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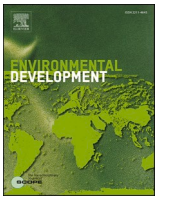

The role of sustainable energy and climate action plans: Synergies with regional sustainable development strategies for a local 2030 agenda

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ABSTRACT

The current environmental and socio-economic crises call for urgent actions, the efficacy of which depend on the coordination among different levels of governance. Response strategies must be devised at different scales, ranging from the international to the local level. This paper explores local "Sustainable Energy and Climate Action Plans" as enacting tools of "Regional Strategies for Sustainable Development." Starting from the assessment of the general situation in Italy, the study then focuses at the local level with the Municipality of Montemarciano in the Marche region (central Italy), selected because partner of the EU Interreg project "RESPONSe." Findings highlight that sustainability and climate issues are not homogeneously acknowledged throughout the Italian regions. There seems to be a significant north-south divide in the adoption of Regional Strategies, while Action Plans appear more scattered. Regional and municipal efforts are not fully aligned, given the lack of a clear relation between actions and policies. In contrast, the potential benefits of an effective coordination emerge within the specific case study of Montemarciano: not only the Action Plan seems able to support the achievement of energy and climate objectives, but it might also contribute to other areas, such as health, water and biodiversity. Given the similar structure, timing and background, the examined local Action Plan appears to support the Regional Strategy pushing forwards the overall sustainable development of the area. Such synergy would also foster the partnership among stakeholders strongly advocated at the international level.

1. Introduction

Concerns over environmental issues rose strongly since the 19th century summoning for the definition of a common strategy. The pioneering global agenda that followed, known as the Brundtland Report, intended to tackle the growing issues in the long term

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(WCED, 1987). This agenda acknowledged the deep interrelation between human and natural processes, providing the framework to formally conceptualise a sustainable development that accounts for social, economic and environmental needs (WCED, 1987). Nowadays, evidences of the human-induced alterations on the planetary system have become unequivocal (IPCC, 2021), thus validating the Anthropocene as a new geological era marked by the effects of human actions on the overall Earth System (Steffen, 2021). The year 2015 was proposed as a tipping point for such human development: humanity was expected to undertake a different development trajectory once the controversial features of the Anthropocene became evident (Steffen, 2021). Indeed, in that year some relevant progress was made, marking a landmark for international policy development, as, for instance, the 2030 Agenda for Sustainable Development was adopted in 2015 (https://sdgs.un.org/2030agenda). This and the other coeval agreements, such as Sendai Framework for Disaster Risk Reduction (https://www.undrr.org/publication/sendai-framework-disaster-risk-reduction-2015-2030), Addis Ababa Action Agenda on Financing for Development (https://sdgs.un.org/documents/ares69313-addis-ababa-action-agenda-thi-21093), Paris Agreement on Climate Change (https://unfccc.int/process-and-meetings/the-paris-agreement), Urban Agenda for the EU (https://www.urbanagenda.urban-initiative.eu/urban-agenda-eu) appear aligned on a strong call for a broad sustainable development and on some common concerns, such as climate change (e.g. the 2030 Agenda commits an entire Goal to it). Within the global variability of climate alterations, the Mediterranean basin appears especially threatened by hot extremes and droughts (IPCC, 2021). There, changes will seemingly exceed expected global trends even under "Paris-agreed" scenarios (Cramer et al., 2018). As the impacts of climate change on humans and ecosystems continue to worsen, also due to unsustainable development paths (IPCC et al., 2022; UNDRR, 2022), mitigation and adaptation efforts become pivotal for the survival of social-ecological systems.

Though the mentioned social, economic and environmental challenges stand at a global level, the first stage of implementation for the 2030 Agenda is necessarily the national dimension. Within the Mediterranean basin, in Italy, the outlined trajectory was downscaled by means of the National Strategy for Sustainable Development (hereafter addressed as "National Strategy"), published in 2017 (https://www.mite.gov.it/pagina/la-snsvs). The National Strategy identifies priorities and objectives especially significant for the Italian reality, along with a preliminary set of enabling instruments and monitoring indicators. Nevertheless, the National Strategy also recognises that a further reduction of scale is necessary, thus urging regional authorities to undertake an analogous effort (see *D. Lgs. n. 152/*2006 *"Norme in materia ambientale"*), eventually leading to the elaboration of Regional Strategies for Sustainable Development (hereafter cited as "Regional Strategies"). Nevertheless, a further dimension should be considered: it is commonly agreed that cities and municipalities own the potential to play a significant role in tackling climate change (Amundsen et al., 2018). Though some inherent limitations have been recognised to the actual effectiveness of city-level initiatives (Messori et al., 2020), cities are still considered at the forefront of climate action, especially in terms of mitigation (Mi et al., 2019), also due to the role of urban green areas (Trentanovi et al., 2021). Similarly, local governments are seen as pioneers of local transformation, both internally and by leading the overall community (Amundsen et al., 2018). Indeed, the commitment and quality of governance are recognised as highly significant for sustainability (Wendling et al., 2022). In other words, cities and municipalities are considered as a fundamental place to curb climate impacts and foster an effective sustainable development (Amundsen et al., 2018; Mi et al., 2019; Zoeteman et al., 2016). This commitment would be especially significant for the Italian case. Indeed, placed at the centre of the Mediterranean basin, Italy is expected to suffer from a severe exacerbation of pre-existing risks due to climate change (e.g. hydrological, geological and fire risks), as well as a deterioration of the overall socio-economic and environmental conditions (Spano et al., 2020). Consequently, it would be crucial to engage in strategies and plans to both mitigate and adapt to the consequences of climate change. Yet, Italian cities appear not completely in line with this approach, and as a matter of fact the autonomous development of comprehensive and dedicated climate adaptation plans is rather limited (Pietrapertosa et al., 2019). Despite this shortcoming, Italian cities are employing other, internationally-accepted instruments to tackle climate change, among which the Covenant of Mayors initiative (https://www.covenantofmayors.eu/en/) (Pietrapertosa et al., 2019), where Italian municipalities represent a significant portion of both overall signatories and people involved (Kona et al., 2018; Reckien et al., 2018). Launched in 2008 by the European Commission, since 2015 the Covenant of Mayors initiative directly engages municipalities all over Europe in an endeavour to adapt their communities and reduce their emissions. In particular, the outlined vision must extend at least to 2030 and is summarised in the Sustainable Energy and Climate Action Plan, SECAP, evolved from the previous Sustainable Energy Action Plan, that comprised a time horizon limited to 2020 and a scope addressing only mitigation (and not adaptation) efforts. This kind of transnational initiative might prove particularly effective. For instance, where national laws do not provide a strong reference framework to guide the reduction of greenhouse gas (GHG) emissions, as in the Italian case, experiences such as the Covenant of Mayors seem able to support the voluntary alignment of local communities to European climate and energy targets (Pietrapertosa et al., 2019). The monitored emission trends of the Covenant of Mayors signatories throughout Europe signal that municipalities appear indeed on track to achieve the set reduction targets and thus to endorse European objectives (Kona et al., 2021).

