have been promoted by the regions (and to some extent also provinces and municipalities). In addition, regions are playing an important role in reducing GHG emissions thought their own Regional Energy Plans. Italian regions have been active in the field of energy planning, which is having important effects in terms of mitigation, but to date only few of them have developed specific climate plans.

In 2002 the Italian National Climate Change Strategy was approved, which defined a set of policies and measures to increase the energy efficiency of the economic system and to foster the use of renewable energy sources. The National Plan for the Reduction of Greenhouse Gas Emissions (2003-2012) was developed with the aim of fulfilling the commitment to the Kyoto Protocol. This document includes a wide variety of mitigation actions including measures to reduce emissions in agriculture and industry. In this context, the National Action Plan for Renewable Energy sources (MSE, 2010) was launched under the EU Directive 2009/28/EC. This Plan aims to achieve a 17% share of gross domestic consumption from renewable sources by 2020. Moreover, the Italian Action Plan for Energy Efficiency (MSE, 2011), in compliance with Directive 2006/32/CE, aims to achieve an overall 9% (126.540 GWh/year) of energy savings by 2016 through energy services and other energy efficiency measures. In March 2013, Italy approved the National Plan to reduce GHG emissions planning sectorial actions for the period 2013-2020. The plan aims to prepare a pathway towards a decarbonisation of the economy in compliance with the Europe 2020 policy

and the Energy Roadmap 2050. In this plan, Italy commits itself to achieving the EU's decarbonisation objectives: a 25% GHG reduction by 2020 compared with the 1990 level, 40% by 2030, 60% by 2040, and 80% by 2050. This will be achieved by adopting a set of measures, including the introduction of a carbon tax (to boost resources for the Kyoto Fund), the improvement of energy efficiency, distributed generation, and the development of smart grids for 'smart cities'. Additionally, the plan promotes eco-buildings and the extension until 2020 of the 55% tax credit to sustain investments for a low-carbon $CO_2$ economy and, finally, the management of forests, which represent both a sink for $CO_2$ and a source of biomass and biofuels.

The Italian National Adaptation Strategy (NAS) development process began in 2007 with the National Conference on Climate Change organized by the Ministry for the Environment, Land and Sea. It represented a very important event that involved a wide range of stakeholders at national, regional and local levels with the fundamental aim of collecting and organizing the most relevant available information on climate change and its impacts. From the final discussion emerged the urgent need to provide Italy with a National Adaptation Strategy. In 2013, a first draft of the Italian NAS was completed and submitted for public consultation. To date, the Italian NAS has not yet been approved, but a reviewed and complete version of the Italian adaptation strategy, including all the observations received, is available (Elements for the elaboration of a National Adaptation Strategy to Climate Change[9]) and final approval should be obtained by the end of 2015. In the Italian case, the late action of the national government has had a direct impact on the way regions have addressed climate policy. In fact, the national government did not provide clear climate action frameworks for local territories and the stakeholders that operate within them (De Gregorio et al., 2014). As we shall see in the next Sections, this has had an impact on the actions undertaken by the Italian cities.

# 4 LOCAL ACTION ON MITIGATION IN SPAIN AND ITALY

This section examines the state of the database of climate mitigation and mitigation-related plans or programmes as of January 2013 and shows the evolution and engagement of Spanish and Italian cities in the fight against climate change.

## 4.1 COMMITMENTS AND LEADERSHIP: NETWORKS MEMBERSHIP AND APPROVAL OF PLANS

### 4.1.1 SPAIN

In the context of the national policy described above, many Spanish municipalities are part of joint international or national networks promoting the development of plans and programmes to fight climate change. Particularly, the Covenant of Mayors (CoM) and the national Spanish Network of Cities for Climate (RECC) (see also (Reckien et al., 2014b) for a comparison of Spanish cities with cities in other European countries). The national network RECC was created in 2004 and currently has 291[10] members, including municipalities, regions and regional networks. 1,431 Spanish cities are signatories of CoM (representing 15% of the total) and 1,172 of them have published their Sustainable Energy Action Plans (SEAPs) (81% of the signatories). The results are monitored in only 32 cities (2.7%). The differences in the level of membership in RECC and CoM suggest a higher tendency of Spanish cities to join international networks. Figure 1 illustrates the network membership of our sample of Spanish and Italian cities, up to January 2013.

9 http://www.minambiente.it/sites/default/files/archivio/allegati/clima/snacc_2014_elementi.pdf.
10 Latest update in 2013. URL http://www.redciudadesclima.es/ (Last accessed June 11, 2015).

