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Covenant of Mayors 2025 Assessment

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Contents

Abstract 4

Acknowledgements 5

Executive summary 6

Main findings 7

Related and future JRC work 8

Quick guide 8

1. Introduction 9

1.1. The role of the Joint Research Centre in the Covenant of Mayors 12

2. Dataset construction and cleaning 15

2.1. MyCovenant data extraction and management 16

2.2. Signatories and commitments 17

2.3. Submitted action plans 23

2.4. Monitoring reports 28

3. Approach and methodology on mitigation 31

3.1. The Covenant of Mayors' approach to mitigation 31

3.2. Statistical analysis 31

4. Results on mitigation 33

4.1. Emission reduction targets 33

4.1.1. Methodological notes 35

4.2. Emission inventories 35

4.2.1. Baseline year 35

4.2.2. GHG emissions in cities' latest available GHG emission inventories 37

4.3. Monitoring emission inventories 41

4.3.1. Monitoring years 41

4.3.2. GHG emission forecasts for 2030 43

4.4. Climate change mitigation actions and measures 44

4.4.1. Actions by sector 44

4.4.2. Actions by area of intervention 45

4.4.3. Actions by policy instrument 50

4.4.4. Actions by origin of the action 52

4.4.5. Actions by key type of measure (KTM) 53
5. Approach and methodology on adaptation 55
5.1. The Covenant of Mayors' approach to adaptation 55
5.2. Approach and methodology to adaptation 55
5.2.1. Data sources 55
5.2.2. Methodology 57
6. Results on adaptation 60
6.1. Risk and vulnerability assessments (RVAs) 60
6.1.1. Climate hazards 60
6.1.2. Vulnerable sectors 71
6.1.3. Vulnerable population groups 75
6.2. Climate adaptation goals 78
6.3. Climate adaptation actions 79
6.3.1. Actions and most addressed climate hazards 80
6.3.2. Actions and most targeted vulnerable sectors 82
6.3.3. Actions and most targeted vulnerable population groups 84
6.4. Adaptation 'gap' and potential incoherence among RVA and actions 85
6.4.1. Climate hazards in RVA and actions 87
6.4.2. Vulnerable sectors in RVA and actions 88
6.4.3. Vulnerable population groups in RVA and actions 89
6.5. Monitoring 90
7. Preliminary analysis on energy poverty 92
7.1. Methodological notes 92
7.2. Key indicators selected for the assessment 93
7.3. Energy poverty actions 95
8. Cross-pillar actions 97
9. Conclusions 98
9.1. Main findings 98
9.2. Concluding remarks 101
References 103
List of abbreviations and definitions 109

List of boxes 111
List of figures 112
List of tables 115
Annexes 117
Annex 1. Signatories and population covered by country 117
Annex 2. MyCovenant Dataset 123
Sector and sub-sector description 123
Dataset Notation keys 127
Annex 3. Methodological Overview 128
Harnessing the information in the GCoM datasets: MyCovenant 128
Harnessing the information in the GCoM datasets: CDP-ICLEI Track 130
Annex 4. Prediction statistical methodology 132
Annex 5. Mitigation actions: data categorisation 135

Abstract

Cities and local authorities are key players in addressing climate change. Since 2008, the European Commission (EC) has endorsed and supported their efforts through the Covenant of Mayors for Climate and Energy (CoM), notably through the provision of capacity building, technical assistance, sharing of best practices and peer learning opportunities. The initiative helps consolidate practices to monitor and report on energy use and greenhouse gas (GHG) emissions as well as on climate-related risks and vulnerabilities and energy poverty at the local level, enabling decision-makers to identify priority sectors for intervention, set emission reduction targets and adaptation goals and plan relevant measures.

This report provides a scientific assessment of the three CoM pillars: climate change mitigation and adaptation, and preliminary analysis of energy poverty, with a focus on EU-27 and EFTA countries. It describes the Covenant community, the plans submitted by signatories, examines actions and measures and gives an overview on the progress made.

Acknowledgements

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We also thank the Covenant of Mayors Office for taking care of relations with signatories, and in particular the IT team for managing the MyCovenant reporting platform and cooperating with the JRC in order to continuously improve the data collection process.

Executive summary

This report presents an assessment of the Covenant of Mayors for Climate and Energy (CoM) initiative based on insights from the Sustainable Climate Action Plans (SECAPs) of EU-27 and EFTA signatories targeting 2030 or later years. The CoM puts together more than 10 800 municipalities in the EU-27 and EFTA countries, reaching almost 11 800 if other regions are considered. Key figures on the overall ambition, greenhouse gas (GHG) emissions by sector and scope, most reported climate hazards and vulnerabilities as well as planned actions are presented. In addition, this study provides a preliminary analysis of the energy poverty assessment and actions planned by CoM municipalities. The report is part of a collection of regularly published reports and analyses aimed at assessing the progress of the CoM initiative and its community.

Policy context

The European Union (EU) has positioned itself as a global leader in climate policy. The European Climate Law that followed the European Green Deal, makes climate neutrality a legally binding objective for the EU by 2050 and sets intermediate milestones, including a target to reduce net greenhouse gas emissions by at least 55 % by 2030 compared to 1990 levels and a political agreement to target a 90% reduction by 2040. Acknowledging that the impacts of climate change are already occurring today, the EU strategy on adaptation to climate change aims to make adaptation smarter, swifter and more systemic and to increase support for international climate resilience.

Addressing climate change is a multilevel governance challenge which highlights the role and contribution of local authorities. This was acknowledged by the European Commission back in 2008, with the launch of the Covenant of Mayors for Climate and Energy (CoM EU), a pan-European initiative that has been supporting local authorities in their climate action efforts for over 15 years and that has achieved, since 2017, global scale within the Global Covenant of Mayors (GCoM).

The CoM EU and the GCoM continue to feature highly in the EU policy agenda on sustainable urban development, as part of the EU Agenda for Cities, and on climate and energy policies, also contributing to the Citizens' Energy Package and the Action Plan for Affordable Energy.

Key conclusions

The CoM has been instrumental in creating a community of almost 11 800 cities and local authorities in Europe and beyond, committed to fighting climate change. Over time, it has positioned itself as a key initiative, supporting local climate action by providing guidance and technical assistance, sharing of best practices and promoting peer learning opportunities. At the same time, it has helped consolidate practices to monitor and report on energy consumption and GHG emissions, as well as climate risks and vulnerabilities at the local level, allowing decision-makers to identify priority sectors, set emission reduction targets and adaptation goals and plan relevant measures. The recent inclusion of the energy poverty pillar, with a harmonised reporting framework and methodological guidance, is expected to further consolidate local efforts in addressing climate challenges and strengthening the relation between climate action and social equity.

While many CoM signatories are still committed to a 2020 mitigation target, the number of signatories with a 2030 target and those that have recently stepped up their commitment with a 2050 target have significantly increased compared to the previous assessment.

EU-27 and EFTA signatories with a 2030 climate mitigation plan have an overall commitment of 51 % emission reduction by 2030, close to the EU 2030 climate target. A subset of 103 municipalities shows a targeted emissions reduction of 93 % by 2050, in line with the EU climate neutrality target. Interim emission reduction achievements, calculated for EU-27 signatories with a 2030 mitigation commitment and at least one monitoring report submitted, indicate a delivery gap of 9 percentage points in comparison to their targeted mean reduction of 57 %.

On adaptation, while committed signatories and adaptation action plans are less numerous than for mitigation, figures are constantly growing. The analysis reveals that CoM signatories are developing a thorough understanding of their climate risks and vulnerabilities. Despite these substantial progresses, there remains a critical need for more comprehensive and targeted adaptation actions.

The CoM energy poverty pillar was recently implemented. Nonetheless, CoM municipalities demonstrate growing interest in addressing this aspect, with 56 signatories having submitted a complete action plan. Municipalities can get support in the assessment of energy poverty by the Energy Poverty Advisory Hub (EPAH), the leading Commission's initiative to tackle energy poverty in the EU.

Despite the progress and the impact of the initiative, reinforced support may be necessary for municipalities to strengthen the planning and implementation of mitigation actions to reach the GHG emission targets, to improve their climate adaptation strategies and to adopt integrated planning approaches in their local climate strategy. It is also essential to bridge the adaptation gap by enhancing municipal capacity for comprehensive risk assessments and fostering the exchange of regional best practices to build community resilience. Improving the collection of high-quality information and harmonising data reporting will provide a better understanding of the issues municipalities face.

Main findings

There are more than 10 000 CoM municipalities in EU-27 and EFTA countries covering a total population of 247.7 million inhabitants. About half of the signatories in the EU-27 and EFTA (almost 51.8 %, covering 31.1 % of the population) remain committed only to the 2020 mitigation targets, while 47.6 % (representing about 65 % of the population) are committed to a mitigation target by 2030 and/or by 2050 combined with adaptation. The remainder (less than 1 %) has a commitment to adaptation only or adaptation combined with a 2020 mitigation target.

The analysis of a subset of 2 333 signatories having submitted climate action plans with a target for 2030, shows the overall committed GHG emissions reduction is 51 % by 2030. A subset of 103 signatories with SECAPs by 2050 shows an overall committed GHG emissions reduction of 93 %, aligned with the EU climate neutrality target.

Emissions reported in baseline emission inventories are predominantly scope 1 (direct emissions associated with energy use and non-energy-related activities occurring in the local territory), followed by scope 2 (indirect emissions related to grid-supplied energy generation and supply), while scope 3 emissions (other GHG emissions associated with activities taking place in the local territory but occurring elsewhere) are accounted for in a minor share of the inventories.

Looking at a subset of 1 134 action plans in the EU-27 with a 2030 target, accompanied by at least one monitoring emission inventory, a 48.5 % reduction for 2030 is forecasted, while targeted mean reduction is 57 %, suggesting that municipalities are lagging behind in the implementation of their mitigation actions and greater effort is necessary to achieve the emission reduction targets they have set by 2030.

Looking at the adaptation information from 2 444 action plans that include a risk and vulnerability assessment (RVA), the most frequently reported climate hazards are 'extreme heat', 'heavy precipitation', 'droughts and water scarcity', and 'floods and sea level rise'. Information on social vulnerabilities is becoming progressively more considered in developing complete RVAs, with 'elderly', 'low-income households' and 'persons living in sub-standard housing' reported as most vulnerable to 'extreme heat', 'floods and sea level rise' and "heavy precipitation respectively.

Climate change adaptation actions are growing. While there is still a gap between hazards and matching measures, actions are increasingly targeting high-risk hazards (65 % of high-risk hazards are tackled by actions). However, the most reported vulnerabilities are not always targeted by actions.

Despite its early stage, energy poverty has seen a growing trend in the number of municipalities that started including this pillar in different phases of their climate action journey (18 % of adoption). The majority of municipalities have integrated energy poverty in their actions, with 94 % of energy poverty actions targeting also other pillars, showing a deep holistic approach in CoM municipalities' climate action.

Related and future JRC work

This report is part of a series of JRC reports assessing the CoM to track the overall progress of the initiative based on action plans and monitoring reports of GCoM municipalities in the EU, (Cerutti et al. 2013), (Melica et al. 2022, 2024), (Franco de Los Rios et al. 2024) and in other world regions (Davide et al. 2024, 2025b; Palermo et al. 2022; Treville et al. 2025).

Specific aspects of the CoM are also explored in dedicated studies, such as multi-level governance models (Melica et al. 2018); review of reporting platforms (Bertoldi et al. 2018b); projections towards Paris Agreement target (Kona et al. 2018a); methods on indirect emission accounting (Kona et al. 2019); climate mitigation policies (Palermo et al. 2020); GHG emission inventories approaches (Palermo et al. 2024); impacts of mitigation actions on air quality (Monforti-Ferrario et al. 2018; Peduzzi et al. 2020), financing climate change mitigation actions in cities (Todeschi et al. 2026); key factors enabling higher climate ambition (Rivas et al. 2021), and key predictors of greenhouse gas emissions for cities (Franco et al. 2022, 2023).

Quick guide

This report provides a scientific assessment of the CoM EU and the GCoM by looking at data reported by EU -27 and EFTA countries signatories through the MyCovenant reporting platform and/or through the CDP-ICLEI Track reporting platform until the end of December 2024. The assessment is based on climate change mitigation and adaptation plans and monitoring reports, as well as on first submissions on energy poverty. The study examines planned and implemented actions and gives an overview on the progress achieved.

1. Introduction

The European Union (EU) has positioned itself as a global leader in climate policy, committing to becoming the world's first climate-neutral continent by 2050. This objective is the central pillar of the European Green Deal (COM(2019) 640), a roadmap aimed at transforming the European Union into a modern, resource-efficient, and competitive economy where economic growth is decoupled from resource use and environmental impacts. The goal has been enshrined into law through the European Climate Law (EU) 2021/1119). This landmark legislation makes climate neutrality a legally binding objective for the EU and sets intermediate milestones, including a target to reduce net greenhouse gas emissions by at least 55 % by 2030 compared to 1990 levels. More recently, the EU has advanced its planning with a provisional political agreement to target a 90 % emissions reduction by 2040 (European Commission 2024), bridging the gap towards the mid-century goal.

Acknowledging that the impacts of climate change are already occurring today, the EU strategy on adaptation to climate change aims to make adaptation smarter, swifter and more systemic and to increase support for international climate resilience (COM/2021/82). In this regard, it intends to support the further development and implementation of adaptation strategies and plans at all levels of governance and aims to spread adaptation awareness across the EU, including local authorities, companies and households.

Recognising the strong relationship between climate action and social equity, the EU has progressively developed a comprehensive policy framework to address energy poverty. Key milestones in this process include the 2016 launch of the Energy Poverty Observatory, which in 2020 evolved into the Energy Poverty Advisory Hub (EPAH). In 2017, the European Pillar of Social Rights (2017/C 428/09) declared energy to be an essential service, and the Clean Energy for All Europeans package (2019) and the Governance of the Energy Union and Climate Action Regulation (Regulation (EU) 2018/1999) required Member States to address energy poverty in their National Energy and Climate Plans (NECPs). This was further reinforced by the 'Fit for 55' package (COM/2021/550 final), which introduced the Social Climate Fund to support vulnerable households during the green transition. More recently, the European Commission (EC) presented the Citizens' Energy Package (COM/2026/115), a key deliverable of the Action Plan for Affordable Energy (COM/2025/79), aimed at delivering affordable energy for all Europeans and empowering citizens to participate in the energy transition.

The ambition of becoming net-zero by 2050, represented in the European Green Deal and codified in the European Climate Law, is a multilevel governance challenge requiring a systemic transformation. The role of cities and local authorities as key actors in the fight against climate change was acknowledged in 2015 during the United Nations Climate Change Conference COP21 (United Nations 2015) and strengthened since then, with the recent recognition at COP28 through the Coalition for High Ambition Multilevel Partnerships (CHAMP)[1], which encourages national governments to formally integrate subnational strategies into their Nationally Determined Contributions (NDCs) and was endorsed by the EU in November 2025.

This pivotal role of local authorities is scientifically recognised in the broad literature on the topic, with the Sixth Assessment Report (AR6) from the Intergovernmental Panel on Climate Change (IPCC) highlighting the increasing diversity of actors in the global effort against climate change, with non-

[1] Coalition for High Ambition Multilevel Partnerships (CHAMP) for Climate Action https://www.champ-climate.org/

state and sub-national actors (including cities) playing a growing role in offering opportunities to increase resource efficiency and mitigate GHG emissions through the systemic transition of infrastructure and urban form towards net-zero emissions (Lwasa, et al. 2022). The upcoming IPCC Special Report on Climate Change and Cities[2] looks at cities as complex systems to address the urgent climate challenges and offers practical, region-specific solutions for sustainable urban development by combining cutting-edge research with real-world urban experience key drivers for global climate resilience.

The EU attention to local climate action is grounded into several initiatives, particularly the Covenant of Mayors for Climate and Energy (CoM EU)[3], a pan-European initiative that has been supporting local authorities in their climate change efforts for over 15 years and that has achieved global scale within the Global Covenant of Mayors (GCoM). In addition, the EU has launched the Horizon Europe Mission for 100 Climate-Neutral and Smart Cities by 2030[4] and the Adaptation Mission[5]. Climate neutral mission cities act as innovation hubs, aiming for climate neutrality two decades ahead of the continental deadline, while the Adaptation Mission supports regions and local authorities in accelerating their climate resilience. More recently, the role of cities at the forefront of major challenges, including tackling climate change, appeared prominently also in the EU Agenda for Cities (COM,/2025/739), a major strategy providing the EC vision for thriving cities.

Within this context, the CoM EU [3] provides a structured methodology for municipalities to translate their ambition into concrete actions through the development of Sustainable Energy and Climate Action Plans (SECAPs) (Davide et al. 2025a), ensuring that local efforts are not fragmented, are scientifically robust, and aligned with the EU policy targets. Through its integration into the GCoM [6], it has established a standardised 'common language' for climate action worldwide.

Box 1. Covenant of Mayors: from pledges to actions

Mayors who join the CoM EU commit to take the lead and enhance the transparency and accountability of local climate and energy policies by:

1. Setting ambitious and quantified GHG emission reduction targets, adaptation goals and energy poverty goals;

2. Estimating their GHG emissions in a base year according to a common methodological approach;

3. Assessing climate risks and vulnerabilities in their territories;

4. Assessing energy poverty in their territories;

5. Defining a strategy and concrete actions to mitigate and adapt to climate change, and to tackle energy poverty;

6. Approving and making their action plan publicly available;

[2] Special Report on Climate Change and Cities — IPCC https://www.ipcc.ch/report/special-report-on-climate-change-and-cities/

[3] EU Covenant of Mayors - https://eu-mayors.ec.europa.eu/en/home

[4] Climate-neutral and smart cities - https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/eu-missions-horizon-europe/climate-neutral-and-smart-cities_en

[5] Mission Adaptation - https://research-and-innovation.ec.europa.eu/system/files/2021-09/climat_mission_implementation_plan_final_for_publication.pdf

[6] Global Covenant of Mayors - https://www.globalcovenantofmayors.org/

7. Regular reporting (both qualitatively and quantitatively) on the implementation of their action plan through monitoring reports. Complete monitoring reports include a monitoring emission inventory (MEI);

8. Sharing their vision, results, experience and know-how with fellow local and regional authorities within the EU and beyond through direct cooperation and peer-to-peer exchange.

The initiative has evolved over time to reflect the ambition and scope of the EU climate and energy objectives. As a result of the EU's commitment to reducing its net GHG emissions by at least 55 % by 2030 and becoming climate neutral by 2050, the EU chapter of the GCoM initiative announced in April 2021 its renewed ambition, with participating cities pledging to the goal of climate neutrality by 2050 and to tackling in an integrated manner the three pillars of the initiative:

— Climate change mitigation: decarbonisation strategies to reduce GHG emissions in comparison to a base year. The SECAP has to contain the results of a GHG baseline emission inventory (BEI), a GHG emission reduction target of at least 55 % by 2030 and a clear outline of the actions (including at least three key actions) that the local authority intends to take in order to reduce its GHG emissions. The SECAP may as well cover a longer period, in which case it is advised that the plan contains intermediate targets and goals for the year 2030 (Davide et al. 2025a).

— Climate change adaptation: enhancing resilience of the territory and citizens. Through risk and vulnerability assessments (RVA), municipalities can systematically evaluate the risk they are subject on, due to the combination of various climate change hazards, vulnerabilities and exposure. The RVA supports strategic planning and decision-making. Drawing on the RVA, the SECAP also includes at least one adaptation goal and a set of actions (including at least three key actions) to increase the resilience of vulnerable sectors and groups (Palermo et al. 2025).

— Energy poverty: ensuring climate action is just and contributes to energy poverty's alleviation. CoM signatories are required to carry out an assessment of energy poverty within the local context to inform effective action planning. The assessment is based on a set of indicators organised into six macro-areas. Municipalities set a goal and plan relevant actions. Given that the reporting requirements on energy poverty have been recently introduced, until the end of 2024 a transition period applied, during which no mandatory requirements applied and signatories reported on a voluntary basis (Pittalis et al. 2025a).

Signatories are required to report specific data and information, reflecting the content of the action plan formally approved by the local council, through one of the two officially recognised reporting platforms: MyCovenant [7] or CDP-ICLEI Track [8]. MyCovenant is also used by several regional Covenants (notably the European one) to manage signatories' commitments, regardless of the platform each city reports to.

This report is based on data submitted through either of the two platforms and is structured as follows. Section 2 provides an overview of signatories, submitted action plans and monitoring reports, from the following regions:

— European Union (EU-27)

[7] MyCovenant: https://mycovenant.eumayors.eu
[8] CDP-ICLEI Track: https://www.cdp.net/en/cities-discloser

— European Free Trade Association (EFTA)

— Europe non-EU (including the United Kingdom)

— Eastern Partnership - CoM East

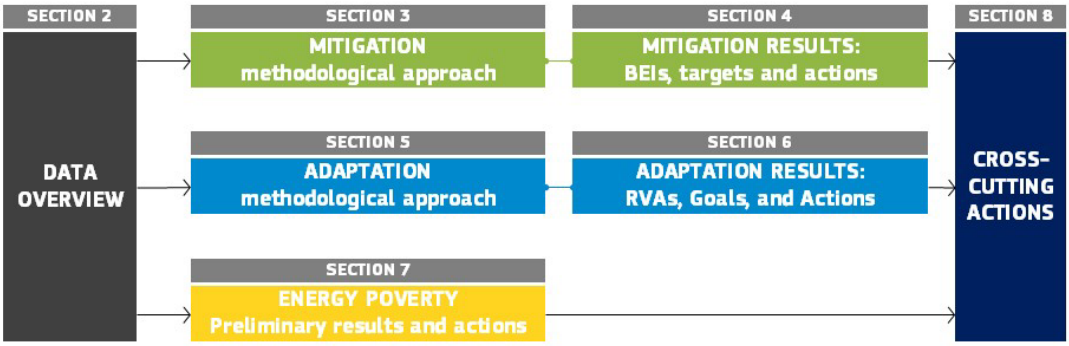
— Southern Partnership - CoM South / Clima-MED

— Western Balkans and Türkiye

— Central Asia

Sections 3 to 8 provide a more in depth analysis of data from action plans and monitoring reports for the EU-27 and for EFTA. In particular: section 3 describes the approach and methodology on climate change mitigation, section 4 illustrates results on mitigation, section 5 describes the approach and methodology on climate change adaptation, section 6 illustrates results on adaptation, section 7 focuses on preliminary analysis of energy poverty. Section 8 is dedicated to the analysis of integrated actions. Finally, section 9 draws conclusions. **Figure 1** summarises the structure of this study. Action plans and monitoring reports from signatories in Eastern Partnership (CoM East), Southern Partnership (CoM South / Clima-MED) and Central Asia are not analysed in this report as they follow a slightly different methodological approach and are the subject of separate, regional studies.

Figure 1. Structure of the report



Source: JRC elaboration

1.1. The role of the Joint Research Centre in the Covenant of Mayors

The Joint Research Centre (JRC) of the European Commission was entrusted since the launch of the initiative with the role of providing scientific, methodological and technical support to the CoM EU initiative to ensure its coherence with EU climate and energy policies as well as its scientific soundness.

One of the key tasks of the JRC is to assist signatories with the preparation and implementation of their action plans through the development of methodological guidebooks. In 2025, the JRC conducted a comprehensive update of the CoM EU Guidebook (Davide et al. 2025a) considering the latest policy developments, improving guidance on GHG emission accounting (Bastos et al. 2025), on risk and vulnerability assessment (Palermo et al. 2025) and introducing new methodologies for evaluating energy poverty - a growing concern for cities (Pittalis et al. 2025a). The guidebook also

includes real-world examples to serve as an inspiration (Hernandez Moral et al. 2025) and financial instruments for mitigation, adaptation and energy poverty actions (Todeschi et al. 2025).

With the extension of the CoM beyond the EU, the JRC has been responsible for adapting the CoM EU methodology to the environmental, economic and political contexts of other world regions (e.g. Eastern Partnership countries (Kona et al. 2018b), Southern Partnership countries (Rivas et al. 2018), Sub-Saharan Africa (Palermo et al. 2019). In this process, the JRC works closely with the consortium operating the EU Covenant of Mayors Office[9], with the Global Covenant of Mayors' Secretariat[10] as well as with other offices managing regional Covenants[11,12,13] with the goal of ensuring the applicability and consistency of these methodologies. The JRC also contributes to the definition and regular update of the reporting frameworks.

The JRC is responsible for the evaluation of submitted action plans and the provision of feedback to signatories[14], with the objective of verifying the compliance of the plan with the Covenant commitments, principles and methodological approaches, and to assess the soundness of the action plan in relation to the set targets and goals. Through its feedback, the JRC may provide further guidance and suggestions to CoM signatories for the potential improvement of their plans. The JRC is also responsible for regularly publishing datasets of submitted action plans and monitoring reports as open data (Franco et al. 2024)[15].

In the context of the GCoM, the JRC collaborates with partners and other research institutions to produce aggregation reports[16] and co-chairs the GCoM technical working group (TWG) on data. This TWG cooperates with cities and city networks to develop an efficient and robust assessment, planning, reporting and monitoring framework by ensuring that the global initiative benefits to the maximum extent from the work, knowledge and resources placed over the years. A key output of the TWG on data has been the GCoM Common Reporting Framework (CRF)[17] which ensures consistent and comparable reporting approaches for signatories worldwide, and its updated version introducing a simplified reporting level.

Finally, the JRC prepares scientific publications on the CoM outcomes in order to evaluate the policies adopted by local governments and their path towards the targets. Since 2013, the JRC has published a series of assessment reports on the CoM status in the EU e.g., (Cerutti et al. 2013), (Melica et al. 2022, 2024), (Franco de Los Rios et al. 2024) and other regions (Davide et al. 2024, 2025b; Palermo et al. 2022; Treville et al. 2025) in order to track and showcase the overall progress of the initiative on the basis of action plans and monitoring reports transmitted by CoM municipalities to the EC.

Specific aspects of the Covenant are also explored in dedicated studies, on, for example, multi-level governance models in the Covenant (Melica et al. 2018); review of reporting platforms (Bertoldi et al. 2018b); projections towards Paris Agreement targets (Kona et al. 2018a); methods on indirect

[9] https://eumayors.eu/about/support-the-community/office.html
[10] https://www.globalcovenantofmayors.org/about/
[11] http://com-east.eu/en/
[12] https://www.com-med.org/en/
[13] https://comssa.org/en/
[14] Only to signatories from Europe, Eastern Partnership, Southern Partnership, and Sub-Saharan Africa.
[15] https://data.jrc.ec.europa.eu/dataset/6684edc9-9b78-464a-990d-810555957550
[16] The latest GCoM aggregation report is available at https://www.globalcovenantofmayors.org/impact2024/
[17] https://www.globalcovenantofmayors.org/our-initiatives/data4cities/common-global-reporting-framework

emission accounting (Kona et al. 2019); climate change mitigation policies (Palermo et al. 2020); approaches to prepare GHG emission inventories (Palermo et al. 2024); impacts of GHG mitigation actions on air quality (Monforti-Ferrario et al. 2018; Peduzzi et al. 2020), financing climate change mitigation actions in cities (Todeschi et al. 2026); key factors enabling higher climate ambition (Rivas et al. 2021), key predictors of GHG emissions for cities (Franco et al. 2022, 2023).

2. Dataset construction and cleaning

The analysis of the current report is based on a dataset combining information from the GCoM My-Covenant dataset (Bezerra et al. 2025) and the CDP-ICLEI Track 2018-2025[18] (CDP 2024). From the latter, only cities belonging to the GCoM initiative were included in the analysis, as not all cities reporting to CDP are GCoM signatories.