In light on these considerations, the potential role of the Covenant of Mayors initiative and of the related Action Plan has gathered a rather spread interest (Coelho et al., 2018; Kona et al., 2018). The literature has explored many facets, among which the factors influencing the decision to join the Covenant of Mayors initiative and the established reduction targets (Pablo-Romero et al., 2015a, 2015b); the role of the adhesion to the Covenant of Mayors initiative in driving climate mitigation action at a local level (Damsø et al., 2016; Reckien et al., 2018); the public perception and barriers to the engagement in the Covenant of Mayors initiative (Christoforidis et al., 2013); the assessment of the local priorities to inform the Action Plan (Marinakis et al., 2017); the development process of an Action Plan for a medium-size city (Nuss-Girona et al., 2016); the methodology to quantify the emissions with insights on whether a small-size municipality should adhere to the Covenant of Mayors individually or jointly with other municipalities (Matak et al., 2016); the reduction targets in terms of influencing drivers, pivotal sectors and available policy instruments (Croci et al., 2017); a preliminary in-depth quantification of energy consumptions and related emissions of municipal facilities (Oliver-Solà et al., 2013). The Covenant of Mayors database has also been suggested as a tool to track GHG emissions and the related reduction targets of cities worldwide

(Zoeteman et al., 2016). In particular, investigations on the effects of the implementation of Action Plans result noteworthy. Authors have reported that signatory municipalities have higher rates of reduction in energy consumptions (Pablo-Romero et al., 2016). The solid involvement of local stakeholders has been encouraged as well as the exploitation of Action Plans as broad urban planning tools rather than just as energy planning tools (Rivas et al., 2015). Furthermore, local experiences add that a thorough behavioural change would benefit the effective enacting of an Action Plan (Di Leo and Salvia, 2017). Researchers have also focused on methodologies to evaluate the level of preparedness against climate threats (Heidrich et al., 2013) as well as energy sustainability of local communities (Doukas et al., 2012) or even the comparative energy performance of port cities (Kilkiş, 2015) following the adoption of an Action Plan. Some relevant case studies directly investigated Italian experiences, for instance in an overview of the Italian adhesion to the initiative with a focus on Sicily Region (Famoso et al., 2015); in an analysis of the development process adopted by some municipalities of the Foggia province (Lombardi et al., 2014); in the proposal of a methodology to integrate an Action Plan with Nature-Based Solutions to adaptation challenges in San Donà di Piave municipality (Magni et al., 2020); in a proposal of a monitoring methodology, with relevant insights from the case of Genova municipality to possibly foster energy policies (Delponte et al., 2017). Lastly, a notable discussion revolved around the role of Action Plans as decision support systems, to aid local governments in managing the impacts of climate change, debate based on both European (Bjelic and Ciric, 2014; Kyriakarakos et al., 2014; Marinakis et al., 2015, 2016) and Italian (Dall'O et al., 2013, 2012; Gagliano et al., 2015; Zanni et al., 2015) practices. This last point hints at a potential significant contribution that Action Plans might play in designing and implementing local climate policies. The literature has already evidenced that the traditional separation among political dimensions, institutional scales and societal roles has become inapt (Betsill and Bulkeley, 2006). Though it has already been argued that limited research explores this theme, it also has been suggested that the cooperation across a multi-level governance, engaging municipalities along with provinces and regions, might boost the effectiveness of climate actions at all levels (Betsill and Bulkeley, 2006; Fuhr et al., 2018), especially for small-size municipalities and in the Italian case (Melica et al., 2018). Such synergies not only would bring significant opportunities, but might also limit the danger of maladaptive practices, threating to jeopardise the overall efforts (Pietrapertosa et al., 2019). With the Covenant of Mayors initiative, such collaborations might be implemented also through regional authorities. Indeed, Regions can engage in such initiative as Territorial Coordinators, thus facilitating the development and execution of Action Plans on a broader and more comprehensive stage (Melica et al., 2018).

Therefore, the aim of this paper is to investigate whether a SECAP might act as an enacting tool to foster the sustainable development for Italian communities. In particular, the potential role of the SECAP of a small-size municipality (Montemarciano) is explored in the context of the pertaining Regional Strategy (Marche Region, Central Italy). To this end, an overview of the Italian Regional Strategies is discussed, followed by an in-depth analysis of the Marche's Regional Strategy and SECAP.

2. Materials and methods

2.1. Case study

As previously mentioned, in Italy, Regions are required by law to design Strategies for Sustainable Development, in order to downscale the National Strategy and adapt it to local needs. Specifically, Regions are expected to match the international objectives set by the UN 2030 Agenda for Sustainable Development, attuning them to the local characteristics and demands directly advocated by stakeholders and making them binding for strategic environmental assessments.

