Air Quality and Climate Planning: Paving the Way for Better Integration

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Abstract. Scientific literature increasingly recognizes air quality (AQ) and climate change (CC) as two interconnected issues since many of the same sources are responsible for both greenhouse gas (GHG) emissions and air pollutants. This overlap means that integrated strategies could result in relevant synergies covering not only environmental issues but also social, economic and public health-related implications.

This research explores how air-climate integration is approached within a multi-level governance framework, with a focus on identifying the main factors driving upscaling dynamics. To support this, the study emphasizes the importance of knowledge exchange among cities (horizontal upscaling) and engagement with regional governments to both enhance the conditions for replicability (vertical upscaling) and establish binding standards across municipalities (hierarchical upscaling). Targeting resilient, carbon-neutral and healthy cities, the results provide insights into a better understanding of how well-performing climate actions can be multiplied, accelerated and broadened to pursue a more effective air quality and climate integration.

Keywords: Climate plans · Air quality · Healthy cities · Multi-level governance · Upscaling

1 Introduction

Climate change (CC) and air quality (AQ) are two closely related environmental issues and represent key global challenges requiring proactive and collaborative multi-level policies [1].

However, because of the nature and lifetimes of the compounds involved as well as the time horizons set to target goals, they are usually addressed by different policy departments. At the European level, the Directorate-General for Environment (DG-ENV) deals with AQ while the DG CLIMA (Directorate-General for Climate Action) is in charge of addressing climate change and related impacts [2].

On the climate front, sub-national governments have already been acknowledged as key players in taking actions to address major CC-related challenges. However, an

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increasing number of scholars emphasize that cities are best positioned also to produce environmental co-benefits from climate policies, such as to pursue an improvement of local AQ [3]. Furthermore, with the rise of voluntary initiatives and transnational networks, cities have become innovation boosters able to foster integrated strategies that contribute to the achievement of multiple sustainability goals [4–6].

In order to widen the impact of integrated CC and AQ strategies through the involvement of the upper levels of governance [7], a promising strand of research focuses on upscaling local climate policies [8]. This is defined as the process by which an initiative expands its area of impact and can reach a greater number of people in different places and/or at higher levels over time [9].

It can rely on knowledge exchange among cities (horizontal upscaling), involve several levels of governance (vertical upscaling) or it can be founded on legally binding rules (hierarchical upscaling) [10].

The aim of this work is to contribute to this research strand by focusing on the integration between air quality and climate plans through a multi-level governance system. After assessing the level of AQ-CC integration within climate plans, the paper identifies and investigates different upscaling dynamics by analyzing the case study of the Tuscany region.

The results provide insights about key drivers of upscaling, paving the way for a better understanding of how well-performing urban climate action and its governance can be multiplied, accelerated and broadened [11] coupling environmental benefits with broader societal, strategic, and collaborative goals [12].

The paper is structured as follows: the next section presents the case study, and the methodologies used to assess the integration of air quality into climate plans and to investigate the factors driving upscaling. Section 3 presents the main results and discusses them considering a broad body of scientific literature on the topic of upscaling. Finally, Sect. 4 outlines the key conclusions and highlights potential future developments in the research.

2 Materials and Methods

2.1 Case Study

Tuscany is a region in central Italy, stretching from the Apennine Mountains in the east to the Tyrrhenian Sea in the west and covering about 22,990 square kilometers. It includes 273 municipalities shared among 10 provinces: Arezzo, Florence, Grosseto, Livorno, Lucca, Massa-Carrara, Pisa, Pistoia, Prato, Siena.

On the climate side, Tuscany voluntarily approved a regional mitigation strategy, the “Toscana Carbon Neutral”, targeting carbon neutrality by 2050. It is implemented through the adoption of ten-year Action Plans involving two main lines of action: reducing greenhouse gas (GHG) emissions through the development of a more circular economy-oriented model and increasing emission absorption through the enhancement of green areas and achieving a net zero emission balance by 2050. The current 2020–2030 Action Plan is based on 6 pillars: i) Electricity production from geothermal source;

ii) Electricity production from solar source; iii) Increasing energy efficiency interventions in public and private buildings; iv) Promotion of circular economy interventions; v) Forestation interventions; vi) Promoting sustainable mobility (Fig. 1).

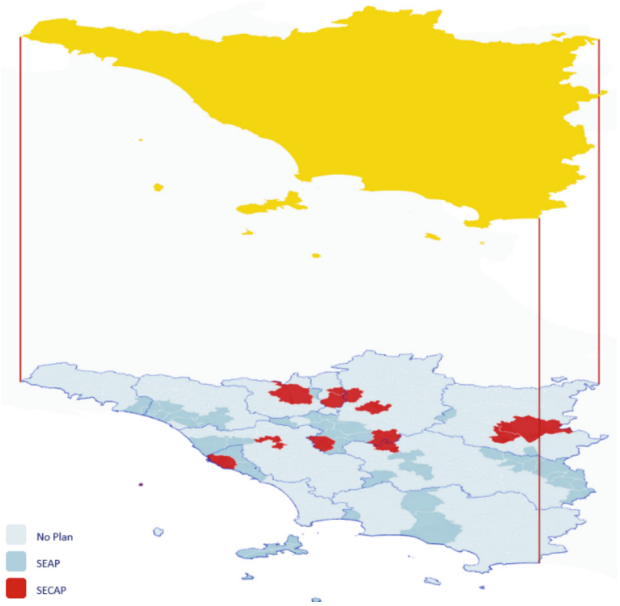

Fig. 1. Overview of climate planning related to the selected case study. At the regional scale Tuscany approved the Toscana Carbon Neutral mitigation plan; at the municipal scale 48 local plans have been approved between SEAP (35) and SECAP (13).