The combined dataset covers, for each signatory:

- GHG emission inventories;

- GHG emission reduction targets;

- climate risk and vulnerability assessment (RVA);

- adaptation goals;

- energy poverty assessment;

- mitigation, adaptation and energy poverty actions planned.

Since the reporting on energy poverty became mandatory as of 1st January 2025, the related data is limited, and this report provides only a preliminary analysis on this pillar.

Under the CoM framework, municipalities voluntarily report their own data through the official reporting platforms. While data is overall of good quality, accurate and regularly updated, self-reported data may naturally contains a range of sources of uncertainty, such as biased estimations, errors due to misinterpretation of or misalignment with the CoM reporting framework, missing information or lack of coherence (Rivas et al. 2021). Within the framework of the Data Policy agreement, to further improve overall quality, the JRC removes evident errors or irregularities. As a consequence, after the JRC-harnessing process, a structured collection of action plans and monitoring reports from MyCovenant reporting platform is available in the GCoM MyCovenant datasets[19]. As mentioned, this report assesses the CoM progresses using the CDP-ICLEI full cities dataset and the GCoM datasets.

The general methodology for extracting and harnessing the reference GCoM datasets from the full set of raw submissions consists of two steps, namely data extraction and data cleaning. The first, described in the following section 2.1, refers to the extraction and management of the data from the full MyCovenant set of submissions. The second, which is described in section 3.2 and in annex 3, includes a more in-depth analysis, screening and cleaning of the data from unexplained outlier observations in both GCoM and CDP data. 'GCoM data' in this report refers to the aggregated datasets from both platforms, reflecting the latest available information.

[18] CDP-ICLEI Track is a climate reporting platform and progress tracker for cities developed by the Carbon Disclosure Project (CDP) and the International Council for Local Environmental Initiatives (ICLEI).

[19] https://data.jrc.ec.europa.eu/collection/id-00354

2.1. MyCovenant data extraction and management

All the data used in this report was extracted from a 'frozen' version of the MyCovenant PostgreSQL database as of January 2025. The signatories and the action plans for the analysis were selected according to the following main criteria:

— Signatories with initiative status corresponding to ‘published’ (i.e., active, compliant with the reporting requirements) or ‘on-hold’ (i.e., active, but suspended due to non-compliance)
— Action plans with submission status ‘submitted’ or ‘resubmitted'.

Signatory profiles that fulfilled these two criteria were included, while signatory profiles were excluded if they had: initiative status corresponding to ‘unpublished’ (i.e., signatories that never concluded the registration process: 256 profiles) or ‘under evaluation’ (i.e., not yet formally confirmed as signatories: 188 profiles). Besides, action plans with submission status ‘under completion’ (i.e., not submitted) were also excluded (3 874 plans).

Along the extraction process from MyCovenant, an important challenge consisted of linking each action plan with its commitments. A careful examination had to be performed, plan by plan, considering the date of submission of the plan, the level of completeness of the templates related to the plan, and most importantly, the presence of a reduction target[20].

The overall procedure was carried out in different stages. On a first stage, the raw data extraction was performed. Then, on a second stage, the available data was integrated into structured tables, adding extra information such as the GCoM identification codes for each organisation-signatory in the GCoM platform. On a third stage, the main information quality-harnessing procedure was performed, as it is explained in the mitigation (3) and adaptation (5.2) sections and annex 3. The new clean and structured tables were published (Bezerra et al. 2025), following the FAIR (Findability, Accessibility, Interoperability, and Reusability) guiding principles for scientific data management and stewardship (Wilkinson et al. 2016).

[20] In the mitigation action plans, setting reduction targets and developing a baseline-year emission inventory were minimum criteria for completeness. In the adaptation part, the presence of adaptation goals was not considered among the completeness criteria, since it was an optional information until 2020 only afterwards introduced as a mandatory requirement in the reporting template. The presence of at least one reported climate hazard was considered among the completeness criteria for adaptation plans. See also Section 5.2. For the Energy poverty, no specific criteria have been applied so far.

2.2. Signatories and commitments

At the cut-off date for the analysis (January 2025), there was a total of 11 799 municipalities registered as CoM signatories through MyCovenant, covering a total population of 380.6 million inhabitants as shown in **Table 1**. Some of these municipalities have committed to submitting a joint action plan (i.e., a plan covering a group of local authorities) instead of an individual plan, notably in EU and in South Mediterranean countries. As a result, the number of expected action plans that should be submitted by those 11 799 signatories is 10 206.

Table 1. Overview of signatories and expected action plans.

GCoM - Regions	Number of signatories committed to the CoM	Number of inhabitants	Number of expected Action Plans, considering joint commitments
Europe - EU	10 787	244 179 927	9 206
Europe - EFTA	38	3 582 203	38
Europe - Non EU	64	25 959 852	64
Eastern Europe - CoM EAST	540	31 488 000	540
Southern Mediterranean - CoM MED	159	16 126 608	147
Western Balkans and Türkiye	196	56 317 795	196
Central Asia	15	2 945 955	15
Total	**11 799**	**380 600 340**	**10 206**

[1] Several signatories have renewed their commitment to 2050 in group as joint commitments; therefore, their previous individual profile or diverse group configuration has been "unpublished" in MyCovenant.
[2] Eastern Europe - CoM EAST region does not include municipalities from Belarus.

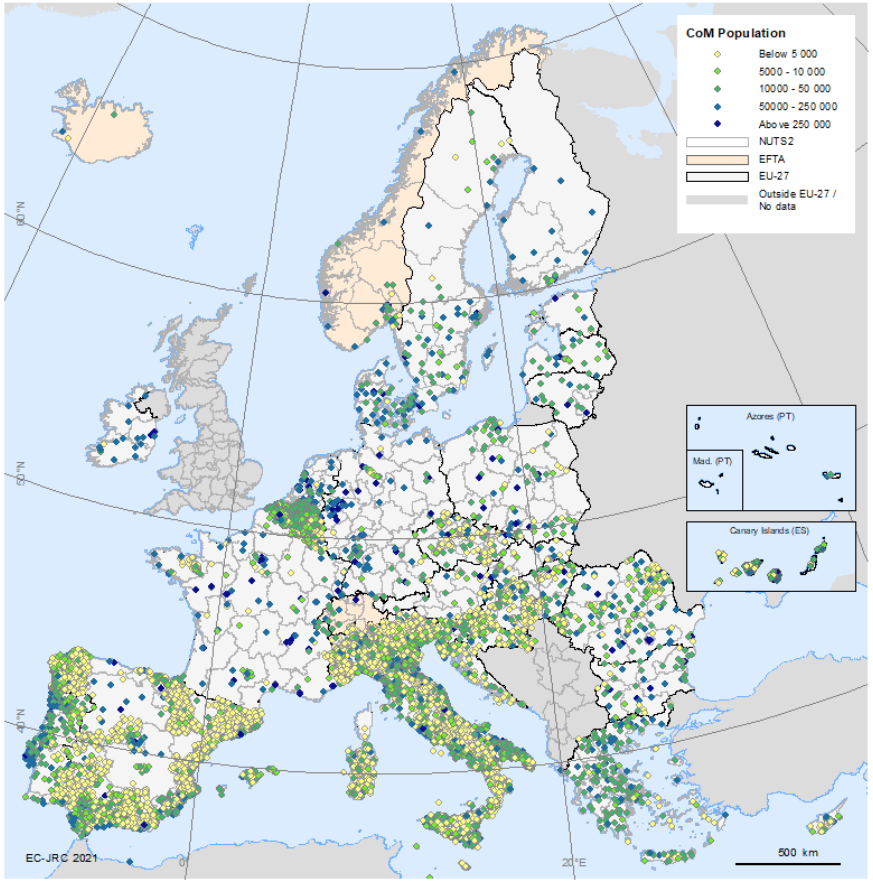
Source: JRC elaboration based on GCoM data

As shown in **Table 1**, the majority of signatories come from the EU-27, covering more than 244 million inhabitants, followed by the Eastern Partnership countries (CoM EAST) (540 signatories, 31 million inhabitants), Western Balkans and Türkiye (196 signatories, 56 million inhabitants), Southern Partnership countries (CoM MED) (159 signatories, 16 million inhabitants), Europe – non-EU and EFTA (102 signatories, 29 million inhabitants) and Central Asia (15 signatories, 2.9 million inhabitants).

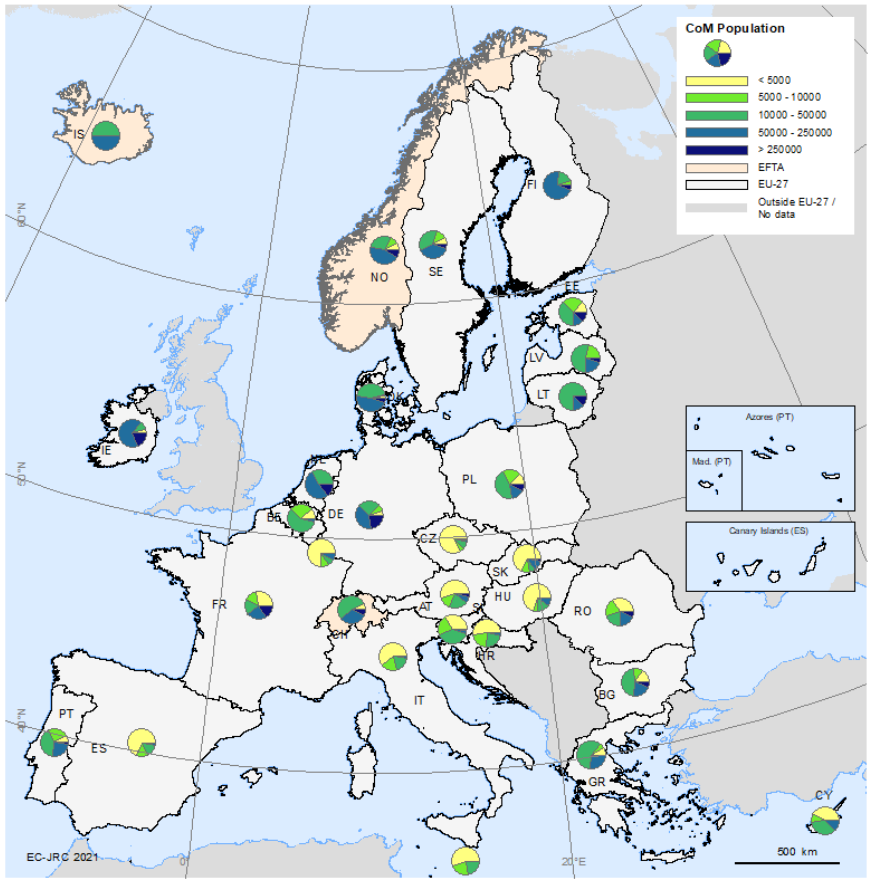
This report focuses on two GCoM regions, namely EU-27 and Europe – EFTA. For a global assessment the reader is referred to a set of 2024 GCoM impact reports, namely '2024 Global Covenant of Mayors Impact Report'[16], 'Global Covenant of Mayors: A Comprehensive Assessment of Climate Adaptation Plans' (Treville et al. 2025), and 'Global Covenant of Mayors: Aggregation Report on Energy Access and Energy Poverty 2025' (Pittalis et al. 2025b). For insights into the Eastern partnership region (CoM East), the reader can refer to the 'CoM East overall assessment and in-depth SECAPs analysis' (Davide et al. 2025b). **Figure 2** shows signatories from EU-27 and EFTA, by population range and the share of signatories by population range per Member State and country. Looking back at previous CoM assessment reports (Melica et al. 2022, 2024), a steady increase is observed in the number of signatories in the EU-27 (7.3 % increase compared to 2021 data) an din the population covered by the initiative (3 % increase compared to 2021 data). The maps illustrate in greater details EU-27 and EFTA signatories, in particular, (a) shows the signatories in circles of different colours based on population ranges, while (b) presents for each country the share of

signatories per population range, showing that in Austria, Czechia, Hungary, Italy, Malta, Slovakia and Spain more than half of the signatories are local authorities with less than 5 000 inhabitants.

Figure 2. Signatories from EU-27 and EFTA countries, by population range (a) and share of signatories by population range per Member State and EFTA countries (b).



a)



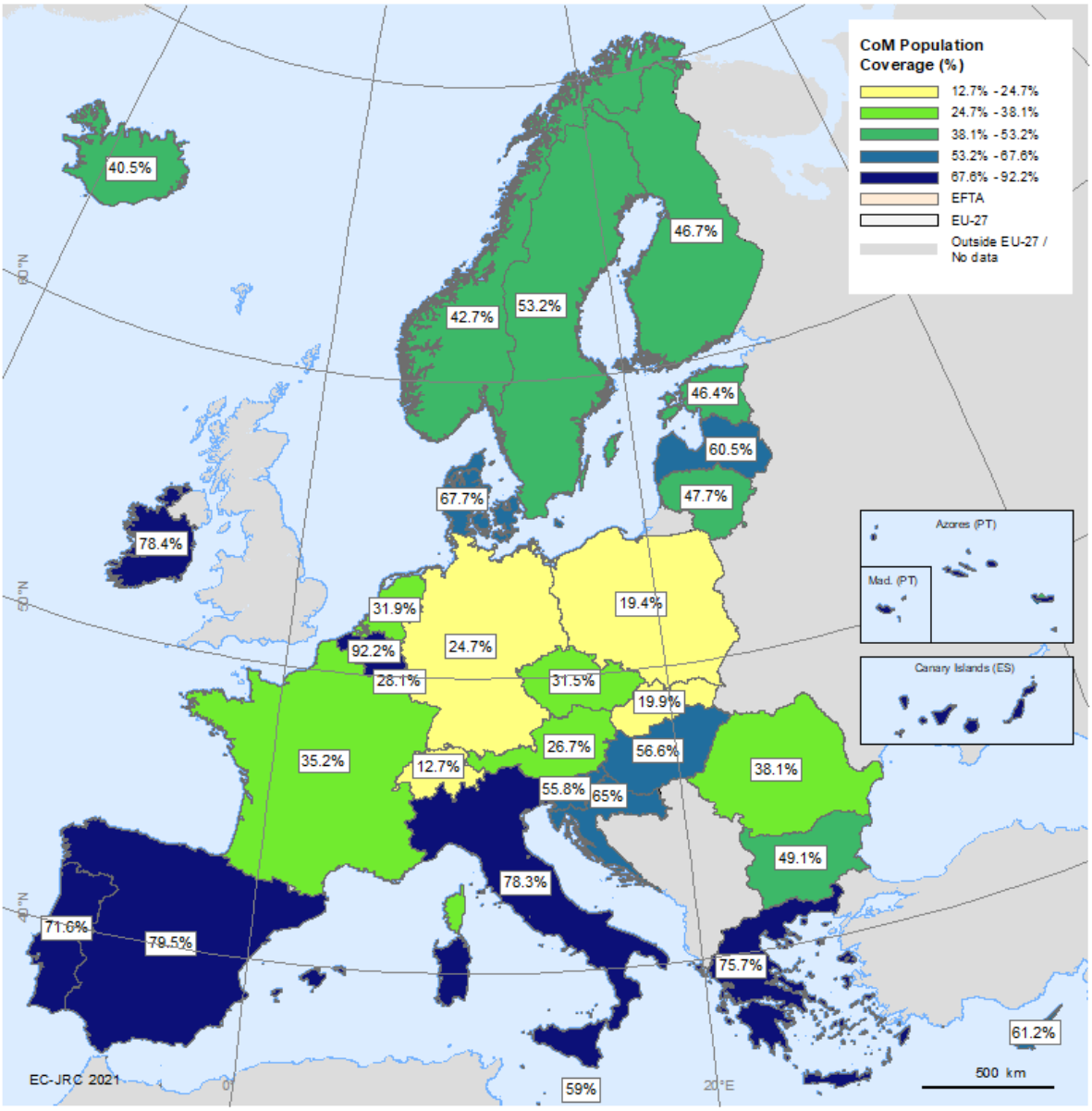
b)

In the Nomenclature of Territorial Units for Statistics (NUTS) classification, NUTS2 indicates the basic regions for the application of regional policies.

Source: JRC elaboration based on GCoM data

The map in **Figure 3** shows the share of population covered by the CoM per EU Member State and EFTA.

Figure 3. Share of country population covered by the CoM, for EU-27 and EFTA.



Source: JRC elaboration based on GCoM data

Both **Figure 2** and **Figure 3** show that in Mediterranean countries as well as in Belgium, there is high coverage of population in CoM signatories. The uneven distribution of signatories across Europe is linked to diverse reasons, one of the most considered being the fact that no similar framework nor national policies supporting climate action in cities were in place before the CoM.

As described in section 1, the CoM EU initiative has evolved over time in line with the EU energy and climate policy. Signatories have, therefore, undertaken different commitments according to the moment of adhesion. **Table 2** and **Table 3** show the number of signatories and the population covered by region, based on the commitment they signed up to:

— CoM 2020 refers to signatories of the Covenant of Mayors up to October 2015, committing only to mitigation with a minimum 20% emission reduction target by 2020;

— Mayors Adapt refers to Mayors Adapt signatories up to October 2015, committing only to climate change adaptation;

— CoM 2030 refers to signatories of the Covenant of Mayors for Climate and Energy, with a commitment to adaptation combined with mitigation with a 40% emission reduction target by 2030[21];

— CoM 2050 refers to signatories of the new Covenant of Mayors for Climate and Energy, with a commitment to adaptation combined with mitigation with the climate neutrality goal by 2050 and a recommended interim emission reduction target of 55 % by 2030.

Table 2. CoM signatories by region and by commitment.

GCoM regions	CoM 2020	Mayors adapt	CoM 2030	CoM 2050
Europe - EU-27	7 735	187	3 795	1 647
Europe - EFTA	21	0	25	7
Europe - Non EU	46	6	38	9
Eastern Europe - CoM EAST	178	1	417	58
Southern Mediterranean - CoM MED	50	116	117	0
Balkans and Türkiye	58	4	79	85
Central Asia	15	0	0	0
Total	**8 103**	**314**	**4 471**	**1 806**

Source: JRC elaboration based on GCoM data

Table 3. Population covered by region and by commitment.

GCoM regions	CoM 2020	Mayors adapt	CoM 2030	CoM 2050
Europe - EU-27	182 499 655	24 153 077	127 248 669	71 805 184
Europe - EFTA	2 737 514	0	3 125 390	1 260 369
Europe - Non EU	23 806 044	4 503 799	20 766 189	9 812 625
Eastern Europe – CoM EAST	19 428 204	98 953	20 061 912	3 366 963
Southern Mediterranean – CoM MED	6 393 281	10 053 125	10 063 997	0
Balkan and Türkiye	15 935 461	1 730 511	24 450 436	29 431 752
Central Asia	2 945 955	0	0	0
Total	**253 746 114**	**40 539 465**	**205 716 593**	**115 676 893**

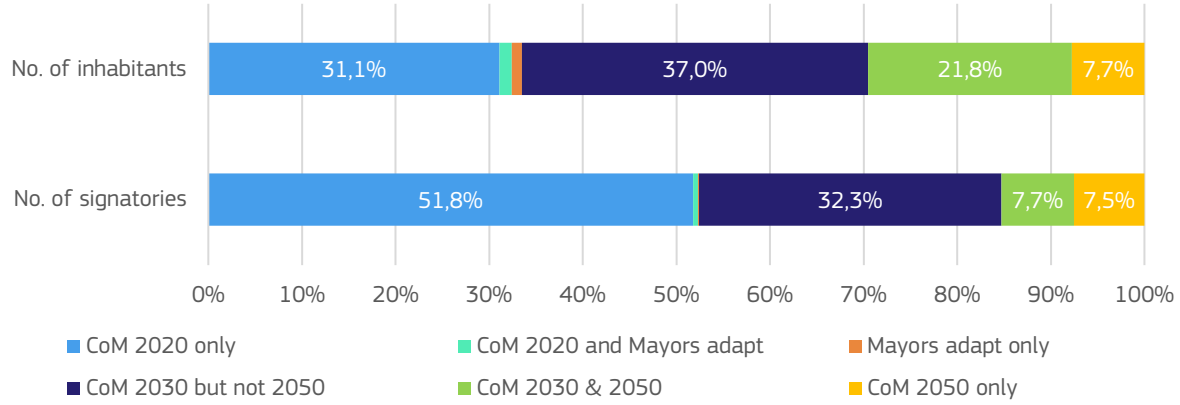
Source: JRC elaboration based on GCoM data

A more detailed analysis of the number of signatories and population covered by country is presented in Annex 1.

As shown in **Figure 4** and **Figure 5**, despite the high number of signatories, about 50 % across all regions and 52 % in the EU-27 have not yet renewed their commitment to CoM 2030 or 2050 target. However, in addition to new signatories, about new 5 % of municipalities across all regions and 4 % in the EU-27, have renewed their commitment from 2020 only to 2050 compared to previous figures. In terms of population, however, the signatories committed to 2030 or 2050 targets represent about 70 % of the CoM population across all regions and 63.3 % in the EU-27.

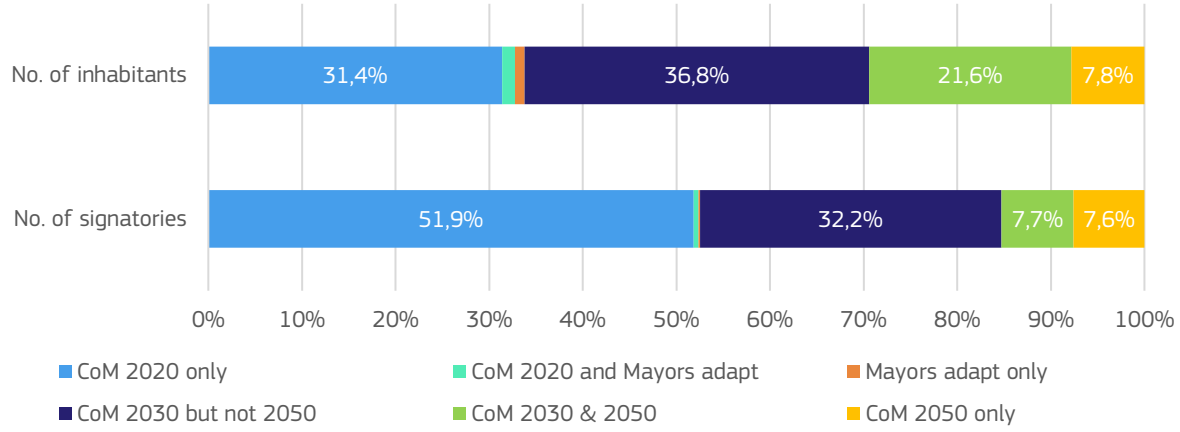
[21] For CoM-EAST signatories, the 2030 target was originally set to 30% by 2030.

Figure 4. Number of signatories and population covered by commitment (EU-27+EFTA).



Source: JRC elaboration based on GCoM data

Figure 5. Number of signatories and population covered by commitment (EU-27 only).



Source: JRC elaboration based on GCoM data

At the cut-off date of this study, there were 816 signatories that subscribed to the CoM 2050 commitment only, which suggests an increasing interest and acknowledgement of the importance of climate action. In addition, a total of 98 signatories (94 in the EU-27 and 4 in EFTA) are also signatories of the Horizon Europe Climate-Neutral and Smart Cities (CNC) Mission [22], with the goal of climate neutrality by 2030. For the purposes of this report, EU Cities Mission municipalities will not be included in the analysis described in the next sections.

[22] https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/eu-missions-horizon-europe/climate-neutral-and-smart-cities_en

2.3. Submitted action plans

The total number of signatories with a submitted action plan in the EU-27 and EU EFTA regions is 7 000, covering about 144 million inhabitants.

Table 4 and **Table 5** show the number of signatories with a submitted action plan in the two regions and the population covered. **Table 6** shows the number of action plans for each commitment.

Table 4. Number of signatories with a submitted action plan per pillar [23].

Region	Mitigation only	Mitigation and Adaptation	Adaptation only	Total
Europe - EU-27	4 648	2 320	14	6 982
Europe - EFTA	7	9	2	18
Total	**4 655**	**2 329**	**16**	**7 000**

Source: JRC elaboration based on GCoM data

Table 5. Number of inhabitants of signatories with a submitted action plan per pillar.

Region	Mitigation only	Mitigation and Adaptation	Adaptation only	Total
Europe - EU-27	77 782 663	63 841 242	1 116 510	142 740 415
Europe - EFTA	173 242	1 579 336	65 008	1 817 586
Total	**77 955 905**	**65 420 578**	**1 181 518**	**144 558 001**

Source: JRC elaboration based on GCoM data

Table 6. Number of submitted action plans for each commitment.

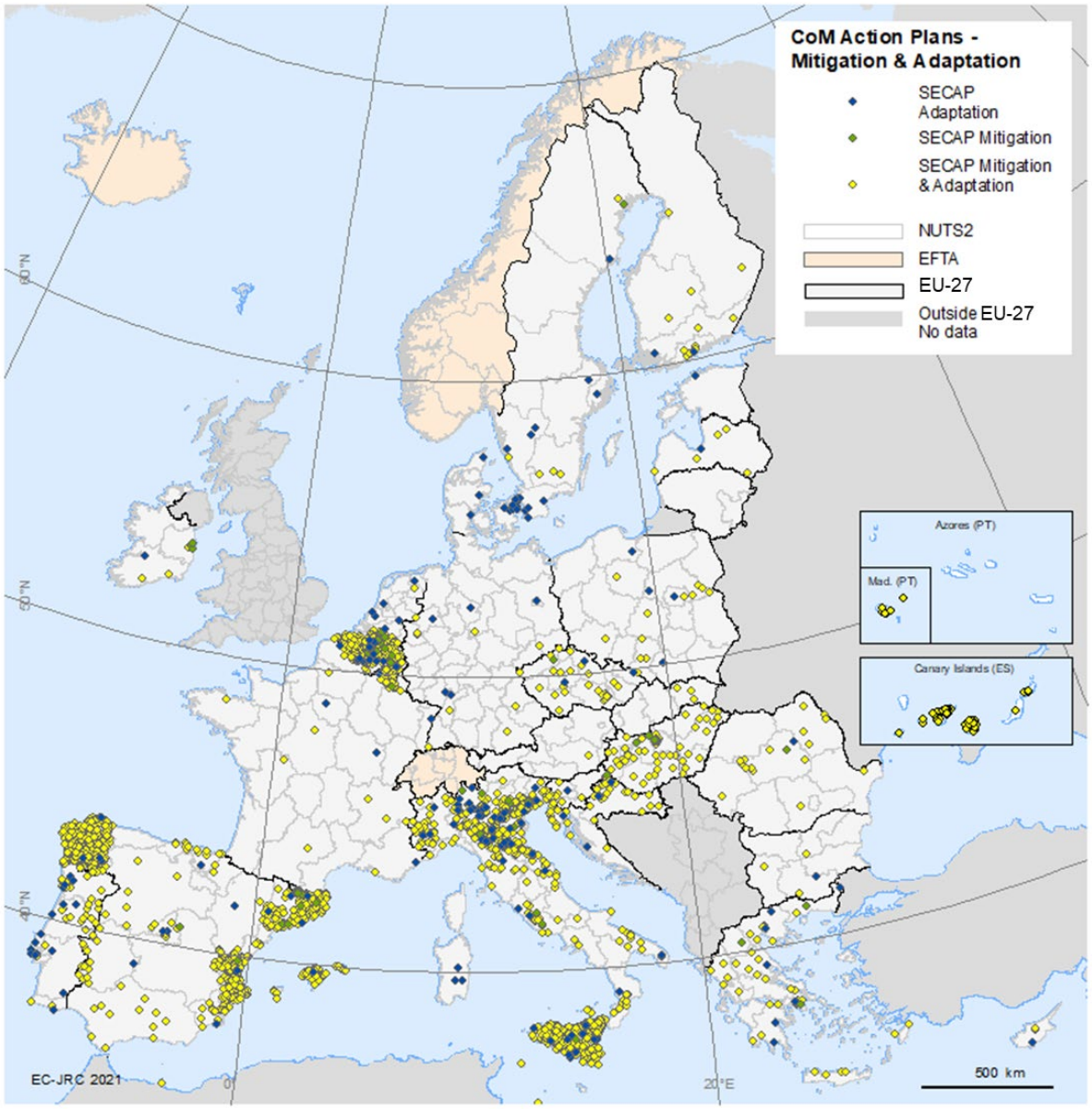
Region	Mitigation 2020	Mitigation 2030	Mitigation 2050	Adaptation
Europe - EU-27	5 691	2 108	303	2 525
Europe - EFTA	12	9	4	23
Total	**5 703**	**2 117**	**307**	**2 548**

Source: JRC elaboration based on GCoM data

An overview of the signatories with a submitted action plan is provided in **Figure 6** and **Figure 7.** Similarly to what we observed regarding the number of signatories, also the majority of action plans have a time horizon limited to 2020. However, it is worth noting that between March 2023 and December 2024 the number of action plans with a mitigation target by 2050 in the EU-27 increased from 34 to 303 and the population covered is more than ten times larger, reaching 34 million inhabitants. The number of action plans covering adaptation has grown by 42 % (from 1703 to 2525), and those with a 2030 target increased from 1 660 to 2 108 in the EU-27.