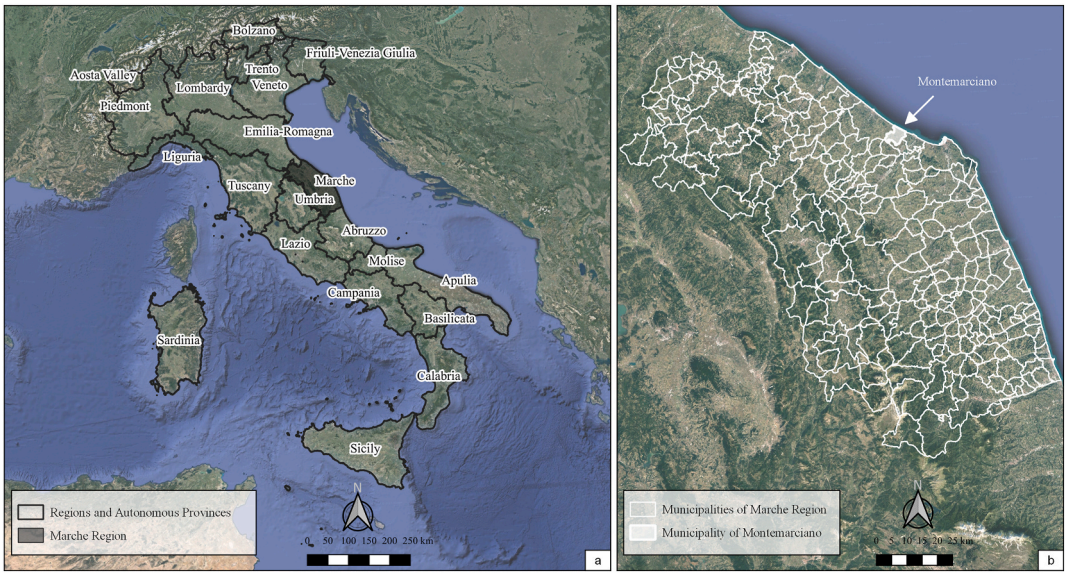

Fig. 1. Localisation of the Marche Region (a) and of Montemarciano Municipality (b) in the Italian and regional context, respectively.

On the other hand, signing the Covenant of Mayors initiative is a voluntary action, that municipalities undertake alone or in joint groups, possibly supported by local coordinators. Signatories have 2 years after the adhesion to formally issue the Action Plan (that is, the SECAP), that is later evaluated by experts and eventually officially approved. After this step, municipalities start the process of implementation of the envisioned actions as well as of monitoring the achievement of the proposed targets, that should be periodically reported. It might be relevant to note that although SECAPs replaced SEAPs in 2015, the SEAPs already enacted remain in force, at least until further updating.

Italian municipalities appear to hold the highest number of submitted Action Plans (covering about 40% of the municipalities) throughout Europe, followed only by Spanish municipalities (Adami et al., 2020; Kona et al., 2018). The Marche Region (Fig. 1a) issued its Regional Strategy in late 2021, and considering that about 90% of its municipalities appear to have signed the Covenant of Mayors agreement (Adami et al., 2020), it is a case study worth to investigate. Certainly, the rate of actual commitment of the signed Action Plans is yet unclear, and further assessment is desirable. In this research, the Marche Regional Strategy is twinned to the SECAP of Montemarciano, a small-size municipality (less than 10000 inhabitants in 2021, see ISTAT, 2022) lying along the coasts of the region (Fig. 1b). The Montemarciano SECAP is one of the main outputs provided by the RESPONSe project ("Strategies to adapt to climate change in Adriatic regions") developed within the framework of the EU INTERREG V-A IT-HR CBC Programme (https://www.italy-croatia.eu/web/response). The RESPONSe project provided technical assistance for 3 Italian and 3 Croatian coastal municipalities to advance smart governance systems and tools intended to enhance local climate resilience.

2.2. Data source and analysis

The available Strategies of the 19 Italian Regions and 2 Autonomous Provinces were retrieved online and are collected in Appendix A (latest access: July 20, 2022). The structure of the qualitative analysis built on a survey administered by the Italian Ministry for the Environment and Energy Security to the regional authorities with the aim of assessing the progress in the preparation of the Regional Strategies (Ministry of Environment and Energy Security, 2022). Four main topics have been considered: i) Governance, or the internal organisation dedicated to the Regional Strategy development; ii) Forum for sustainable development, that is the establishment of a place of mutual exchange with relevant stakeholders; iii) Networking, or the relations initiated with other authorities and institutions; and iv) Assessment and monitoring, namely the selection of indicators to evaluate the local achievements of sustainable development and/or to monitor the implementation of the Regional Strategies. Textual analysis was performed on the Regional Strategies searching for specific keywords, such as SEAP/SECAP (*PAESC* in Italian) or Covenant of Mayors (*Patto dei Sindaci* in Italian). A further in-depth analysis explored other possible forms or expressions for SECAPs as well as related scope and context.

Data on the Covenant of Mayors signatories was collected from the initiative website (https://www.covenantofmayors.eu/about/covenant-community/signatories.html, latest access: July 26, 2022). Italian Municipalities were selected using two filters: by province ("region", on the website), that is the most suitable geographical scale available, and by actual submission of an Action Plan, as a proxy of a substantial engagement of local authorities towards climate action. Next, the municipalities were aggregated on a regional base, that is the scale of interest of the present study. It is here acknowledged that this method might overlook inaccuracies in the association of municipalities to the related provinces due to possible ambiguities of the system. Indeed, in the cases of Campobasso and L'Aquila provinces, the ambiguities in the association of the municipalities were so evident and undermining that it appeared crucial to check the related municipalities one by one in the common database.

The in-depth analysis of the Regional Strategy of Marche and the SECAP of the Montemarciano Municipality was also carried out through documents available online (Appendix A and Council Resolution n. 74 enacted on December 22, 2021) (Comune di Montemarciano, 2022). The above-mentioned criteria adopted for the Italian Regional Strategies were retrieved and tailored to this specific case (as, for instance, small municipalities can hardly be expected to organise complex events comparable to regional forums). In particular, the criteria were re-framed as: i) Governance; ii) Networking; iii) Broader engagement; iv) Technical contents; v) Sustainable Development Goals. This last criterion was included to assess the interest in enacting the 2030 Agenda in local policy frameworks. To add an operative dimension to such criteria, a preliminary indication was found in the SMART approach. Originated in the field of management studies to theorise an effective goal-setting strategy (Doran, 1981), this approach advocates for the selection

Table 1
Criteria and Indicators selected for the cross-analysis of the Marche Regional Strategy and the Montemarciano SECAP.