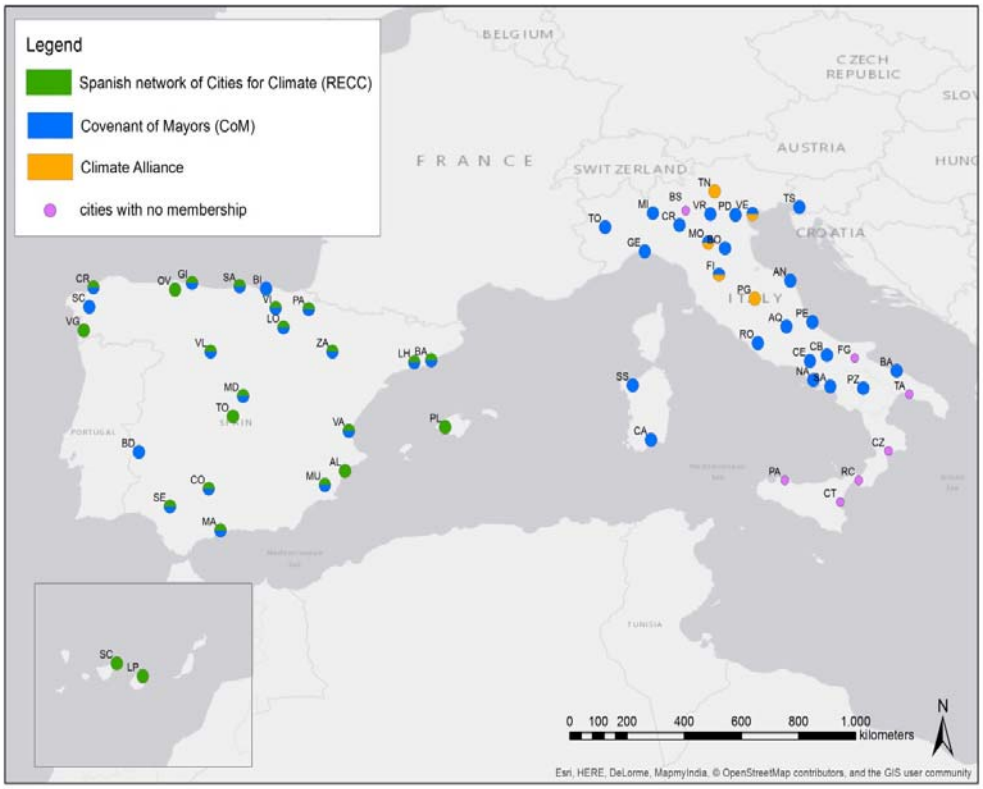



Fig. 1 Climate Network Membership of the Spanish and Italian cities analysed

The 26 Spanish cities in our sample show a tendency to enroll in national and international networks such as RECC or CoM. As argued in De Gregorio et al. (2014), it is interesting to note that participation in RECC has not had a significant influence in the development of plans, whereas participation in CoM has been crucial. These 26 selected UA cities do not demonstrate active approval of the plans until 2008. As of January 2013, only 54% of them had approved their CCM plans, 23% were in the process of developing one, and another 23% had presumably no intention of doing so in the short term (according to personal communications from municipal officials). All the documents considered in this case are CCM (i.e. no CCMR has been identified; see Sect. 2 for definitions).

### 4.1.2 ITALY

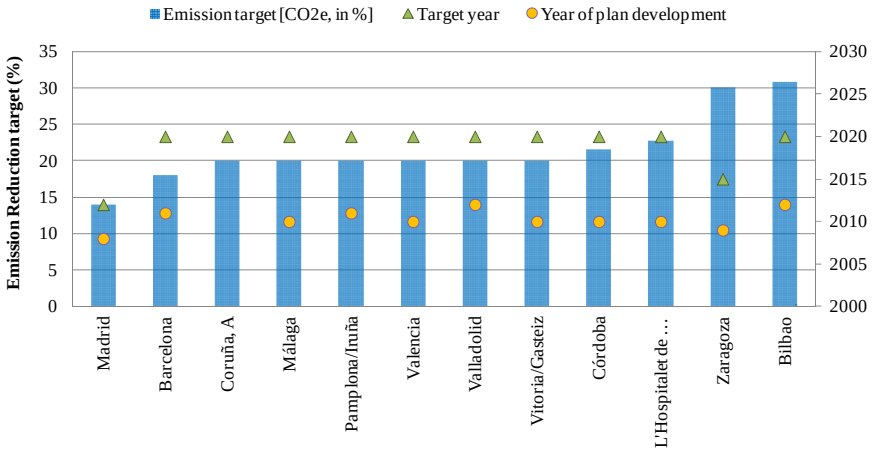
There are two important climate mitigation city networks in Italy. One is the CoM, as Italian cities are by far the largest group of signatories compared with other countries (see Reckien et al., 2014b, for a comparison with cities in other European countries). In Italy, 3,101 cities (38% of the total number of municipalities in Italy) are signatories to the CoM: 2,543 (82%) have already submitted a SEAP, and only 255 (8%) are already monitoring the results (according to the CoM website[11]). The other main network is the Climate Alliance[12]. In Italy, 148 municipalities and associations are currently member of the Climate Alliance. Again, as in Spain, CoM is much more popular. In 2010, the Italian Local Agenda 21 Association, together with the National Association of Italian Municipalities (ANCI) and the Union of Italian Provinces (UPI) developed the Charter of Italian Cities and Territories for Climate, with the aim of becoming a reference document for spatial policies in Italy, putting climate planning into practice through multi-level governance and

11 http://www.covenantofmayors.eu/ (Last accessed June 11, 2015)
12 http://www.klimabuendnis.org (Last accessed June 11, 2015)

cooperation also on climate issues[13]. In our sample, 19 out of 32 of the Italian UA cities are signatories to the CoM, and only five have joined Climate Alliance (see Figure 1). We observe that CoM is crucial to the development of CCM or CCMR plans in Italy (Olazabal et al., 2014 and Salvia et al, 2014). In January 2013, 25% of the Italian UA cities in our sample had not yet approved mitigation plans (CCM or CCMR). As the authors found, very few plans were being developed, i.e. the great majority of cities that developed a plan had already approved it and published it. Unlike in Spain, the development of some mitigation plans started early in Italy (in 1997). However, the majority of cities started to act after 2005. Indeed the number of approved plans has steadily increased since then, reaching 24 approved CCM and CCMR in January 2013. It is important to note that 18 of these plans are CCM, while the rest are CCMR (e.g. Cagliari, which has developed a plan to promote solar energy) (Olazabal et al., 2014).

## 4.2 EMISSION TARGETS

Among the indicators collected in the database developed, we gathered information regarding the emission reduction targets included in the CCM plans. All Spanish cities express emission targets as % of $CO_2$ equivalent (henceforth, $CO_2e$). All Italian cities, in contrast, (except Rome) express emission targets as % of $CO_2$. Figure 2 shows the $CO_2e$ emission reduction emission targets of Italian and Spanish cities. We only show those UA cities that set quantitative targets, i.e. 11 Spanish cities and 19 Italian cities.




**(a) Spanish UA cities that have set emission reduction targets in their CCM plans**


**(b) Italian UA cities that have set emission reduction targets in their CCM or CCMR plans**

Fig. 2 Emission reduction targets of the Spanish (a) and Italian (b) cities analysed that have set targets in their CCM or CCMR plans (adapted from Olazabal et al. 2014).

[13] English version available at: http://www.a21italy.it/medias/746CAD83A40F3AB9.pdf

In both countries, most cities set reduction targets of 20% until 2020, which is the compulsory target for the CoM agreement. Bilbao and Zaragoza are the most ambitious cities in Spain, with a target of about 30%. In Italy, more cities set reduction targets above 20% as compared with cities in Spain. Naples, Turin, Bari and Brescia set targets above or equal to 25%.