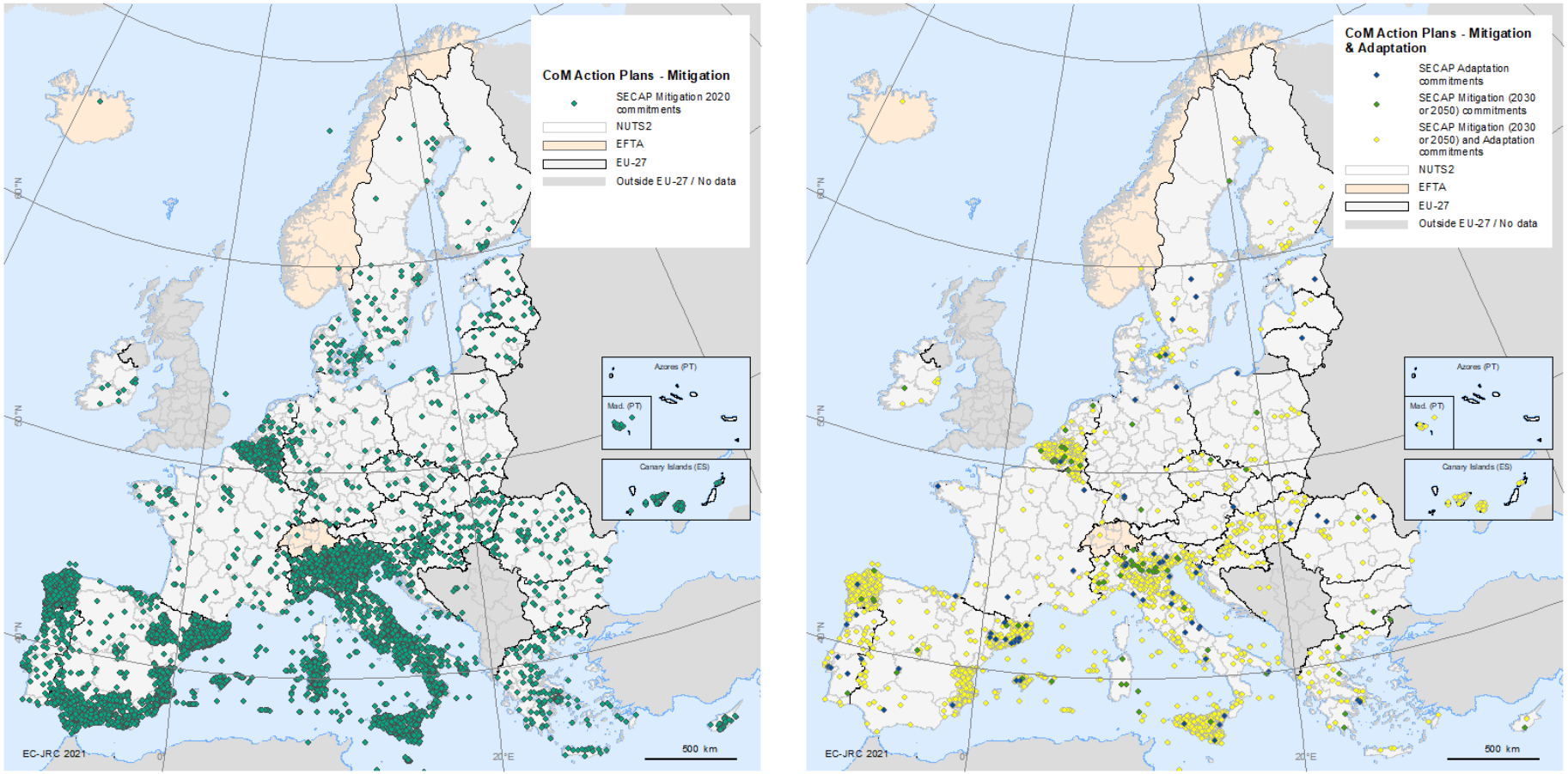
[23] Indicating that the climate action plan covers either mitigation or adaptation only, or it deals with both climate mitigation and adaptation

Figure 6. Overview of signatories with a submitted action plan according to the pillar covered.



Source: JRC elaboration based on GCoM data

Figure 7. Overview of signatories with a submitted action plan covering only mitigation until 2020 (a) or both mitigation until 2030 or 2050 and adaptation (b).

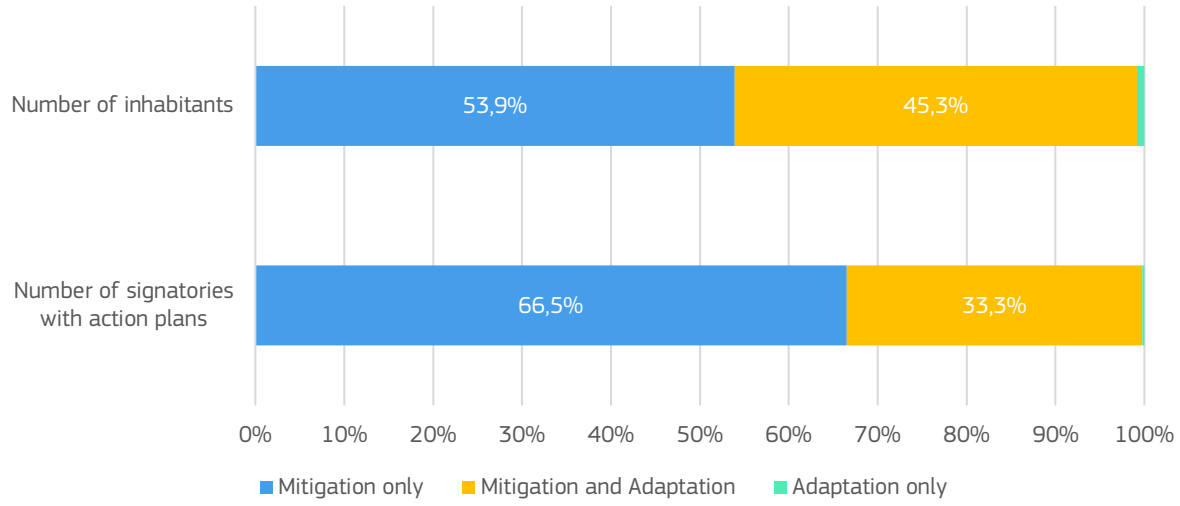


a) b)

Source: JRC elaboration based on GCoM data

Looking at the action plans by pillar (**Figure 8**), it is noted that 66.5 % of the action plans address the mitigation pillar alone and that 33.3 % of the actions plans address simultaneously mitigation and adaptation. Less than 1 % of the action plans address the adaptation pillar alone. In terms of population, the signatories with action plans addressing only mitigation cover more than half of the population. The limited share of municipalities reporting information on the adaptation pillar is partly due to the historical focus of the European Covenant of Mayors on mitigation efforts. As introduced in section 1, originally, the initiative began with a commitment to mitigation, the reduction of greenhouse gas (GHG) emissions through a series of actions across various sectors (see section 4). Over time, the scope expanded to include adaptation, reflecting the growing recognition of the need to address climate change impacts comprehensively (see section 60).

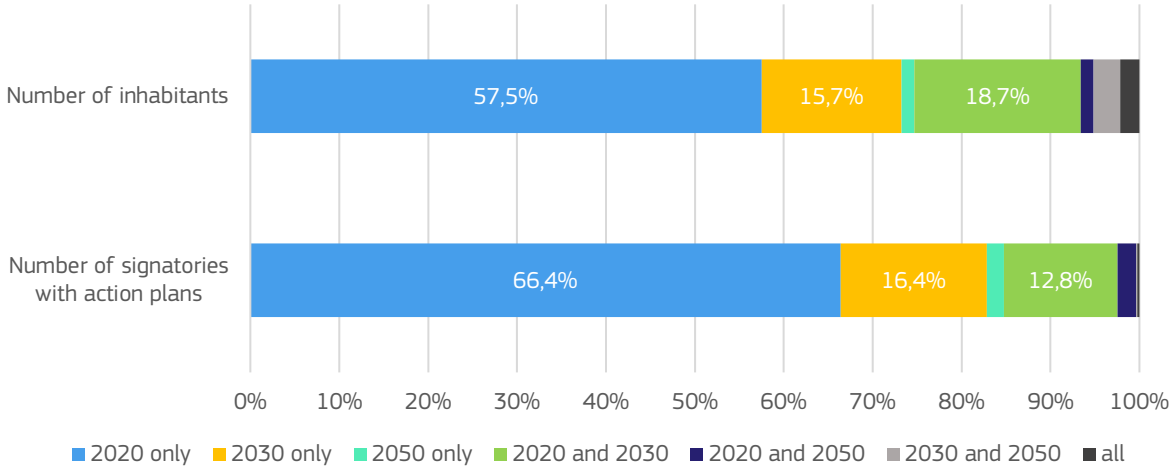
Figure 8. Signatories with action plans and population covered as a function of the pillar addressed (EU-27 and EFTA).



Source: JRC elaboration based on GCoM data

Figure 9 shows the signatories and the population covered as a function of commitment. It can be observed that 66 % of the mitigation plans (covering 58 % of the population) have a 2020 commitment; 29 % of the plans (covering 34 % of the population) have a 2030 commitment, either combined with a 2020 target or not; 5 % of the plans (covering 8 % of the population) have a plan consistent with the CoM 2050 commitment.

Figure 9. Number of signatories and population covered as a function of the commitment of their action plans (EU-27 and EFTA).



Source: JRC elaboration based on GCoM data

2.4. Monitoring reports

CoM signatories are expected to regularly monitor their action plan by submitting a monitoring report on the implementation status of their actions (light monitoring) every two years after the submission of their action plan and a monitoring emissions inventory (MEI) (complete monitoring report) following the same approach and methods as the BEI, at least every four years. This part of the analysis is only based on data submitted through MyCovenant, since CDP-ICLEI Track requires annual reporting during pre-defined reporting windows. Based only on MyCovenant data, **Table 7** reports the number of signatories having submitted at least a monitoring report, **Table 8** shoes the population covered. The two tables show that the number of signatories having submitted at least one monitoring report by the cut-off date is 2 997, covering 77.1 million inhabitants. When accounting for the 50 signatories to EU Cities Mission municipalities that reported at least a Monitoring Emission Inventory (MEI), the population covered reaches 107.3 million inhabitants [24].

The monitoring reports (light and complete) are submitted via the monitoring templates in 'MyCovenant' platform. It can be highlighted that 796 signatories have reported their MEI through their action plans templates and for this reason, they are not included in the tables [25].

As shown also in **Figure 10**, out of 2 997 signatories with a monitoring report, 1 508 (covering 49.8 million inhabitants) submitted a monitoring report flagged as 'complete', i.e., including at least one MEI. Signatories with at least a monitoring report represent 43 % of those having an action plan, while the figure decreases looking at completed MEI which represent the 22 % of signatories having submitted an action plan. This underlines a slight increase compared to the latest report (i.e., 41 % and 21 % for EU-27 respectively) (Melica et al., 2024). While the low figure might reflect difficulties in complying with the reporting requirements or a lack of implementation of the action plans on the ground, it must also be noted that the results do not consider how many signatories have actually reached the deadline to submit their first monitoring report.

An estimation of the number of monitoring reports that were actually due by the cut-off date of the analysis has been made based on the number of years that had passed since the approval of the plan by the city council (2 years for 'light' reporting or 4 years for 'complete' reporting). It is observed that approximately 33 % of 'light' monitoring reports and 24 % of 'complete' monitoring reports that were due, were actually submitted by the cut-off date of the analysis.

[24] Municipalities that are signatories of the Horizon Europe Climate Neutral and Smart Cities Mission are not included in this analysis.

[25] When reporting data through MyCovenant platform, CoM signatories report data related to SECAP in dedicated action plans templates (AP) and data related to monitoring in dedicated monitoring report (MR) templates.

Table 7. Number of signatories with at least one submitted monitoring report.

Regions	Signatories with AP having at least one MR	Share of signatories with AP having at least one MR	Signatories with AP and at least one MEI	Share of signatories with AP having at least one MEI, over AP
Europe – EU-27	2 993	43 %	1 505	22 %
Europe – EFTA	4	25 %	3	25 %
Total	**2 997**	**43 %**	**1 508**	**22 %**

[1] The share is calculated considering n. 6 962 signatories having reported via MyCovenant platform

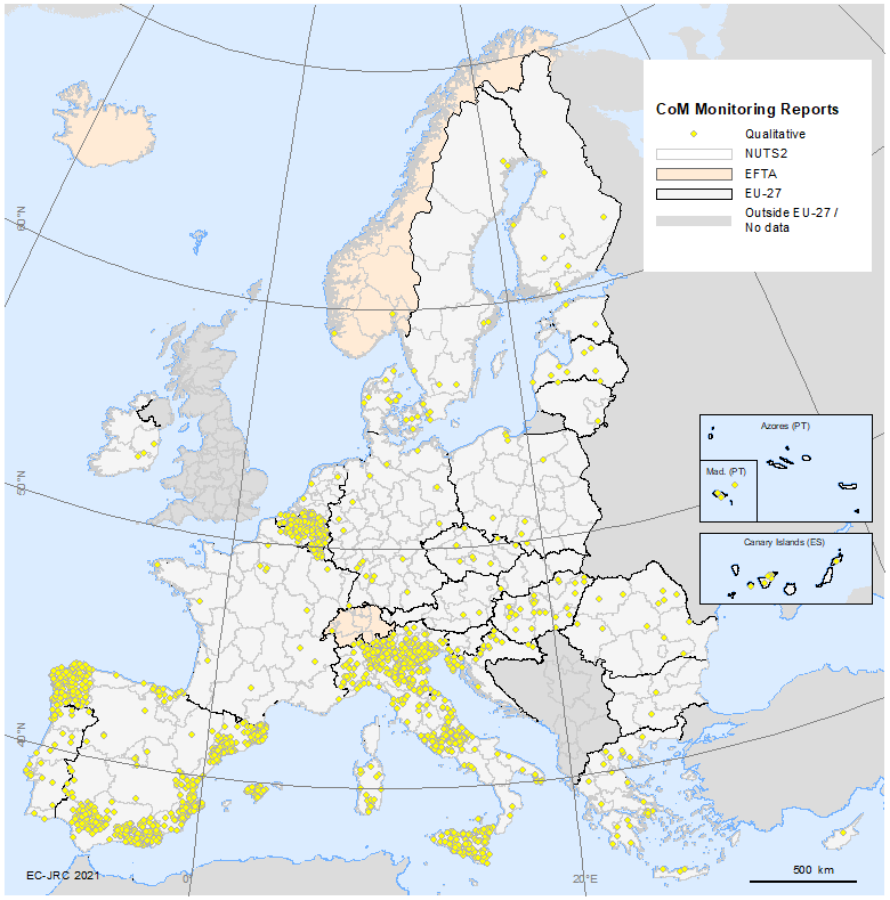
Source: JRC elaboration based on GCoM data

Table 8. Number of inhabitants in cities with submitted monitoring reports.

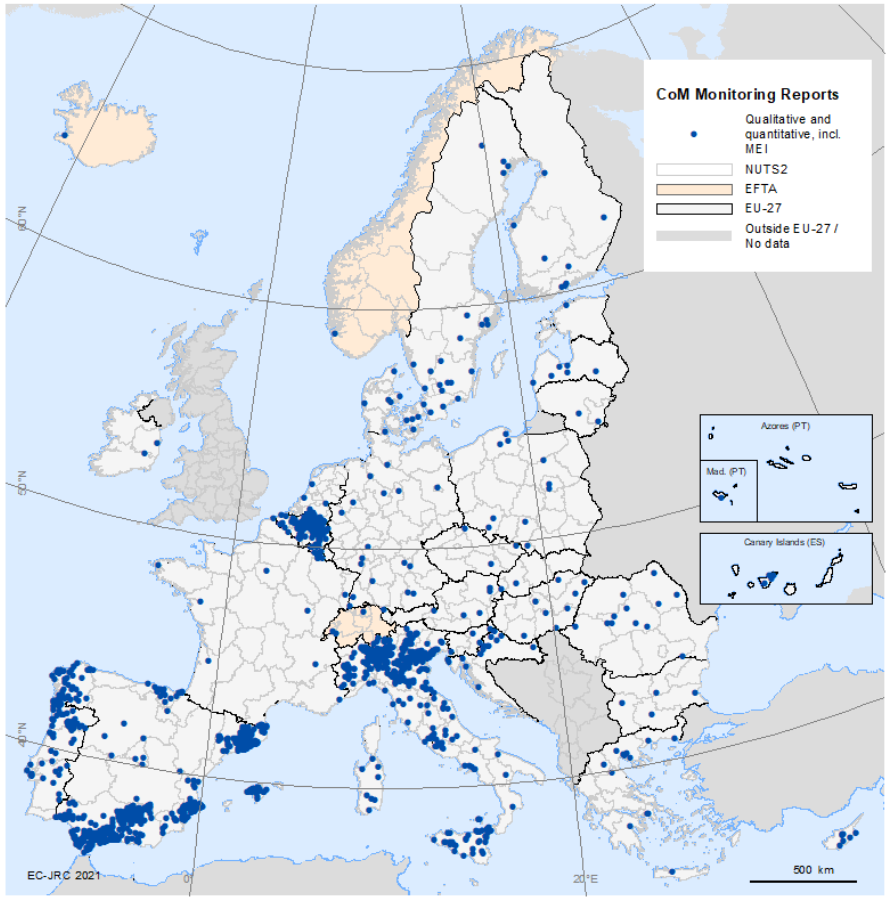
Regions	Signatories with AP having at least one MR	Share of signatories with AP having at least one MR	Signatories with AP and at least one MEI	Share of signatories with AP having at least one MEI, over AP
Europe - EU-27	77 191 698	55 %	49 074 083	35 %
Europe - EFTA	657082	51 %	562 582	44 %
Total	**77 848 780**	**55 %**	**49 884 093**	**35 %**

Source: JRC elaboration based on GCoM data

Figure 10. Overview of signatories with at least one submitted monitoring report, either qualitative (a) or quantitative, with MEI (b).



a)



b)

Source: JRC elaboration based on GCoM data reported via MyCovenant platform

3. Approach and methodology on mitigation

3.1. The Covenant of Mayors' approach to mitigation

A municipality developing a climate mitigation plan should begin by compiling a baseline emission inventory (BEI), which quantifies GHG emissions for a base year using a common methodological approach (Bastos et al. 2025) The BEI identifies the main emitting sectors, enabling prioritisation of mitigation actions. The CoM signatories choose a baseline year from 1990 onwards for which comprehensive, reliable and meaningful inventory data can be obtained, consistently with UNFCCC guidelines.

Signatories may calculate their inventories using one of the following approaches: the activity-based approach, which uses fuel carbon content for emission factors; the Life-Cycle (LC) based approach, accounting for the full supply chain. Depending on the chosen approach and sectors included, signatories report either CO_2 only or with two additional GHGs (methane CH_4 and nitrous oxide N_2O) converted to CO_2-equivalents based on IPCC global warming potentials (GWPs).

CoM emission inventories capture both direct emissions (Scope 1) generated within the municipal territory, such as fossil fuel combustion, and indirect emissions (Scope 2) from grid-supplied energy (electricity or district heating and cooling) consumed locally, regardless of where generation occurs. As shown in **Table 31** in Annex 2, the inventories cover the main sectors excluded from the EU Emissions Trading System. Local energy generation data and associated emissions are considered in the emission factor applied to grid-supplied energy and excluded from total emissions.

With the BEI results, local authorities can identify the highest-emitting sectors and quantify the effort required to meet the initiative's minimum target or a more ambitious one. Beyond the BEI, signatories may calculate more recent inventories to track emission trends across sectors, have knowledge on the current emissions and gaps enabling informed prioritization of action areas in line with local, regional, and national policy priorities. Targets can be set on an absolute basis, per capita, or relative to a business-as-usual scenario for non-EU signatories.

3.2. Statistical analysis

The analysis of GCoM signatories' data required a systematic approach to data validation and processing across two distinct reporting platforms. This section presents a concise overview of the harnessing procedures applied by the JRC to the GCoM datasets, from the MyCovenant and CDP-ICLEI Track platforms, together with the statistical methods employed for estimating signatories' emission reduction achievements.

The methodology addressed several key challenges inherent in self-reported municipal data, including the identification and correction of evident errors, validation of emission factors against reference values, assessment of internal consistency across multiple reporting years, and standardization of emissions inventories to enable meaningful comparison across signatories. Given the comprehensive nature of these procedures, the full technical details, including the specific clustering algorithms applied for outlier detection, the precise thresholds and validation criteria for energy consumption and emissions, and the emission factor reference values, are provided in Annex 2.

To assess signatories' progress towards their emission reduction commitments, a statistical methodology was developed to forecast emissions from baseline to target years. Signatories' action plans include a BEI against which their achievements are measured, along with periodic monitoring

reports. Following the approach detailed in Annex 3, overall GHG emissions were estimated for a common baseline year of 2005 and projected to 2030 using a statistical model that minimised prediction error for the most recent known values.

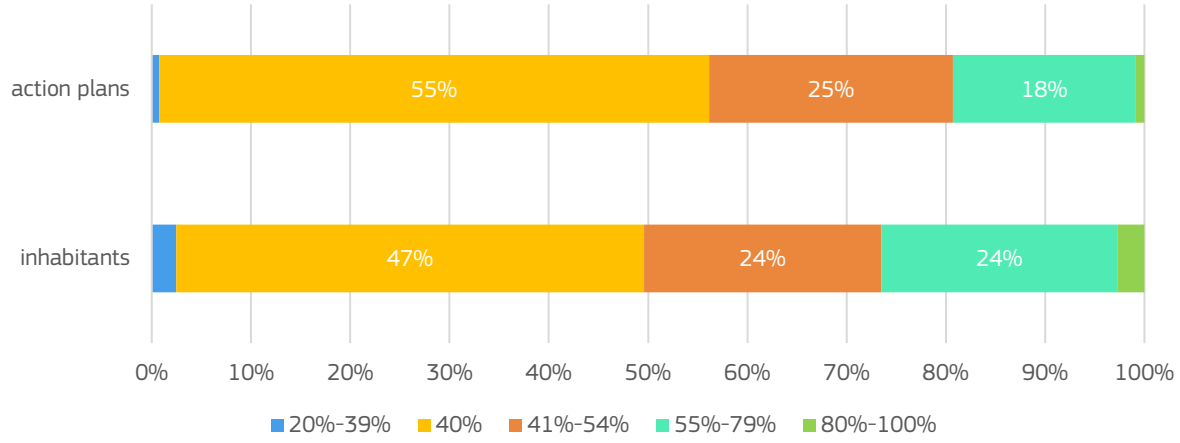
4. Results on mitigation

4.1. Emission reduction targets

CoM signatories are free to set a more ambitious GHG emission reduction target than the minimum target proposed by the initiative for each commitment (see section 1). As a result, different levels of ambition in terms of mitigation targets can be seen among action plans with a time horizon for 2030 and/or 2050. The analyses described within this section refer to signatories with a 2030 and/or a 2050 commitment, from EU-27 and EFTA excluding signatories that are also part of the Horizon Europe Climate-Neutral and Smart Cities (CNC) Mission.

Looking at the SECAPs with a 2030 time horizon (**Figure 11**), it can be observed that in 55 % of the cases the minimum 40 % target set for EU signatories is chosen, while in about one fourth of the cases a more ambitious target is selected, yet not as ambitious as the 55 % target set by the EU for 2030 [26]. However, 18 % of the action plans set a target of at least 55 % emission reduction, showing an increasing trend compared to previous figures (11 %) (Melica et al. 2024). It is also worth noting that about 1 % of the action plans set a target lower than 40 % or above the 80 %. In terms of population, almost 50 % of the population is covered by the action plans with targets above 40 % reduction. **Figure 11** combines results from signatories located in EFTA countries (n:9) and EU-27 member states (n: 2 325).

Figure 11. Number of action plans with a 2030 time horizon and population coverage as a function of the level of ambition of the GHG emission reduction target declared by signatories in the EU-27 (n. 2 325) and EFTA (n. 9).



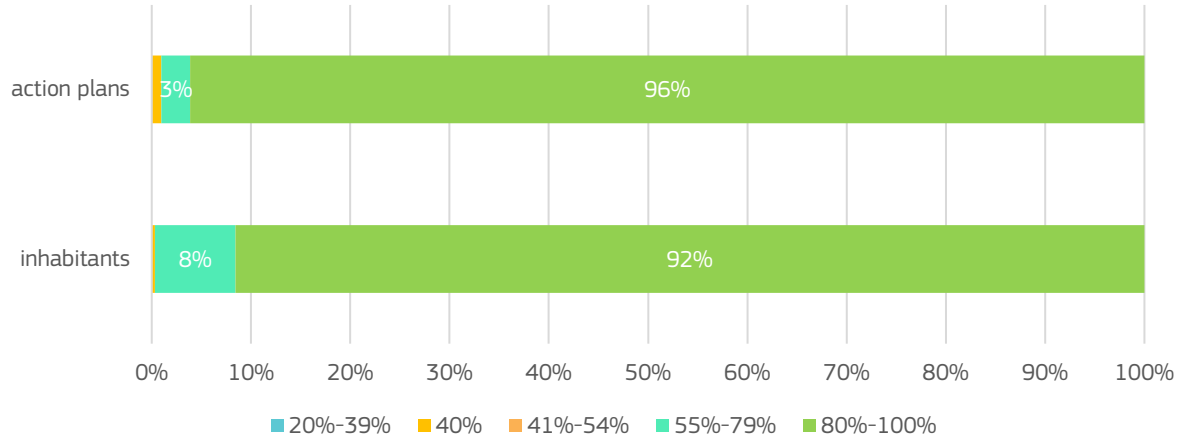
Source: JRC elaboration based on GCoM data

While the number of SECAPs with a 2050 time horizon is growing, it remains less than 10% of the overall sample. **Figure 12** shows the level of ambition in the targets of SECAPs with a 2050 time horizon. It can be observed that in more than 90% of the cases, the plans are very ambitious

[26] The CoM EU originally set a target of 40% emission reduction by 2030 in alignment with the EU target.

aiming at climate neutrality (reduction between 80% and 100%) in line with the target set by the EU for 2050. The remaining 3 % of the plans show a target between 55 % and 79 %. In terms of population, 8 % of the population is covered by action plans with a target comprised between 55 % and 79 % reduction, while the majority of inhabitants is coherently represented in the most ambitious plans. **Figure 12** combines results from signatories located in EFTA countries (n:3) and EU-27 member states (n: 100).

