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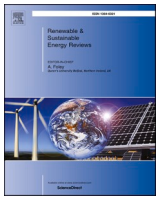

Understanding the motivations and implications of climate emergency declarations in cities: The case of Italy

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ABSTRACT

This study investigates the climate emergency declaration (CED) movement in cities and its effects and synergies with local climate planning. Urban areas are experiencing a wide range of climate-induced extreme events, particularly those located in the Mediterranean hotspot. The focus is on Italian cities, which have only recently become key players in climate planning. The method is based on the collection, analysis, and comparison of data on CEDs and local climate plans (LCPs), integrated with information on city membership in climate networks, to extrapolate key performance indicators of the CED movement. The results show that the CED movement can motivate municipalities to become more ambitious in climate action. As of February 2021, the "climate emergency" movement was supported by 105 Italian cities geographically concentrated in the northern regions (66.7%). The motivation behind a CED is often attributable to local populations calling for concrete climate action (91.1% referred to the Fridays for Future movement) but also to a greater perception of the impacts of climate change (85.6% referred to the Special Report on Global Warming of 1.5 °C). Networking plays an important role (85 cities in the Covenant of Mayors). Interestingly, 36 cities (34.3%) were not engaged in local climate planning previously, but the CED shows now they see the urgency to act. 24.4% cities aim at carbon neutrality in their CEDs (most with local adaptation aspirations), with a much smaller fraction of cities doing so in LCPs and generally lower ambition in terms of greenhouse gas emission reduction targets.

1. Introduction

Cities are at the forefront of addressing the impacts of climate change as they are affected by increasingly serious extreme weather events [1]. However, attempts to quantify the risks posed by climate change have mostly targeted the national and regional level [2], with less attention to the urban level [3]. Cities are among the largest contributors to energy consumption and anthropogenic emissions of greenhouse gases [4] and

Abbreviations: C40, C40 Cities Climate Leadership Group; CA, Climate Alliance; CED, Climate emergency declaration; CN, Carbon neutrality; CO_2, Carbon dioxide; CoM, Covenant of Mayors for Climate and Energy; DEGURBA, Degree of urbanisation; EU, European Union; FFF, Fridays for Future; GCN, Italian Green City Network; GDP, Gross domestic product; GHG, Greenhouse gas; ISTAT, Istituto Nazionale di Statistica (The Italian National Institute of Statistics); LCP, Local climate plan; LG, Local group; NUTS, Nomenclature of territorial units for statistics; SEAP / SECAP, Sustainable Energy (and Climate) Action Plan; UA, Urban Audit; UK, United Kingdom; XR, Extinction Rebellion.

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concentrate most of the infrastructure and economic resources [5], making them particularly vulnerable to the negative impacts of climate change. In addition, the design and implementation of climate policies in cities may not be straight-forward due to the complexity of the urban texture [6] and the high variability of urban microclimate [7].

European cities have so far focused more on mitigation than adaptation interventions [8]. This is at odds with the observation that a mainstreaming approach in other local policy initiatives plays an important role mainly for adaptation [9]. Although an integrated approach to mitigation and adaptation seems to help accelerating urban adaptation planning, there are several barriers to the implementation of such an approach in climate planning at the local scale [10]. A strong impediment is the institutional and administrative capacity [11], such as poor data, lack of funding and a limited access to global governance processes [12]. Furthermore, urban climate change governance involves integrating multiple actors [13] and multiple pathways to achieve low-carbon development [14] and a climate-resilient future [15], which can be complex and difficult.

There are also different triggers of change to help move towards a more sustainable and resilient stage [16] and different types of urban solutions (technological, nature-based and social) can be integrated to ensure the greatest benefits based on local needs and specificities [11].

Despite the difficulties cities face when embarking on the path of climate planning, their decisive role is widely recognized. The United Nations General Assembly resolution "Transforming our world: the 2030 Agenda for Sustainable Development", of September 2015 [17] set the 17 Sustainable Development Goals, including the commitment to "take urgent action to combat climate change and its impacts" (No. 13) and "make cities and human settlements inclusive, safe, resilient and sustainable " (No. 11) [18]. The Paris Agreement, signed by 192 nations in December 2015, recognized the role of cities and other subnational entities in addressing climate change and called on them to step up their efforts to reduce greenhouse gas emissions and, at the same time, reduce their vulnerability to the negative effects of climate change [19]. In October 2018, the IPCC Special Report on Global Warming of 1.5 °C highlighted the need for rapid and far-reaching transitions in land, energy, industry, buildings, transport, and cities systems in order to limit global warming to 1.5 °C [20]. The recent Summary for Policymakers of the IPCC Working Group II report, Climate Change 2022: Impacts, Adaptation and Vulnerability points out that cities are "hotspots of impacts and risks", but also "a crucial part of the solution" because they provide opportunities for climate action, e.g. through green buildings, renewable energy, and more sustainable and efficient transport systems [21].

Hence, many regions across the world support cities in taking climate action or set legally binding targets for cities to help achieve a carbon neutral future. In Europe, the European Green Deal makes the EU's climate neutrality target legally binding, which means that by 2050 the EU's domestic emissions will need to be net-zero [22]. The EU climate and energy framework, which initially included a European-wide target of 40% reduction in GHG emissions by 2030, was considered not sufficient to meet the Paris agreement target [23]. This led to the enactment of the European Climate Law, which entered into force in July 2021. It increases the intermediate 2030 target to at least 55% GHG reductions compared to 1990 levels and includes "a process for setting a 2040 climate target" and "a commitment to negative emissions after 2050" [24].

However, while cities and local communities are increasingly engaged in climate action [25] there is also the recognition that this is not enough to prevent dangerous interference with the climate system and safeguard a world at or below 2 °C warming above pre-industrial levels [26]. Much more drastic action would be needed, widespread and soon.

On November 19, 2019, in a letter published in BioScience, a group of over 11,000 signatory scientists from around the world made it clear and unambiguous that planet Earth is facing a climate emergency [27]. This letter was a signpost of a wave or movement that began among Australian governments between 2008 and 2016 and eventually became known as the climate emergency declaration (CED) movement starting around 2016. As of May 14, 2021, a total of 1940 jurisdictions and local governments world-wide had declared a state of climate emergency, as outlined by the "Climate Emergency Declaration and Mobilisation in Action" – CEDAMIA [28], affecting a global population of 826 million citizens. In the European Union, representing 28 member states in 2019, CEDs were declared by the EU Parliament (November 28, 2019) [29] and 8 national governments (UK, Ireland, Portugal, France, Spain, Austria, Malta, and Italy, in sequence of adoption between 1 May and December 12, 2019) [30]. The Italian Parliament was the last to declare a state of climate emergency among these countries.

The general objective of this research is to provide evidence and insights into the effects of the CED movement in European cities, particularly with regard to its interrelationships with local climate actions and climate planning. To this end, Italy represents an interesting case to study the contribution of CEDs to local climate action, as many lower-level jurisdictions such as cities and regions have been willing to take the lead in this movement despite the national government's delay. It also offers a broad and diverse picture in terms of local climate planning, capturing the general situation of European cities trying to cope with the climate crisis, in order to investigate whether CED declarations fit into and influence local climate planning.

Specifically, two main research questions are addressed. First, what are the motivations that led cities to declare a climate emergency (hereinafter referred to as "CED cities") and what kind of actions have they undertaken? Second, what are the impacts of CEDs in terms of climate mitigation and adaptation targets and what is the current status of CED cities in terms of local climate planning? The research method used to analyse the case study under review (Italy) is broadly applicable and replicable for investigating the effects of the CED movement in other countries, both in Europe and beyond, and for informing researchers and policy makers at multiple levels of government involved in the transition of cities to climate neutrality.

This work is structured in six sections. Following this introduction, a brief overview of the scientific literature on climate emergency declarations is given and then the case study and methods adopted are thoroughly described. The results obtained from the survey and analysis of the content of the CEDs and local climate plans (LCPs) are then reported with specific reference to the research questions of this study. After a critical discussion of the key findings achieved, the final sections conclude with key messages and further possible research developments.

2. Literature review on climate emergency declarations

Local governments across the world, spearheaded by Australian local governments, have declared a climate emergency in recent years [31]. Although CEDs are often described as symbolic gestures [32] on rhetorical statements [33] and there are still controversial views on the use of the terminology [34], the rapid increase in such declarations requires the attention of the scientific and political world to better understand this phenomenon and how local government responses will be operationalised [35].