## 4.3 ASSESSMENT OF EMISSIONS ACCOUNTING (DIAGNOSIS)

Previous to the identification and design of potential mitigation options for the different sectors, every plan has a diagnosis phase where cities assess the baseline emissions from the different sectors (residential, municipal, industrial, transport, etc.) and identify the most important challenging or problematic area. This phase of diagnosis is therefore highly important in singling out the strategic sectors in which mitigation measures should be carried out. Our investigation also focused on the methods used by cities to develop emissions inventories. It should be noted that the type of method depends on the sector being examined and that different approaches can often exist in one single planning document. Thus, we have classified the methods as (a) detailed emissions inventory, (b) estimates from regional and/or national data, and (c) a mix of the previous methods depending on the sector under analysis (e.g. the residential sector using a detailed inventory and the transport sector using estimates).

In Spain, we have found that 14 plans (54%) included emissions inventories (using a, b or c above). This set includes not only approved plans but also some plans under development which have already published emissions diagnosis (and have thus been taken into account in this study). Regarding the types of methods applied to develop the diagnosis, most of the Spanish cities use mix methods depending on the sector under analysis (38% of the total Spanish UA cities) (see Figure 3, Spanish plans are blue shaded and Italian plans are red shaded). Only 4 % use estimates to account for emissions, and 12% use detailed emissions inventories in all sectors.

In Italy, 19 plans (59% of the total Italian UA cities) include emissions inventories. Surprisingly, 5 Italian cities (9%, see Figure 3) do not specify the method used. Regarding the rest, approximately half of them (31% from the total) use a detailed emissions inventory for all the sectors under assessment. Only 3% use estimates from regional or national data and approximately 16 % use a mix of methods.

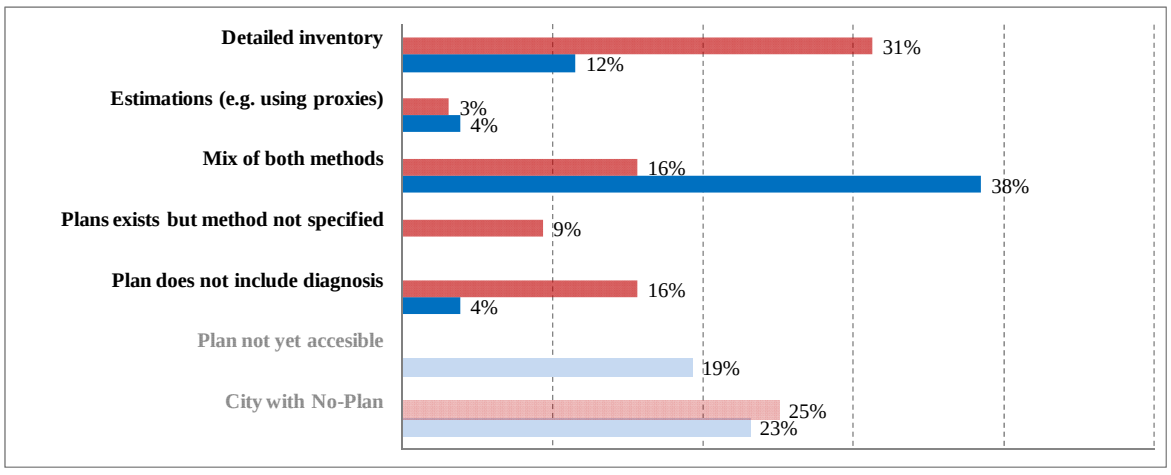



Fig. 3 Methods used to develop base emission inventories in Spanish (blue shaded) and Italian (red shaded) CCM and CCMR plans.

## 4.4 MITIGATION TOPICS

Table 1 shows the topics most frequently included in the Spanish and Italian mitigation plans. Energy efficiency measures, building interventions (e.g. increase energy performances) and electricity production from renewable sources are the topics prevalently addressed in the Spanish CCM plans, but there is also a greater focus on actions involving the transport sector and waste management. Contrastingly, urban planning, intramunicipal reorganization, agriculture and heating from renewable energies are included less.
Similarly, in Italian CCM plans, energy efficiency and renewable implementation are the topics most extensively covered, with heat production from renewable energies (poorly implemented in Spanish UA cities). Both the public and private building sectors are extensively targeted in the Italian cities (boosted by the EPBD EU Directive[14], aiming to diffuse "nearly zero-energy buildings - NZEB" by 2020). Agriculture and waste management are barely covered topics.

| Mitigation topics | % of Spanish plans | % of Italian plans |
|---|---|---|
| Energy efficiency | 100 | 91.3 |
| Renewable energies | 93.3 | 95.7 |
| Heating from renewable energies | 13.3 | 91.3 |
| Waste management | 73.3 | 56.5 |
| Urban planning | 26.7 | 73.9 |
| Agriculture | 6.7 | 17.4 |
| Transportation | 86.7 | 87 |
| Intramunicipal reorganization | 13.3 | 69.6 |
| Buildings (e.g. Heating) | 100 | 100 |
| Jobs | 0 | 43.5 |
| Industry | 46.7 | 39.1 |
| Commerce, trade, services | 73.3 | 47.8 |
| Households | 93.3 | 82.6 |

Tab.1 Topics most included in the Spanish and Italian mitigation plans.

## 4.5 CLUSTER ANALYSIS OF MITIGATION PLANS DESCRIPTORS

Cluster analysis has been used in this paper to analyse the distribution of mitigation topics in the database of climate plans by Italian and Spanish UA cities. In this application, the 'objects' are the cities that have taken mitigation actions, and the 'descriptors' are the topics included in the mitigation plans (Table 1).

### 4.5.1 SPAIN

A matrix [objects x descriptors] was constructed using the database of the Spanish mitigation plans as the starting point. The initial matrix [26 x 15] (see Footnote 1 for acronyms) consisted of 26 Spanish cities and CCM plans, and 15 mitigation topics.
The initial matrix [26 x 15] was reduced to a matrix of [15 x 14] subtracting those cities that lacked all topics (AL, BD, GI, LP, OV, PL, SC, SA, SC, TO and VG). Regarding descriptors, only one topic (job) is not considered by all cities.