Figure 12. Number of action plans with a 2050 time horizon and population coverage as a function of the level of ambition of the GHG emission reduction target declared by signatories in the EU-27 (n. 100) and EFTA (n. 3).



Source: JRC elaboration based on GCoM data

Based on the targets and on the results of baseline emissions inventories reported by 2 339 municipalities with data considered valid according to the procedure described in section 3 , the overall commitment by 2030 and by 2050 (**Table 9**) was calculated. Overall, signatories have reported baseline emissions for 342 157 394.43 t CO_2-eq in 2005 in the EU-27 and 5 110 728.64 t CO_2-eq in EFTA countries, for a total of 347 268 123.07 t CO_2-eq. Signatories made a commitment (51%) beyond the minimum 40% target originally set for EU signatories, and close to collectively target the ambition of EU 55 % reduction by 2030, and are aligned with the EU ambition for climate neutrality in 2050. Annex 1 presents the same analysis at the country level.

Table 9. Baseline GHG emissions in t CO_2-eq projected to 2005 based on signatories' submitted action plans.

Region	Number of signatories	BEI GHG emissions in 2005 [t CO_2-eq]
Europe – EU-27	2 330	342 157 394.43
Europe - EFTA	9	5 110 728.64
Total	**2 339**	**347 268 123.07**

Source: JRC elaboration based on GCoM data

Table 10. Overall emission reduction by 2030, based on submitted action plans.

Region	Number of signatories	BEI 2005	Targeted emissions 2030 [t CO_2-eq]	Committed reduction by 2030
Europe – EU-27	2 324	337 110 509.77	165 746 010.10	51 %
Europe - EFTA	9	6 260 728.64	3 071 956.22	51 %
Total	**2 333**	**343 371 238.41**	**168 817 966.32**	**51 %**

Source: JRC elaboration based on GCoM data

Table 11. Overall emission reduction by 2050, based on submitted action plans.

Region	Number of signatories	BEI 2005	Targeted emissions 2050 [t CO_2-eq]	Committed reduction by 2050
Europe – EU-27	100	53 310 987.77	3 559 167.12	93 %
Europe - EFTA	3	1 362 309.21	111 385.37	92 %
Total	**103**	**54 673 296.98**	**3 670 552.49**	**93 %**

Source: JRC elaboration based on GCoM data

4.1.1. Methodological notes

The analysis in this chapter is based on a sample of 2 330 signatories for the EU27 and 9 for EFTA. A subsample of 97 signatories (94 in EU-27 and 3 in EFTA countries) have indicated targets for both 2030 and 2050.

In addition, a substantial difference in sample size is recorded between the 103 municipalities having a plan with a 2050 time horizon and 2 239 municipalities having a plan with a 2030 horizon.

Covenant signatories can select the most convenient base year to report baseline emissions (see sections 3.2 and 4.2). Baseline emissions reported by signatories have been projected to 2005 (one of the most common reported base year) to allow for aggregation and comparison.

Notably, for those 97 municipalities with targets for both 2030 and 2050, the projected emissions for 2005 in the BEI have been accounted for once per signatory (**Table 9**).

The 2030 targeted emissions are based on all action plans with a 2030 time horizon, either an overall 2030 commitment or a specific mid-term target for that year (i.e., 2333). Targeted emissions for 2050 refer to those 103 cities with a 2050 time horizon action plan, and hence, should be assessed with this substantial reduction in the statistical base in mind.

Finally, the committed reduction per each target year (**Table 10** and **Table 11**) is determined considering the BEI emissions and emissions in the target year indicated in each individual action plan.

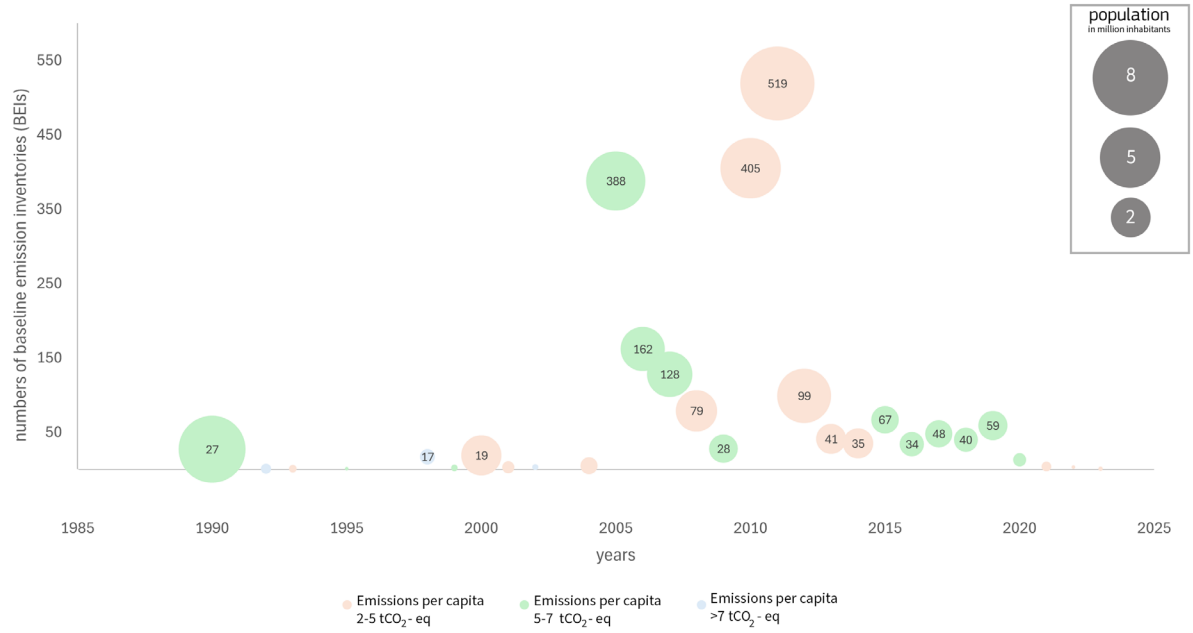
4.2. Emission inventories

4.2.1. Baseline year

As mentioned previously in section 3.2.3, signatories are free to choose the base year against which their progress can be measured. Thus, different BEI years are used, as shown in **Figure 13 Figure 14** for EU-27 and EFTA for 2030 and 2050 time horizons, respectively. In alignment with figures from the previous report, the majority of EU-27 GCoM signatories in their climate action plans with a 2030 time horizon selected 2005, 2010 and 2011 as their base year (representing respectively

17 %, 18 % and 23 %) of all the BEIs (see **Figure 13**) and covering a population of 20.3 million inhabitants overall and generating 4.7 t CO_2-eq per capita. As shown in **Figure 13**, higher emissions per capita are mainly recorded in less recent years, with 1990 showing a population of slightly less than 8 million inhabitants generating 6.95 t CO_2-eq per capita and 1992 with a population of 173 000 inhabitants generating 9.5 t CO_2-eq per capita.

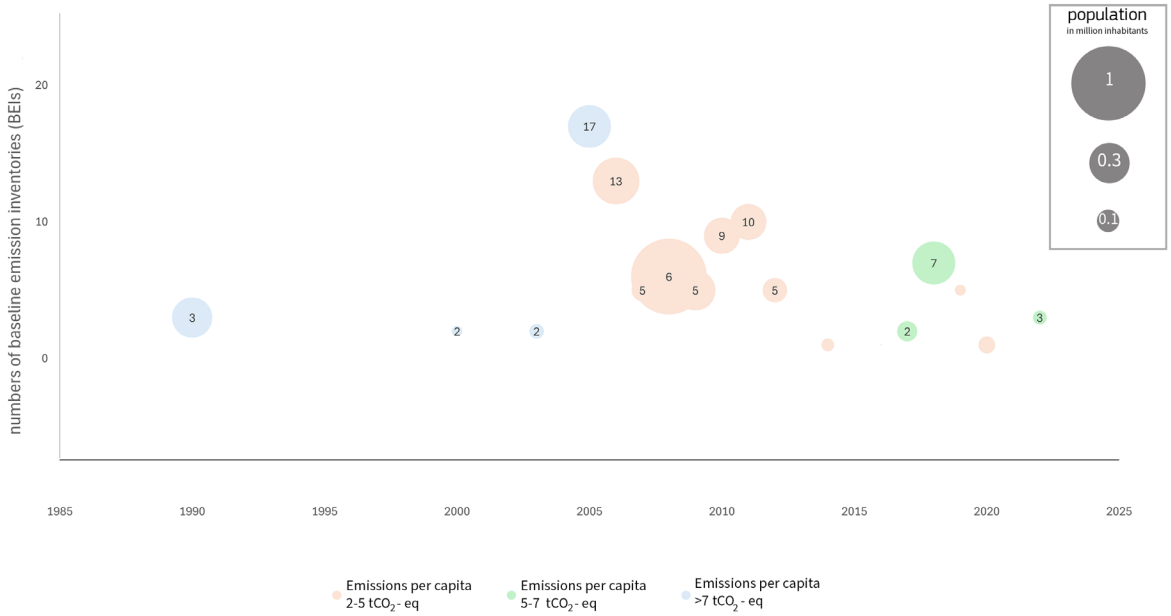
Figure 13. Frequency of BEIs for the different base years regarding 2030 time horizon in EU-27, along with the population (in millions) and emissions per capita (t CO_2-eq) for every year.



Source: JRC elaboration based on GCoM data

Concerning SECAPs with a 2050 time horizon, the trend recorded for 2030 is confirmed, as shown in **Figure 14**.

Figure 14. Frequency of BEIs for the different base years regarding 2050 time horizon in EU-27, along with the population (in millions) and emissions per capita (t CO_2-eq) for every year.



Source: JRC elaboration based on GCoM data

The base years selected most often are 2005, 2006, 2010 and 2011, representing respectively 17 %, 13 %, 9 % and 23 % of all the BEIs and covering a population of 1.1 million inhabitants overall and generating 5.9 t CO_2-eq per capita.

4.2.2. GHG emissions in cities' latest available GHG emission inventories

Looking more in detail at the GHG emissions reported by signatories through their latest emission inventories from SECAPs with a 2030 and 2050 horizons, the following tables provide a finer disaggregation by sector and scope [27] for both EU-27 (**Table 12**) and EFTA signatories (**Table 13**).

[27] GHG emission inventories in the CoM do not classify emissions by scope, the classification of emissions by scope has been based on assumptions.

Table 12. Aggregated GHG emissions in the municipalities' latest EIs related to 2030 and 2050 time horizons commitments, by sector and scope – EU-27 (in t CO_2-eq/year).

Sector	Scope1	Scope2	Scope3	Total
Municipal buildings, equipment/facilities	1 470 342	5 589 636		7 059 978
Residential buildings	36 965 716	34 095 46		71 060 863
Tertiary (non-municipal) buildings, equipment/facilities	12 395 550	30 488 689		42 884 239
Industry Non-ETS	3 324 005	3 986 956		7 310 961
Agriculture, Forestry, Fisheries (excluding AFOLU)	2 267 237	1 344 473		3 611 710
Transport	73 750 914	1 609 184		75 360 098
Waste/wastewater			2 334 534	2 334 534
Other	464 955	269 769		734 724
TOTAL	**130 638 720**	**77 727 708**	**2 334 534**	**210 700 962**

Source: JRC elaboration based on GCoM data reported via MyCovenant platform

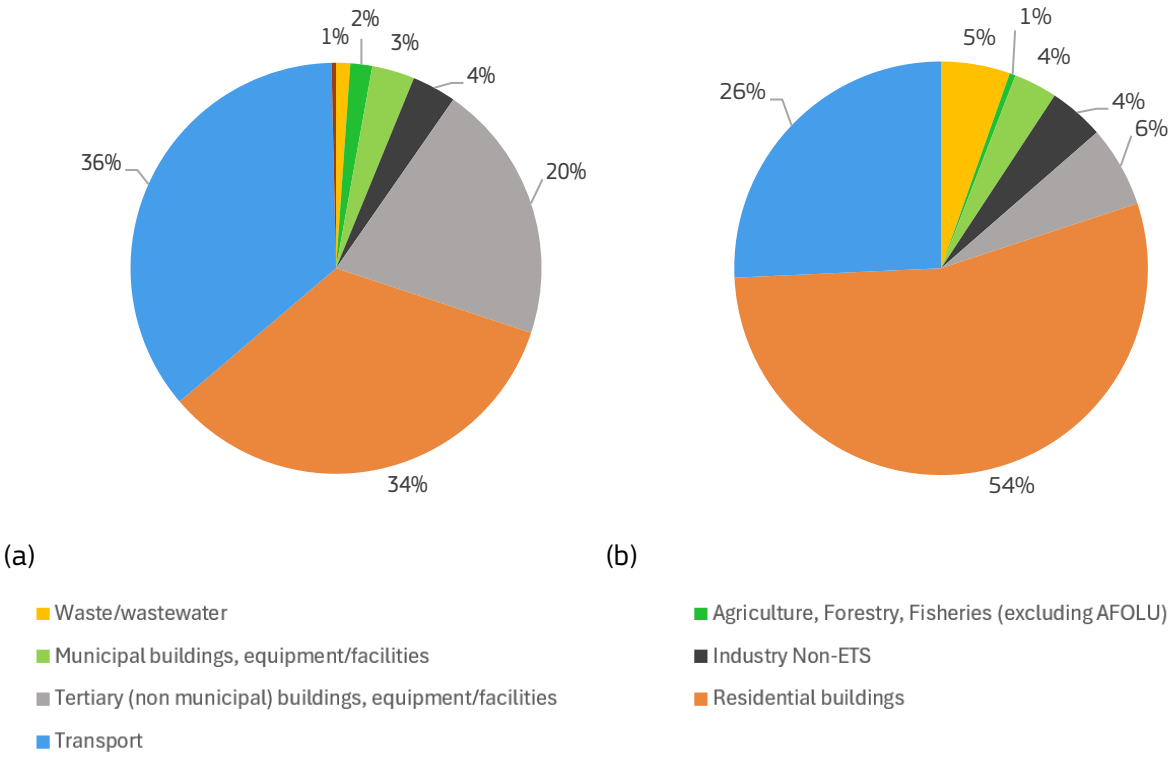
Table 13. Aggregated GHG emissions in the municipalities' latest EIs related to 2030 and 2050 time horizons commitments, by sector and scope – EFTA (in t CO_2-eq/year).

Sector	Scope1	Scope2	Scope3	Total
Municipal buildings, equipment/facilities	6 685	17 390		24 076
Residential buildings	227 011	157 995		385 007
Tertiary (non municipal) buildings, equipment/facilities	201	44 694		44 895
Industry Non-ETS	5 288	25 368		30 657
Agriculture, Forestry, Fisheries (excluding AFOLU)		3 328		3 328
Transport	178 300	3 949		182 249
Waste/wastewater			38 206	38 206
TOTAL	**417 487**	**252 725**	**38 206**	**708 418**

Source: JRC elaboration based on GCoM data reported via MyCovenant platform

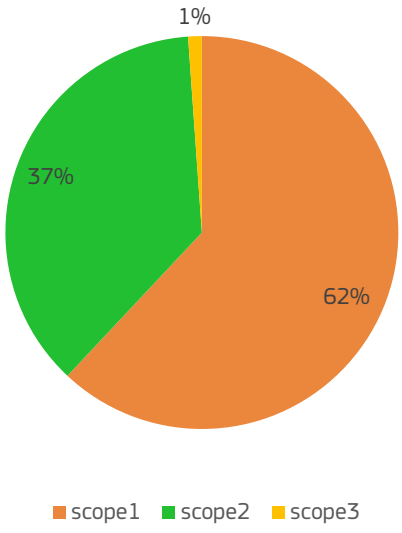
As shown in **Table 12** and **Figure 15**, buildings account for 57 % of the total emissions in EIs from EU-27 signatories. In particular, residential buildings account for more than half of sectoral emissions, with tertiary buildings being the second most important, with roughly one-third of sectoral emissions. Municipal buildings, under the direct control of the local administration, account for just about 6 % of sectoral emissions. Transport represents 36 % of total GHG emissions, while waste and agriculture, forestry and fisheries altogether account for 3 % of total reported emissions. A similar distribution is recorded for municipalities in EFTA (**Table 13** and **Figure 15**), where, however, the buildings' macro sector accounts for 65 % of total emissions and waste for 5 %. In alignment, the figures of emissions according to scopes **Figure 16** and macro-sectors (including data reported through CDP-ICLEI Track) as shown in **Figure 17**.

Figure 15. GHG emissions by sector in the municipalities' latest EIs for SECAPs in EU-27 (a) and in EFTA (b)



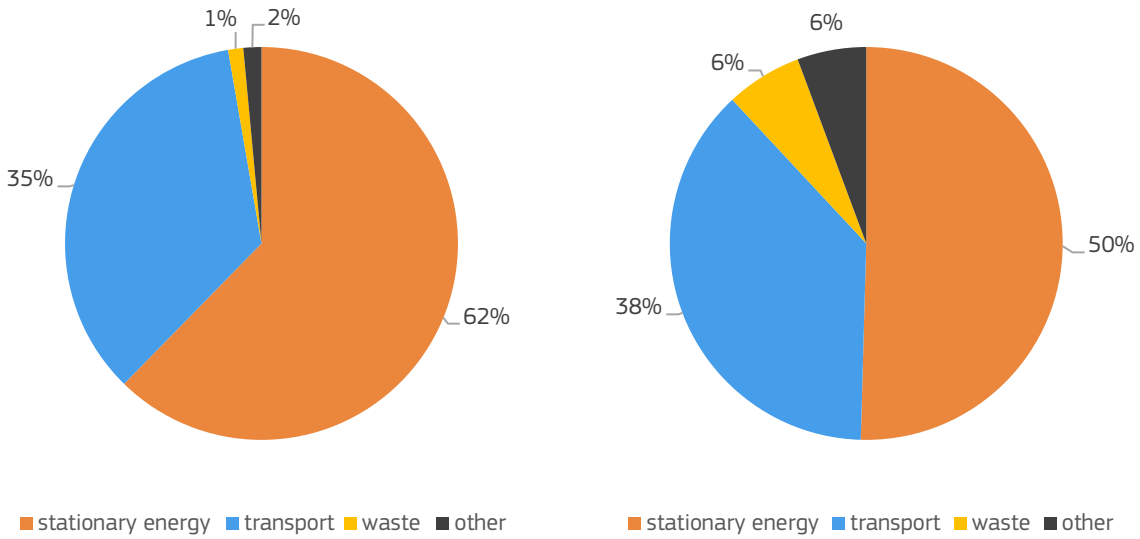
Source: JRC elaboration based on GCoM data reported via MyCovenant platform

Figure 16. GHG emissions by scopes in the municipalities' latest EIs for SECAPs in EU-27 and in EFTA



Source: JRC elaboration based on GCoM data reported via MyCovenant platform

Figure 17. GHG emissions by sector in the municipalities' latest EIs for SECAPs in EU-27 (a) and in EFTA (b)



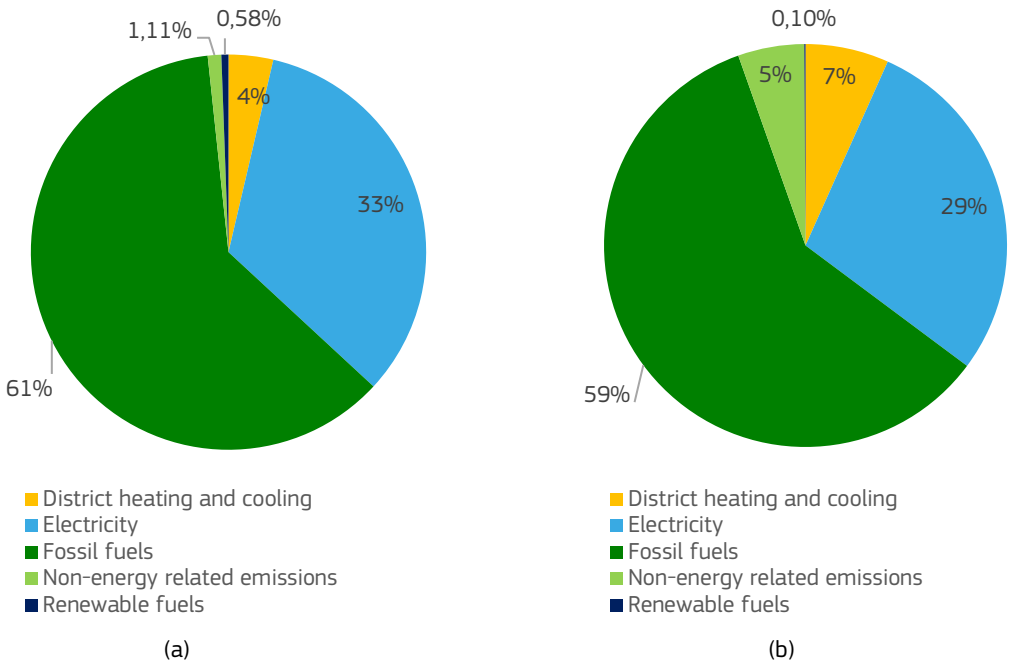
Source: JRC elaboration based on GCoM data from MyCovenant and CDP-ICLEI Track

Almost the totality (>98 %) of the reported emissions are related to energy use, with waste treatment playing a minor role in the inventories, due to the fact that waste is an optional sector in the CoM EU and, therefore, just a limited number of municipalities report on it. Direct (Scope 1) emissions represent 62 % of the total GHG emissions, followed by 37 % indirect (Scope 2) emissions, associated with the consumption of grid-supplied energy. Scope 3 emissions represent only 1 % of the total GHG emissions for all municipalities included in the analysis (EU-27 and EFTA). These results are linked to the structure of the inventories in the CoM framework, which is centred on energy-related emissions and covers specific mandatory sectors, namely stationary energy and transport.

A more detailed analysis by energy carrier, shown in **Figure 18**, was performed based on the data reported through MyCovenant.

Based on the emission inventories of signatories from EU-27 (n. 2 402), fossil fuels are associated with 61 % of reported emissions, while electricity is the second carrier with 33 % of reported emissions. District heating follows with 4 % of reported emissions and renewable fuels and non-energy related emissions account for about 2 %. The emission inventories of signatories from EFTA countries (14) show similar trends, with fossil fuels associated with 59 % of emissions, electricity with 29 %, and non-energy related emissions being slightly more significant (7 % of emissions).

Figure 18. GHG emissions by energy carrier in the municipalities' latest EIs for SECAPs in EU-27 (a) and EFTA (b)



Source: JRC elaboration based on GCoM data reported via MyCovenant platform only

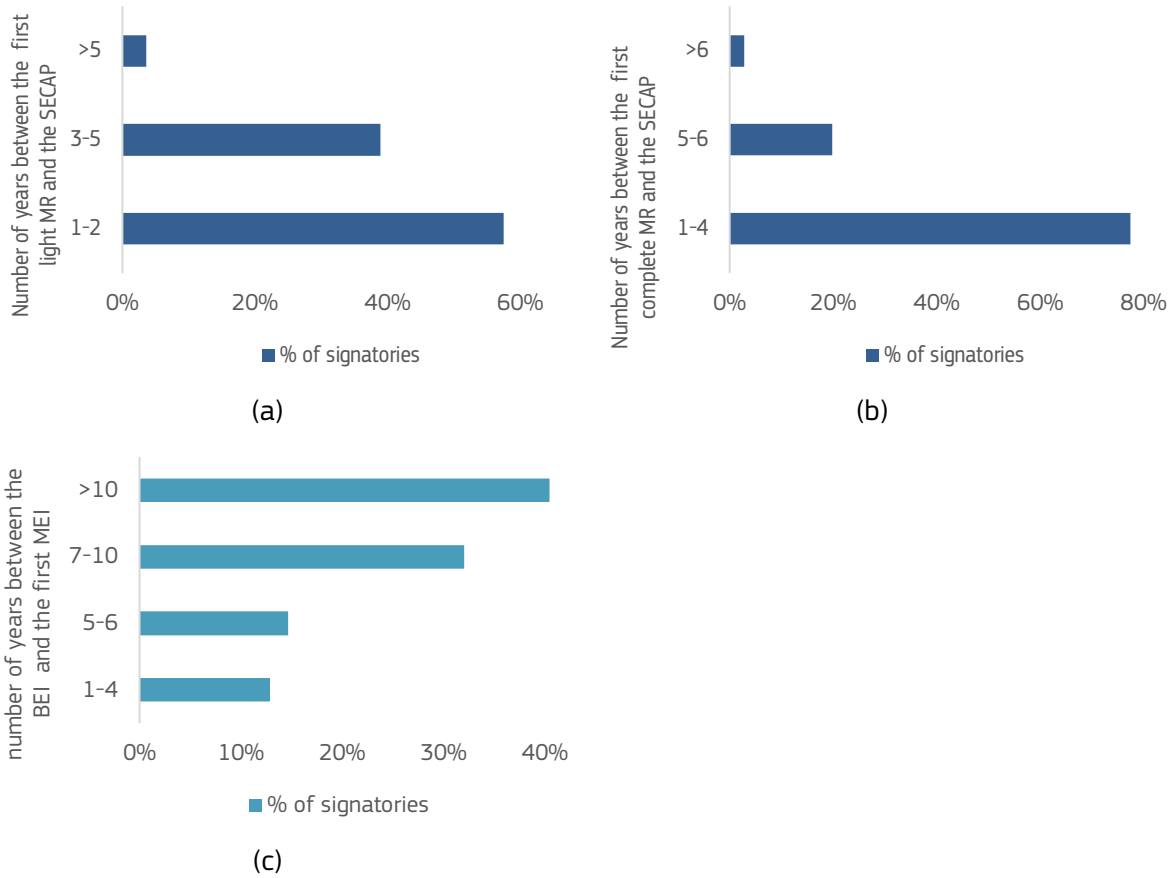
Compared to 2023 data (Melica et al. 2024), the overall yearly amount of emissions shows a decrease, which is linked to the decreasing trend of municipalities after the adoption of their policies as reported in their progress reports and most recent emission inventories.

4.3. Monitoring emission inventories

4.3.1. Monitoring years

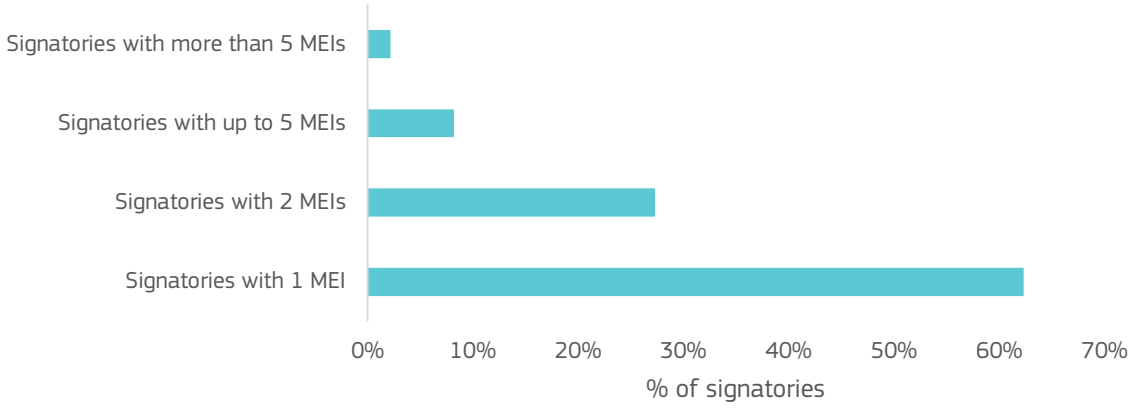
Signatories are free to choose the monitoring years for their emissions inventories. The reporting guidelines recommend to report every two years after the submission of the action plan, a monitoring report on the implementation status of the actions (light monitoring) and, at least every four years, a Monitoring Emissions Inventory (MEI) (GCoM 2023). **Figure 19** shows that the majority of EU-27 and EFTA signatories are aligned with these recommendations. With 57 % submitting a light monitoring report within the first two years and a MEI within the first four after their SECAP submission. In terms of time, between the baseline emission inventories and the first monitoring emission inventory, **Figure 19** shows that the majority of signatories considers a time range above 7 years. **Figure 20** shows the frequency of monitoring reports, observing that most signatories are reported one MEI, while 27 % have two MEIs and 8 % have more than two MEIs, with 2 % having more than five.