CEDs represent the strongest statements by governments at various levels calling for more action on climate change [35] and also an opportunity to promote changes in climate change governance [36]. In particular, CEDs provide cities with a new policy framework with high potential to mobilise and accelerate local climate action and can drive engagement at higher levels of governance, up to national government [33].

One commonality among the studies conducted so far concerns the main motivations for cities to declare a climate emergency, which seem to stem mainly from civil society pressure [32] and in particular from protests against climate inaction by social movements such as Fridays

For Future [37].

The main concerns that have emerged from the studies to date relate to the implementation phase following a CED, which has to deal with substantive and challenging climate action [33] within the constraints posed by existing organizational aspects and resources of local governments [36]. The development of post-CED climate emergency plans is a very recent and not yet widespread activity, as can be seen from the fact that only a few studies have focused on this aspect so far. Included in this exception are studies by Davidson et al. [35], who analysed the new action plans implemented by two cities (Darebin, Australia and Auckland, New Zealand), and by Harvey-Scholes C [38]. who studied 237 local authorities in the UK, showing that a concrete action plan for decarbonization followed the declaration in most of the CEDs in this country.

It is therefore evident that scientific studies to date have not fully grasped the potential of CEDs adopted at all jurisdictional levels around the world, particularly the many CEDs adopted at urban and local levels. The few studies currently available focus on the few countries where the CED movement appears to be geographically concentrated [32], namely mainly the United Kingdom [38] and Australia [39]. There is a lack of studies on the CED movement and its effect in other countries, particularly within the European Union.

It is noteworthy that, to the best of the authors' knowledge, no study has focused on the roots of the CED movement in local climate planning and the links between local climate planning and CEDs. This research intends to contribute to filling this gap by providing a timely and in-depth survey on a Mediterranean country, Italy. This country, for its complex system of multi-level governance, for the framework of energy and climate policies in place and for the considerable diversity of cities in terms of geographical, socio-economic and environmental characteristics, may in fact provide an interesting case study from which to start for an eventual extension of the research to other countries, both European and non-European.

3. Case study

This section aims at providing an overview of the climate and energy policy framework for the case study cities. Italy contributes 11.4% [40] of the EU and 1% [41] of the global greenhouse gases (GHG) emissions respectively in 2020 with 14% [42] of the total EU and 0.78% [43]of the global population. The Italian climate policy scene is complex and multifaceted: there are cities pioneering in the mitigation and adaptation fields, acting according to different kinds of motivations, policy incentives and regulations [24], and cities that are struggling to advance in this policy domain. In this rich and complex scene, climate policies have been addressed in a synergetic and complementary way to energy planning and other sectoral policies. Particularly, energy planning has been for a long time a relevant action tool in the hands of public administrations at national, regional and local levels to mitigate climate change and improve energy efficiency, increase the use of renewable sources, and stimulate energy saving and the rational use of energy [44]. Energy plans have exerted a relevant influence in fighting climate change at the municipal level. On the local level, the history of the municipal energy plans began with Law 10/91 [45], which established that the City Plan (in Italian, *Piano Regolatore Generale - PRG*) of municipalities with a population greater than 50,000 inhabitants should integrate a specific plan for the use of renewable energy sources. In 1997, a national agency published the Municipal Energy Planning Guide, which identified seven modules to be considered to develop the municipal energy plan [46]. It can be said that this regulation, together with the guidebook and the significant participation of Italian cities in EU projects tackling climate or energy issues, provided a framework in which large Italian cities began to build technical and administrative capacity with regard to climate policies.

On the national level, following EU directives, Italy approved its National Energy and Climate Plan (NECP) [47]. The NECP was discussed with the regions and various local entities, also involving the association of Italian municipalities and other stakeholders.

This new framework provides incentives and guidelines to promote cities' contribution to mitigating climate change. However, the NECP does not set binding targets for the municipalities in terms of emissions reduction or other related goals and indicators. In terms of sectors, both energy efficiency and urban mobility emerge as relevant drivers of action. Something similar is currently being developed in the field of adaptation to climate change, with the National Plan to Climate Change Adaptation (PNACC) [48] still in the process of approval (currently in the strategic environmental assessment phase).

Over the last two decades, in particular before 2019, the real impetus to move from traditional energy planning to municipal climate planning [49] has come from transnational climate networks [50], confirming that in countries where national climate policies are lacking or weak, the most active and sensitive cities to climate change take their steps within international climate networks [8].

In this situation an important role for the Italian public local authorities has been played by the Covenant of Mayors (CoM) [51], which makes it mandatory for the participating municipalities to develop local climate plans (LCPs). Since the CoM launch in 2008, signatory cities have committed to developing a mitigation plan (Sustainable Energy Action Plan - SEAP) with a carbon dioxide (CO_2) reduction objective of 20% by 2020 compared to 1990 levels (in line with the European Union 2020 Climate and Energy package [52]). Subsequently, following the launch of the new integrated Covenant of Mayors for Climate and Energy (October 2015), the signatories of the new Covenant have pledged to support implementation of the EU 40% greenhouse gas reduction target by 2030 (compared to 1990 levels) [53]. This is done by reducing their CO_2 emissions (and potentially other GHGs) and taking a joint approach to address climate change mitigation and adaptation through the adoption of a Sustainable Energy and Climate Action Plan (SECAP).

In summary, according to previous studies, the climate response of Italian cities over the last two decades has mainly been fostered by their adhesion to the Covenant of Mayors (e.g. Pietrapertosa et al., [54]). However, the effects of the CED movement in this country are not reflected in previous studies; and their contribution to the adaptation and mitigation aspirations and achievements of Italian cities is unknown. This study aims to contribute to the understanding of the role of CEDs, as new policy frameworks in this field, in encouraging and spreading climate action in European cities, drawing on the complex and multifaceted Italian case study.

4. Materials and methods

The methods used to investigate the roots of the CED movement in local climate planning build on previous studies concerning the analysis of local climate plans of European [8] and Mediterranean cities [26]. They were further developed to analyse climate emergency declarations and, most importantly, the links between local climate planning and CEDs.

The approach adopted in this study was based on the identification of a sample of cities for the selected case study (Italy), the collection and analysis of relevant data and indicators characterising these cities, and a content analysis of official data sources (documents produced by transnational/national networks and city councils) and materials contained in relevant websites, integrated with additional information provided through email exchange by key informants (city councillors and environmental activists). The main research steps and the interrelated feedback are represented graphically by the flowchart of Fig. 1.

4.1. Identification and collection of relevant documents

To identify the sample of cities for the case study, first an inventory was made of all Italian cities that had declared their CED by the end of February 2021. For this purpose, the CEDAMIA database [28] was