[14] Directive2010/31/EU EPBD on the Energy Performance of Buildings

Applying the cluster analysis to this reduced matrix, three clusters are obtained, corresponding to a similarity index value of approximately 0.65, as reported in Figure 4. The obtained clusters group the Spanish cities characterized by the peculiar behaviour of some descriptors:

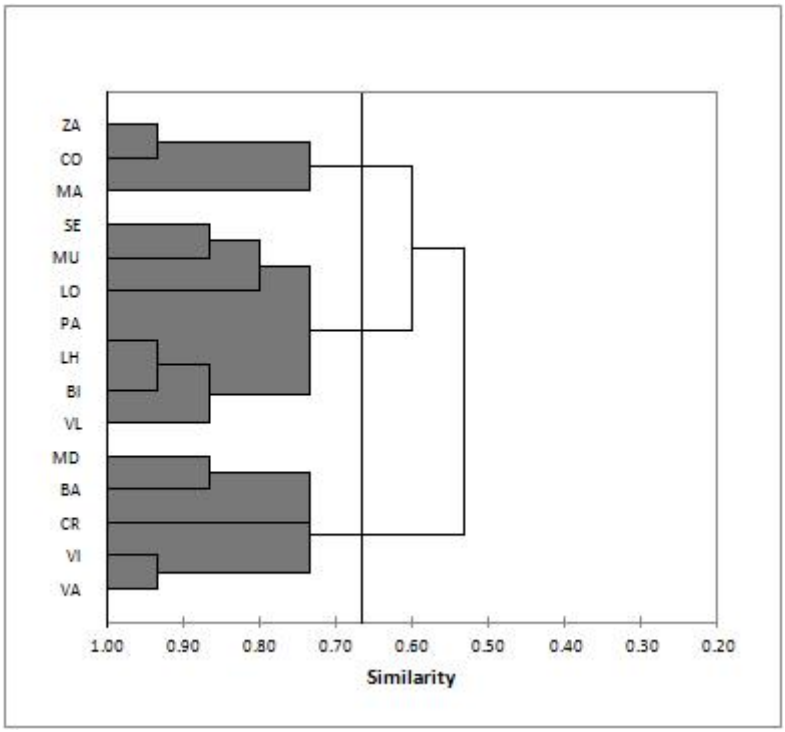



Fig. 4 Dendrogram of cluster analysis for Spanish cities

- Cluster 1 is made up of Zaragoza, Córdoba and Málaga, cities that have included only a few topics in their mitigation plans. They include the GHG emission target, boost energy efficiency, implement waste management strategies, and promote actions to increase building efficiency. These cities have to make extra effort in mitigating climate change in order to keep pace with the most active Spanish cities;
- Cluster 2 (Seville, Murcia, Logroño, Pamplona-Iruña, L'Hospitalet de Llobregat, Bilbao and Valladolid) is characterized by a high number of common topics implemented (energy efficiency, renewable energies, transportation, buildings and households). On the other hand, all cities belonging to this cluster lack urban planning measures, intramunicipal reorganization (such as Green Public Procurement - GPP), and actions in the agriculture sector;
- Cluster 3 includes the cities of Madrid, Barcelona, A Coruña, Vitoria and Valencia which present the most complete mitigation plans implementing seven common topics, including the commerce, trade and service sectors, unlike in the other clusters.

All the Spanish cities include energy efficiency measures and interventions on buildings in their mitigation plans. Consequently these are not characterizing factors for the obtained clusters.
It is worth noting that the most ambitious cities in terms of reduction targets (Zaragoza and Bilbao) are included in the two less ambitious clusters. Figure 5 shows the distribution of clusters across Spain.

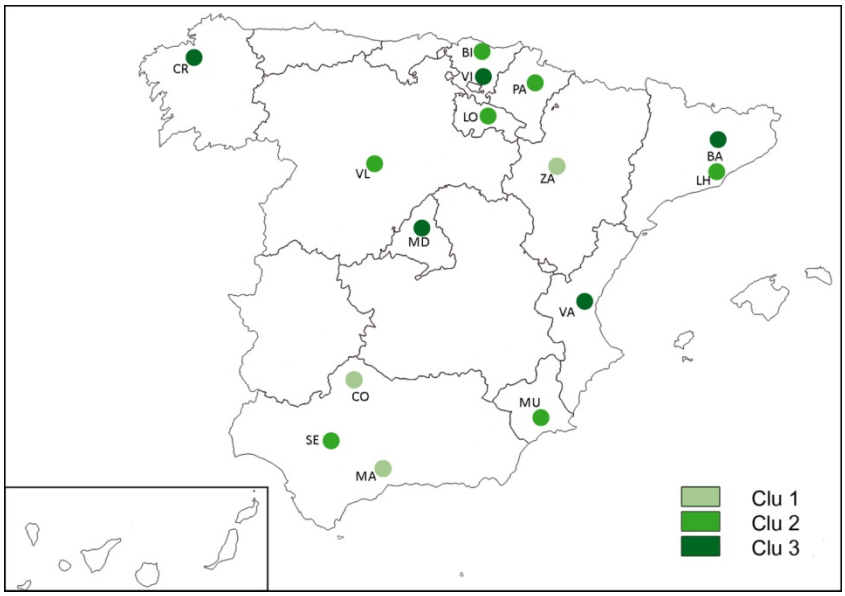



Fig. 5 Spatial representation of cluster aggregations for mitigation efforts in Spanish cities.

### 4.5.2 ITALY

In the Italian sample of 32 cities 15 topics were considered (Table 1) resulting in an initial matrix of [32 x 15] (see Footnote 2 for acronyms). Taking into account all the topics absent in nine cities (Campobasso, Caserta, Catania, Catanzaro, Cremona, Reggio Calabria, Sassari, Taranto and Trieste) the number of objects was reduced to 23, thus obtaining a matrix of [23 x 15]. The results for the Italian database are shown in Figure 6.