Figure 19. Number of years elapsed between the SECAP and the signatories' first monitoring report, light (a) and complete (b), and between the BEI and the first MEI (c).



Source: JRC elaboration based on GCoM data reported via MyCovenant platform only

Figure 20. Frequency of MEIs.

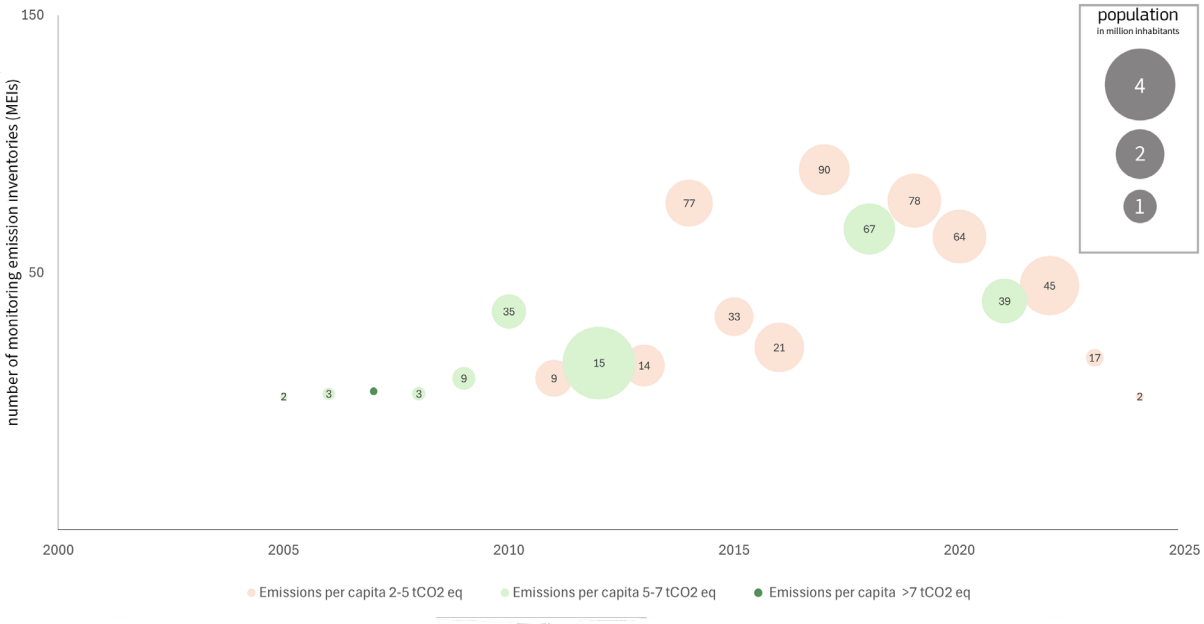


Source: JRC elaboration based on GCoM data reported via MyCovenant platform only

The most frequent monitoring years selected by signatories for their monitoring reports are 2014, 2017, and 2019 (see **Figure 21**), representing 12 %, 14 % and 12 %, respectively of all MEIs. For 2014, MRs cover a total of 1.7 million inhabitants and 4.58 t CO_2-eq per capita; for 2017, MRs cover

a total of 2.0 million inhabitants and report an average of 4.02 t CO_2-eq per capita, and for 2019, MRs cover 2.2 million inhabitants with an average of 4.01 t CO_2-eq per capita.

Figure 21. Frequency of MEIs for the different years in EU-27, along with the population (in millions) and emissions per capita (t CO_2-eq) for every year.

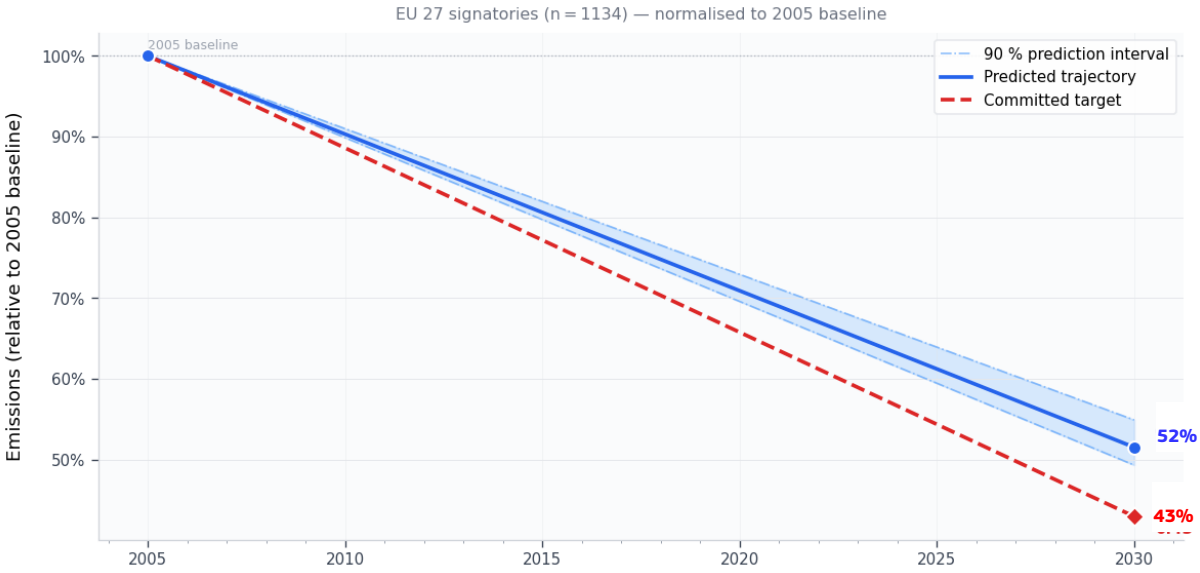


Source: JRC elaboration based on GCoM data reported via MyCovenant platform

4.3.2. GHG emission forecasts for 2030

There are 1 134 signatories in EU-27 with a target for 2030 (commitment 2030 and 2050), with a BEI and at least one MEI. For this subset of signatories and focusing only on the emissions consistently reported for the same sectors throughout the different inventory years, it is observed that an estimated 48.5 % mean absolute reduction is expected to be achieved, with a 90% prediction interval seating between 45.1 % and 50.7 %, counting from a common base year of 2005 to the target year 2030. As a result, from 2005 to 2030, the signatories would be falling short by 9 % points from their targeted mean reduction of 57.0 % (**Figure 22**). The 90 % prediction interval (45.1% –50.7 %) indicates substantial uncertainty in these projections, reflecting variability in individual city trajectories, reporting completeness, and implementation progress. Notably, the findings should be interpreted as indicative, given that the analysis relies on a subset of signatories with consistent sectoral reporting across both baseline and monitoring periods. The observed gap suggests that more ambitious mitigation efforts, enhanced monitoring, and stronger policy implementation may be necessary if EU-27 municipalities are to align with their more ambitious commitments.

Figure 22. Aggregate GHG emission forecasts and committed targets.



Source: JRC elaboration based on GCoM data reported via MyCovenant platform only

4.4. Climate change mitigation actions and measures

As part of the reporting, CoM signatories provide information associated with actions planned to achieve their targets and goals. The total number of actions reported through the MyCovenant and CDP-ICLEI Track is 65 946. A more detailed analysis has been conducted on the mitigation actions reported through MyCovenant, which allows signatories to categorise the actions by the sector they address, the specific area of intervention and the type of policy instrument they rely upon.

The analysed MyCovenant dataset includes 2288 action plans with a total of 62 173 mitigation actions/measures from signatories in EU-27 + EFTA countries (2 signatories from EFTA reported actions through the MyCovenant), committed to 2030 and/or 2050 targets. Municipalities have to report at least three key mitigation actions through MyCovenant, however, several signatories report many more actions with an average of 27 actions per plan. MyCovenant also allows indicating the initiator of the actions, considering that a local action plan may, to a certain extent, rely on measures decided by other levels of governance, such as the national or the regional one.

This section describes the mitigation actions/measures based on the categories assigned by signatories. In addition, further elaborations have been conducted aggregating action by key type of measure (KTM) used for clustering measures with the goal of enhancing comparability and the easing reporting procedures (Hernandez Moral et al. 2025; Leitner et al. 2020, 2021). Actions planned by signatories from EU-27 and EFTA are analysed jointly.

Out of all mitigation actions/measures, 2 703 are also targeting adaptation to climate change, 1 097 are also targeting energy poverty and 506 target all three pillars (see section 8).

4.4.1. Actions by sector

MyCovenant allows signatories to classify their actions according to the targeted specific sectors, namely:

— Buildings (Municipal buildings and facilities, residential buildings, tertiary buildings, equipment/facilities);

— Industry (excluding IPPU);

— Transport;

— Local electricity production;

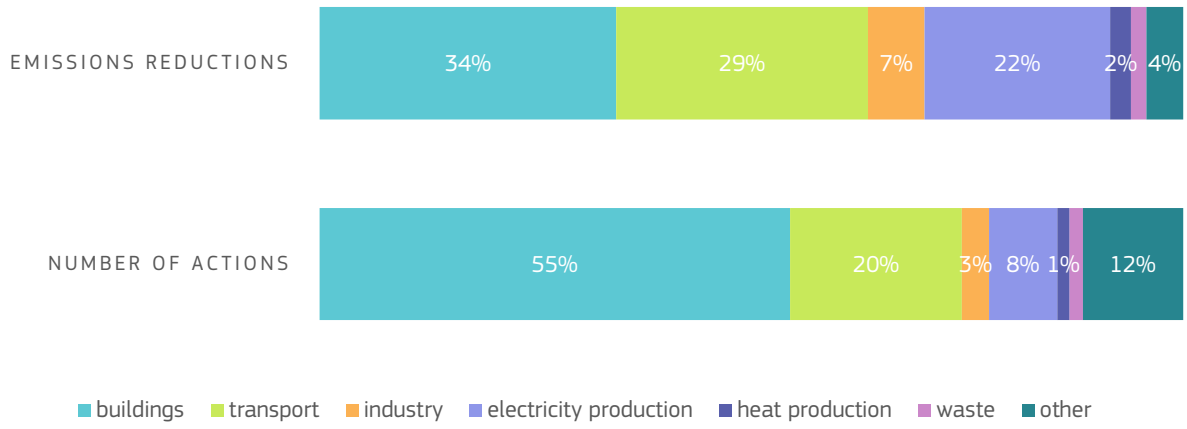
— Local heat/cold production;

— Waste;

— Others.

Based on the data reported through MyCovenant (**Figure 23**), it is observed that most of the actions target the building sector (55 %), followed by the transport sector (20 %) and the waste and other sectors (12 %). In terms of estimated emission reduction, the buildings sector is the main contributor (34 %) followed by transport (29 %). Electricity production has also a significant share, with 22 % of total planned emission reduction associated with this sector, although it only represents 8 % of the actions reported.

Figure 23. Share of actions per sector and contribution to GHG emission reduction in SECAPs from the EU-27.



Source: JRC elaboration based on GCoM data reported via MyCovenant platform

4.4.2. Actions by area of intervention

MyCovenant allows signatories to classify their actions according to the specific area of intervention they tackle. The areas of intervention depend on the sector addressed by the action reported. This section analyses separately the four macro-sectors, as the areas of intervention are very different among them:

— Stationary energy (incl. Buildings and Industry, excluding IPPU);

— Transport;

— Energy production;

— Waste and others.

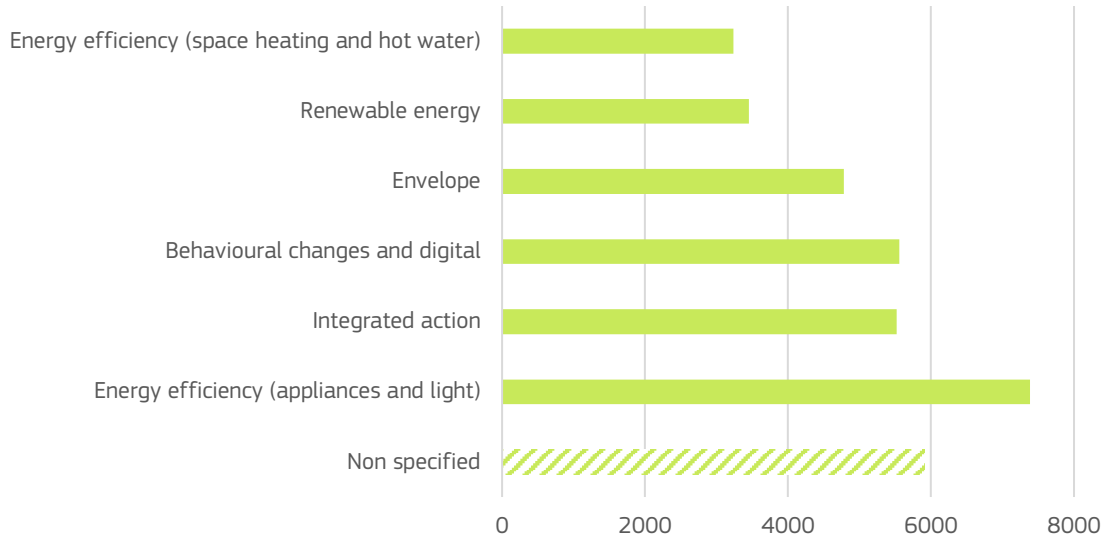
For each sector, multiple areas of intervention can be reported. In order to simplify and consolidate the analysis, some areas were grouped (see Annex 5).

The **stationary energy sector** is addressed by 36 877 actions/measures. Most of the actions for which an area of intervention is indicated, are classified in the group Energy efficiency (appliances and lighting), that contemplate actions targeting appliances and light efficiency (**Figure 24**). Many actions are also reported as 'integrated action', meaning that they target in a holistic way the building system. Actions targeting integrated interventions represent 24 % of the emissions reductions expected by the detailed reported actions.

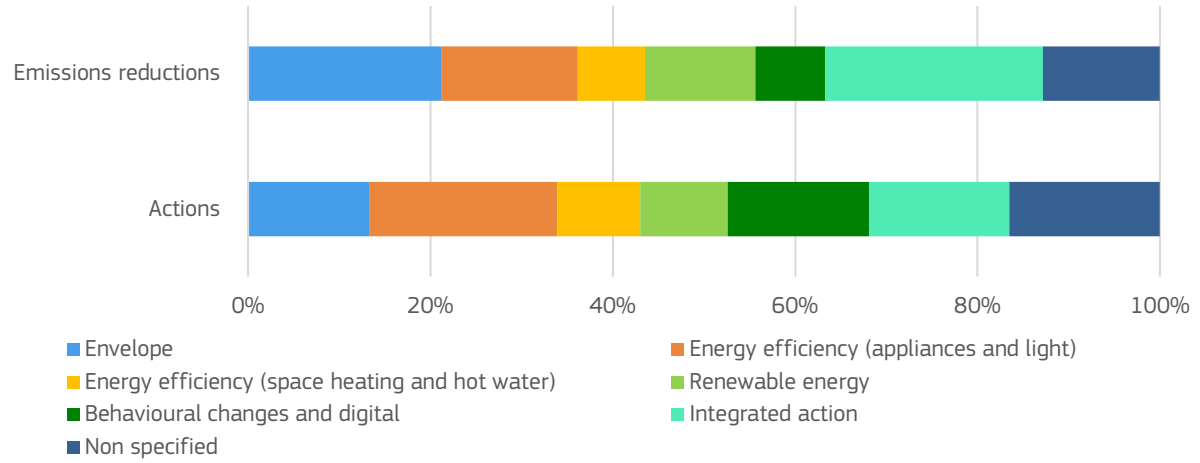
A significant share of actions concerns behavioural and digital interventions, (information and communication technologies (ICT) and behavioural changes) for example, remote management systems and energy management software for municipal buildings and street lighting, and campaigns and information systems to promote energy savings, especially in the residential sector. Several measures target space heating and hot water systems, by promoting either energy efficient boilers or the use of renewables (notably through solar thermal collectors and biomass boilers). About 16 % of the actions/measures were reported under the category 'Other' or not specified.

In terms of contribution to GHG emission reduction, actions targeting building envelopes account for a significant share (21%).

Figure 24. Stationary energy sector – Number of actions by area of intervention (a) and share of actions and contribution to GHG emission reduction (b) in SECAPs from the EU-27.



(a)

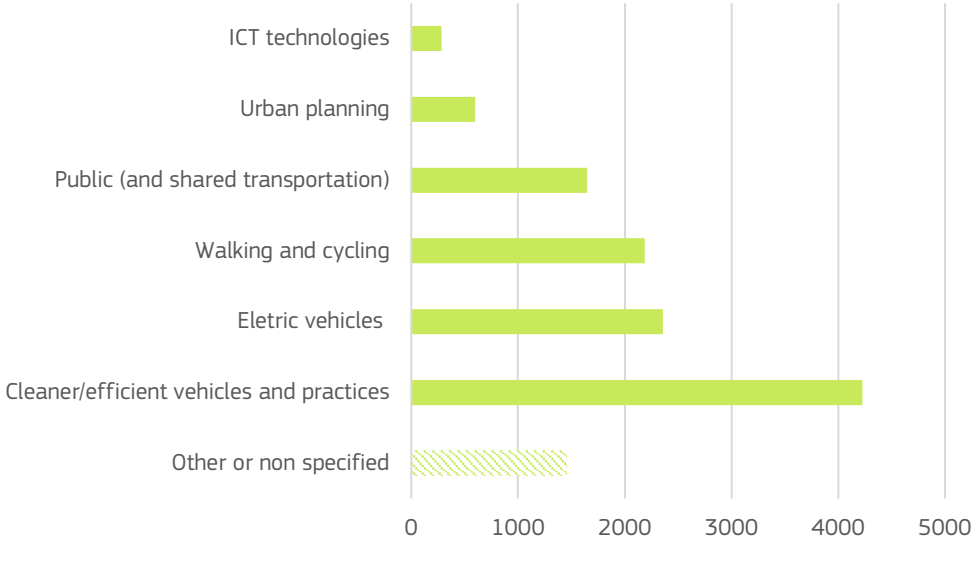


(b)

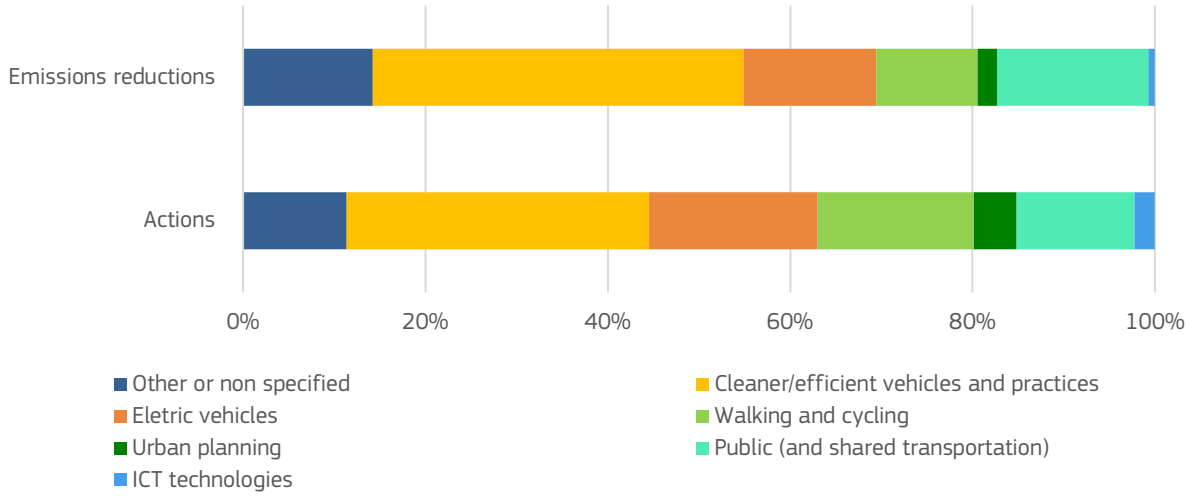
Source: JRC elaboration based on GCoM data reported via MyCovenant platform

In the **transport sector** (**Figure 25**), the large majority of the 12 746 total planned actions, and related emissions reduction impact expected, concerns cleaner/efficient vehicles and practices and electric vehicles (6 580 actions in total), showing that local authorities rely to a great extent on the gradual improvement of the fleet of vehicles, which are bound by European standards, and might also depend on national incentives and economic performance. Local authorities then try to promote electric vehicles and encourage a shift towards active mobility (with 2 187 actions classified as a modal shift to walking and cycling) or towards public transport (more than 1 647 actions).

Figure 25. Transport sector – Number of actions by area of intervention (a) and share of actions and contribution to GHG emission reduction (b) in SECAPs from the EU-27.



(a)

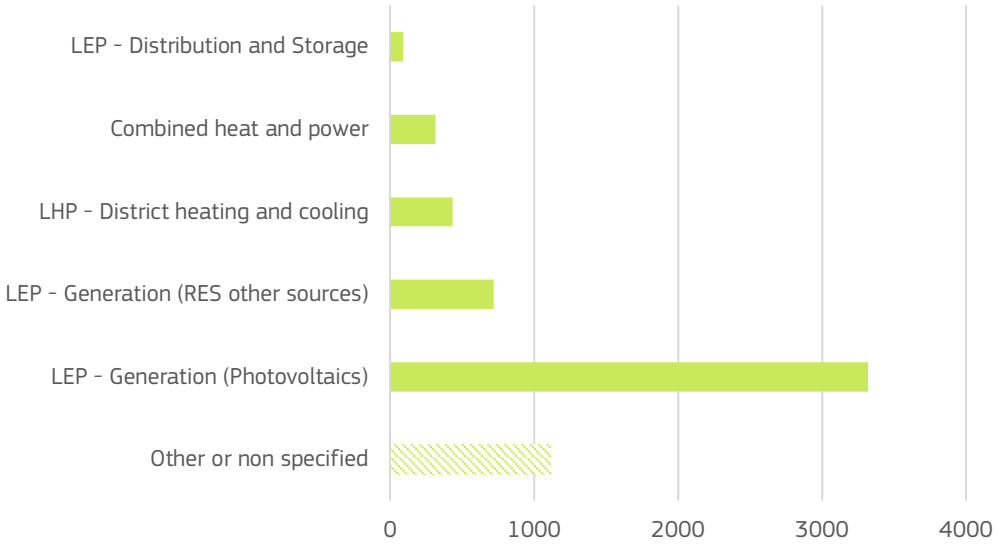


(b)

Source: JRC elaboration based on GCoM data reported via MyCovenant platform

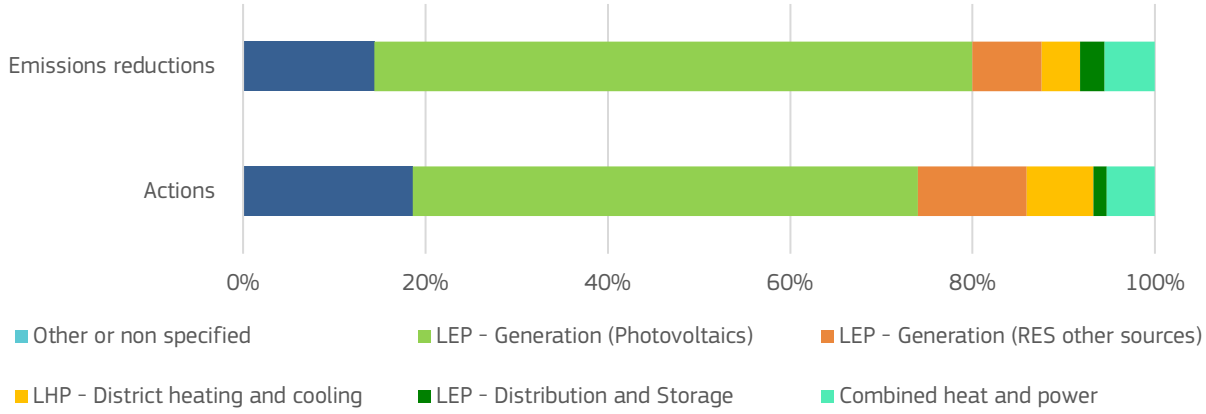
Looking at the 6 000 actions addressing the **energy production sector** (**Figure 26**), a strong push towards photovoltaic (3 322 measures) can be seen – probably thanks to its decreasing costs and growing accessibility. In contrast, other technologies for renewable energy production, such as hydroelectric and biomass, seem to receive less attention from local authorities.

Figure 26. Energy production sector – number of actions/measures by area of intervention (a) and share of actions and contribution to GHG emission reduction (b) in SECAPs from the EU-27 [28].