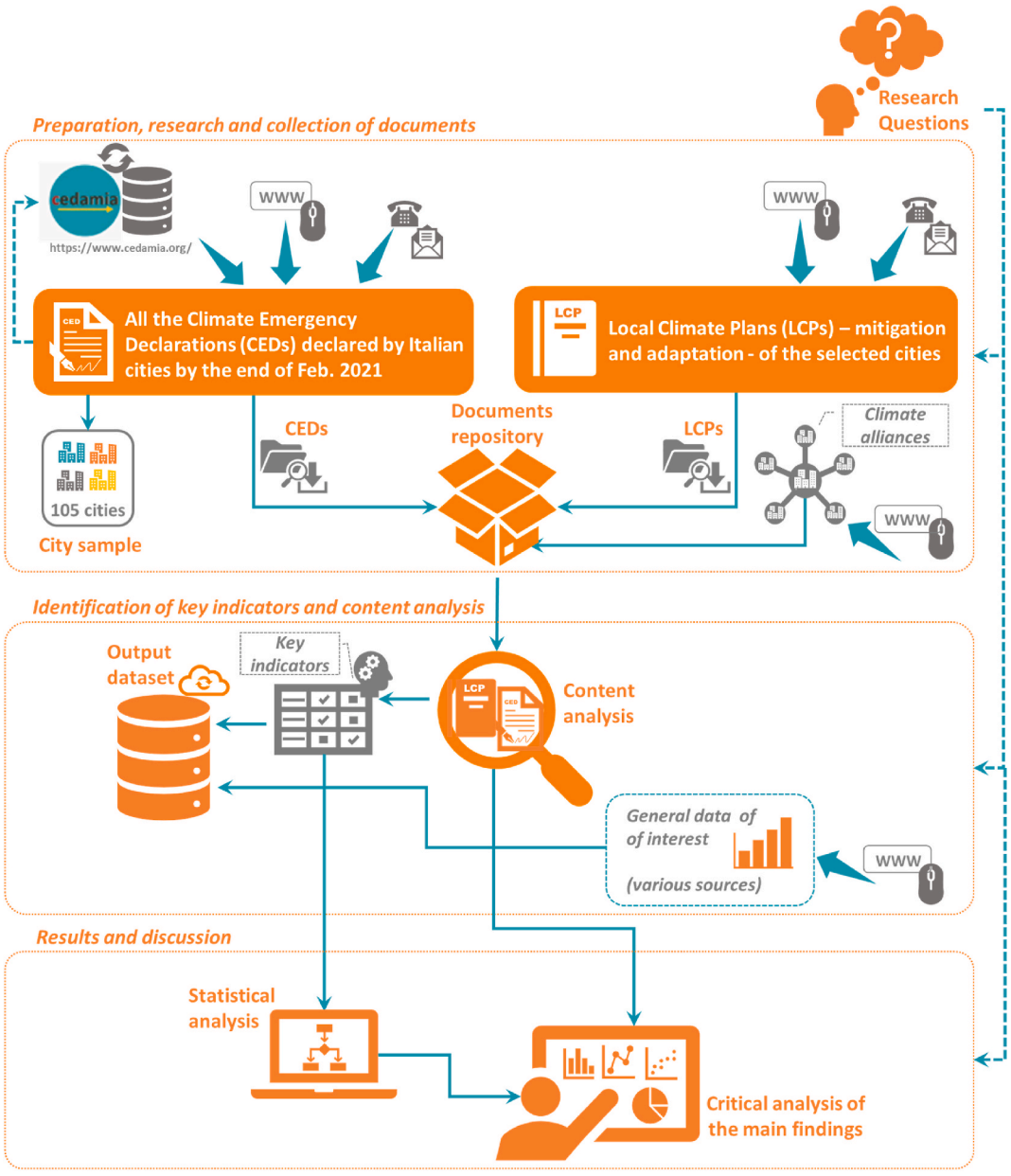


Fig. 1. Flowchart of the research method utilised in this study.

consulted, which also provides links to the available CED documents. This search was supplemented with a review of the information contained on local administrational websites, available online press and other relevant websites related to non-governmental organisations (NGOs). This made it possible to verify and complete the list of cities. In case of insufficient information available online, direct interactions (through email exchange) were carried out with key actors, such as city councillors and environmental activists, identifying any relevant additional documents.

In parallel, the available information on the LCPs (both mitigation and adaptation) of the selected cities was compiled (as of April 19, 2021). Following the methodological approach adopted in previous studies (e.g. Reckien et al. [9]), the identification of LCPs was carried out by the native or fully proficient language authors using desk/web review and keyword searches in the Italian national language, such as: "[city name] plan for mitigation/adaptation to climate change", "[city name] strategy for mitigation/adaptation to climate change", "[city name] climate plan", "[city name] integrated plan for mitigation and adaptation to climate change", and "[city name] SEAP/SECAP".

Further research on the Sustainable Energy Action Plans (SEAPs) and Sustainable Energy and Climate Action Plans (SECAPs) was also conducted through the Covenant of Mayors for Climate and Energy portal [51]. In the case of the availability of a SECAP updating and replacing an older SEAP, only the latter planning document was considered in the analysis. As a result, a comprehensive repository was built containing all CEDs declared by Italian cities along with and the local climate plans (LCPs). These documents were used in order to proceed with the content analysis described in Section 4.2.

4.2. Identification of key indicators and content analysis

Subsequently, all data and indicators of interest for the research were collected and a content analysis of all the CEDs and LCPs documents, gathered and organised in a common repository, was carried out (Fig. 1).

The first step dealt with data collection. The first column of Table 1 (1.1 General data) provides the list of data on the sample cities that were

Table 1
Key data and information gathered for the sample of cities.

1. Data collection		2. Content analysis	
1.1. General data	1.2. Adhesion to transnational/ national climate networks	2.1. CEDs indicators	2.2. LCPs indicators
Name of the Council Province Region Population (2019) Surface area (sq. km) DEGURBA (1/2/3) Coastal/non-coastal GDP per capita at NUTS-3 FFF local groups XR local groups	C40 Climate Alliance Covenant of Mayors Italian Green City Network	CED approval date Web sources Reference to CED petitions Reference to Fridays for Future Reference to CEDAMIA Reference to IPCC Report 2018 Reference to SD Goals CO_2/GHG target Reference to climate networks Reference to LCP and its targets Mention of Adaptation Mention of local air pollution Support for citizen initiatives Request to local and national institutions to promote climate	LCP approval date Web sources Name of the LCP Commitments CO_2/GHG target: - emission target - baseline year - target year Carbon neutrality target (in the LCP or in other plans): - target year - web source Integration of adaptation and mitigation in the same LCP Mention to local air pollution
Main sources: Istat [58], UrbiStat [59], Eurostat [60], Kona et al., 2020 [56]	Network websites [61–64]	Cities' CEDs [57]	Cities' LCPs [57]

sought through official and statistical sources. In particular, the Degree of urbanisation (DEGURBA) makes it possible to distinguish between 1) Cities (densely populated areas); 2) Towns and suburbs (intermediate density areas); and 3) Rural areas (thinly populated areas) [55]. The Eurostat classification of local administrative units (LAUs) into 'coastal' or 'non-coastal' areas was associated with the sample cities to take into account whether the cities analysed are (or are not) bordering or close to a coastline [55]. The gross domestic product (GDP) per capita (average 2010–2018) at current market prices by NUTS-3 regions were taken from Kona et al. [56] for CoM member cities and from Eurostat for other cities. In parallel, information on the cities' adhesion to transnational/national climate networks (listed in the second column of Table 1) were retrieved from their official websites. In addition, to better frame the Italian situation in terms of citizens' participation in climate and environmental issues a further search was conducted to collect data on the presence in Italy and in CED cities of local groups (LGs) of the Fridays for Future (FFF) and the Extinction Rebellion (XR) movements.

Second, the official CEDs and LCPs were analysed and evaluated to identify the key indicators (listed in the third and fourth columns of Table 1) able to answer the main research questions. All the LCPs collected consisted of complete and information rich documents for the content analysis. In the case of the CEDs, the sample of 105 Italian cities with a CED was considered in its entirety for all the statistics of this study, while for the content analysis it was possible to analyse only those CEDs for which complete documentation was available. Thus, 15 cities (14.3% of the total sample) were excluded from the analysis because their CED consisted only of short minutes of a city council resolution.

The resulting dataset is made available as an open-source online data repository hosted at Mendeley Data [57].

4.3. Statistical analysis

In order to provide robust statistical evidence of the relation between CEDs and local climate planning statistical analyses were conducted. In particular, these statistical analyses provide robust insight into the relation between the variables associated with the research questions of this study through statistical tests undertaken to scrutinize whether.

- Any of the international movements and agreements has had an impact on the CED outcomes, and
- A carbon neutrality target (as local ambition for the CED) is related to any of the following:
  - o memberships in international networks,
  - o international climate movements and agreements,
  - o local climate and environmental impacts, or
  - o local adaptation and mitigation planning, including the mitigation target.

First, correlation analyses were conducted using Kendall tau-b correlation coefficients and two-tailed significance [65]. The outcome was thereafter cross-checked using a Chi-Square test of independence [66]. Both test results are attached as Appendix A. In this work, results of the Kendall tau-b correlation coefficients and significance are reported in the results section.