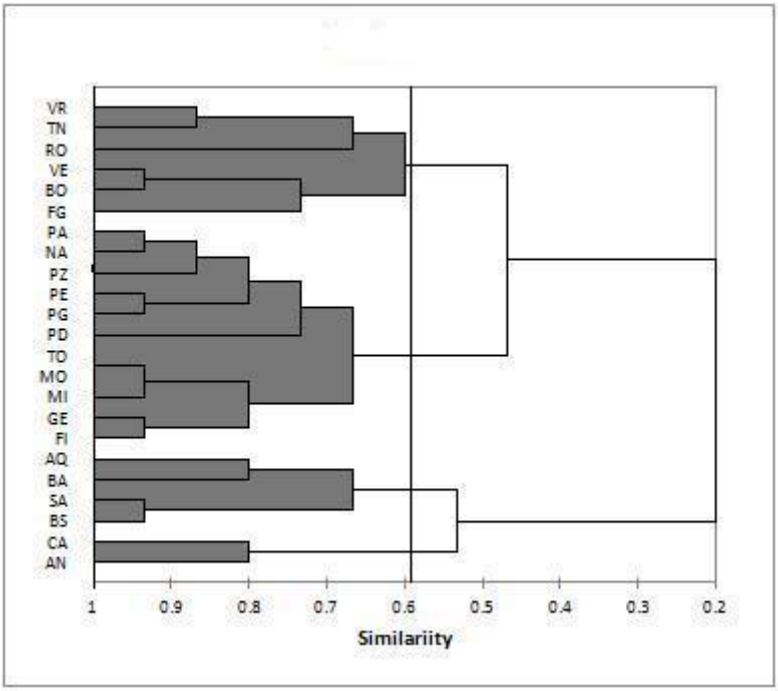



Fig. 6 Dendrogram of the cluster analysis for the Italian cities

This dendrogram identifies the formation of four clusters grouping homogeneous cities in terms of the scope of the mitigation measures (number of sectors addressed) and their focus (which sectors are included).

Clusters 1 and 2 integrate the most active cities, i.e., those undertaking the highest number of mitigation initiatives involving the main economic sectors. The cities in Cluster 1 (Venice, Bologna, Rome, Verona, Trent and Foggia) have mainly promoted measures aiming to increase energy efficiency and renewable energies involving the main economic sectors: commerce, trade, services sectors and households.

All the cities in Cluster 2 (Turin, Modena, Milan, Genoa, Florence, Padua, Naples, Palermo, Potenza, Pescara and Perugia) focused on energy efficiency, renewable energies (both for electricity production and heat production), waste management, urban planning and transportation to reach their mitigation targets.

The medium and low ambitious Clusters 3 and 4 address only a few topics; in particular, the cities in Cluster 3 (L'Aquila, Bari, Salerno and Brescia) have not developed any actions for agriculture, intra-municipal reorganization or jobs. The proposed initiatives include an increase in energy efficiency and the implementation of renewable energies in the commerce, trade and services sectors.

Cluster 4 grouping Cagliari and Ancona refers to the lowest number of topics included in their plans, namely two (transportation and buildings) and three (renewable energies, heating from renewable energies and buildings) respectively.

Figure 7 shows the territorial distribution of the cities. Although 6 out of 9 cities not considered in this analysis (having no topic) are located in the South of Italy, the clusters are rather homogeneously distributed over the Italian national territory.

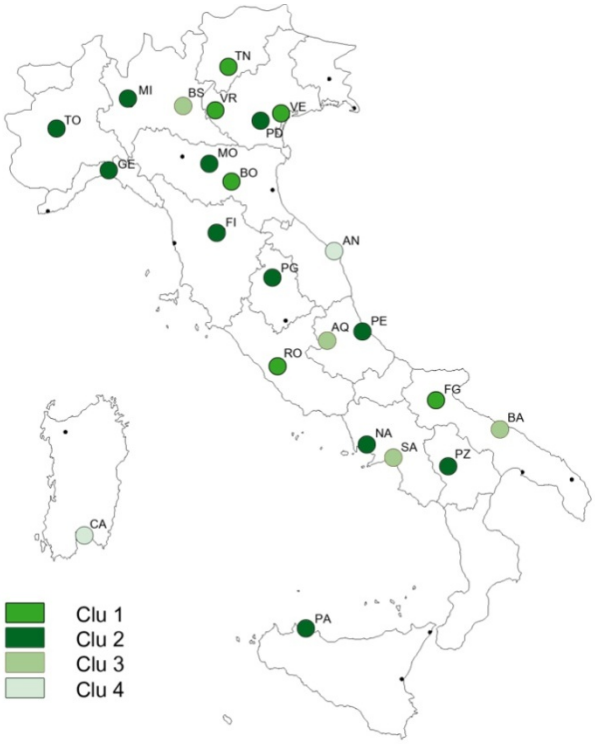



Fig. 7 Spatial representation of cluster aggregations representing mitigation efforts in Italian UA cities

## 4.6 NEW MITIGATION PLANS: ADVANCES SINCE JANUARY 2013

### 4.6.1 SPAIN

The review of the new mitigation plans developed from January 2013 shows that 5 out of 6 Spanish cities that had signed the CoM at that moment (Badajoz, A Coruña, Gijón, Santa Cruz de Tenerife, and Logroño), have already approved their SEAPs. It is to be noted that none of them had previously developed a CCM plan. Vigo signed the CoM in 2010, but, as it does not have a SEAP yet, it no longer appears as "signatory". Santiago de Compostela signed its participation in the CoM in 2013 (after January), but it has not approved its SEAP. Its plan has been under development since September 2014.

### 4.6.2 ITALY

In Italy, CoM influence continues to be very strong; indeed 10 more cities have joined the network in the last two years. Among these, Ancona, Cagliari, Campobasso, Cremona, Palermo, Sassari, Trent and Trieste have implemented and approved their SEAPs and committed themselves to reducing $CO_2$ emissions by at least 20% before 2020, whereas Caserta and Catania are currently preparing their plans. In addition, Reggio Calabria has shown an interest in the CoM but has not yet joined.

Outside the CoM initiative it is important to underline the key role played by Municipal Energy-Environmental Plans in the definition of mitigation strategies. This is the case, for instance, of Perugia where detailed $CO_2$ target reduction for specific actions was specified in the update of its Municipal Energy-Environmental Plan.