(a)

[28] LEP - Local electricity production; LHP - local heat production

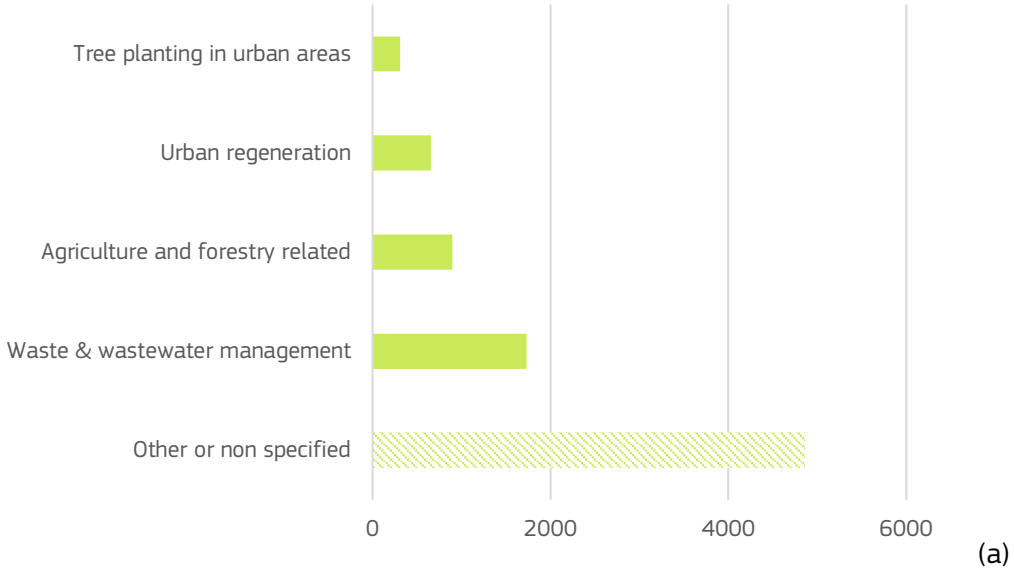


(b)

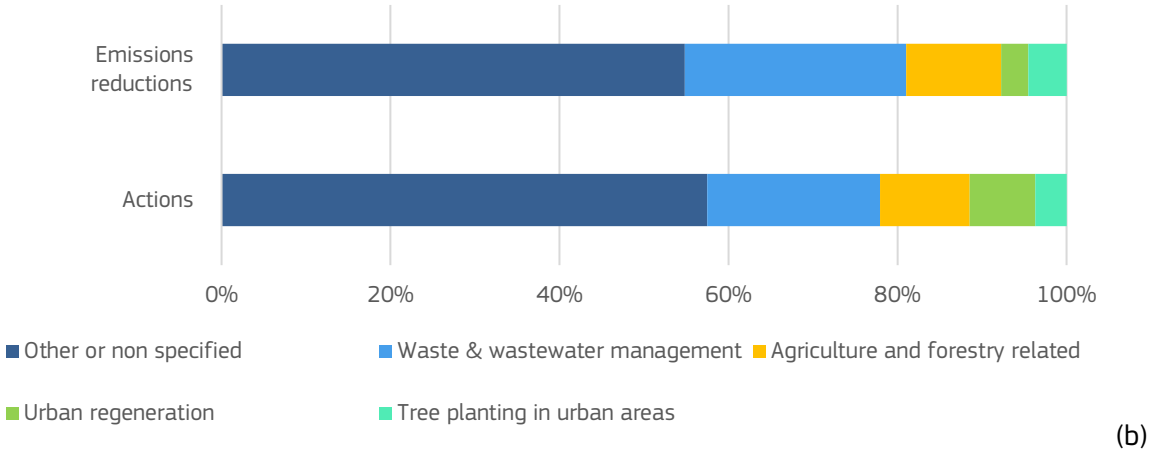
Source: JRC elaboration based on GCoM data reported via MyCovenant platform

The sector **waste and others** (**Figure 27**) is more heterogeneous and comprises many actions that were not classified under the proposed categories. Its importance is likely to grow in the future, with cities currently expanding the scope of their action plans to include non-energy related emissions from other emitting sectors, (e.g., agriculture, forestry and other land use, or industrial processes and products use) in an effort to reach climate neutrality goals.

Figure 27. Waste and others sector – number of actions by area of intervention (a) and share of actions and contribution to GHG emission reduction (b) in SECAPs from the EU-27.



(a)



(b)

Source: JRC elaboration based on GCoM data reported via MyCovenant platform

4.4.3. Actions by policy instrument

Similarly to what is observed for the 'area of intervention' categories, also the 'policy instrument' categories vary depending on the sector. In this section, the actions falling under the same macro-sector were grouped for analysis purposes.

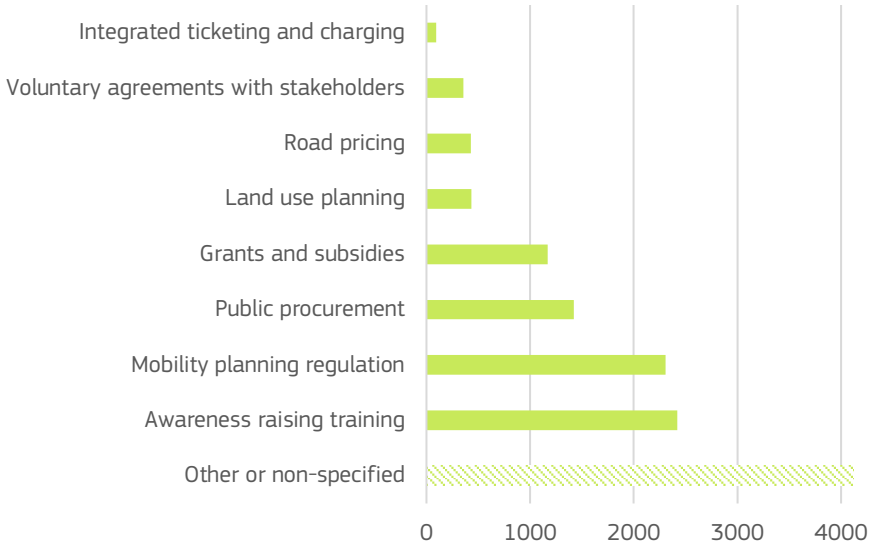
Figure 28 shows the policy instrument assigned to actions/measures targeting the **stationary energy sector**. The energy management policy instrument is associated with 11 616 reported actions (31 %), mainly addressing municipal buildings. The second preferred instrument is awareness-raising and training (8 268 actions), targeting, in particular, the residential buildings sector, but also municipal and tertiary buildings. Grants and subsidies are also a quite common instrument (3 457), followed by public procurement (2 926 actions), energy certification/labelling (1 774) and building standards (1 617). Other instruments, such as energy suppliers' obligations or third-party financing, seem less common in local mitigation plans.

Figure 28. Stationary sector – number of actions per policy instrument.

Source: JRC elaboration based on GCoM data reported via MyCovenant platform

In the **transport sector** (**Figure 29**), the preferred instrument is awareness raising and training (2 419 actions out of 12 746; 19 %), followed by mobility planning regulation (2 306 actions, 18 %), public procurement to renew municipal fleet and vehicles used in public transport (1 422 actions, 11 %), and grants and subsidies (1 168 actions, which may include tax reduction or subsidies for more efficient vehicles or incentives for the purchase of electric bikes, 10%). Instruments classified as road pricing and integrated ticketing and charging are less numerous, probably because they mainly apply to larger urban centres that represent a small number of Covenant signatories, compared to the high number of small towns. Almost one third of the reported actions are not classified under any of the proposed policy instruments.

Figure 29. Transport sector – number of actions per policy instrument.



Source: JRC elaboration based on GCoM data reported via MyCovenant platform

In the **energy production sector** (**Figure 30**), the most common policy instrument (when indicated) are grants and subsidies (1 774 actions out of 6 000), followed by awareness raising and training (752 actions), public procurement (578), third-party financing (515), land use planning regulation (256), building standards (192), energy suppliers' obligations (103).

Figure 30. Energy production sector – number of actions per policy instrument.

Source: JRC elaboration based on GCoM data reported via MyCovenant platform

Finally, the sector **waste and others** (**Figure 31**) includes two main policy instruments (when reported): awareness raising and training (2 975 actions) and land use planning (1 037 actions).

Figure 31. Waste and others sector – number of actions per policy instrument.

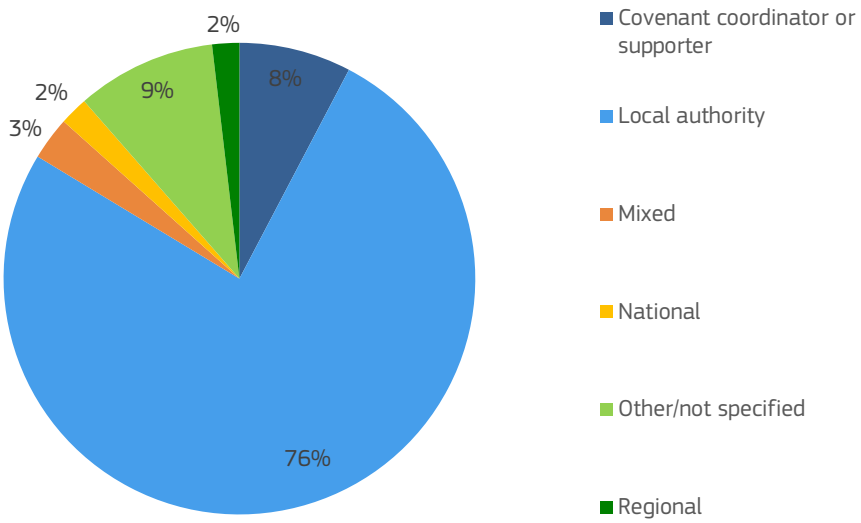
Source: JRC elaboration based on GCoM data reported via MyCovenant platform

4.4.4. Actions by origin of the action

CoM signatories are also invited to indicate the level of governance initiating each action/measure. This allows appreciating if the local authority is actually taking the lead in the effort to reduce emissions in its territory or rather counting on the effect of actions decided by other authorities. About three fourths of the actions are declared as being initiated by the local authority. Covenant

coordinators or supporters are indicated as the initiators of about 8 % of the actions/measures. For about 10 % of the actions, the initiator is either 'other' or not specified (**Figure 32**).

Figure 32. Share of actions/measure by origin.



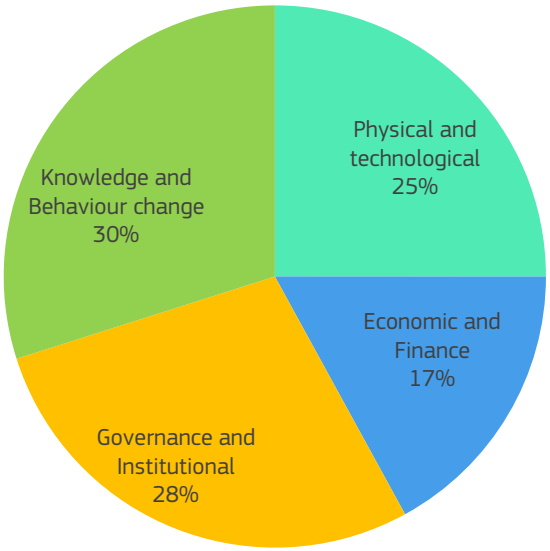
Source: JRC elaboration based on GCoM data reported via MyCovenant platform

4.4.5. Actions by key type of measure (KTM)

For better insights and related with the policy instruments, the actions reported are merged into four main action types – key types of measures (KTM) (**Figure 33**) (Hernandez Moral et al. 2025). The greatest shares of action types are knowledge and behaviour change, almost in parallel with governance and institutional and physical and technological actions. The strong presence of the knowledge and behavioural change actions appears in in the 'waste and others' sector (73 %) and in the 'transport sector' (28 %) (**Figure 34**).

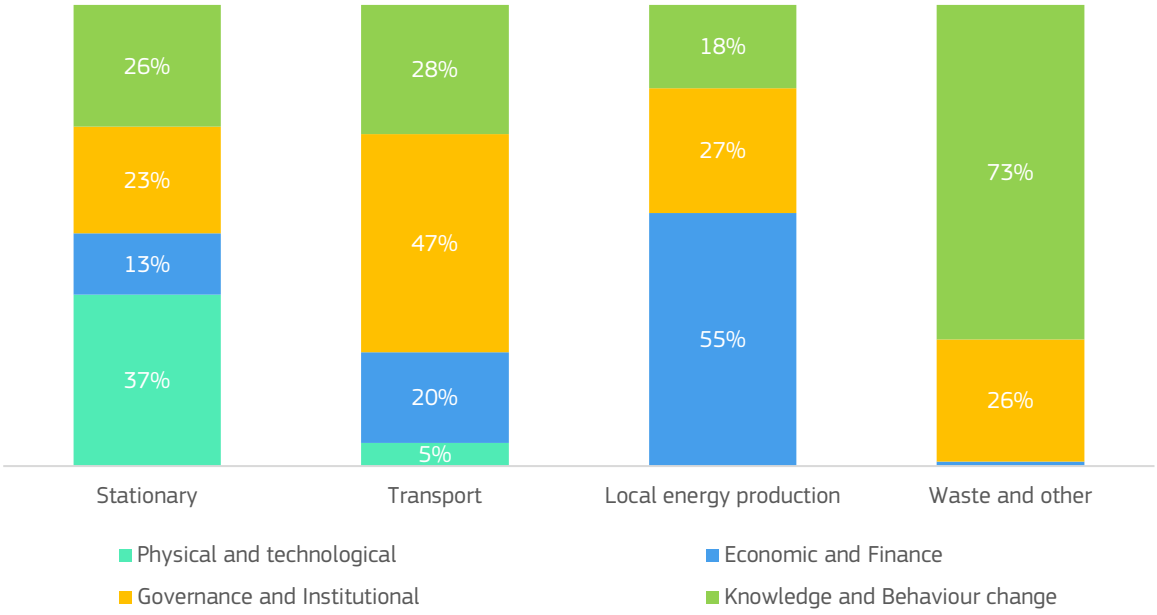
Finally, signatories appear to target less on economic and finance, being that more represented in the 'local electricity production' (55 %), and in the 'transport' (20 %) sectors. See the figures below for a comparison on the shares and refer to the Annex 5 for further insights into the main action types and how these relate to 'policy instruments'.

Figure 33. Share of actions according to KTM.



Source: JRC elaboration based on GCoM data reported via MyCovenant platform

Figure 34. Actions reported by sector, according to their main key type of measures.



Source: JRC elaboration based on GCoM data reported via MyCovenant platform

5. Approach and methodology on adaptation

5.1. The Covenant of Mayors' approach to adaptation

Climate change adaptation involves implementing strategies and policies to increase resilience against climate-related hazards such as extreme weather events, including measures like enhancing flood defences and climate-proofing urban infrastructure. The Global Covenant of Mayors' approach to climate change adaptation is structured around five key components, and data is collected and reported for each of them:

1. Commitment to climate adaptation: municipalities pledge to take decisive action to adapt to the changing climate, demonstrating leadership and responsibility at the local level.
2. Risk and vulnerability assessment (RVA): each participating municipality conducts a detailed RVA to identify climate hazards and the most vulnerable sectors and groups within their jurisdiction. This assessment forms the foundation of their adaptation planning.
3. Defining adaptation goals: based on the RVA findings, municipalities set clear and measurable adaptation goals. These goals guide the development of strategies and actions tailored to local needs and priorities.
4. Developing climate change adaptation actions: municipalities define and prioritise specific adaptation actions that address the identified vulnerabilities. These actions are designed to enhance resilience and reduce risks across various sectors.
5. Monitoring progress: continuous monitoring and evaluation are integral to the adaptation approach. By tracking progress, municipalities can assess the effectiveness of their actions and make necessary adjustments to improve outcomes.

Reporting requirements on adaptation for GCoM are set by the Common Reporting Framework (CRF) (GCoM 2023), the set of global recommendations aimed at streamlining measurement and reporting procedures, to enable global aggregation and comparison of data.

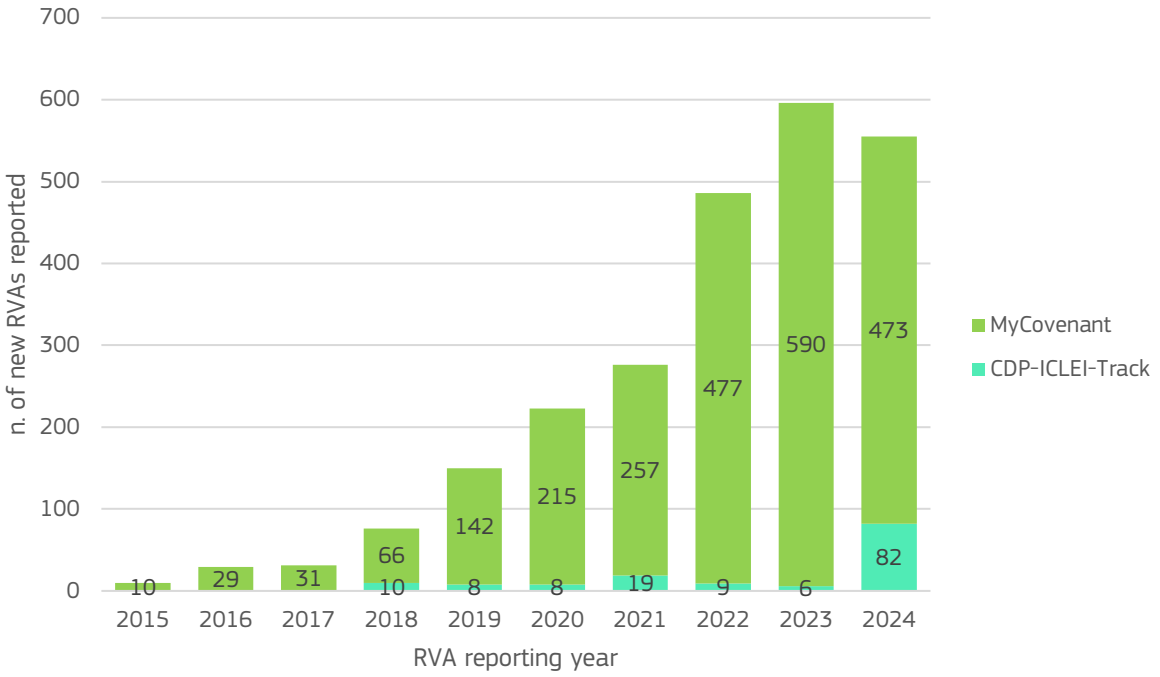
5.2. Approach and methodology to adaptation

5.2.1. Data sources

As introduced in section 2, the datasets used in this report are sourced from the MyCovenant (Bezerra, 2025) and CDP-ICLEI Track (CDP 2024) reporting platforms and their reported data with a cut-off date of January 2025 and December 2024 respectively. Their integration ensures a comprehensive dataset, capturing the main climate adaptation data and initiatives undertaken by municipalities and regions worldwide. A selection of countries part of the EU-27 or EFTA was applied. Where discrepancies were identified due to differing data collection methods or regional variations, the definitions and methodologies from the GCoM CRF (GCoM 2023) were applied to standardise the analysis. In this context, 'action plan' refers to the data reported by municipalities on the platforms, detailing the key elements of their climate action plans (CAP), or, in Europe, the Sustainable Energy and Climate Action Plan (SECAP). **Figure 35** shows the number of municipalities reporting adaptation information, namely risk and vulnerability assessments (RVAs) in both reporting platforms. While only 6 % of data comes from CDP-ICLEI Track, more than 94 % of

reports come from MyCovenant, which remains the preferred platform to report adaptation information in Europe.

Figure 35. Number of GCoM municipalities reporting information per reporting platform.



Source: JRC elaboration based on GCoM data

Table 14 below summarises the number of GCoM municipalities by country, highlighting those that have reported risk and vulnerability assessments (RVAs) and adaptation actions.

There are 2 262 municipalities reporting adaptation actions (21 % of total GCoM municipalities), with similar but slightly lower shares compared to the RVA reporting.

Table 14. GCoM municipalities and adaptation action plans by region.

EU27+EFTA Country	with reported RVA		with reported adaptation actions	
Austria	1	3 %	1	3 %
Belgium	364	64 %	330	58 %
Bulgaria	5	10 %	3	6 %
Croatia	41	21 %	41	21 %
Cyprus	2	6 %	2	6 %
Czech Republic	28	10 %	18	6 %
Denmark	16	31 %	14	27 %
Estonia	2	25 %	2	25 %
Finland	14	82 %	13	76 %
France	19	10 %	18	9 %
Germany	17	18 %	14	15 %
Greece	44	19 %	34	14 %
Hungary	65	19 %	58	17 %
Iceland	2	67 %	2	67 %
Ireland	6	27 %	4	18 %
Italy	706	14 %	675	14 %
Latvia	6	25 %	3	13 %
Lithuania	2	12 %	1	6 %
Luxembourg	1	8 %	1	8 %
Norway	9	33 %	7	26 %
Poland	15	17 %	14	16 %
Portugal	54	27 %	43	22 %
Romania	20	11%	20	11%
Slovakia	4	10 %	4	10 %
Slovenia	8	11 %	6	8 %
Spain	959	32 %	899	30 %
Sweden	20	26 %	21	27 %[29]
Switzerland	6	43 %	6	43 %
The Netherlands	8	22 %	8	22 %
Total	**2 444**	**22 %**	**2 262**	**21 %**

Source: JRC elaboration based on GCoM data

5.2.2. Methodology

The methodology adopted ensured a systematic consolidation of data from CDP-ICLEI Track and MyCovenant platforms, ensuring its applicability and reliability. To standardise data fields across the two platforms, climate change adaptation tables were structured to include mandatory fields as per the GCoM CRF. This included aligning fields such as climate hazards, probability, impact, and

[29] One signatory from Sweden has an incomplete RVA, having, however, reported climate change adaptation actions

intensity, among others. Conversion tables were developed to reconcile differences in terminology and options between MyCovenant and CDP-ICLEI Track datasets, ensuring consistency and facilitating an accurate merging process. Further details on the methodological approach can be found in Annex 3.

Two approaches were employed to analyse the datasets which are further developed in the next sections: a first approach involves counting the total number of reported records (i.e. hazards, vulnerable sectors, vulnerable population groups) and calculating their respective shares; the second alternative approach counts the number of GCoM municipalities reporting each type of data (i.e. hazard, vulnerable sectors, vulnerable population groups) at least once. The second approach avoids double counting because it assesses the frequency of single reported data points, rather than aggregating the total reported instances.

Table 15 summarises the analysis conducted in each of the following sections, highlighting the attributes, records, and plans examined. Section 6.1 covers risk and vulnerability assessments, analysing thousands of climate hazards, vulnerable sectors, and population groups. Section 6.2 reviews 4 464 climate adaptation goals. Section 6.3 assesses 24 641 adaptation actions, including those targeting specific hazards and sectors. Section 6.4 identifies gaps and incoherences between RVAs and actions. Section 6.5 focuses on monitoring data for adaptation actions.

Table 15. Summary table with the number of attributes examined in each section.

Sections	Attributes analysed	Number of records analysed	Number of plans analysed
Section 6.1 Risk and vulnerability assessments (RVAs)	Climate hazards	18 044	2 444
	High-risk climate hazards	2 897	1 202
	Vulnerable sectors	51 756	2 233
	Vulnerable population groups	10 395	1 096
Section 6.2 Climate adaptation goals	Climate adaptation goals	4 550	1 608
Section 6.3 Climate adaptation actions	Adaptation actions	24 641	2 263
	Adaptation actions addressing climate hazards	13 920	1 847
	Adaptation actions addressing vulnerable sectors	24 046	2 201
	Adaptation actions addressing vulnerable population groups	6 435	932
Section 6.4 Adaptation 'gap' and potential incoherence among RVA and actions	High-risk climate hazards in RVA and in adaptation actions	1 894	920
	Vulnerable sectors in RVA and in adaptation actions	30 972	1 866
	Vulnerable population groups in RVA and in adaptation actions	816	450
Section 6.5 Monitoring	Climate adaptation actions with implementation data	24 528	2 247
Total GCoM municipalities analysed			**2 444**

Source: JRC elaboration based on GCoM data

6. Results on adaptation

6.1. Risk and vulnerability assessments (RVAs)

As mentioned in **Table 14**, there are 2 444 GCoM municipalities with an RVA. In cases where multiple RVAs where found, the most recent one was retained for this analysis. Each RVA includes mandatory information on the climate hazards, as well as other information on vulnerable sectors and population groups.

6.1.1. Climate hazards

While only one hazard is the minimum reporting requirement, municipalities averagely identify six hazards, and the dataset includes more than 18 000 hazards. Each hazard has the following data associated:

- Level 1 (L1) hazard or level 2 (L2) sub-hazard
- Current hazard probability
- Current hazard impact/Consequence
- Expected change in hazard intensity
- Expected change in hazard frequency
- Timeframe: short-term, mid-term, long-term, not known (not possible to define).

The CRF (GCoM 2023) offers a comprehensive list of climate hazards categorised into Level 1 (L1) and Level 2 (L2), along with detailed definitions and attributes for reporting climate hazard data. For this analysis, all reported hazards coming from the two reporting platforms were re-classified using the CRF categories, with ten L1 categories (plus 'Other'), and some of them allowing a possibility of L2 sub-hazards.

Within the CRF, the risk is intended as the result of the combination of 'Probability of Hazard' and the 'Consequence of hazard'. The impact is therefore intended as the consequence of the climate event or hazard and is linked to exposure and vulnerability. The impact represents the realisation of the risk driven by the hazard, the exposure, and the vulnerability. Further information on the definition of climate hazards and risk can be found in the guidebook published by the JRC (Palermo et al. 2025).

A total of 18 044 records is reported for climate hazards, of which only 5 789 (32 %) specify a level 2 sub-hazard definition (see **Table 16**). In the table, hazards listed in bold refer to Level 1 (L1) categories, while those not in bold represent Level 2 (L2) sub-hazards. The term 'unspecified' indicates a Level 1 hazard that does not have a specified Level 2 sub-hazard.

Table 16. Climate hazards reported: L1 hazards and L2 sub-hazards.

Climate hazard	Count of records	%
Floods & sea level rise	**3 013**	**16.7 %**
(Unspecified)	2 106	
River flood	402	
Flash / surface flood	291	
Coastal flood	166	

Climate hazard	Count of records	%
Groundwater flood	31	
Permanent inundation	17	
Heavy precipitation	**2 906**	**16.1 %**
(Unspecified)	2 103	
Rain storm	600	
Hail	96	
Heavy snow	67	
Fog	40	
Extreme heat	**2 231**	**12.4 %**
(Unspecified)	2 205	
Heat wave	20	
Extreme hot days	6	
Wildfires/Wildfires [30]	**2 143**	**11.9 %**
(Unspecified)	1 619	
Forest fire	419	
Land fire	105	
Droughts & water scarcity	**419**	**11.7 %**
Drought	2 099	
(Unspecified)	12	
Storm & wind	1 606	**8.9 %**
(Unspecified)	1 129	
Severe wind	279	
Lightning / thunderstorm	88	
Cyclone (Hurricane / Typhoon)	36	
Tropical storm	34	
Tornado	23	
Storm surge	10	
Extra tropical storm	7	
Mass movement	**1 589**	**8.8 %**
(Unspecified)	1 130	
Landslide	336	
Rock fall	57	
Subsidence	48	
Avalanche	18	
Extreme cold	**1 043**	**5.8 %**
(Unspecified)	1 041	
Extreme winter conditions	1	
Cold wave	1	
Biological hazards	**733**	**4.1 %**
(Unspecified)	347	

[30] The CRF's guidance note (GCoM 2019) defines 'Wild fire' as weather conditions conducive to triggering and sustaining wild fire, usually based on a set of indicators and combinations of indicators including temperature, soil moisture, humidity and wind. Fire weather does not include the presence or absence of fuel load. Forest fire: Type of wildfires in forested/wooded area. Land fire: (brush, bush, pasture) type of wildfires in a non-wooded area such as bush, grassland, scrub or pasture. In this document, the CRF term 'wild fire' is also referred as 'wildfires' to be consistent with the terminology used by the JRC EU Science Hub and the Copernicus European Forest Fires Information System (EFFIS) (European Commission Joint Research Centre 2025).

Climate hazard	Count of records	%
Insect infestation	140	
Vector-borne disease	104	
Water-borne disease	72	
Air-borne disease	70	
Other [31]	**389**	**2.2 %**
(Unspecified)	389	
Chemical change	**280**	**1.6 %**
(Unspecified)	169	
Atmospheric CO_2 concentrations	67	
Salt water intrusion	33	
Ocean acidification	11	
Grand Total	**18 044**	**100 %**

Source: JRC elaboration based on GCoM data

Figure 36 shows both L1 and L2 sub-hazards, following the CRF definitions.

Based on the data analysed, the most frequently reported climate hazards in municipalities' RVAs are 'floods & sea level rise' (approximately 16.7 % of entries), with 'river flood' being the most common sub-hazard at 402 records. 'Heavy precipitation' accounts for 16.1 % of reports, with "rainstorms" leading as the predominant sub-hazard at 600 records. 'Extreme heat' represents 12.4 % of the entries. 'Droughts & water scarcity' make up 11.9 % of reports.

Further notable categories include 'wildfires,' with 'forest fire' documented 419 times and 'storms & wind,' with 'severe wind' reported 279 times.