5. Results

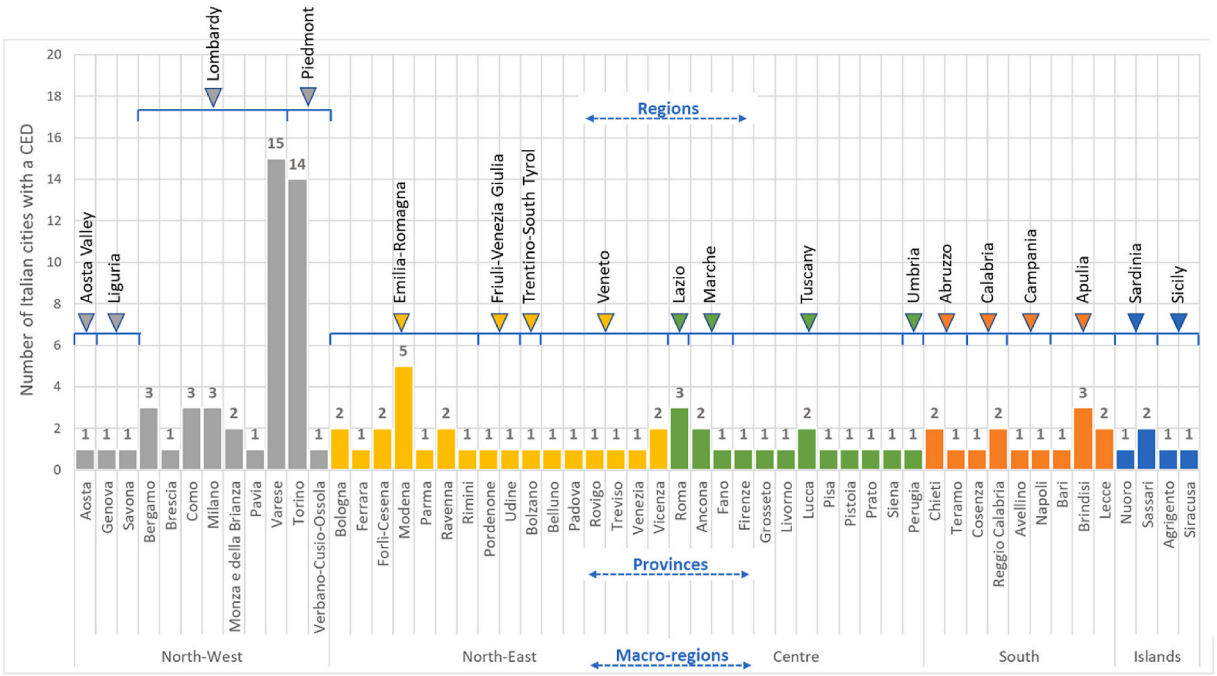
The complete CEDs of the 90 cities (85.7% of the city sample) were analysed in detail to highlight important common characteristics and distinctive elements of the different local realities. First, the main characteristics of the sample of CED cities are briefly introduced, focusing on the geographical peculiarities and the level of involvement of these cities in transnational climate networks. To complement the data presented in this section, more complete and detailed data are provided in the cloud-based dataset supplementary to this study [57]. Next, the main results obtained through the content analysis of CEDs are described in detail with reference to the two main questions that guided this research. A critical analysis of the research findings forms the basis of the discussion section of this study.

5.1. Geographical distribution, key characteristics and participation in transnational climate initiatives

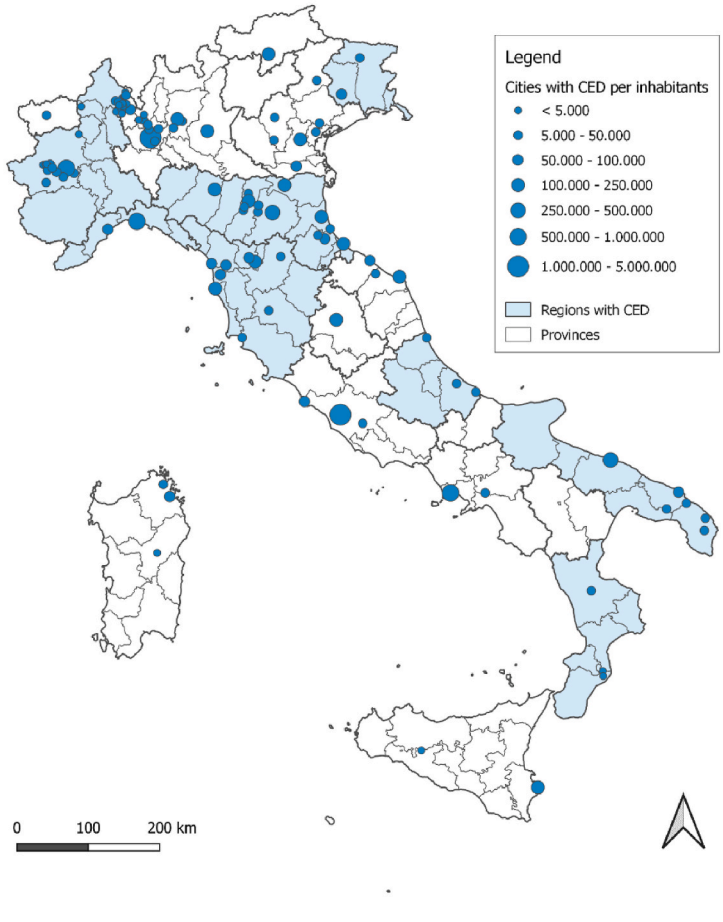
Research carried out on CEDs approved by Italian administrations at various levels of government showed that 8 out of 20 regional governments (Marche, Tuscany, Liguria, Emilia-Romagna, Apulia, Friuli-Venezia Giulia, Calabria, and Piedmont) approved a CED between 7 June and December 12, 2019. The analysis also showed that 105 Italian cities had declared a climate emergency by the end of February 2021. Of these, 81 were reported in the CEDAMIA database (as of January 27, 2021).

Fig. 2 shows the geographical distribution of the CED cities, which are spread over.

- The 5 Italian *macro regions* (the first-level NUTS of the European Union): 46 cities that have declared climate emergency (that is 43.8% of the total cities in the sample) are located in the North-West, 24 (22.9%) in the North-East, 16 (15.2%) in the Centre, 14 (13.3%) in the South, and 5 CED cities (4.8%) in the Islands.
- 18 out of 20 Italian *regions*: Basilicata and Molise are the only two regions in which no city has declared a CED. Moreover, these regions also do not have a CED. Among the other regions with a CED, 28 CED



a)



b)

Fig. 2. Distribution of the 105 sample cities among the Italian macro-regions, regions and provinces (a); and geographical representation of cities (by city size) and regions with a CED (b).

cities (26.7% of the total 105 cities) are in Lombardy (which has not declared climate emergency), 15 (14.3%) in Piedmont, 14 (13.3%) in Emilia-Romagna, 9 (8.6%) in Tuscany (without a CED at regional level) and (7) 6.7% in Veneto (without a CED).

- 53 out of 107 Italian *provinces*: among which, 15 CED cities (14.3%) in the Province of Varese (Lombardy), 14 cities (13.3%) in Turin Province (Piedmont) and, 5 (4.8%) in Modena Province (Emilia-Romagna).

The population covered by the CED cities represents 19.2% of the national population (as of December 31, 2019) and ranges from 520 inhabitants of Pazzano (Calabria) to 2,837,332 inhabitants of Rome (Lazio), with an average population of 124,158 inhabitants. The classification of CED cities in the sample by number of inhabitants is shown in Fig. 3 a, whereas Fig. 3 b shows the total population of each class of cities in the sample. Fig. 3 a highlights the great attention and important role played by smaller cities (in relative terms) regarding the climate issue. In fact, and interestingly, cities with a population between 20,000 and 59,999 inhabitants are the most represented in the sample (21 cities, that is 20.0% of the total number of cities in the sample), covering a population of 781,695 inhabitants (6,8% of the sample). This is followed by CED cities with a population of 10,000 to 19,999 inhabitants (18, 17.1%), representing 260,099 inhabitants (2,3%).