Criteria	Indicators
Governance	Administrative level
	Approving Authority
	Date of adoption
	Background motivation
Networking	Working group
Broader engagement	Stakeholders' involvement (y/n; if yes, how)
Technical contents	Scope
	Presence of interventions/actions (y/n)
	Fixed targets (y/n)
	Target year
	Greenhouse gases reduction target (%)
SDGs	Addressing of SDGs

of: a) Specific, b) Measurable, c) Assignable, d) Realistic and e) Time-related (SMART) criteria to develop appropriate metrics. Against this background, the authors identified and compared the most significant indicators that could respond to the outlined criteria as well as account for the inherent characteristics of the analysed documents (Table 1).

3. Results and discussion

3.1. Italy

The state-of-the-art of the Regional Strategies and of the SECAPs adoption by Italian Regions and Autonomous Provinces is summarised in Table 2. The table displays the main information about Regional Strategies (adoption and eventual related date) and SEAPs/SECAPs per each Region and Autonomous Province (number and share of municipalities with a submitted Action Plan). In addition, the table evidences the Regional Strategies mentioning SEAPs/SECAPs within the document, highlighting whether the analysis of the Regional Strategies found any reference to SEAPs/SECAPs. See Appendix A for the available Regional Strategies for Sustainable Development and the Covenant of Mayors website for the information related to SEAPs/SECAPs.

Fig. 2 below displays the spatial analysis, performed with GIS software, of data from Table 2. The map visualises the Regions and Autonomous Provinces that adopted a Regional Strategy (dotted pattern) and the rate of Municipalities that submitted an Action Plan (coloured background).

Observing both Table 2 and Fig. 2, the foremost emerging information is that more than half Regions/Autonomous Provinces of Italy have a Regional Strategy, specifically 12 out of 21 adopted a Regional Strategy (57%), mostly in northern Italy. Additionally, most of the Regional Strategies were approved in the second half of 2021, though such recent adoption of Regional Strategies might be due to the relatively recent approval of the Italian National Strategy.

As mentioned, Regional Strategies were qualitatively inspected through four main criteria: i) Governance, ii) Forum for sustainable development, iii) Networking, and iv) Assessment and monitoring. In terms of "Governance", it was possible to observe that most of the Regions/Autonomous Provinces activated multi-/trans-sectoral and multi-level governance systems. The guidance remained principally related to the regional presidency or secretary for the 2 Autonomous Provinces (Bolzano and Trento), while for Veneto the guidance was not specified, and others maintained a shared working-group scheme. Concerning the "Forum for Sustainable Development", 9 Regional Strategies (all except for Trento, Bolzano, and Piedmont) planned at least one such event and most of them already took place. When considering the "Networking" area, many of the Regions/Autonomous Provinces brought in the contribution of further local authorities and institutions, such as Provinces and Regional Environmental Protection Agencies in the development

Table 2
Regions and Autonomous Provinces associated with the date of the possible adoption of a Regional Strategy for Sustainable Development (SRSvS) (latest access: July 20, 2022), along with the number of submitted Actions Plans and related share of the overall Municipalities (latest access: July 26, 2022).

Regions/Autonomous Provinces	Regional Strategies for Sustainable Development (SRSvS)			Sustainable Energy and Climate Action Plans (SEAPs)/Sustainable Energy and Climate Action Plans (SECAPs)	
	Adoption		Any mention of SEAPs/SECAPs?	Municipalities with a submitted Action Plan	Share of municipalities with a submitted Action Plan
Piedmont	yes	December 2021	yes	254	22%
Aosta Valley	no	(not available)	(not available)	2	3%
Liguria	yes	January 29, 2021	no	89	38%
Lombardy	yes	November 2021	no	761	51%
Autonomous Province of Trento	yes	October 15, 2021	no	127	77%
Autonomous Province of Bolzano	yes	July 20, 2021	yes	8	7%
Veneto	yes	July 20, 2020	no	345	61%
Friuli-Venezia Giulia	no	(not available)	(not available)	64	30%
Emilia-Romagna	yes	November 08, 2021	yes	255	77%
Tuscany	yes	March 2021 (presumed)	no	56	21%
Umbria	no	(not available)	(not available)	14	15%
Marche	yes	December 13, 2021	yes	50	22%
Lazio	yes	March 30, 2021	yes	76	20%
Abruzzo	yes	October 22, 2021	yes	227	74%
Molise	no	(not available)	(not available)	59	43%
Campania	no	(not available)	(not available)	216	39%
Apulia	no	(not available)	(not available)	105	41%
Basilicata	no	(not available)	(not available)	80	61%
Calabria	no	(not available)	(not available)	93	23%
Sicily	no	(not available)	(not available)	286	73%
Sardinia	yes	October 08, 2021	yes	243	64%