[31] The category 'Other' allows municipalities to report climate hazards not explicitly listed in the CRF categories. However, upon analysing the text entries under 'Other', it becomes apparent that they often include hazards already present in the list but written in a language other than English. In some cases, the text is in English but refers to a recognised climate hazard, suggesting a possible misunderstanding by the municipality (e.g., terms like 'extreme hot temperature' or 'increasing heat' should be classified as 'extreme heat'). Additionally, some entries describe impacts rather than climate hazards, such as 'loss in green space/green cover' or 'coastal erosion'. Occasionally, the text pertains to non-climate hazards (e.g., 'earthquakes') or other concerns (e.g., 'air pollution').

Figure 36. Most reported L1 climate hazards (inner circle) and L2 sub-hazards (outer circle) [32].

Source: JRC elaboration based on GCoM data

Both the CDP-ICLEI Track and MyCovenant reporting platforms can lead to duplicate entries, due to their respective storage methods, albeit in slightly different ways [33, 34]. When these datasets are

[32] Due to the small size of some slices in the donut pie chart, labels may not be fully visible. Please refer to the accompanying Table 16 for a detailed breakdown of all categories and their corresponding values and shares.

[33] The CDP- ICLEI Track data contains numerous duplicate records, where the same hazard is reported multiple times with only minor differences in associated information. These differences may include variations such as identical text presented in different languages or the separate recording of vulnerable groups and sectors for each hazard ID, rather than linking them to a single hazard ID.

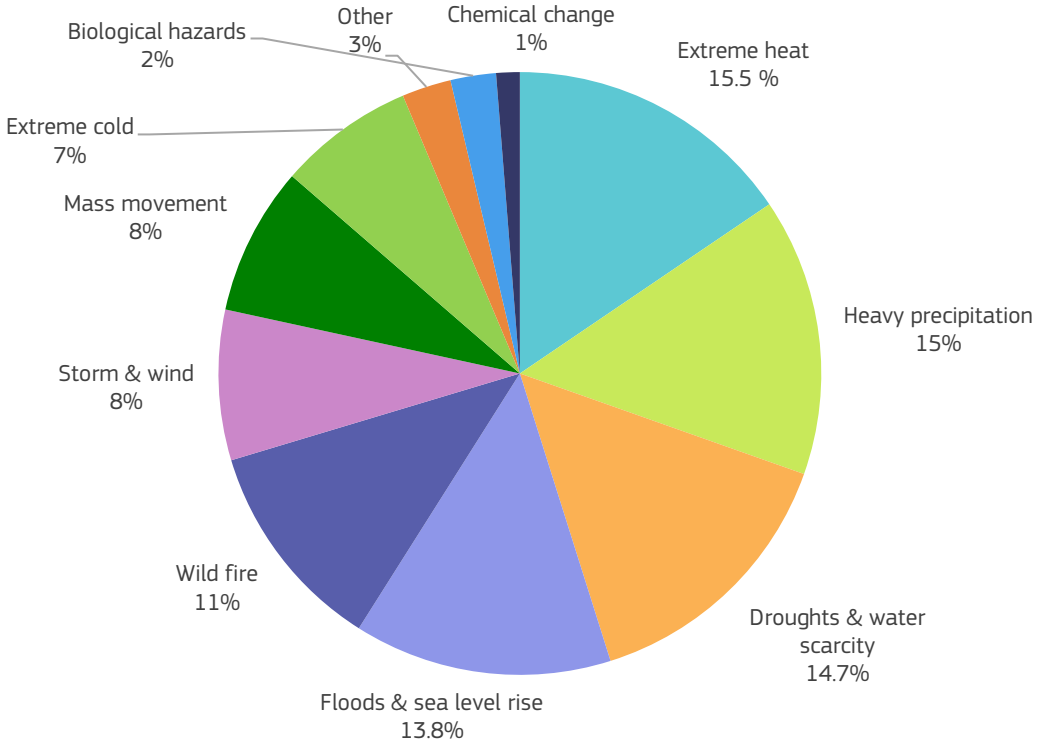
[34] In MyCovenant, duplicate records can occur due to the way Level 1 (L1) and Level 2 (L2) information is documented. For example, if a municipality reports both 'sea level rise' and 'river flood,' the system might generate an L1 record for

aggregated, as explained in section 5.2.2, the duplication issue can result in an inflated count of reported hazards.

To address these duplication issues and provide a more accurate representation of the most reported hazards, a data cleaning process was undertaken. This process considered duplicates municipality by municipality, ensuring that only one hazard type (L1) could exist for each municipality. For example, if a municipality reported three flood hazards—L1 flood and sea level rise, L2 river flood, and L2 coastal flood—these were consolidated into a single L1 flood and sea level rise record. In doing so, the most severe characteristics among the original entries, such as the highest probability or most significant future frequency change, were used to represent the consolidated record. As a result of this cleaning process, the refined hazard dataset consists of 14 270 records, reduced from the original 18 044 records.

The following **Figure 37** shows the updated shares, with a shift in the most reported hazards, compared to **Figure 36**: extreme heat (15.5 %), heavy precipitation (15 %), droughts & water scarcity (14.7 %), and floods & sea level rise (13.8 %).

Figure 37. Most reported climate hazards in RVAs after addressing duplication.



Source: JRC elaboration based on GCoM data

An alternative approach to analysing reported hazards, which also avoids double counting, focuses on assessing how frequently each L1 hazard is mentioned across municipalities in their RVAs (see

'floods & sea level rise' due to the overarching category, as well as separate L2 entries for each specific hazard ('sea level rise' and 'river flood'). This could lead to three records being created: one for the general category and two for the specific sub-hazards, instead of the expected two records (one for each specific hazard).

Table 17) [35], rather than summing the total reported hazards (as shown in the pie chart above). This methodology identifies whether L1 hazards were mentioned in each municipality's assessment. This confirms the top reported hazards from the cleaned dataset without overrepresenting L1 hazards that encompass multiple sub-hazards, such as "floods & sea level rise".

- 'Extreme heat' is identified as a climate hazard in 91 % of RVAs, with 2 214 out of 2 444 municipalities mentioning it.
- 'Heavy precipitation' is noted in 87 % of RVAs, with 2 126 municipalities mentioning it.
- 'Droughts & water scarcity' appear in 86 % of RVAs, reported by 2 101 municipalities.
- 'Floods & sea level rise' are present in 81 % of RVAs, cited by 1 974 municipalities.
- 'Wildfires' is mentioned in 66 % of RVAs, with 1 624 municipalities reporting it.
- Other hazards appear in less than 50 % of RVAs: 'storm & wind' (47 %), 'mass movement' (46 %), 'extreme cold' (43 %), 'other' (15 %), 'biological hazards' (14 %), and 'chemical change' (7 %).

Table 17. Climate hazards reported in municipal RVAs, with alternative approach.

Climate Hazard	Count of municipalities mentioning the climate hazard	Share of municipalities in %
Extreme heat	2 214	91 %
Heavy precipitation	2 126	87 %
Droughts & water scarcity	2 101	86 %
Floods & sea level rise	1 974	81 %
Wild fire	1 624	66 %
Storm & wind	1 150	47 %
Mass movement	1 135	46 %
Extreme cold	1 041	43 %
Other	377	15 %
Biological hazards	348	14 %
Chemical change	180	7 %
Total of municipalities with an RVA	**2 444**	**100 %**

Source: JRC elaboration based on GCoM data

The two following figures (**Figure 38** and **Figure 39**) include the level of probability and impact reported by municipalities in their RVAs for the 18 044 hazard records. To ensure dataset consistency, data homogenisation was performed. For the purpose of these charts, certain attributes have been reclassified: 'medium high' and 'medium low' were both categorised as 'medium'; 'does not currently impact the municipality' was reclassified as 'low'; 'not expected to happen in the future' was labelled as 'decrease'; 'not available' was designated as 'not known'; and 'immediately' was reclassified as 'short term.' The 'future expected magnitude' field was excluded

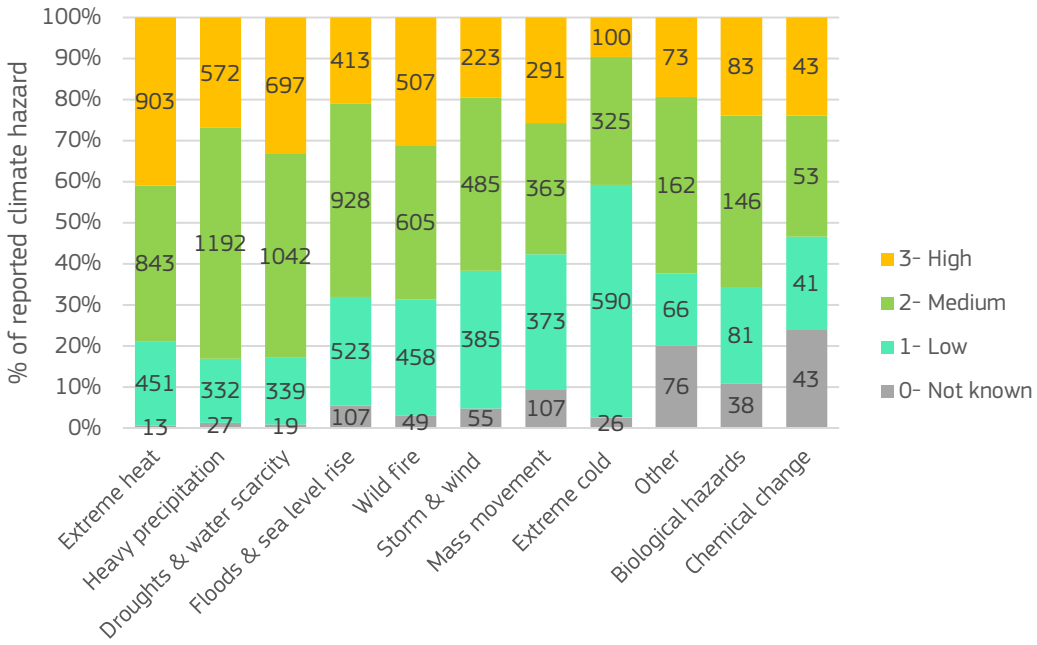
[35] This alternative approach removes the necessity for data cleaning to address duplicates since each Level 1 (L1) hazard category is counted only once per municipality, irrespective of how many times it is reported by the same city. This method will be employed in subsequent analyses to evaluate the most frequently identified vulnerable sectors and population groups, as well as the most commonly addressed hazards, sectors, and groups in adaptation actions.

from this analysis as it is not part of the CRF. Additionally, for these analyses, L2 hazards were reclassified to their corresponding L1 categories

Among the climate hazards, 'extreme cold' is reported with the lowest probability and impact, suggesting it is a less prominent concern. In contrast, 'chemical change' and 'other' categories have the highest proportion of entries marked as 'not known,' indicating uncertainty or lack of data for these hazards.

The remaining climate hazards predominantly exhibit medium to high levels of both probability and impact, suggesting general recognition among municipalities of the significant risk these hazards pose.

Figure 38. Probability of occurrence of the climate hazard in the present [36].

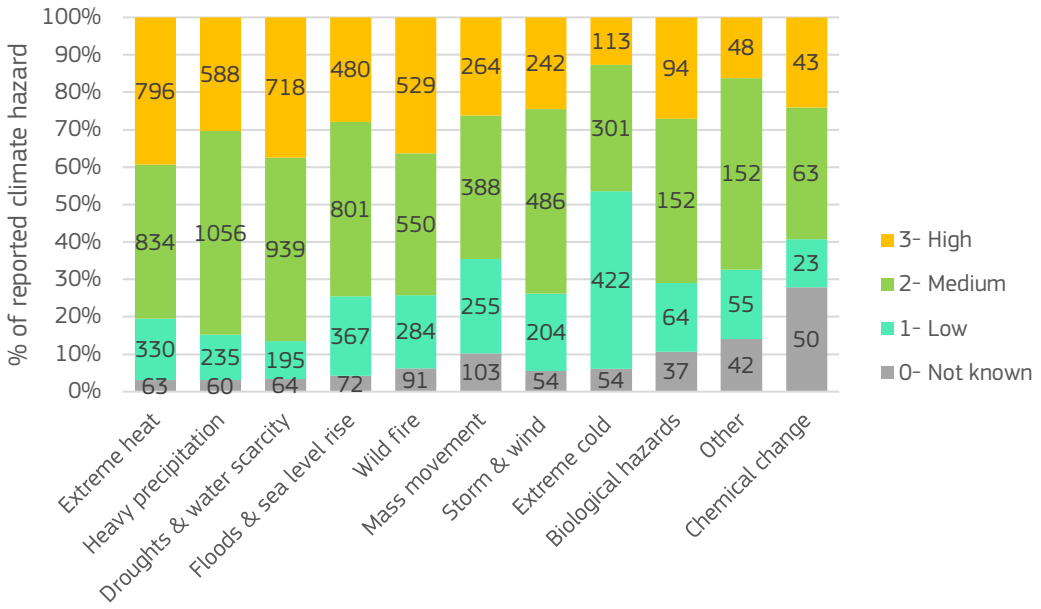


High = extremely likely that the hazard occurs (e.g., greater than 1 in 20 chance of occurrence).
Moderate = likely that the hazard occurs (e.g., between 1 in 20 and 1 in 200 chance of occurrence).
Low = unlikely that the hazard occurs (e.g., between 1 in 200 and 1 in 2 000 chance of occurrence).
Not known =municipality has not experienced or observed climate hazards in the past or has no way of accurately reporting this information based on evidence or data.

Source: JRC elaboration based on GCoM data

[36] For further information on these definitions, see Box 4 'Guidance on probability and consequence of hazards' in the CRF's guidance note (GCoM 2019). They are also part of the Covenant reporting guidelines (CoM Europe 2020).

Figure 39. Impact/consequence of the climate hazard in the present [37].



High = the hazard represents a high (or the highest) level of potential concern for your jurisdiction; when it occurs, the hazard results in (extremely) serious impacts to the jurisdiction and (catastrophic) interruptions to day-to-day life.
Moderate = the hazard represents a moderate level of potential concern for your jurisdiction; when it occurs, the hazard results in impacts to your jurisdiction, but these are only moderately significant to day-to-day life.
Low = the hazard represents a lower (the lowest) level of potential concern for your jurisdiction; when it occurs, the hazard results in impacts to your jurisdiction, but these are deemed less significant (or insignificant) to day-to-day life.
Not known = municipality has not experienced or observed climate hazards in the past or has no way of accurately reporting this information based on evidence or data.

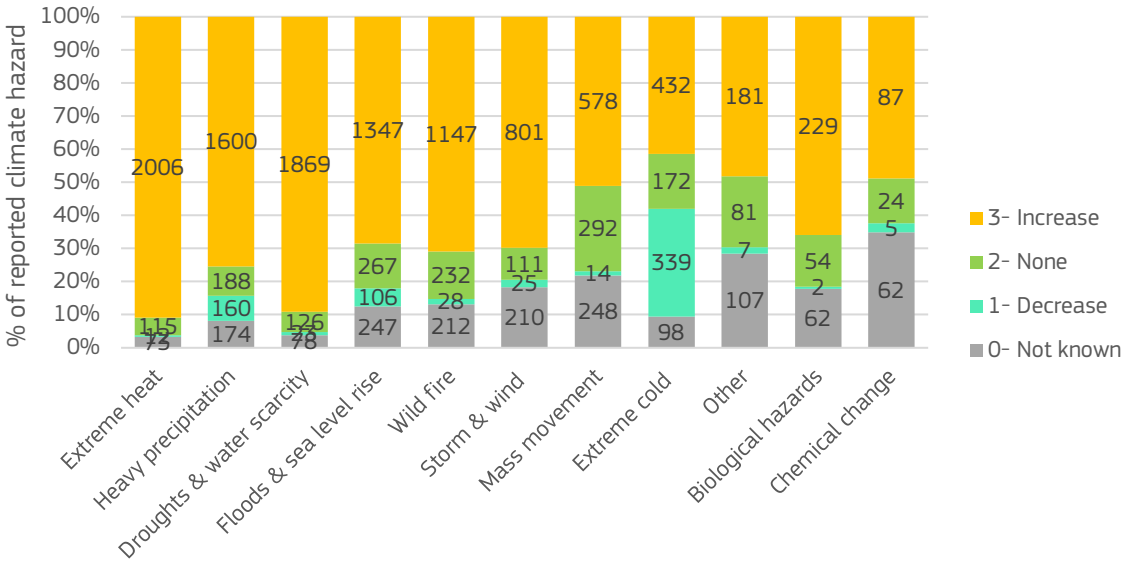
Source: JRC elaboration based on GCoM data

The two following figures (**Figure 40** and **Figure 41**) include the future expected change in hazard frequency and intensity as reported by municipalities in their RVAs. They provide an overview of the anticipated future changes in both the intensity and frequency of climate hazards, as reported in municipality RVAs. The data indicates a general expectation for an increase in both intensity and frequency across most climate hazards. Notably, 'extreme heat' is projected to increase in intensity in approximately 92 % of records and in frequency in about 91 % of records. Similarly, 'droughts & water scarcity' are expected to increase in intensity in over 91 % of records and in frequency in nearly 89 % of records.

Conversely, 'extreme cold' stands out as the hazard most frequently expected to decrease, with anticipated decreases in intensity in around 32 % of records and in frequency in about 33 % of records.

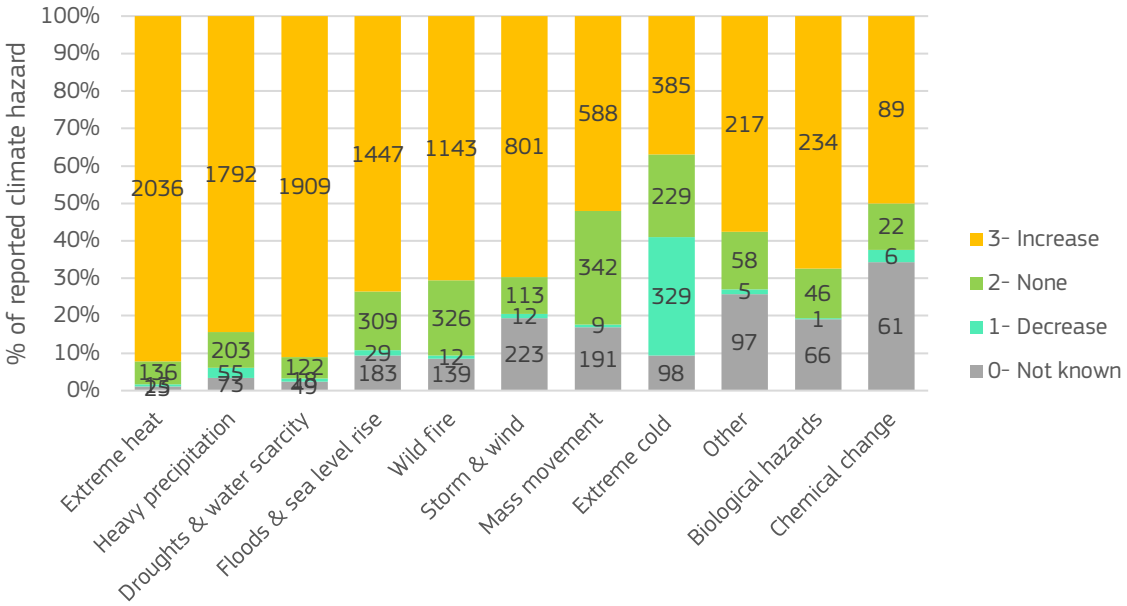
[37] For further information on these definitions, see Box 4 'Guidance on probability and consequence of hazards' in the CRF's guidance note (GCoM 2019). They are also part of the Covenant reporting guidelines (CoM Europe 2020).

Figure 40. Future expected change in hazard frequency.



Source: JRC elaboration based on GCoM data

Figure 41. Future expected change in hazard intensity.



Source: JRC elaboration based on GCoM data

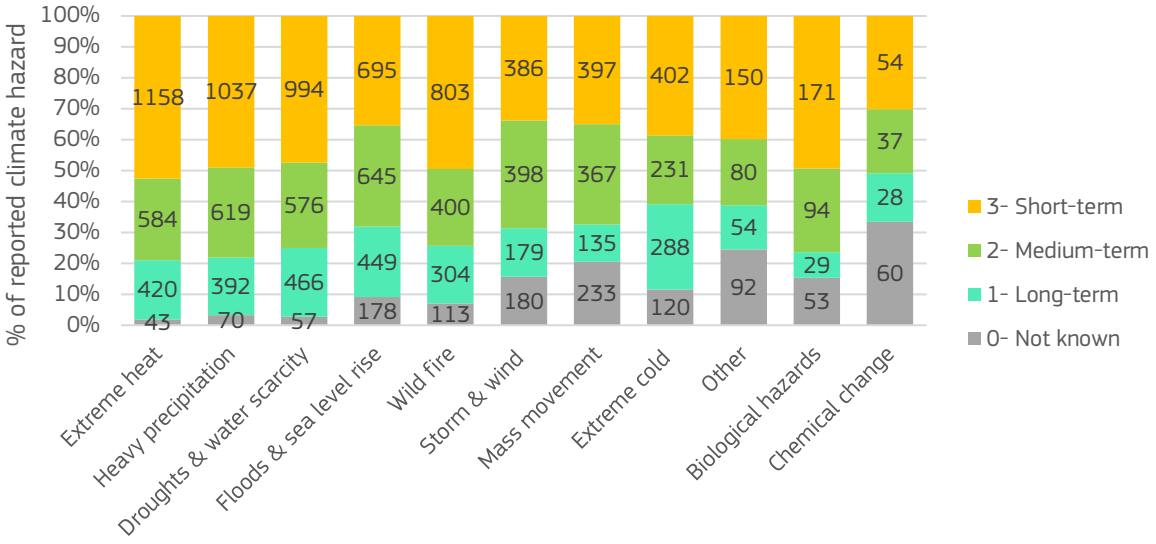
Figure 42 shows the timeframes of reported climate hazards [38]: The chart indicates that most climate hazards are expected to change in the short-term. 'Extreme heat' is projected for short-term

[38] Multiple options can be selected by signatories for each climate hazard reported in RVA in MyCovenant, while in CDP-ICLEI Track there is only one timeframe option per hazard.

changes in about 53 % of records. 'Heavy precipitation' and 'droughts & water scarcity' are expected to change in the short-term in approximately 49 % and 47 % of records, respectively. 'Floods & sea level rise' show nearly equal expectations for medium-term and short-term changes. 'Wildfires' changes are anticipated in the short-term for about 50 % of records. 'Storm & wind' and 'mass movement' display a more even distribution between medium-term and short-term timeframes.

A notable portion of records, around 8 %, is marked as 'not known,' indicating uncertainty or lack of specificity regarding when changes in these hazards are expected to occur. Proportionally, 'chemical change' has the highest percentage of 'not known' entries, with approximately 34 % of its records lacking a specified timeframe, highlighting significant uncertainty in this area.

Figure 42. Timeframe of reported climate hazards [39].



Source: JRC elaboration based on GCoM data

Figure 43 shows all climate hazards and their attributes for comparison:

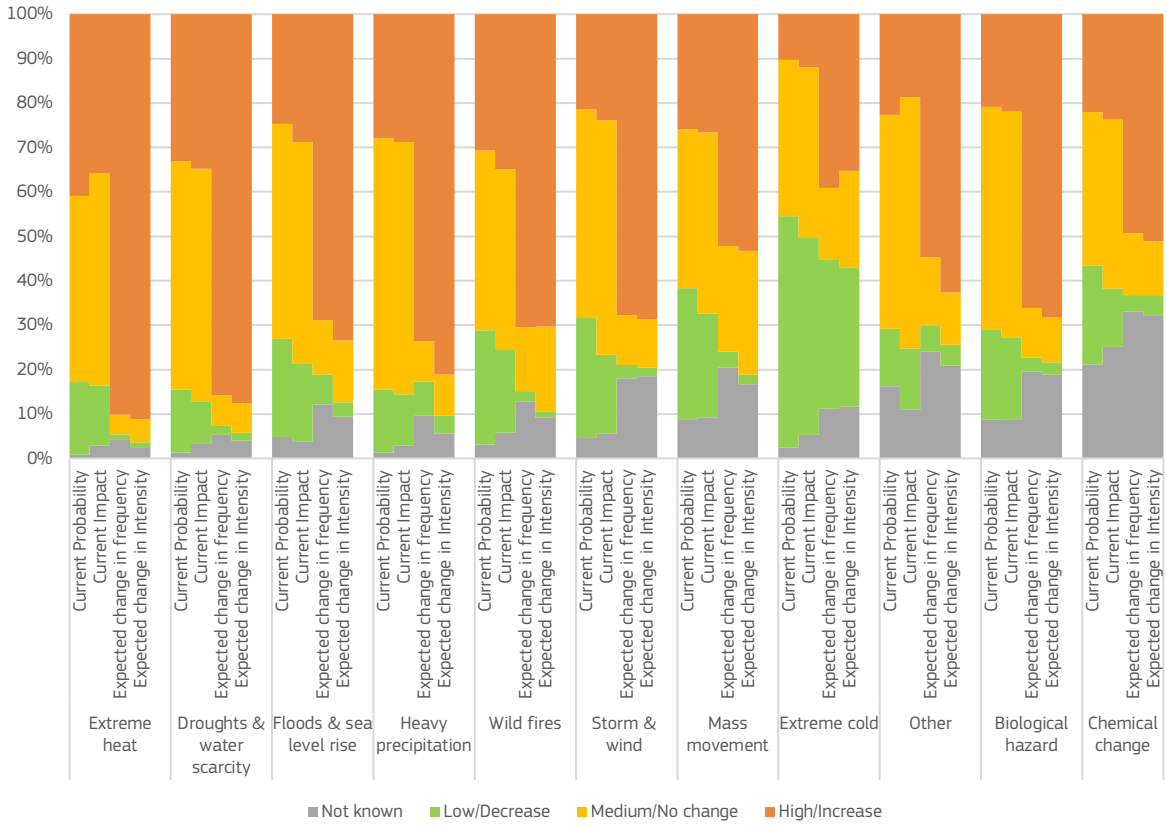
— Looking at the shift from current to future (first two bars vs. last two bars), 'extreme heat' and 'droughts & water scarcity' exhibit the most significant reported expected change, indicating a future increase in both intensity and frequency.

— Considering the green bars, 'extreme cold' is reported with the current lowest impact and probability and is also expected to have the highest decrease in both intensity and frequency. All other climate hazards predominantly show medium to high impact and probability, with an expected increase in intensity and frequency.

[39] Timeframes are analysed here as reported on the reporting platforms. There is a slight difference in how they are defined in the CRF (Short-term = by 2025; Medium-term = 2026-2050; Long-term = after 2050) (GCoM 2019, 2023) and in the Covenant reporting guidelines (Short-term = 20-30 years from now; Mid-term = after 2050; Long-term = close to 2100) (CoM Europe 2020). The data presented here reflects the information collected by the two platforms without any reclassification, and the definitions should be interpreted according to the CRF specifications

— Considering the grey bars (not known), it is apparent that estimating future conditions is more challenging for certain hazards, particularly 'chemical change,' 'mass movement,' and 'biological hazard,' which have a higher proportion of records with unknown future projections.

Figure 43. Climate hazards and their attributes [40].



Source: JRC elaboration based on GCoM data

Overall, nearly half of the municipalities with an RVA (49 %) have identified at least one high-risk hazard, defined as climate hazards with both high probability and high magnitude/impact. **Table 18** provides a detailed overview of the high-risk climate hazards identified in municipal RVAs. Compared to **Table 17**, the order of the five most reported hazards remains largely consistent, except for 'floods & sea level rise' and 'heavy precipitation', which are switched in their ranking.

[40] Climate hazards are ordered by number of records having the four characteristics analysed (current probability and impact, future expected change in hazard frequency and intensity).

Table 18. High-risk climate hazards reported in municipal RVAs.