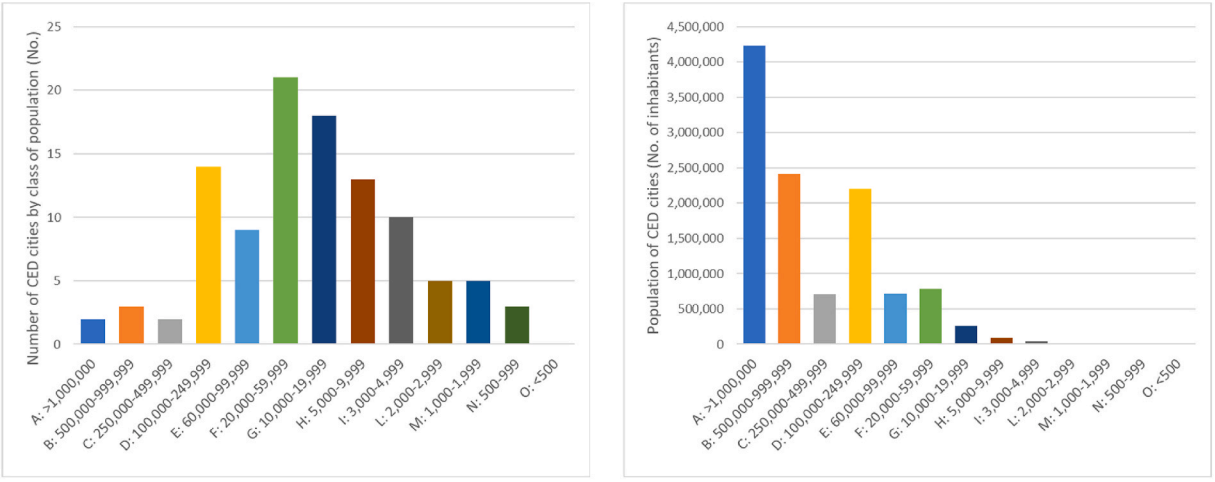
The analysed cities are characterised by a surface area ranging from 4.18 km^2 (Brenta, Lombardy) to 1287.37 km^2 (Rome, Lazio); with an average value of 96.12 km^2. Three quarters of the cities that have declared a climate emergency are located in a non-coastal area and only the remaining 24.8% in a coastal area, according to the EUROSTAT classification [60]. Regarding the Eurostat degree of urbanisation of the analysed CED cities, half of them (55,2%) fall in the category of towns and suburbs (i.e., intermediate density areas), more than a quarter (27, 6%) are cities (i.e., densely populated areas) and only the remaining 17, 1% are rural areas (thinly populated areas).

The annual average 2010–2018 GDP per capita (Euro per inhabitant per year) at NUTS3 level varies considerably from a minimum of 14,311 of the Province of Agrigento (Sicily) to 46,678 of the Province of Milan, with an average value of 27,737.21 Euro per inhabitant, which well represents the Italian average value of 27,800 Euro per inhabitant. This difference in GDP values also highlights the substantial differences in economic development between the north and south of Italy, which are also confirmed by the average GDP values at macro-region level: 34,125 euros per inhabitant in the north-west of the country, 32,763 in the north-east, 30,563 in the centre, 18,588 in the south and 18,125 in the islands. Fig. 4 shows the average GDP per capita at NUTS3 by classes of population and degree of urbanisation unearthing that rural areas are generally characterised by the lowest GDP per capita, with only two exceptions. The first, for population class B (500,000–999,999 inhabitants) where the average value of the 2 "cities" (Genoa, in the northwest, and Naples in the south of Italy with a GDP of, respectively, 31,022 and 17,900 euros per inhabitant per year) is 24,461, which is lower than the 27,406 euros per inhabitant per year of the "rural area" of the province of Ancona (central Italy). The second, for population class F (20,000–59,999 inhabitants) where the 2 'rural areas' are Siena (Tuscany, central Italy) and Bologna (Emilia-Romagna, northwest Italy) with an average GDP of 32,100 euros per inhabitant per year, which is lower than that of the 5 cities (35,144) but higher than the average of the 14 'cities and suburbs' that fall into this population class (28,662).

The findings of the analysis of CED documents show that the majority of cities declaring CE is a member of a national/transnational climate network. Among these networks, the Covenant of Mayors for Climate and Energy represents the most successful transnational climate alliance in Italy, counting 85 cities in the sample among the signatories (2 of which also adhere to the C40 Cities Climate Leadership Group). 10 cities are members of the Climate Alliance while 33 cities have been actively involved in the Italian Green City Network. Fig. 5 geographically represents the commitment of Italian CED cities in one or more of the analysed national/transnational climate networks.

This is partially reflected in the findings of the content analysis of the analysed CEDs: 32 (35.6%) cities refer to their previous adhesion to the CoM or the willingness to adhere in the following months. Only one city (Alagna Valsesia) refers to the Climate Alliance [67] whereas two cities (Syracuse and Tolmezzo) refer to the Italian Green City Network (GCN) [64]. These findings resonate with the recent research (including [68, 69]) showing how diverse networks stimulate heterogeneity in local climate experiments and develop new and innovative climate solutions in their member cities.

Moreover, an involvement in EU-funded projects related to climate change is found only in the CEDs of four cities (4.4%) demonstrating the widespread inability of local and municipal authorities to access European funds through international cooperation projects. The CED of the city of Ravenna refers to the Permanent Forum for Climate Change of the Emilia Romagna Region, recognising the important role of the regional framework in driving sustainable transition.



a) b)

Fig. 3. Number of CED cities in the sample by class of population (a) and total population of each class of cities (b).

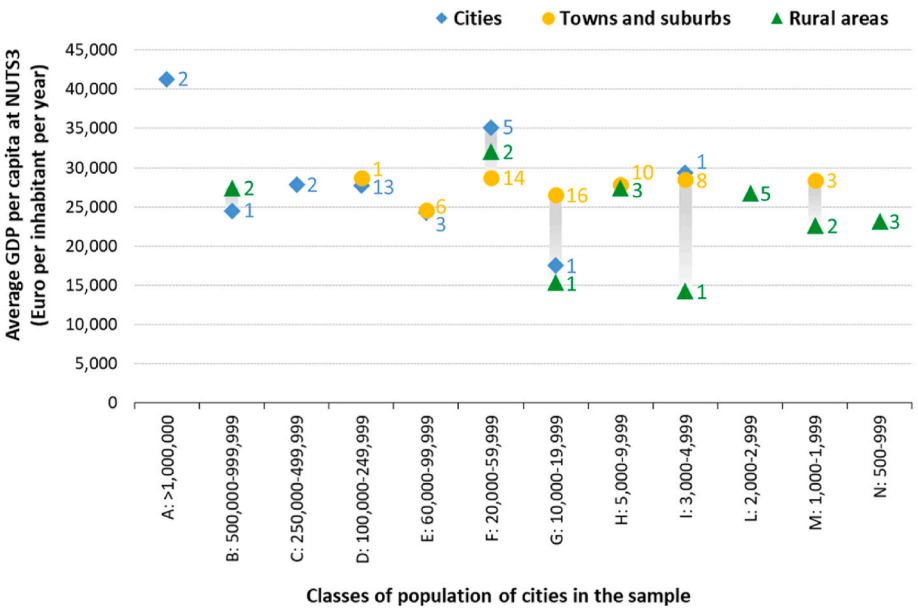


Fig. 4. Average GDP per capita at NUTS3 by classes of population and degree of urbanisation (the number of cities, towns and suburbs and rural areas are indicated next to their symbols in the respective colours).

5.2. Motivations and actions promoted by the CED cities

The findings of this study show that the majority of cities (82 cities, i.e. is 91.1% of the 90 CEDs analysed) refer to the Fridays for Future movement [70], confirming the findings of existing studies (e.g. Davies et al. [37]), and 77 (85.6%) to the IPCC 2018 Special Report [20] as key motivations for declaring a CED. In addition to that, 15 (16.7%) cities mention in the CED rationale the Sustainable Development Goals [18], 7 (7.8%) an online petition containing the request of citizens and campaigners to the Italian government, regions and municipalities to "declare a state of climate emergency" [71]. Only in one case (Bologna) the CED was requested by the Extinction Rebellion group [72].

Regarding the motivations of CEDs, the statistical analysis further showed that those CEDs that mention the IPCC Report on 1.5 Degrees also call for both more local (τ_b, is 0.461, p = 0.000) and national support (τ_b, is 0.447, p = 0.000) in accelerating climate action (Appendix A.1 and A.2.4.2). The mention of the IPCC 1.5° Report is also significantly associated with a higher GHG mitigation target in the local climate mitigation plan (τ_b, is 0.228, p = 0.039) (Appendix A.1). This shows that cities that are already ambitiously committed to climate action, perceive that more is needed, but this cannot be accomplished by the local authorities themselves. This is in agreement with the results of a recent study by Peng and Bai [73] on 39 Chinese cities promoting the development of hydrogen energy, emphasising that the ambition of cities and the relationship between local and national government are important elements in local climate actions. In contrast, the CEDs that refer to the FFF movement are of mixed characteristics and are not significantly related to any other city or CED characteristic.