On the other hand, Catanzaro, Foggia and Taranto, all of them in Southern Italy, continue to be characterised by a strong inertia regarding mitigation issues; in fact no structured initiatives and plans have been promoted even in the last two years.

# 5 LOCAL ACTION ON ADAPTATION IN SPAIN AND ITALY

## 5.1 COMMITMENT AND LEADERSHIP

On the basis of their overall capacity to adapt to the climate change index elaborated by ESPON (2011), all the Spanish and Italian regions have a low or very low ability to adapt to climate change. This means that 84% of the cities in these countries have a vulnerability index of 4 or higher, on a scale from 1 (low) to 5 (high) (ibid.). Despite the negative impacts expected and the low capacity for adaptation, it can be said that neither Spanish nor Italian cities have really focused their attention on adaptation.

In Spain, even though the RECC has developed some actions oriented to guiding cities to undertake adaptation action (RECC, 2011), only 7 cities out of the 26 studied (27%) have included initiatives related to adaptation in their CCM plans. Four of these cities have integrated an adaptation section or measures in their CCMR plans (Bilbao, Madrid, Murcia and Valencia), while the other 3 have created (or are creating) an adaptation plan specifically. Among those plans, there is only one published (Zaragoza, 2010), while the other 2 are in the early stages of development. Barcelona is compiling information, and Vitoria-Gasteiz has completed the first step through a scenario analysis and a sectorial vulnerability assessment. The small number of Spanish cities developing specific adaptation plans reveals that adaption is not understood as a significant area of action policy by local governments. It is worth noting that the 3 cities that are preparing, or have published, their specific adaption plans can be considered at the forefront of Spanish cities regarding the implementation of a sustainable urban development approach.

In Italy, 11 cities out of 32 (34%) have an adaptation-related plan. Many of these plans were designed to address specific risks.

| Context (motivation) of the plans | % of plans |
|---|---|
| Climate Change Adaptation | 7,69 |
| Energy | 7,69 |
| Heatwaves | 30,77 |
| Hydrology risks | 15,38 |
| Urban greening | 38,46 |

Tab.2 The context (motivation) of the plans related to adaptation in Italian UA cities (% of plans)

Four plans are related to heat waves (Perugia, Potenza, Catania and Milano). Two others focus on hydrogeological risks (Perugia and Catania), and one addresses urban greening (Napoli). In fact, two cities (Perugia and Catania) have a plan for each risk (heat waves and hydrogeological risk). Only one plan mentions adaptation as one of its motives (Padoa, 2011), even though it was enacted along with the mitigation strategy. Five of them have Sustainable Energy Action Plans that also include adaptation measures (Verona, Venice, Sassari, Salerno and Rome).

## 5.2 DIAGNOSING ADAPTATION NEEDS: DO CITIES INCLUDE VULNERABILITY ASSESSMENTS?

In order to identify vulnerable sectors or social groups that require adaptation measures in the short, medium or long term, good practices indicate the need to develop an assessment of vulnerability. This assessment is normally based on current and projected future conditions (e.g. 2020, 2050, 2100…) according to selected scenarios. The assessment of vulnerability not only under current conditions but also in the future is therefore a crucial step in identifying and prioritising adaptation measures and in allocating resources to guarantee sustainability in the medium and long term. Thus, we have identified here which plans from the sample develop and take into account a current and/or future vulnerability assessment for the design of adaptation measures.

In Spain, the review shows that adaptation measures included in the above-mentioned plans have been developed on the basis of little supporting information. Only 2 of these cities (Valencia and Vitoria-Gasteiz) have developed a vulnerability assessment. Valencia has developed a current vulnerability analysis, mainly focusing on health issues, while Vitoria-Gasteiz has further included a future vulnerability assessment by projecting regional temperature and precipitation scenarios onto the local scale and by developing flood and heat wave scenarios for both 2050 and 2100 (Olazabal et al., 2012). Two other cities have also included scenarios in their diagnoses, i.e., Zaragoza (2040 and 2100) and Madrid (2100).

In the case of Italy, not much can be said about the method of diagnosis used for developing these plans, due to the paucity of the contents. Only plans relating to heat waves and hydrological risks have developed (current) vulnerability assessments. For those plans, a reference scenario was used based on the extreme heat wave events of 1998 and 2003 (Perugia and Catania) whereas, in the example of Catania, the extreme rainfall events of 1955, 1999 and 2003 were taken into consideration when assessing hydrological risks. In the case of Perugia historical observations of precipitation from 1860 to 2001 were used. In any case, none of these plans employed medium-long term scenarios to plan for potential risks based on scientific knowledge.

## 5.3 ADAPTATION TOPICS

Table 3 shows the topics most frequently covered in the Spanish and Italian CCA and CCAR plans.

| Adaptation topics | % of Spanish plans | % of Italian plans |
|---|---|---|
| Health aspects | 85.70 | 38.50 |
| Water management | 7.70 | 57.10 |
| Agriculture | 28.60 | 0.00 |
| Forest management | 42.90 | 38.50 |
| Flood protection | 57.10 | 15.40 |
| Urban planning and development | 42.90 | 30.80 |

Tab.3 Topics most included in the Spanish and Italian plans

Most of the topics, except water management, are more frequently covered in the Spanish plans as compared with the Italian sample. Health is the topic most frequently addressed. Forest management, urban planning and development are also included in more than 30% of the plans in both countries.

The Spanish plans approach adaptation to climate change more holistically, acting on a number of topics. Health is the most commonly addressed issue (in fact, taking into account that Barcelona has produced no document, it may be said that all cities consider health aspects). Valencia is an exemplary case, in which all the measures to adapt to climate change have to be implemented by health authorities.

Water issues are also very important. Bilbao and Murcia mention storm water network improvement in relation to flood protection, and Vitoria-Gasteiz aims to draw up a flood map. Water management, being an important issue in Spain, is also widely addressed. The measures in Murcia's plan are mostly geared towards maximizing water savings.

Urban planning and development, along with forest management, mainly focused on prevention, sealing and the development of green spaces. Agriculture is the least addressed topic, only mentioned in Vitoria-Gasteiz and Zaragoza.

More than half of the Italian plans focus on a specific risk rather than a holistic approach to adaptation to climate change. The documents are not based on future scenarios. In general, the Italian cities have drawn up ad-hoc programmes, which in some cases are renewed every year to help citizens face extreme temperatures during the summer season.