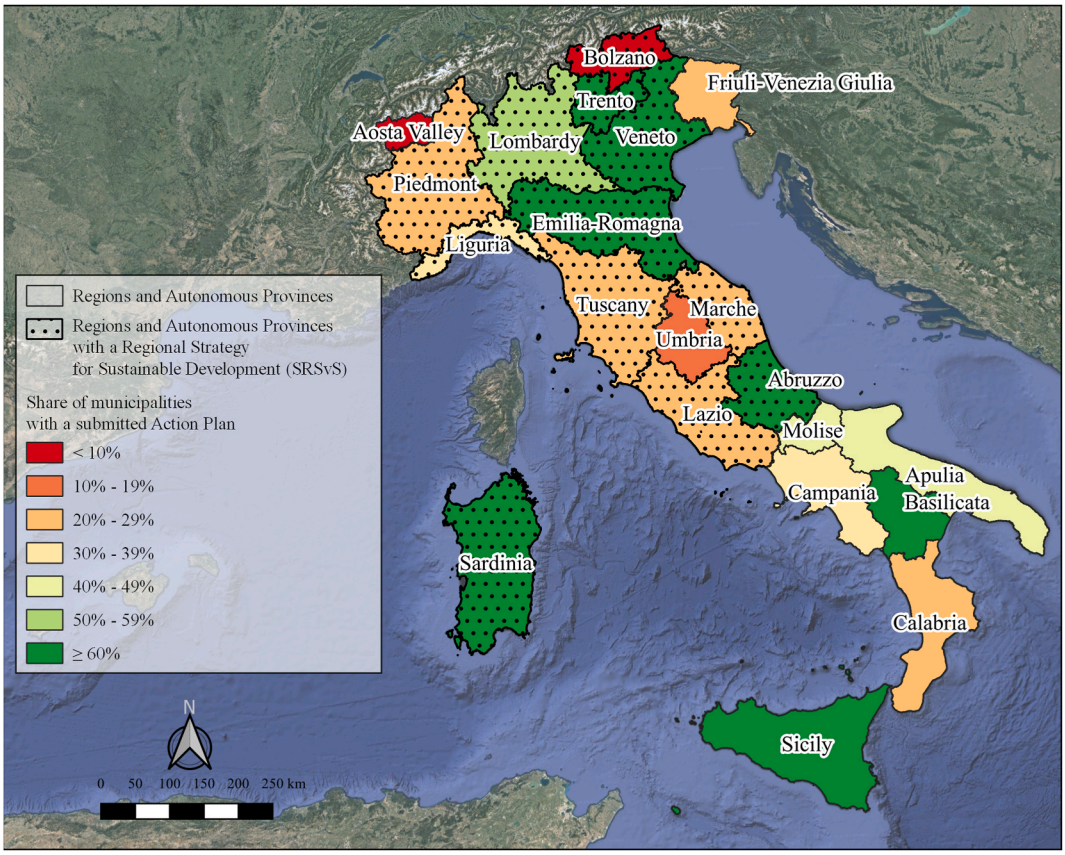

Fig. 2. Regions and Autonomous Provinces distinguished per adoption of a Regional Strategy for Sustainable Development (dotted pattern) and per share of submissions of Actions Plans by related Municipalities (coloured background).

process of the Regional Strategy. In addition, all Regional Strategies envisaged a further collaboration with either other local authorities, such as Provinces, Municipalities, or other Regions, or private entities such as Universities. Lastly, in terms of "Assessment and monitoring", all Regional Strategies identified indicators on which to act to achieve the Goals of the 2030 Agenda. Such indicators might be devoted to either the assessment or the monitoring (or both) of the regional sustainable development and were selected among those relevant for the National Strategy or the national monitoring of the SDGs.

In terms of possible integration among SECAPs, Table 2 evidences how slightly more than half of the Regional Strategies explicitly mentions SECAPs (or the previous SEAPs), precisely 7 Strategies out of 12 (58%). Commonly, these Regional Strategies recognise the role of SECAP as a tool to effectively implement the selected actions at the local level, especially in energy and climate domains. Furthermore, Municipal Authorities and municipalities in general are recognised as key actors of local development. Interestingly, the share of Municipalities that have submitted an Action Plan highly varies, from a minimum of 3% for Aosta Valley (not equipped with a Regional Strategy) to a maximum of 77% for Emilia-Romagna and Trento (both equipped with a Regional Strategy).

With such premises, it might be expected an effective and integrated effort of a multi-level governance to foster local sustainability and climate action. One can expect that the presence of a Regional Strategy would correspond to a high rate of municipalities with a submitted Action Plan. As a matter of fact, there is not an evident relation between Regional Strategies and submitted municipal Action Plans. Indeed, all the Regions of the North and Centre adopted a Regional Strategy (except for Friuli-Venezia Giulia and Aosta Valley), however, 7 out of 13 Regions and Autonomous Provinces present less than 30% of municipalities with an adopted Action Plan. At the same time, with the exception of Sardinia and Abruzzo, none of the Regions of South have submitted a Regional Strategy, nevertheless, a high percentage of municipalities of these regions have adopted Action Plans (e.g. 74% of municipalities in Abruzzo; 73% in Sicily, and 61% in Basilicata). It can be said that sustainability and climate challenges appear widely yet unevenly embraced from North to South Italy. The submission of Action Plans appears more casual than policy-driven, or possibly influenced by other factors, such as for example driven and motivated territorial coordinators.

3.2. The Marche Region

The case of the Marche Region seems to epitomise the above-described contrasts. Indeed, the issued Regional Strategy acknowledges the potential of SECAPs, yet the number of submitted municipal Actions Plans is relatively low across the region. For this Region

Table 3
Comparison between criteria and indicators of the Marche Regional Strategy for Sustainable Development and the Montemarciano municipal Sustainable Energy and Climate Action Plan (latest access: July 20, 2022).

Criteria	Indicators	Regional Strategy for Sustainable Development (SRSvS) of the Marche Region	Sustainable Energy and Climate Action Plan (SECAP) of Montemarciano Municipality
Governance	Administrative level	Regional authority	Municipal authority
	Approving Authority	Resolution of the Legislative Assembly	Resolution of the Municipal Council
	Date of adoption	December 13, 2021	December 22, 2021
	Background motivation	Mandatory (Article 34 of the Legislative Decree 152/2006)	Voluntary (Covenant of Mayors EU initiative)
Networking	Working group	Regional authority in collaboration with other territorial and interregional agencies	Municipal authority in collaboration with Università Politecnica delle Marche (within RESPONSe project)
Broader engagement	Stakeholders' involvement (y/n; if yes, how)	Yes: questionnaire to population; recreational activities with youngsters; engagement events; informative webinars; final consultation.	Yes: questionnaire to municipal and regional technicians, questionnaire to population; questionnaire to local experts; informative webinar; engagement events.
Technical contents	Scope	Prevent and reduce disaster risks by reducing exposure to hazards and vulnerability, increasing responsiveness and resilience, thus strengthening resilience (Strategic choice A) Address climate change and related social and economic asymmetries (Strategic choice B) Recognise the value of ecosystem services and thus protect biodiversity (Strategic choice C) Pursue equity by striving towards the elimination of poverty and inequality of the development, and the creation of conditions of dignity for the life of each person (Strategic choice D)	Increase resilience and prepare for the adverse impacts of climate change
		Promote industrial research and technological innovation towards the development of new sustainable production solutions, in terms of innovation and energy efficiency, reduction of emissions into the environment, recovery and reuse of by-products and waste, development of biocompatible productions (Strategic choice E)	Reduce greenhouse gas emissions on the local territory
	Presence of interventions/actions (y/n)	Yes	Yes
	Fixed targets (y/n)	Yes	Yes
	Target year	2030	2030
	Greenhouse gases reduction target (%)	−33% compared to 2005	−43.91% compared to 2010
SDGs	Addressing of SDGs	Explicitly	Implicitly

the different perspectives in climate-related issues are discussed comparing the main characteristics of the Regional Strategy with the municipal SECAP of Montemarciano (see, Appendix A and Comune di Montemarciano, 2022). Results are summarised in Table 3 below.