The rationale for declaring the climate emergency also indicates the CED's timeframe. More specifically, beginning in 2019, Italian local governments began declaring CEDs, following the release of the IPCC 1.5° report in October 2018 and the activation of FFF movements from the end of August 2018. Climate movements are an ongoing process even after the approval of the CEDs. As of April 2022, 161 FFF Local Groups (LGs) are distributed in 19 Italian regions (except only Molise). In particular, there are 40 CED cities with a FFF Local Group of which 8 are in Emilia Romagna (north-east), 6 are in both Lombardy (north-west) and Tuscany (centre), 4 CED cities are in the south and 2 on the islands. The presence of local groups of Extinction Rebellion (XR) [74] is smaller, with 35 sites in Italy, of which 17 are in CED cities (59% of which are in northern regions and none on the islands). More detailed data on the FFF and XR local groups in Italy can be found in the dataset supplementary to this study [57].

Regarding awareness raising and participation, 81 (90.0%) cities commit with the CED to inform, educate and guide citizens towards sustainable consumption models and support citizen initiatives in favour of the climate. 60 (66.7%) of the analysed CEDs end with a request of the cities directed towards other jurisdictions (particularly Regions, but also the central government) to promote climate actions and their mainstreaming in energy and environmental policies. CED declarations help cities promote more climate actions-related to the decarbonization of energy systems and the achievement of climate neutrality.

5.3. Impacts of CEDs in terms of mitigation targets and adaptation planning

Concerning the potential relation with climate adaptation, the content analysis of the documents collected has shown that in 41 CEDs (45.6% of the 90 analysed CEDs) "adaptation" and "resilience" are explicitly mentioned among the specific objectives of the municipality. Similarly, the improvement of air quality is among the objectives set in 29 CEDs (32.2%), with reference to the regional planning framework (e.g., Genova), and, in particular, to the exceeding of the PM10 threshold envisaged by the legislation (e.g., Modena and Rome).

As regards mitigation and CO_2/GHG emission targets in the CED, only 27 (30.0%) cities explicitly set the objective of reducing GHGs. Among these, three cities do not identify specific targets and/or timeline for achieving them, two cities aim to reach a 40% GHGs reduction by 2030. The remaining 22 (24.4%) cities aim for carbon neutrality (CN) as their final target: 14 by 2030, 1 by 2035, 3 by 2040 and 4 by 2050. Four of the cities striving for CN also identify intermediate goals: −45% by 2030 (1 city), −50% by 2025 (1 city) and −50% by 2030 (2 cities).

It should be noted that the greatest number of the cities striving for carbon neutrality (CN) are those with a population ranging from 20,000 to 59,999 inhabitants (18% of the CED cities with a CN target in the sample, class F) and those with a population from 5,000 to 9,999 inhabitants (18%, class H), followed by cities with a population from 60,000 to 99,999 (14%, class E). Cities with over 250,000 inhabitants (classes A + B + C) aiming to become carbon neutral represent a total of 15% of the sample.

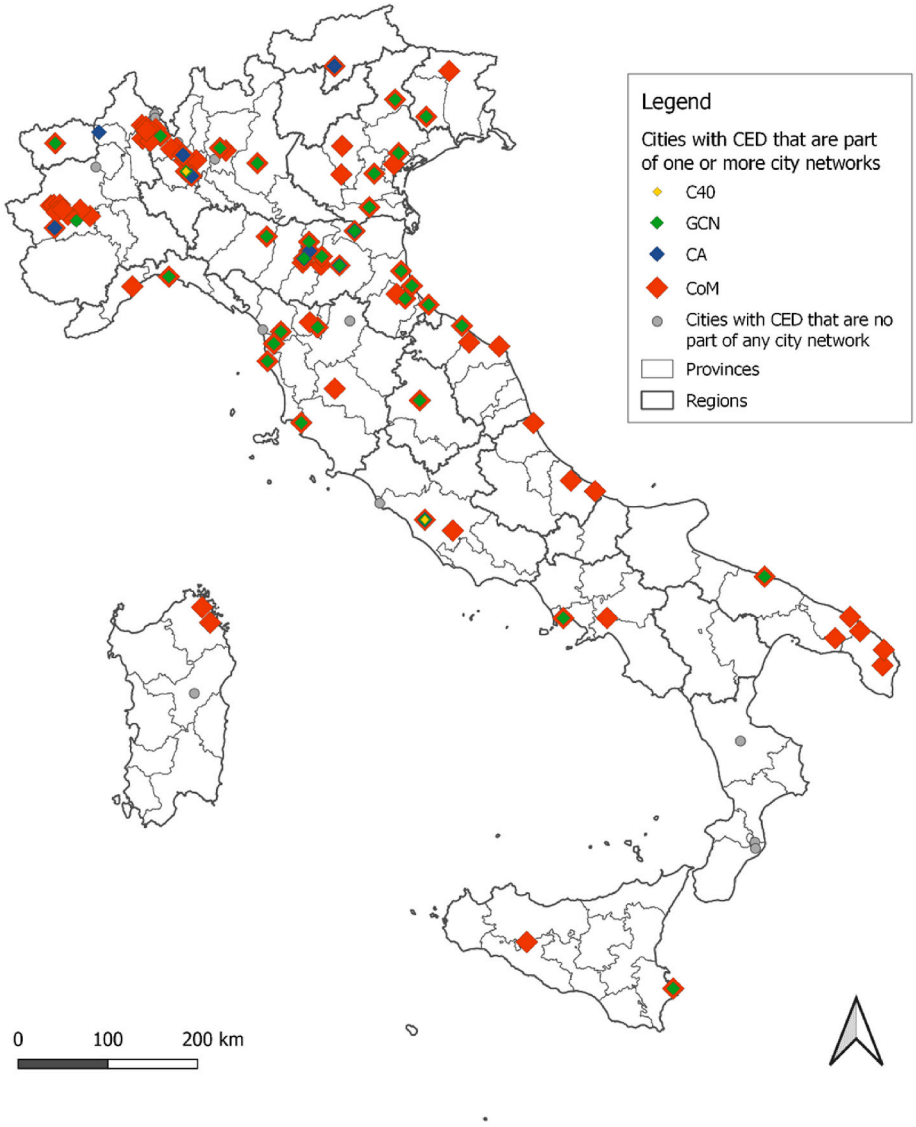


Fig. 5. Commitment of Italian CED cities in one or more national/transnational climate networks (C40 – C40 Cities Climate Leadership Group, GCN – Italian Green City Network, CA – Climate Alliance, CoM - Covenant of Mayors for Climate and Energy).

The statistical analysis shows that the strive for climate neutrality is significantly related to aspirations for local adaptation. Both the fact of having a local climate adaptation plan (τ_b, is 0.397, $p = 0.001$) and the mention of adaptation in the CED (τ_b, is 0.425, $p = 0.000$) are significantly related to CEDs with a carbon neutrality target.

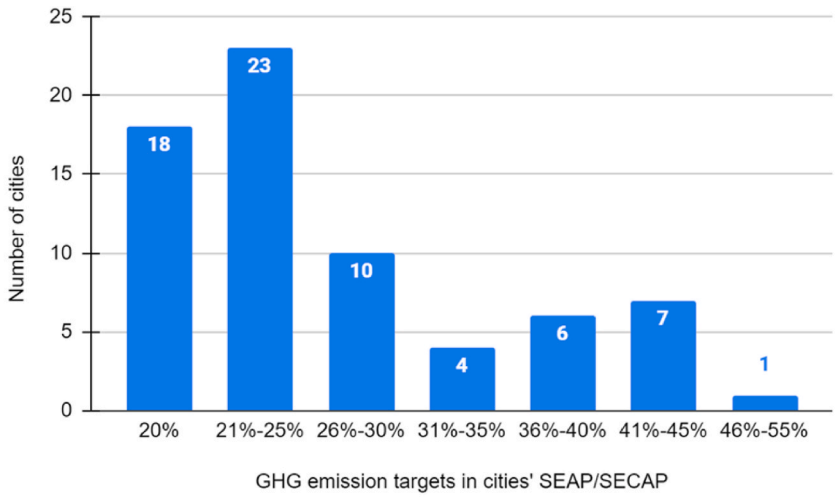
Cities that have a local climate adaptation plan are those that are significantly more often member of the Climate Alliance (τ_b, is 0.381, $p = 0.002$), have high GHG emission targets (τ_b, is 0.449, $p = 0.000$), long-term targets and/or target years (τ_b, is 0.831, $p = 0.000$), integrate adaptation and mitigation (τ_b, is 0.585, $p = 0.000$) and report on local air pollution (τ_b, is 0.388, $p = 0.002$). This shows that cities that strive for CN are those that have some form of environmental affectedness, are medium-sized and rather advanced and progressive in climate planning in general (i.e., as the integration of mitigation and adaptation shows). However, these are not frequent in Italy.