The topics most often addressed in these plans and strategies are health (in plans relating to heat and hydrological risks), forest management (mostly in plans motivated by emissions reduction) and urban planning and development (regarding codes and certification in plans related to sustainable energy). Water management and flood protection are poorly covered, apparently because these issues fall within the competences of upper levels of government (i.e. regions). The topic of agriculture is not addressed in the Italian context.

## 5.4 NEW ADAPTATION PLANS: ADVANCES SINCE JANUARY 2013 AND MAYORS ADAPT

Recent adaptive action in Spain and Italy relies on the support of a new European initiative arising from the EU adaptation strategy package Mayors Adapt, which follows the successful CoM structure. The Mayor Adapt initiative has been set up to engage cities in taking action to adapt to climate change, by increasing support for local activities through the provision of a platform for engagement and networking. Cities signing up to the initiative commit to contributing to the overall aim of the EU Adaptation Strategy by developing a comprehensive local adaptation strategy or integrating adaptation measures to climate change into existing

plans. The aim is to include the main outputs into the European Climate Adaptation Platform CLIMATE-ADAPT[15], a partnership between the European Commission and the European Environment Agency (EEA).

In Spain, the cities of Barcelona, Madrid and Valencia have signed this commitment as a first step. Barcelona is currently developing a new plan (the Adaptation to Climate Change and Resilience Plan/Plan de Resiliencia y Adaptación al Cambio Climático). To this end, a report has been produced to address the seven main challenges relating to climate change for the city of Barcelona: health, tourism, water and energy, sanitary infrastructures, governance, coastline (erosion) and civilian protection (regarding improvement of emergency plans). As mentioned above, Madrid has a new Climate Change Plan (Plan de Uso Sostenible de la Energía y Prevención del Cambio Climático - Horizonte 2020/Plan of Sustainable Use of Energy and Climate Change Prevention - Horizon 2020), which represents an improvement on the previous one.

Valencia City Council held the Covenant of Mayors and Adaptation to Climate Change meeting in which they offered other municipalities located in the province of Valencia the possibility to join Mayors Adapt and help them with their local adaptation plans.

Regarding the effects of Mayors Adapt in Italy, Bologna was the first city to join this initiative in 2014, followed by Turin in 2015, whereas Napoli, Palermo and Ancona are in the process of joining it. Bologna has developed the Local Urban Environment Adaptation Plan for a Resilient City, which includes actions on the following main topics: drought and water scarcity, heatwaves in urban areas and extreme weather events. It is also worth mentioning that other cities have developed adaptation plans out of the Mayors Adapt framework. Padua has one of the best Italian climate plans, being carried out within the context of the LAKS-LIFE project, where the adaptation actions are integrated into the SEAP. In January 2014, the Venice City Council approved the Future Climate Venice document, a preliminary document for the development of an adaptation plan.

As happened in the case of the Covenant of Mayors and the development of mitigation plans, cities' commitment to the Mayors Adapt initiative is acting as an important element to enhance the implementation of local adaptation measures on a local scale in both countries.

# 6 DISCUSSION

## 6.1 DISCUSSION ON MITIGATION

Our study reveals substantial differences between the two countries, with Italian cities being on average more active in mitigation as compared with Spain. Considering emission reduction targets, Italian cities are more ambitious than their Spanish counterparts. More cities in Italy (22%) than in Spain (15%) have local $CO_2e$ emissions reduction targets (above 20%). In contrast, and when this study was carried out, Spain had a national climate framework in place, but fewer cities with ambitious or pro-active climate plans (De Gregorio et al, 2014). 75% of the Italian cities and almost 77% of the Spanish cities analyzed have approved climate change mitigation (CCM) or climate change mitigation-related (CCMR) plans, or have officially committed to develop it.

To understand how the mitigation measures were identified, we also examined the types of methods used when developing emissions assessments. We observed that in Spain there is a greater tendency to include emissions assessments and also an increasing tendency to publish material in different phases of plan development. Despite the fact that developing SEAPs is a compulsory condition for CoM signatories, in Italy there are several plans where measures have been identified without any emissions diagnosis at their basis, or where the methods are not specified. Of the Italian plans that do include them, more than half use detailed inventories for all the sectors studied.

[15] Climate-ADAPT platform: http://climate-adapt.eea.europa.eu/

Compared with Italy, Spain shows a more consolidated culture of using emissions assessment information to gain an understanding of problematic sectors when taking decisions about how, when and why certain activities generate more emissions than others. In the absence of a national network in Italy, this could be a sign of an effective influence of the Spanish Network of Cities for Climate (RECC) in recent years.

Regarding the topics in mitigation plans, both the Italian and Spanish cities largely focus on the local energy system and transportation (in both cases, this seems to be related to the significant actions undertaken by the Regional governments on these two issues), but Italian cities cover a greater number of topics, in general. Cluster analysis made it possible to identify homogenous groups of cities characterized by the inclusion (or exclusion) of topics in the cities' mitigation plans. In Spain, analysis reveals three classes of cities, characterized by a different level of ambition underlying their mitigation measures (number of sectors addressed) and their focus (which sectors are included). Cluster 3 addresses the highest number of issues across the highest number of sectors (from 9 to 12 sectors out of 14). This Cluster is integrated by the three largest cities in Spain (Madrid, Barcelona and Valencia), together with Vitoria-Gasteiz (2012 European Green Capital) and A Coruña, with a new plan, released in December 2013. The inclusion of the 3 most populated cities in the country in this cluster shows that bigger cities are undertaking mitigation climate change from a more inter-sectorial perspective than the medium-sized ones. Also noteworthy is the presence of Vitoria-Gasteiz within this group. It is an example of how medium-sized cities with a relevant political will and a long-standing commitment to tackle climate change can keep pace with the bigger ones by devoting financial resources and developing technical expertise. Nevertheless, Cluster 1 does not include cities with the most ambitious reduction targets. In fact, Zaragoza and Bilbao, the two Spanish cities with the higher reduction targets, are integrated into the clusters that address climate action in a small number of sectors, demonstrating that in the Spanish case ambitious target reduction does not go hand in hand with a holistic understanding of mitigation.