To begin with, it is worthy to observe the "Governance" context in which these tools were designed and approved. Specifically, the Marche Strategy was adopted by the Regional Legislative Assembly, after transposing a National Legislative Decree, whereas the SECAP is the consequence of a voluntary Resolution of the Municipal Council. For this reason, the working groups behind their drafting and implementation reflect different levels of "Networking". The Regional Strategy was formulated and managed at three levels: i) Internal, under the guidance of the Regional Departments Directors, ii) Territorial, with the formal and informal collaboration of the local authorities' representatives (i.e. the National Association of Italian Municipalities and the Union of the Provinces of Italy), and iii) Interregional, through a coordination table designed by the Ministry for Ecological Transition with representatives from the neighbouring regions of Abruzzo, Marche, and Umbria. Conversely, the definition and management of the SECAP was led by the municipal authority which availed of additional technical and scientific knowledge from the partners of the EU RESPONSe project. Interestingly, both documents, Regional Strategy and municipal SECAP, were officially adopted in December 2021 after a long path that diffusely involved a "Broader engagement" of specific stakeholders to identify local priorities, areas of commitment and good practices already in place. Indeed, both processes envisaged the distribution of questionnaires aimed at the population and the organisation of engagement events and webinars. Particularly, the participatory activities for the Marche Regional Strategy lasted from June 2020 to May 2021 and consisted of a questionnaire addressed to the regional population, recreational activities with youngsters, webinars aimed at informing the population on sustainable development, consultation with individual citizens and local associations, workshops with local authorities and other technical stakeholders such as Universities and professional associations. Similarly, the participatory activities for the Montemarciano SECAP lasted from January 2019 to November 2020 and consisted of a questionnaire addressed to the municipal population, a questionnaire addressed to municipal and regional public authorities, webinars aimed at informing the population on climate change and adaptation, workshops with local citizens, local and regional public authorities, and other technical

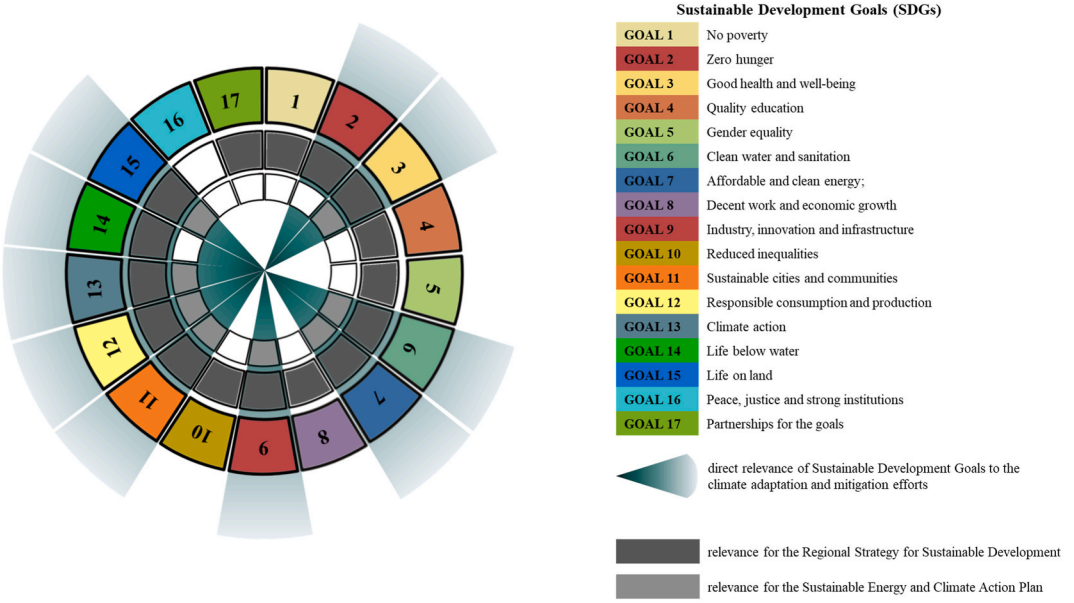

Fig. 3. Sustainable Development Goals (outer circle, in colour) and their relevance for the Regional Strategy for Sustainable Development (middle circle, coloured if applicable) and Sustainable Energy and Climate Action Plan (inner circle, coloured if applicable). The Sustainable Development Goals are highlighted if directly related to the climate adaptation and mitigation efforts (coloured triangular background). (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

stakeholders such as Universities and Environmental associations. Therefore, representatives of the municipal authorities were engaged for the Regional Strategy and representatives of the regional authorities were consulted for the Montemarciano adaptation plan.

From the technical-content perspective the Marche Regional Strategy has been framed by 5 missions of regional sustainable development towards which the sectoral policies must converge. Each regional strategic choice is divided into several objectives. For each objective, the quantitative targets and the interventions that contribute to the achievement of the objectives have been identified. A similar hierarchy is identifiable in the SECAP of Montemarciano. In this case, however, since it is a local action plan, much more space and details are devoted to the targets to be achieved and the actions to be undertaken. Overall, both the Regional Strategy and the SECAP are aimed at tackling climate change through mitigation, such as the reduction of GHG emissions, and adaptation, or the responsiveness and the resilience to the expected impacts. Regarding the mitigation efforts, even if the target year is always 2030, the

Table 4
Comparison among interventions included in the Regional Strategy for Sustainable Development (SRSvS) of the Marche Region (latest access: July 20, 2022) and the actions included in the Sustainable Energy and Climate Action Plan (SECAP) of the Montemarciano Municipality (latest access: July 27, 2022).