Regarding local climate planning in general, i.e., outside the CEDs, 36 cities (34.3%) of the analysed sample have not yet adopted a mitigation or adaptation plan. These cities were not yet active in local climate planning, prior to the CED. This shows the enormous importance of the CED movement in sensitizing localities for more climate action and the call for more support from higher level of governance. Results of the content analysis of CEDs and LCPs also revealed some examples of alliances among neighbouring small city councils that seem to work effectively in addressing the climate challenge. An interesting example is the Verbano Climate Network [75] which is a network of 13 small municipalities (77% of which are under 5,000 inhabitants) that declared a climate emergency in a coordinated manner, using a common template.

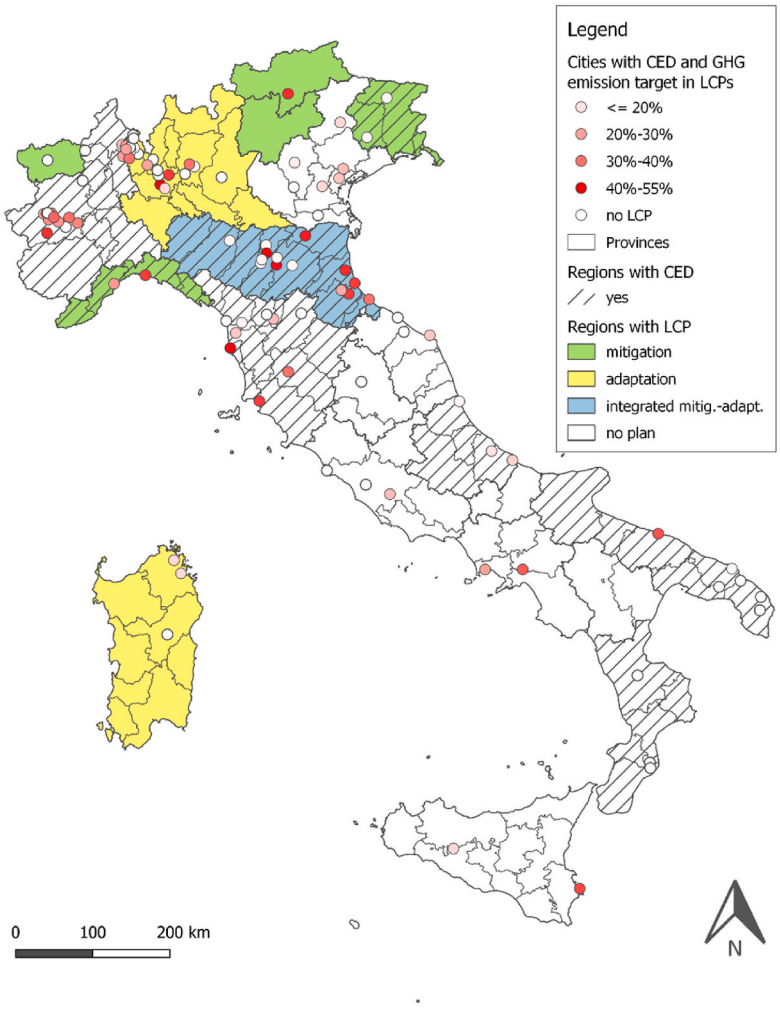
However, among the cities that were active prior to the CED, more than two thirds of cities (69 cities) have developed an LCP within the Covenant of Mayors framework, of which.

- 58 cities have adopted a Sustainable Energy Action Plan (SEAP) [76], which contains the city's strategies and actions to address climate mitigation, acknowledging the EU's 20-20-20 targets.
- 11 cities have most recently developed a Sustainable Energy and Climate Action Plan (SECAP) [76] with the aim of achieving a reduction in greenhouse gas emissions of at least 40% by 2030, adopting a joint approach to address mitigation and adaptation to climate change.

For them, the CED is a continuation of their climate change efforts



a)



b)

Fig. 6. Main targets set by the LCPs of the sample cities: number of cities by GHG emission reduction target classes (a) and their geographical distribution (b). Information on regional climate plans was taken from a previous study by Pietrapertosa et al. [54].

(Fig. 6). In addition, inter-municipal alliance is also reflected in the trend towards the diffusion of so-called "area" or "joint" SECAP models, which is potentially linked to greater effectiveness of adaptation measures when applied to larger territorial areas [77]. Several examples were found in the analysed sample, one of which is that of the city of Ferrara, Emilia-Romagna, which first prepared a joint SEAP for the entire territory ("Terre Estensi Associazione Intercomunale") with 2 other neighbouring cities (Voghiera, Masi Torello), and, more recently, developed a SECAP with the same approach involving the same supra-municipal territory [78].

However, striving for carbon neutrality does not appear to be a common aim of Italian mitigation LCPs, at least prior and/or independently of the CED movement. Among the 69 analysed local climate mitigation plans only two aim to become carbon neutral: Bolzano, by 2030, boosted by its participation to the "AlpStar" carbon neutrality project [79], and Milan, which set this long-term target (2050) in its Air and Climate Plan [80]. Moreover, both for Sovicille and Parma, the objective of neutrality was set at the provincial level, respectively by 2015 and 2030.

5.4. Timing of CEDs and LCPs

In order to understand if the climate action plans on a local scale can be considered forerunners of the declarations of climate emergency it is useful to compare the distribution over the time horizon of the approval dates of CEDs and LCPs. The sample cities approved their SEAP or SECAP between April 28, 2010 (Municipality of Avigliana, in Piedmont) and March 9, 2021 (Valsamoggia, in Emilia-Romagna), with two thirds of the plans approved between 2011 and 2014, certainly due to the great success achieved by the Covenant of Mayors in recent years, particularly in Italy and Spain [81].

The same sample of cities declared climate emergency from April 29, 2019 (Acri, in Calabria) to February 19, 2021 (Leggiuno, in Lombardy) with 84 CEDs (80.0% of the total) approved in 2019. All this again shows the importance of the CED movement in calling for more and more ambitious climate actions.

6. Discussion

The study was aimed at understanding the overall response of cities to the climate emergency declaration movement that has recently spread around the world and the possible roots of the CED objectives in current local climate planning strategies. Italy was used as a case study, by virtue of its multi-level governance system and diverse responses to climate action at various levels. Moreover, it provides a large and diverse sample of 105 cities that have declared a climate emergency, with different backgrounds in terms of local climate planning. The results of the Italian case study can thus be extended to other countries and inspire further studies to advance research and help local governments play a leading role in addressing the climate crisis.

The first research questions aimed at understanding the reasons for declaring a climate emergency given by the municipal councils in their CEDs. The content analysis revealed that a common goal of the CED Italian cities is to give climate change the highest priority on the municipal administration's agenda, to respect the principle of climate justice and to keep a dialogue open among local associations and regional and national institutions willing to increase the effectiveness of their actions. These findings are in agreement with previous research (for instance Cattino and Reckien [82]) showing that the effect of public participation on the political choices of municipal councils and on local energy and climate planning is becoming influential. In particular, the results emphasize how different movements at local level, and in particular youth participation promoted by Fridays for Future [83], are effectively influencing policies at city level by promoting bottom-up change.

At the same time, it is evident that the general public is more sensitive and attentive to technical reports and the appeals of scientists. In fact, from this in-depth analysis of the Italian CEDs it is emerged, that another important reason that prompted a city council to declare the climate emergency is the IPCC 2018 Special Report on 1.5 °C [20] and the related 1.5 °C objective of the UNFCCC Paris Agreement.

The results showed that relatively small Italian cities are particularly active and ready to declare a climate emergency, very much in contrast to previous research on local climate planning (e.g. Reckien et al. [8]) that had shown a higher level of activism by larger cities. The macro-regions with the highest share of CED cities are those with a higher average GDP at NUTS-3 level (specifically north-west and north-east, where the GDP is 23% and 18% above the national average respectively).

Multilevel governance also matters, although it would be an over-simplification to deduce that EU-wide, national and regional CEDs motivated Italian city councils to make their own CED. For example, 28 cities out of 105 in the analysed sample are in the Lombardy region. Lombardy is the Italian region with the largest number of cities that adhere to the CED movement even if the region itself has not declared the climate emergency. Also in Australia, where the CED movement started, local governments have demonstrated their climate leadership over the federal government [31]. This seems to suggest that recognition of the lack of regional/national action on the part of city governments has indeed prompted them to act but more importantly that there is a complexity of relevant factors that determine local action, beyond the influence that may be exerted by higher government levels.