## 6.2 DISCUSSION ON ADAPTATION

In general, there are very few climate change adaptation plans, although large parts of both countries are highly vulnerable (ESPON, 2011). By January 2013, 11 Italian cities (34%) and 7 Spanish cities (26%) had developed Climate Change Adaption (CCA) plans or Climate Change Adaptation Related (CCAR) plans. Italian cities seem to be more active, since the percentage of plans in relation to the total number of cities analysed is higher; at the same time, Spanish plans are more comprehensive, as they deal with more topics.

In addition, the difficulty of translating best adaptation practices from one city to another without important investments has to be taken in account. A relevant reason for this has to do with climate action developed by national and regional governments in both countries, which has focused on mitigation, paying less attention to adaptation (De Gregorio et al., 2014).

There have been some advances in both countries (from January 2013 up to June 2015) regarding climate adaptation plans, despite being among those with the least capacity to adapt to climate change (economic, technology, knowledge, awareness and infrastructure) as shown in ESPON (2011). Given that many of the territory of Spain and Italy are considered to have medium or high potential impact on climate change (especially in Spain) (ibid.), it is necessary to start taking steps in the same way that mitigation measures were implemented during the last decade. Initiatives like Mayors Adapt can transform this inertia (up to now: 4 cities in Italy have joined, as have 3 cities in Spain) and help local governments to start an effective pathway towards a more resilient future of their cities.

Referring to the cluster analysis developed for mitigation plans, we can highlight a relationship between the clusters of mitigation topics and advances in the field of adaptation. In Spain, the most ambitious cities with respect to number of sectors addressed in mitigation plans are also the most ambitious in terms of

adaptation. In fact, in Cluster 3 (addressing a higher number of sectors), Barcelona and Vitoria-Gasteiz are in the process of developing an adaptation plan, and Madrid and Valencia have already implemented adaptation measures in their climate change plans (Madrid and Valencia). Regarding Clusters 1 and 2, only Zaragoza has an adaptation plan, while two cities in Cluster 2 (Bilbao and Murcia) have developed adaptation measures.

In the case of Italy we also identified that the most ambitious cities in terms of mitigation have been in general the most proactive ones in terms of adaptation. Cluster 2, the more ambitious one, contains the highest number of cities that have undertaken adaptation actions (7 out of 11). They are followed by the cities in Cluster 1 (3 out of 6), Cluster 3 (1 out of 4) and finally Cluster 4 (0 out of 2), which is the same classification obtained for mitigation.

We may thus argue that the cities that have paid more attention to mitigation issues are at the same time more sensitive to adaptation.

## 7 CONCLUSIONS

This study shows that in Spain and Italy, climate planning has focused on mitigation actions, particularly in the energy area, with policies aiming to increase energy efficiency and promote cleaner energy sources. It seems to be the result of the combined influence of national and international networking initiatives such as the Spanish Network of Cities for Climate (RECC) in Spain, and the Covenant of Mayors (CoM) in both countries, as well as the mitigation policy developed by the upper tiers of government (provinces, regions and central government).

Regarding climate network membership, the great success of the CoM in Italy and Spain (Italy is the country with the highest number of signatory cities in Europe, followed by Spain) has resulted in a great number of Sustainable Energy Action Plans (SEAPs) that must be considered and treated in all respects as climate mitigation plans. In addition, networking activities at national level, such as the RECC in Spain, have demonstrated their ability to effectively support cities in the development of plans and programmes to fight climate change.

Comparison of the two countries from the point of view of the methods used for the base emissions inventories, topics covered by climate mitigation plans, and the level of ambitiousness of $CO_2$ emissions targets shows that Italian cities are generally more ambitious (in terms of the topics covered and emissions reduction targets) than their Spanish counterparts. However, they often lack precise and/or complete information on the method used to develop their inventories.

Although the policies and plans evaluated indicate a trend towards an increasing awareness on climate mitigation, the scarcity of local adaptation plans confirms that urban resilience is a very complex issue. The analysis shows that there is a general delay in dealing with climate change adaptation at the urban level in both countries, because adaptation plans and initiatives are more frequently carried out at a higher administrative level (Metropolitan Area, Province, Region), and because adaptive action is being developed later than mitigation at national and regional levels. This has delayed the potential development of economic and legislative frameworks and policy tools able to incentivise cities to undertake adaptation strategies.

Regarding adaptation, a positive trend has been observed in the last couple of years, as important cities like Barcelona, Madrid and Valencia (in Spain) and Bologna (in Italy) have developed adaptation-related plans. In most of these cities, the development of adaptation strategies/plans was boosted by participation in European projects or by the leading role assumed by the Mayors Adapt initiative. Mayors Adapt seems to play an important role in raising awareness concerning adaptation and giving rise to action in both countries.

Regarding local mitigation initiatives, cluster analysis shows that there are no clear geographical patterns for cities' responses across northern and southern urban areas or between large and medium-sized cities. This

demonstrates a low incidence of the regional level of government on setting models for implementing mitigation. It also makes it possible to observe that the cities that have shown a more holistic approach to mitigation are those that have developed specific adaptation plans. This might lead to the question of whether this should be understood as a best practice.

On the other hand, our study restates the conclusions of Baker et al. (2012): local governments need funding to support effective planning for climate impacts. They also need technical guidance and to engage in awareness-raising and capacity building processes. This is important in general, but particularly in the case of medium cities and cities with fewer resources (Reckien et al., 2015). Also concurring with Bulkeley and Kern (2006), our analysis shows the necessity to provide cities with more political support and guidance so that they can use traditional forms of authority to work in partnership with other relevant local actors in the field of climate protection.

Dealing with climate change at city level needs to be an integral part of city planning and management. This challenge has to be further addressed by Spanish and Italian cities, but also by the wider institutional frameworks in which they are embedded. In order to achieve this vision, knowledge of local climate action has to be produced and effectively used as a basis for local decision-making and negotiations on an international, national and regional scale. This way, urban needs would be better understood and addressed by the legislative and financial frameworks that cities require for them to collaboratively engage with effective climate action.

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## IMAGE SOURCES

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Figs. 1-7: elaborated by the authors.

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