The regional strategy does not foresee any requirement for the municipalities. However, under the umbrella of the Global Covenant of Mayor(GCoM) [13],Tuscanian municipalities have adopted a Sustainable Energy and Climate Action Plan (SECAP) while 33 municipalities approved a Sustainable Energy Action Plan (SEAP).

2.2 The Role of Air Quality in Climate Plans

Sub-national authorities are indeed the most engaged in facing urgent health, social, and environmental challenges [14, 15] with cities in the front line dealing with hotspots of air pollution, noise, heat island effects and other factors detrimental to human health [16]. As cities around the world ramp up efforts to tackle CC, integrating air quality considerations into climate action plans has emerged as both a necessary and strategic move [17]. However, building healthy and sustainable cities requires an assessment of the current degree of integration.

The proposed methodology is based on the following four main criteria:

- Evaluation of the integrated approach [18] pursued during the climate plan's drafting process by a content analysis of the stated objectives;

- The recognition of air pollutants as a co-benefit (or secondary effect) of planned measures to evaluate the degree of coordination between low-carbon development and air quality [19];
- The explicit reference to AQ plans, to both regional and municipal scale to make explicit the synergies potentially deriving from a multi-sectoral approach [20];
- The role assigned to air pollution as an additional risk factor to natural hazards related to CC and exacerbated by extreme events such as heat waves and prolonged droughts [21, 22].

According to the number of criteria fulfilled, to each climate plan was assigned an integration degree ranging from "No integration" (No met criterium) to "Very high" (All criteria fulfilled).

2.3 Investigating Potential Upscaling Dynamics

An upscaling dynamic can be defined as the set of processes that replicate and multiply the most successful strategies [7, 8]. Considering a multi-level governance system, three main types of upscaling are recognized [23].

Horizontal upscaling is based on transfer, replication and knowledge exchange between organizations and authorities that operate at the same level [24]. Typical horizontal upscaling focuses on bilaterally city-to-city interactions as well as through networking arrangements among cities [8], such as trans-municipal networks [23] that cross national borders [25].

Vertical upscaling involves several governance levels, calling for action from supra-municipal authorities to support, perhaps including dedicated funding, the spread of voluntary initiatives [10]. It depends on sub-national and national strategies for broadening climate initiatives and stimulating smaller cities to act. Some examples are the provision of technical support, funding programs or other kinds of incentives.

Hierarchical upscaling entails additional action at the supra-municipal levels of government and is based on legally binding rules exerting their authority to harmonize policies and set standards for all municipalities [7]. As far as climate governance is concerned, these types of actions have found wide use in mitigation [26], for example looking at the EU's mandatory efficiency standards for buildings, not so much in adaptation [27].

Considering the climate planning process across a multi-level governance system [28, 29] and the volunteer approach in leading the development of climate plans at the different sub-national scales [30], the following factors (Table 1) driving the upscaling dynamics were selected in relation to the analyzed case study.

As sub-national climate planning is not mandatory in Italy under the current legislative context, both regional and local climate plans are developed and approved on a voluntary basis. For this reason, any factor guiding hierarchical upscaling could be identified.

Table 1. Driving factors for each upscaling dynamic.

Upscaling dynamic	Driving factors
Horizontal	Membership in climate networks
	Involvement in transnational climate initiatives
	Involvement in transnational project
Vertical	Support from Covenant Territorial Coordinators
	Assistance from Covenant Supporters
Hierarchical	No factors

3 Results and Discussions

The Tuscany region demonstrates a medium level of integration between AQ and climate policies. The region's climate mitigation plan (TCN), in fact, does not explicitly aim to reduce air pollution, even though it lists better air quality as a potential co-benefit of climate actions. Although TCN identifies air pollution as a climate-related risk, it makes no reference to air quality planning efforts.

Looking at the municipal climate plans, the integration landscape is quite varied. Municipalities classified as "No integration" represent 25% of the total number of municipalities with a climate plan. The largest group comprises 23 municipalities (38%) that reach a low degree of integration, while a medium level is observed in 15 municipalities (25%). A high degree of integration is identified in 5 municipalities (8%); the highest degree is achieved by just 3 municipalities (5%). Looking at the municipal climate plans, the integration landscape is quite varied as can be seen in Fig. 2.