Number of SRSvS interventions	59
Number of SECAP actions	61
Number (and percentage) of SRSvS interventions with at least 1 correspondence with SECAP actions	32 (percentage over total interventions: 54%)
SRSvS interventions with highest number of correspondences with SECAP actions	Promotion of tools for improving air quality, considering the different characteristics and needs of the territories (Strategic choice B, number of correspondences: 16) Support for energy efficiency projects and eco-sustainable environmental transition by promoting a low-carbon economy in all sectors (Strategic choice B, number of correspondences: 15) Promote effective and useful interventions to improve the quality of buildings (public, private, productive, etc.) that contemplate multiple objectives (e.g. energy, seismic, adaptation to climate change, etc.) (Strategic choice A, number of correspondences: 13)
Number of SRSvS interventions with at least 1 correspondence with SECAP adaptation actions	21
Number of SRSvS interventions with at least 1 correspondence with SECAP mitigation actions	14
Number of SRSvS interventions with no correspondence with SECAP actions	27
Main causes for no correspondences among SRSvS interventions and SECAP actions	- Focus misalignment (12 interventions) - Authority influence (6 interventions) - Area of application (2 interventions)

GHG reduction goal of the SECAP is significantly higher and the available time span is shorter than in the Regional Strategy. Nonetheless, it is worth stressing that the latter is a strategy meant to steer a transition towards sustainable development at the regional scale, and it must be further interpreted at the local level, whereas the former is an operational plan targeted to a specific Municipal territory.

The relevance of the "SDGs" in the Regional Strategy and the SECAP requires further reasoning. Fig. 3 shows the results of the analysis of the SDGs addressed in the two documents. The outer coloured circle lists the 17 Sustainable Development Goals, with those directly related to climate adaptation and mitigation efforts emphasised with greenish hues. The middle and inner circles highlight through grey shades whether a goal is considered relevant, respectively, to the Marche Strategy or the Montemarciano SECAP.

As expected, the Regional Strategy of the Marche Region covers almost all SDGs, except for the objective of Peace, justice, and strong institutions (Goal 16). Promisingly, the SECAP of Montemarciano addresses almost all the SDGs directly related to climate mitigation and adaptation. The SDGs not addressed concern areas not directly relevant to the domains pertaining to a SECAP, for example Zero hunger (Goal 2) or Life below water (Goal 14). Yet, it should be noted that some goals not directly pertaining to a SECAP are in fact addressed, like for example Good health and well-being (Goal 3), Clean water and sanitation (Goal 6), and Life on land (Goal 15). These results support the importance of establishing a coordination between Regional Strategies and municipal SECAPs, even in domains that extend beyond the specific policy boundaries.

3.3. Potential for synergies among regional and local actions

To understand whether the SECAP could be considered an effective means to implement Regional Strategy interventions, the actions contained in the studied SECAP of Montemarciano and the interventions envisioned in the Regional Strategy of the Marche Region were compared (Table 4). A total of 61 actions are included in the SECAP, almost equally divided between mitigation and adaptation to climate change. A total of 59 interventions are included in the Regional Strategy, classified according to the main scope they pursue.

It is possible to observe that 54% of the regional interventions find a clear correspondence with the municipal actions. Hence, it might be assumed that the issues addressed at the regional and at the municipal levels are substantially related. Air quality and energy efficiency appear to gather the highest policy convergence. These affinities are not surprising, considering that the main focus of the regional interventions is resilience and climate action, also at the very core of a SECAP. Perhaps, more noteworthy is the correspondence among interventions and actions related to policy objectives that are not aligned. This is the case of the intervention "Increase the use of technical tools for environmental analysis in the conservation of territories through sustainable management of natural resources, in compliance with the operating rules and physical, biological, and climatic limits". This intervention strictly relates to the sustainable management of ecosystems, but it finds the fourth highest number of correspondences (10) with municipal actions. This might suggest that although Regional Strategy and SECAP pursue different objectives (i.e. sustainable development and climate action, respectively), there might still be a significant overlay and potential for integration even outside their respective scope. Such evidence corroborates the assumption that a SECAP could be an effective tool for implementing the Regional Strategy even beyond the purposes strictly related to climate change. A further validation of the potential role of SECAPs in supporting a comprehensive sustainable development strategy is the greater effort on climate change adaptation rather than mitigation, found in both the Regional Strategy interventions and the SECAP actions. As a matter of fact, SECAP puts a strong emphasis on the reduction of GHG emissions (i.e. mitigation efforts), while only recently started acknowledging possible adaptation actions.

In spite of such a consistent alignment between the Regional Strategy and the SECAP, there were still some regional interventions (27) that were not related to any of the municipal actions. Even so, a reasonable explanation was identified in the wide majority (74%) of these unrelated interventions. Focus misalignment between interventions and actions appeared to be the main reason of these mismatches, followed by the limited influence of the municipal authority on the processes envisaged by the Regional Strategy. Moreover, the characteristics of the territory of Montemarciano made it not eligible for some of the proposed regional interventions (for example a coastal territory vs interventions focused on mountainous morphology). Such limitations prompted the need for a wide and consistent coordination of SECAPs with other local planning tools, to facilitate the implementation of the Regional Strategy at the local level.

4. Conclusion and further developments

Sustainable development was supposed to gain momentum after 2015, when several novel international agreements advocated for development strategies accounting for social, economic, and environmental needs. In particular, the 2030 Agenda set challenging goals for the upcoming years to be embraced at all levels by the international community. Though some national level authorities (e.g. Italian government) issued related strategies, the question remains on the actual involvement of the lower tiers of governance and stakeholders at the local community level, which are the forefront players in the endeavours to curb the impacts of climate change.