Being part of a transnational or national climate network has shown to have a relevant impact on the efforts made by cities in declaring the climate emergency. In particular, the results show that the Covenant of Mayors for Climate and Energy is a very important network and resource also for cities that engage with climate action, confirming the results of previous studies on local climate planning, both for European (e.g. Salvia et al. [84]) and Italian cities (e.g. Hurtado et al. [85]). Moreover, the participation to international cooperation projects (i.e., Interreg, LIFE, H2020, etc.) represents a privileged opportunity to learn good practises from cities that are forerunners in climate policies and to be guided in the implementation of mitigation and adaptation plans and strategies. The results also provided insights on the important role played by alliances among neighbouring municipalities and inter-municipal planning, as in the case of joint SEAPs [81], especially for small municipalities that suffer from lack of staff and funding.

The second research question aimed to investigate the mitigation ambition of cities declaring climate emergency and the overall status of climate mitigation and adaptation planning in which CEDs were rooted. To the best of the authors' knowledge, this study represents the first investigation of the Climate Emergency Declaration movement in cities, which also addresses the state of existing local climate planning. This complements and enriches the few recent studies conducted on cities in Australia, New Zealand [35] and the United Kingdom [38] that have analysed new action plans as a results of CEDs.

The study shows that about one third of cities with a CED were not active in local climate planning before the climate emergency declaration. For two thirds of the sample cities, declaring climate emergency is a continuation of earlier efforts in local climate planning. Such plans are often referred to within the CEDs and at the same time the declarations must be translated into new strategies and plans. From a temporal point of view, climate action plans on a local scale may be considered forerunners of the declarations of climate emergency, given that their publication date is a few years earlier of that of CEDs, but it can be argued that the impetus for the climate emergency declaration came from the publication of the report of the Intergovernmental Panel on Climate Change (IPCC), which took place in October 2018 [20].

Concerning the cities' ambition in setting mitigation targets, the analysis of the results obtained for the case study showed that the common goal of the Italian CEDs is to reach the global target of halving net greenhouse gas emissions by 2030 and to reach net-zero emissions

by 2050, or sooner. The results showed that while local plans have moderate ambition in terms of CO_2/GHG emission reduction targets, there are many more cities striving for carbon neutrality. Interestingly, although in general cities that have declared a climate emergency are less advanced in terms of climate adaptation than mitigation, the statistical analysis showed that the goal of climate neutrality is significantly correlated with local adaptation aspirations.

The hope is that a "cyclical and iterative" planning process [29] can emerge in which urban climate planning evolves over time and looks further and further ahead in defining its climate goals, moving towards more sustainable cities in which citizens actively participate in meeting their needs in a sustainable manner [86]. However, the relatively large number of cities becoming active in climate issues for the first time clearly witnesses the importance of the CED movement in sensitizing and motivating additional localities towards the climate problems. It underlines the willingness of municipalities to act.

7. Conclusions

This research provides a thorough and timely investigation on the CED movement in cities and a comparative assessment of CEDs and LCPs in terms of availability, goals, greenhouse gases (GHGs) emissions reduction targets, size of the city, and engagement of cities within transnational climate networks. The size and diversity of the city sample make it possible to draw conclusions, although geographically limited to Italy, of general applicability, on the complex state of the art of climate action at the urban level and the interconnections between different planning instruments and strategies. This is useful for researchers and policy makers to provide a political perspective for current and future initiatives to inform, engage and support cities in their transition towards resilience and climate neutrality.

The results show the distribution of climate emergency declarations among Italian city councils, the reasons behind the adoption of the CEDs, their relation to international climate networks and the added value of CEDs with respect to local climate planning. The study found that most cities declaring a climate emergency are located in the North of Italy, many of them in just one region—Lombardy, with the Lombardy region itself not having declared a climate emergency. This points to peer or city-to-city influence, but also to the important role of international climate networks, such as the Covenant of Mayors for Climate and Energy, which is particularly strong in Italy. Climate actions along the climate emergency declarations are achieved through collaboration between neighbouring municipalities and with supra-municipal levels with the sharing of plans, projects, technical and economic resources, favouring the application of "good practices" to reduce greenhouse gas emissions in the municipal area.

The statistical analysis showed that cities that are already ambitiously committed to climate action, perceive that more is needed, but this cannot be accomplished by the local authorities themselves. Most cities with a CED in Italy are, in fact, small to medium-sized (between 20,000–59,999 inhabitants) and often lack the resources and knowledge to act. For them, declaring a climate emergency is a strong call for more support in climate action, a call for help from higher levels of government. Both ambition and the relationship between local and national government are important elements in local climate action.

The strongest motivations for local municipalities in Italy to declare a climate emergency are identified with the international/national climate movements (e.g., the Fridays for Future movement) and the IPCC 2018 Special Report on 1.5°. The role of the citizens, in particular the youth, is therefore becoming a more decisive actor in local politics, but also the international research community and related resolutions.

The results show that the CED movement can motivate municipalities to become more ambitious in climate action. One in four cities with a CED aims to become carbon neutral, while carbon neutrality was not a popular target for cities in Italy prior to the CED movement. The CED movement is certainly a witness of the urgency of the climate action—an urgency that has been well acknowledged by municipal actors. Most ambitious municipalities, however, are those that have been active prior to the CED movement, not only on mitigation. Cities striving for carbon neutrality are affected in some way by environmental changes, such as air pollution, and are also engaged in climate change adaptation (in particular, those that are members of the Climate Alliance). This shows that cities affected by air pollution or concerned about making their territories more resilient to climate change-induced extreme events are willing to increase their individual climate action in light of the challenges ahead, but also that they are calling for support from higher level of government.

The study also produced a comprehensive repository of the CEDs and LCPs developed by Italian cities, which are made publicly available in a cloud-based repository. This dataset may be of interest to the scientific, political, and administrative community in order to have a complete and documented view, in the case study country, of the ongoing process to address the climate emergency and of the efforts that cities they are doing in terms of their local climate declarations and plans.

This work suffers from some limitations that open the way for further research development. Further work is needed to study the influence of the climate emergency declarations on the medium to long term in several European countries and beyond. Subsequent studies may help to understand whether climate emergency declarations have continued to take hold among cities, particularly those in Italy, but also whether the ambitious commitments currently proposed will be followed by the development of post-CED climate emergency plans. In particular, more work needs to be done on measuring the effectiveness of local climate plans and actions to combat climate change, reduce risk and vulnerability, and progress towards climate resilience. How effective are CEDs and related actions in achieving climate goals? For this reason, studies may also scrutinize the CEDs of different levels of government, as all CEDs are light posts for jurisdictions of similar size and level, but also calls from higher level of government. Additional studies might investigate how effective is the call for more support from higher-level governments.

Moreover, the research focused only on Italy and would be supported by an extension of the case study to include other countries, in Europe and beyond, as very different distributions, patters, motivations, and actions can be anticipated in other world regions (as reported in the CEDAMIA database). One might ask, how decisive is the CED movement on an international scale in motivating more and more ambitious climate action? This study lends to hypothesizing that the CED movement is an important mouthpiece for the youth movement and local actors, and that, with the help of national governments, cities stand by and strong to implement ambitious targets for a safer and more resilient future.

Credit author statement

Monica Salvia: Conceptualization, Data collection and curation, Investigation and Visualization, Writing - original draft; Writing – review & editing, **Diana Reckien**: Conceptualization, Supervision, Investigation and Visualization, Writing – review & editing, **Davide Geneletti**: Data collection and curation, Writing - original draft, Writing – review & editing, **Filomena Pietrapertosa**: Conceptualization, Data collection and curation, Writing – review & editing, **Valentina D'Alonzo**: Data collection and curation, Investigation and Visualization, **Sonia De Gregorio Hurtado**: Data collection and curation, Writing – review & editing, **Xuemei Bai**: Conceptualization, Supervision, Writing – review & editing, **Souran Chatterjee**: Writing - original draft, **Diana Ürge-Vorsatz**: Conceptualization, Supervision.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence

the work reported in this paper.

Data availability

Datasets related to this article can be found at https://data.mendeley.com/datasets/nm662r9xy4/1, an open-source online data repository hosted at Mendeley Data (Salvia et al., 2022).

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.rser.2023.113236.

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