Concerning the analysis of factors driving horizontal upscaling, the most widely adopted network among Tuscan municipalities is the Global Covenant of Mayors (GCoM), with 80 out of 273 municipalities (29%) participating. Nevertheless, only 61 of these have proceeded to develop and approve climate plans, resulting in a total of 48 approved plans: 33 SEAPs, 2 Joint SEAPs, and 13 SECAPs. Participation in other international networks is minimal: only three municipalities are part of Eurocities, and Florence is the sole representative in ICLEI. None of the municipalities are affiliated with the Climate Alliance, Energy Cities, or the C40 network. However, Florence, Arezzo, and Prato are members of the Green City Network.

In terms of climate-focused initiatives, only Florence and Prato are involved in the EU Cities Mission. Additionally, 11 other municipalities from their respective provinces (1 from Prato and 10 from Florence) have joined the European Energy Award program. Following the Climate and Environmental Declaration (CED) issued by the Tuscany Region in June 2019, another 9 municipalities, representing roughly 3% of the region, endorsed the declaration within the same year. Regarding the third type of factor, it resulted that 29% of SE(C)APs were drawn up as part of an international EU-funded project.

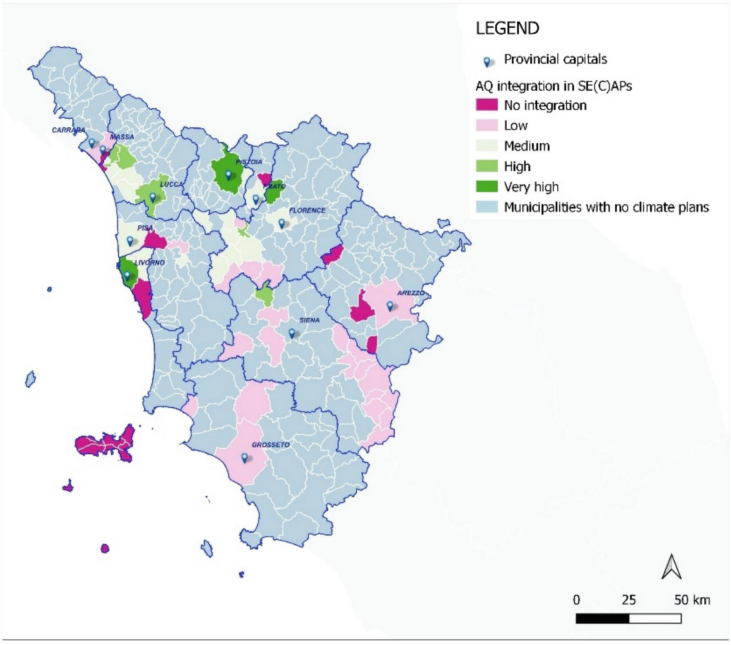

Fig. 2. AQ integration degree assigned to SE(C)APs

Concerning the analysis of factors driving vertical upscaling, 31 municipalities state that their climate plans were approved with the support of a Covenant of Mayors Territorial Coordinator (CTC) under the GCoM framework while 7 plans relied on support from a GCoM Covenant Supporter.

As highlighted by the scientific community, the greatest impact in terms of air quality and climate integration could be reached when the upscaling dynamics interact, creating synergies that imply the involvement of all levels of governance [10]. Horizontal upscaling constitutes a relevant driver of innovation through cross-border knowledge exchange. However, it shows some limits for smaller municipalities because, as highlighted by Kern [9], joining transnational cities networks and institutionalizing climate policy requires certain capacities of the municipal staff. On the other side, vertical upscaling is essential to pursue and support widespread change: without vertical upscaling, good planning practices and initiatives remain little more than "islands of excellence" [10]. Finally, hierarchical upscaling is essential to gather contributions even from cities less engaged in climate challenges, which at least are expected to comply with minimum standards set by regional and national governments [8]. France, for example, has adopted a centralized approach to climate policies with local climate plans required to municipalities [31].

Finally, since the combination of high temperatures, air pollution, and high population density, constitutes a very critical concern in the climate change scenario [32], more efforts are requested to enhance the integration of air quality in adaptation plans.

4 Conclusions

As all levels of governance, from national to local, step up their efforts to address CC, incorporating air quality considerations into climate action plans is increasingly recognized as both essential and strategically beneficial. The connection between air pollution and climate change is in fact not just biophysical; it's also social, economic, and deeply tied to public health and well-being. Clean air goals embedded in climate plans can help the legitimization of efforts to carbon neutrality, improve the quality of life and reduce the incidence of health diseases. Prioritizing cleaner air can also help address environmental justice, as disadvantaged communities often suffer the most from both poor air quality and climate impacts. Incorporating air quality into climate policy planning also boosts economic efficiency, reducing administrative duplication, streamlining implementation, and multiplying returns on investment in mitigation pathways.

The key findings from this research highlight the crucial role of regional and sub-regional authorities in fostering the integration of air and climate considerations within municipal climate plans. Air quality potential co-benefits, directly experienced by citizens, can be used as an effective lever to boost climate actions and engage local authorities in reinforced pathways towards carbon neutrality.

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