To this extent, it becomes relevant to explore whether voluntary initiatives at the municipal level (e.g. Covenant of Mayors and the related Sustainable Energy and Climate Action Plan) might be effective tools to support the implementation of regional development strategies (e.g. Regional Strategies for Sustainable Development). This question appears particularly significant in Italy, a special hotspot for climate-induced risks, when considering the significant north-south divide across the national territory in terms of regional efforts for a sustainable development. Such differences appear less accentuated when considering the local scale, namely the municipal actions against climate change. Consequently, promoting a multi-level governance of local climate planning could be pivotal, especially because Regional Strategies tend to recognise the valuable contribution of SECAPs to achieve climate-related objectives. The

case study of the Marche Region provides a fertile testbed; the Regional Strategy is rather novel and the submitted municipal Action Plans are relatively few. Indeed, the municipality of Montemarciano developed its SECAP thanks to its coincidental participation to the European project RESPONSe.

Comparing regional and municipal tools, it was possible to observe that despite different objectives and contexts, the overall rationale aligns in several stances. As an example, the temporal perspective is the same, suggesting the possibility to coordinate actions and targets envisioned in both regional and municipal strategies. Additionally, though the Regional Strategy is the one explicitly referring to the SDGs proposed in the 2030 Agenda, the SECAP proved to address not only climate-related Goals, but also other issues, such as health and ecosystems wellbeing. This possible connection appears further confirmed when paralleling the proposed practical activities. To begin with, a wide number of regional interventions would find implementation through a municipal action, except when impeded by the intrinsic limited domain of SECAP. Unsurprisingly, SECAP appears especially effective in backing the climate-related endeavours of the Regional Strategy. Nevertheless, ecosystem protection and preservation emerged as a further theme, at the core of a truly sustainable development. Notably, adaptation approaches were the most aligned, when compared to mitigation tactics, signalling a broad acknowledgement of the need to undertake a transformative re-thinking of local communities.

The specific experience of Montemarciano suggests some noteworthy insights for local development planning. For instance, the widespread voluntary engagement of municipalities advocates a more central role for local authorities and communities. The predisposition of focused action plans to go beyond their purpose calls for coordinated planning, that integrates targets and activities in a multi-disciplinary framework, within a multi-dimensional vision. Evidently, neither top-down nor bottom-up approaches alone would fulfil this scope. Rather, local authorities should be involved both in horizontal (e.g. coordinating different municipalities) and in vertical (e.g. favouring the dialogue between municipalities, provinces and regions) directions, while keeping an open dialogue with the overall community. Indeed, while the Covenant of Mayors initiative has consistently shifted towards a global partnership of cities and local authorities, the resolution is pushing for a more comprehensive cooperation among different levels of governance and stakeholders (Global Covenant of Mayors for Climate and Energy, 2022). This should help gather successful actions and innovations to be shared throughout the global network. Eventually, this could result in a significant contribution to the last of the 17 SDGs, calling for a sound partnership among public, private and civic players to pursue a common and comprehensive development path.

Credit author statement

The signatories Alessandra Colocci, Eleonora Gioia, Cristina Casareale, Noemi Marchetti and Fausto Marincioni, as authors of the article “The role of Sustainable Energy and Climate Action Plans: Synergies with Regional Sustainable Development Strategies for a local 2030 Agenda".

Declare

That this writing is the result of a common reflection, such as not to allow a subdivision of it into individual parts; however, the final version of the text is to be attributed as follows:

Alessandra Colocci: Conceptualization, Methodology, Formal analysis, Investigation, Data curation, Writing- Original draft preparation, Visualization. **Eleonora Gioia**: Formal analysis, Investigation, Writing- Original draft preparation, Supervision, Project administration. **Cristina Casareale**: Formal analysis, Investigation, Writing- Original draft preparation, **Noemi Marchetti**: Validation, Investigation, Writing- Original draft preparation. **Fausto Marincioni:** Writing- Reviewing and Editing, Supervision, Funding acquisition.

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Declaration of competing interest

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Data availability

All data are publicy available online.

Appendix A. The Regional Strategies for Sustainable Development (SRSvSs)

Table A.1
Links to the available Regional Strategies for Sustainable Development (SRSvSs) as of July 20, 2022.

Regions/Autonomous Provinces	SRSVS (source)
Piedmont	https://www.regione.piemonte.it/web/temi/strategia-sviluppo-sostenibile
Liguria	https://www.regione.liguria.it/homepage/ambiente/sviluppo-sostenibile/strategia-regionale-sviluppo-sostenibile.html
Lombardy	https://www.sviluppisostenibile.regione.lombardia.it/it/strategia-regionale/la-strategia
Autonomous Province of Trento	https://agenda2030.provincia.tn.it/Trentino-2030/Strategia-provinciale-SproSS#:~:text%20=%20Sviluppo%20sostenibile%20in%20Trentino&text%20=%20La%20Strategia%20provinciale%20per%20lo,20%20obiettivi%20provinciali%20di%20sostenibilit%C3%A0.
Autonomous Province of Bolzano	https://sostenibilita.provincia.bz.it/it/il-progetto
Veneto	https://venetosostenibile.regione.veneto.it/
Emilia-Romagna	https://www.regione.emilia-romagna.it/agenda2030
Tuscany	https://www.regione.toscana.it/-/ebook-toscana-sostenibile-il-percorso-di-sviluppo-sostenibile-della-regione-toscana-
Marche	https://www.regione.marche.it/Entra-in-Regione/Sviluppo-Sostenibile/Strategia-Regionale-Sviluppo-Sostenibile
Lazio	https://www.lazioeuropa.it/laziosostenibile/
Abruzzo	https://www.regione.abruzzo.it/content/progetto-la-strategia-regionale-dello-sviluppo-sostenibile
Sardinia	https://www.regione.sardegna.it/argomenti/strategiaregionalesvilupposostenibile/

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Glossary

SNSvS: National Strategy for Sustainable Development ("Strategia Nazionale per lo Sviluppo Sostenibile", in Italian)
SRSvS: Regional Strategy for Sustainable Development ("Strategia Regionale per lo Sviluppo Sostenibile", in Italian)
CoM: Covenant of Mayors
SEAP: Sustainable Energy Action Plan
SECAP: Sustainable Energy and Climate Action Plan
SDG: Sustainable Development Goal