High-risk climate Hazard	Count of municipalities mentioning the high-risk climate hazard	Share of municipalities in %
Extreme heat	618	25 %
Droughts & water scarcity	535	22 %
Heavy precipitation	429	18 %
Wild fire	400	16 %
Floods & sea level rise	278	11 %
Mass movement	230	9 %
Storm & wind	136	6 %
Extreme cold	80	3 %
Biological hazards	70	3 %
Other	36	1 %
Chemical change	35	1 %
Total of municipalities with an RVA mentioning high-risk hazards	**1 202**	**49 %**
Total of municipalities with an RVA	**2 444**	**100 %**

Source: JRC elaboration based on GCoM data

6.1.2. Vulnerable sectors

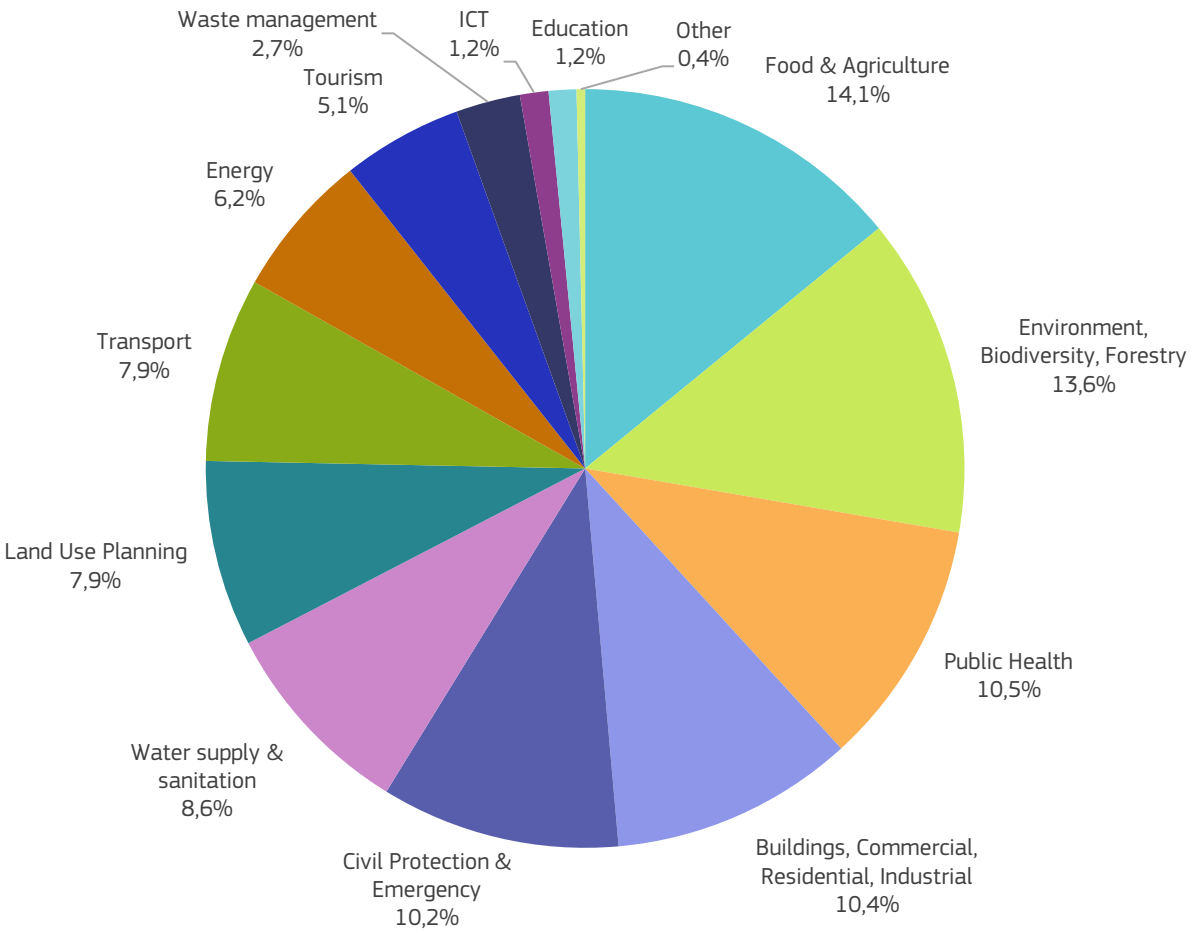
More than 51 700 local vulnerabilities (see **Table 15**) are reported by municipalities for specific vulnerable sectors and are part of 2 444 RVAs [41]. While 2 444 RVAs address climate hazards, only 91 % of them (2 233) include vulnerable sectors, indicating that some assessments identify hazards without detailing sector impacts.

Figure 44 presents key vulnerable sectors [42], with food & agriculture accounting for approximately 14.1 % of records, making it the most frequently reported sector. Environment, biodiversity, and forestry follow at 13.6 %, and the public health represents 10.5 %. Buildings sector, civil protection & emergency services, and water supply & sanitation each account for around 10.4 %, 10.2 %, and 8.6 %, respectively. Land use planning, transport and energy sectors also feature prominently, each contributing around 7.9 %, 7.9 % and 6.2 % of the reports. Tourism, and waste management sectors are noted at 5.1 % and 2.7 %, respectively, while “information and communication technologies (ICT)”, “education” and “other” are reported with the lowest shares.

[41] Local sector vulnerabilities refer to records in the dataset listing sectors vulnerable to, exposed to, or impacted by a specific hazard. Since a single hazard can affect multiple sectors, the number of impacted sectors exceeds the number of hazards, with an average of 5.6 sectors impacted per hazard.

[42] MyCovenant and CDP-ICLEI Track use different labels for sectors. The ones from the CRF are used here, and a re-classification was conducted to ensure consistency (e.g., ‘Commercial’ re-classified as ‘Buildings’).

Figure 44. Most reported vulnerable sectors.



Source: JRC elaboration based on GCoM data

Because each sector is reported as vulnerable to a specific climate hazard, it is possible to analyse the most reported hazards per sector. **Figure 45** shows that:

- **Food & agriculture**: 'droughts & water scarcity' are the most significant concern, accounting for 21 % of the sector's vulnerabilities, followed by 'extreme heat' at 17 %.
- **Environment, biodiversity, forestry**: both 'droughts & water scarcity' and 'extreme heat' are leading concerns, each representing 21 % and 18 % of vulnerabilities, respectively.
- **Public health**: 'extreme heat' is a major concern, comprising 31 % of the vulnerabilities.
- **Buildings, commercial, residential, industrial**: 'floods & sea level rise' dominate this sector, making up 21 % of vulnerabilities, with 'heavy precipitation' also significant at 19 %.
- **Civil protection & emergency**: 'floods & sea level rise' and 'heavy precipitation' are the primary concern, accounting for 20 % and 18 % of vulnerabilities, with 'wildfires' also notable at 16 %.
- **Land use planning**: 'floods & sea level rise' are the most significant, accounting for 23 % of vulnerabilities, with 'heavy precipitation' also at 17 %.

— **Water supply & sanitation**: 'droughts & water' scarcity are the predominant concern, constituting 32 % of vulnerabilities, with 'extreme heat' at 20 %.

— **Transport**: 'heavy precipitation' and 'floods & sea level rise' each account for 23 % and 20 % of vulnerabilities, respectively.

— **Energy**: 'extreme heat' is the leading concern, representing 30 % of the vulnerabilities.

— **Tourism**: 'extreme heat' leads with 22 % of vulnerabilities, with 'floods & sea level rise' and 'heavy precipitation' each at 16 %.

— **Waste management**: 'extreme heat' is the predominant concern, representing 24 % of vulnerabilities, followed by 'floods & sea level rise' at 21 %.

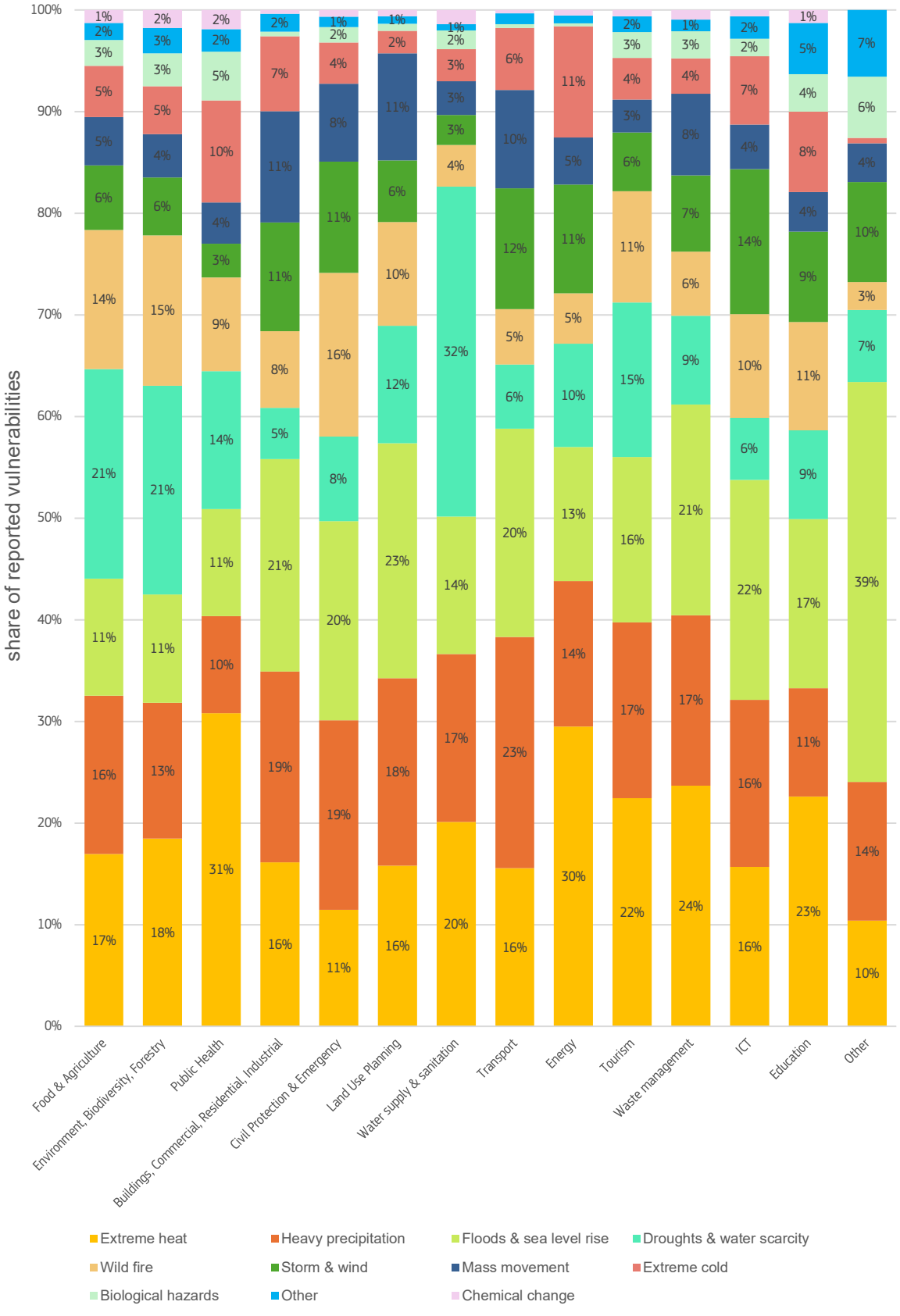
— **ICT**: 'floods & sea level rise' is the primary concern, constituting 22 % of vulnerabilities, followed by 'extreme heat' and 'heavy precipitation', both at 16 %, and 'storm & wind', at 14 %

— **Education**: 'extreme heat' and 'floods & sea level rise' are leading concerns at 23 % and 17 %, respectively.

— **Other** [43]: 'floods & sea level rise' dominate at 39 %, with 'storm & wind' and 'extreme heat' both also significant at 10 %.

[43] The category 'Other' allows municipalities to report sectors not explicitly listed in the CRF categories. However, analysis of CDP-ICLEI Track data reveals that this category often includes sectors already present in the list but written in languages other than English. In some instances, even when the text is in English, it refers to a recognised sector, indicating a potential misunderstanding by the municipality. To ensure consistency between MyCovenant and CDP-ICLEI Track data, certain categories that are absent from MyCovenant—specifically Financial and Insurance Services, Community & Culture, Administrative and Support Services, and Professional, Scientific and Technical Services—were reclassified as 'Other'.

Figure 45. Vulnerable sectors and climate hazards.



Source: JRC elaboration based on GCoM data

An alternative approach to analyse reported sectors, similar to the one presented to analyse the hazards (see **Table 17**), avoids double counting and focuses on assessing how frequently each sector is mentioned across municipalities in their RVAs (see **Table 19**) [44], rather than summing the total reported sectors (as shown in the pie chart above). This methodology identifies whether these sectors were mentioned in each municipality's assessment and confirms the top sectors, albeit with a slight difference in their ranking (e.g., 'public health' is more preponderant in this analysis).

Table 19. Sectors reported as vulnerable/impacted in municipalities' RVAs.

Vulnerable/Impacted Sector	Count of municipalities' RVAs mentioning that sector	Share of municipalities [%]
Environment, Biodiversity, Forestry	1 932	87 %
Public Health	1 928	86 %
Food & Agriculture	1 911	86 %
Buildings, Commercial, Residential, Industrial	1 752	78 %
Water supply & sanitation	1 745	78 %
Civil Protection & Emergency	1 482	66 %
Land Use Planning	1 451	65 %
Transport	1 443	65 %
Energy	1 265	57 %
Tourism	890	40 %
Waste management	593	27 %
Education	313	14 %
ICT	281	13 %
Other	64	3 %
Total municipalities with an RVA including sector vulnerabilities	**2 233**	**100 %**

Source: JRC elaboration based on GCoM data

6.1.3. Vulnerable population groups

More than 13 090 local vulnerabilities [45] are reported by municipalities for specific vulnerable population groups. While 2 444 RVAs identify climate hazard, only 45 % (1 096) include population group vulnerabilities, indicating that some assessments identify hazards without their effect on people [46]. However, this represents an improvement in terms of absolute data compared to 2023 data (888 action plans reporting information on vulnerable groups).

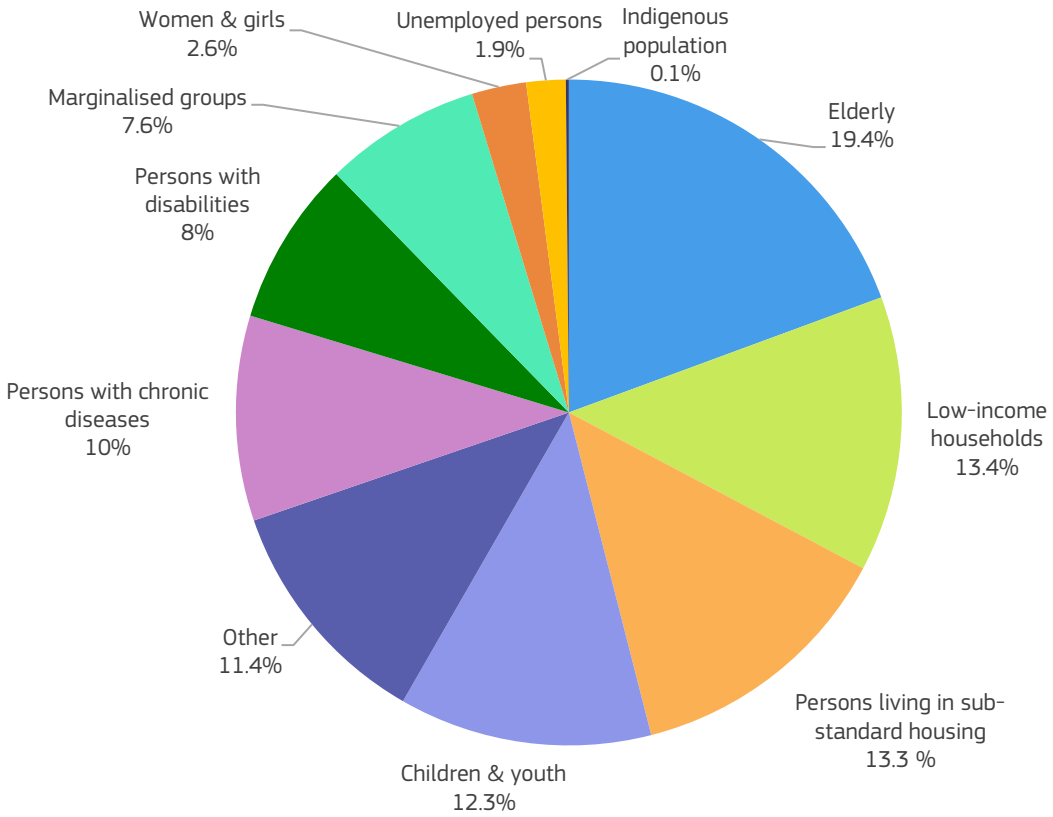
[44] This alternative approach removes the necessity for data cleaning to address duplicates since each sector category is counted only once per hazard per municipality, irrespective of how many times it is reported by the same city. This method will be employed in subsequent analyses to evaluate the most frequently identified vulnerable population groups, as well as the most commonly addressed hazards, sectors, and groups in adaptation actions.

[45] Local vulnerabilities refer to records in the dataset listing population groups vulnerable to, exposed to, or impacted by a specific hazard. Since a single hazard can affect multiple groups, the number of vulnerable groups exceeds the number of hazards, with an average of 3.8 groups impacted per hazard.

[46] In MyCovenant, this information is not mandatory.

As shown in **Figure 46** [47], 'elderly' (19.4 %), 'low-income households' (13.4 %), 'persons living in sub-standard housing' (13.3 %) and 'children & youth' (12.3 %) are the most frequently reported vulnerable groups, while 'other'[48] (11.4 %), 'persons with chronic diseases' (10 %), 'persons with disabilities' (8 %), 'marginalised groups' (7.6 %), 'women & girls' (2.6 %), 'unemployed persons' (1.9 %), indigenous people' (0.1 %) have lower reports.

Figure 46. Share of most reported vulnerable population groups.



Source: JRC elaboration based on GCoM data

Given that each group is identified as vulnerable to particular climate hazards, it is possible to analyse the most frequently reported hazards for each group. **Figure 47** reveals that:

[47] MyCovenant and CDP-ICLEI Track use different labels for some vulnerable population groups. The ones from the CRF are used here, and in some cases a re-classification was conducted to ensure consistency (e.g., 'children' re-classified as 'children & youth'). To avoid double counting, each category was counted as one even when reported multiple times (as vulnerable to multiple hazards). The category 'all' was ignored for this analysis.

[48] The category 'other' allows municipalities to report vulnerable population groups not explicitly listed in the CRF categories. However, an analysis of CDP-ICLEI Track data indicates that this category often includes groups already present in the list but written in languages other than English. In some cases, even when the text is in English, it refers to a recognised group, suggesting a potential misunderstanding by the municipality. To ensure consistency between MyCovenant and CDP-ICLEI Track data, certain categories absent from MyCovenant—specifically 'migrants and displaced people', 'frontline workers', 'people experiencing homelessness', and 'small businesses'—were reclassified as 'other'.

— **Extreme heat**: this is the hazard heavily affecting a wide range of vulnerable groups: 'elderly,' 'women & girls, 'children & youth,' and 'persons with chronic diseases' are reported as most vulnerable to 'extreme Heat,' with 33 %, 34 %, 39 %, and 41 % respectively.

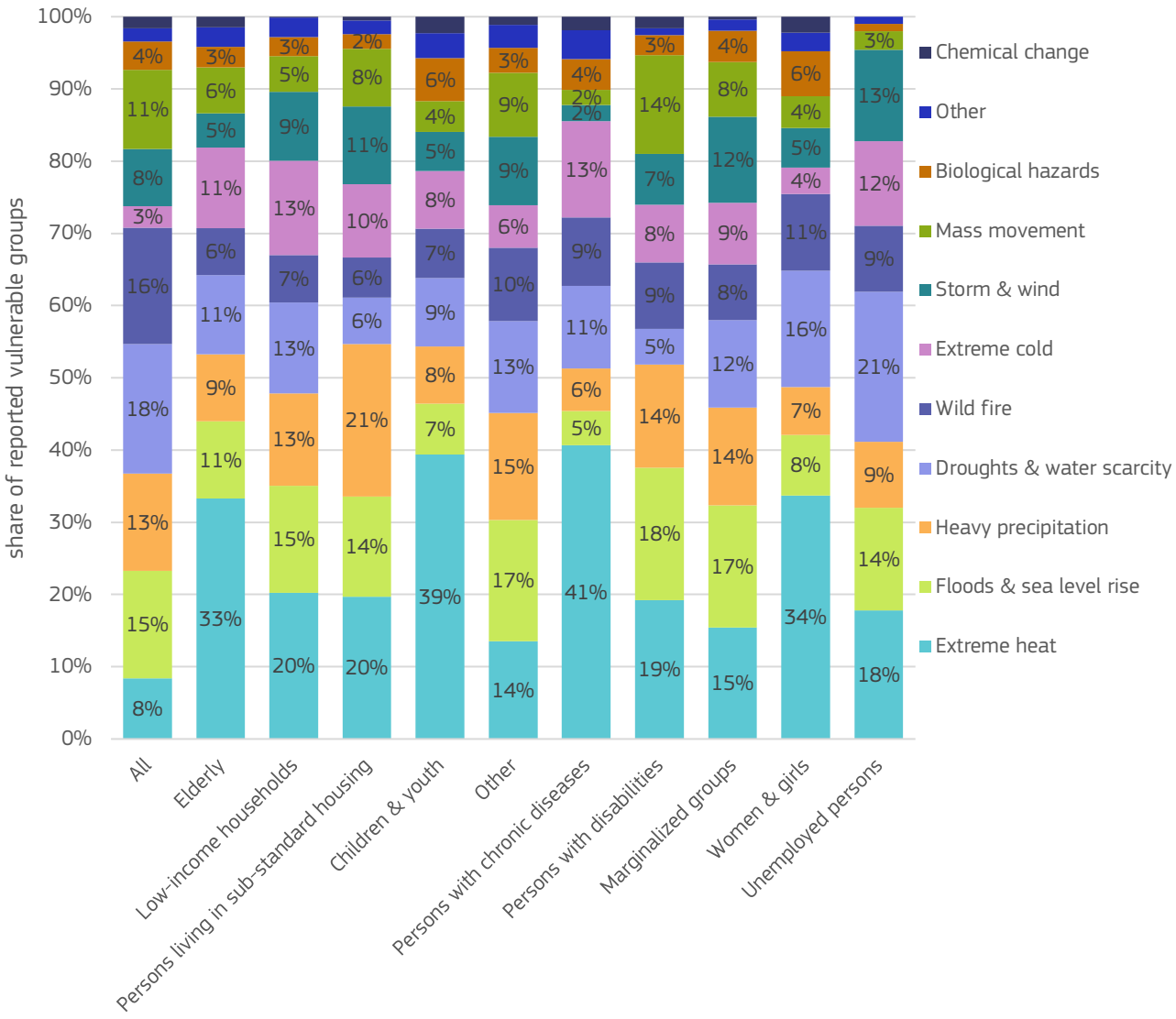
— **Floods & sea level rise**: 'low-income households', 'marginalised groups', and 'persons with disabilities' are most affected by 'floods & sea level rise,' accounting for 15 %, 17 %, and 18 %.

— **Heavy precipitation**: 'persons living in sub-standard housing' report the highest vulnerability to 'heavy precipitation' at 21 %.

— **Mass movement**: 'persons with disabilities' show significant vulnerability to 'mass movement,' with 11 %.

— **Drought & water scarcity**: 'unemployed persons' show significant vulnerability to 'drought & water scarcity,' with 21 %.

Figure 47. Vulnerable population groups and climate hazards.



Source: JRC elaboration based on GCoM data

Another approach to analysing the reported vulnerable groups, similar to the one presented to analyse the hazards (see **Table 17**) and vulnerable sectors (see **Table 19**) avoids double counting and focuses on assessing how frequently each group is mentioned across municipalities in their RVAs (see **Table 20**). This approach identifies whether these groups were mentioned in each municipality's assessment and confirms the top ones, albeit with a slight difference in their ranking (e.g., 'children & youth' is more preponderant in this analysis).

Table 20. Population groups reported as vulnerable/impacted in municipalities' RVAs.

Vulnerable/Impacted Population Group	Count of municipalities' RVAs mentioning that group	Share of municipalities [%]
Elderly	827	75 %
All	692	63 %
Children & youth	614	56 %
Persons with chronic diseases	510	47 %
Persons living in sub-standard housing	502	46 %
Low-income households	466	43 %
Persons with disabilities	380	35 %
Marginalised groups	289	26 %
Other	229	21 %
Migrants and displaced people	201	18 %
Women & girls	155	14 %
Unemployed persons	91	8 %
Outdoor workers	51	5 %
Frontline workers	14	1 %
Indigenous population	10	1 %
People experiencing homelessness	1	0 %
Total municipalities with an RVA including vulnerable groups	**1 096**	**100 %**

Source: JRC elaboration based on GCoM data

6.2. Climate adaptation goals

The dataset contains 4 464 adaptation goals from 1 580 municipalities, representing 64 % of the municipalities that have an RVA. Municipalities are expected to define adaptation goals and specify for each: a goal description, unit, metric/key performance indicator (KPI), the baseline year and the delivery/target year (GCoM 2023), and possibly a related hazard [49]. More than 80 % of these goals have numeric or categorical targets (e.g., %', 'ha'), while the remaining goals are qualitative. However, a comprehensive analysis was not performed in this report, as data from the two platforms require further harmonisation and the application of text analytical tools.

'Extreme heat', 'Droughts & water scarcity' and 'Floods & sea level rise' are the most frequently cited hazards with 522, 446 and 423 mentions. The next most common are 'Others' and 'Heavy

[49] Example of goal definitions are listed in the JRC guidebook (Palermo et al. 2025): 'Reduce the annual expected loss due to floods in the city by at least 80% by 2030', with a base year value of €10 000 000 in 2025 (and target value of € 2 000 000 in 2030).

precipitation' with receptively 367 and 320 citations. Lesser-cited hazards include wildfire, mass movement and storm & wind. The top cited hazards slightly differ from the most identified hazards in RVAs, for example 'droughts' is more prominent in the goal definition compared to the RVAs whereas 'wildfires' ranks lower.

The primary objectives are centred around enhancing resilience in water management and sanitation, including water supply and conservation, stormwater management, and wastewater management. Additionally, there is a strong emphasis on urban greening and nature-based solutions (NBS), such as increasing tree canopy, developing green infrastructure, and restoring ecosystems and biodiversity. Other themes addressed by the goals are heat resilience (urban heat island (UHI) reduction and cooling, protecting vulnerable population, governance and infrastructure), infrastructure and built environment (building renovation, flood defence), governance, planning and community resilience.

The target years for the adaptation goals provide insight into the planning horizons of municipalities:

- **Short- to medium-term goals (2024-2030):** many goals are set with target dates in the near future. These often involve foundational activities like developing plans (e.g., 'develop a heat vulnerability index by 2024' to improve the RVA and improve monitoring data), implementing specific projects (e.g., 'implementation of the "100 000 trees Future Project") which is not the suggested approach for goal setting, and achieving initial quantitative targets (e.g., 'increase canopy cover across the municipality to 25 % by 2030').
- **Long-term vision (2040-2050 and beyond)**: the years 2040 and 2050 are common milestones for more transformational, long-term goals. These include objectives like achieving a 40 % tree canopy, becoming a fully 'climate-robust' municipality, having zero persons evacuated due to storms, and preparing the municipality for climate changes projected out to 2100.

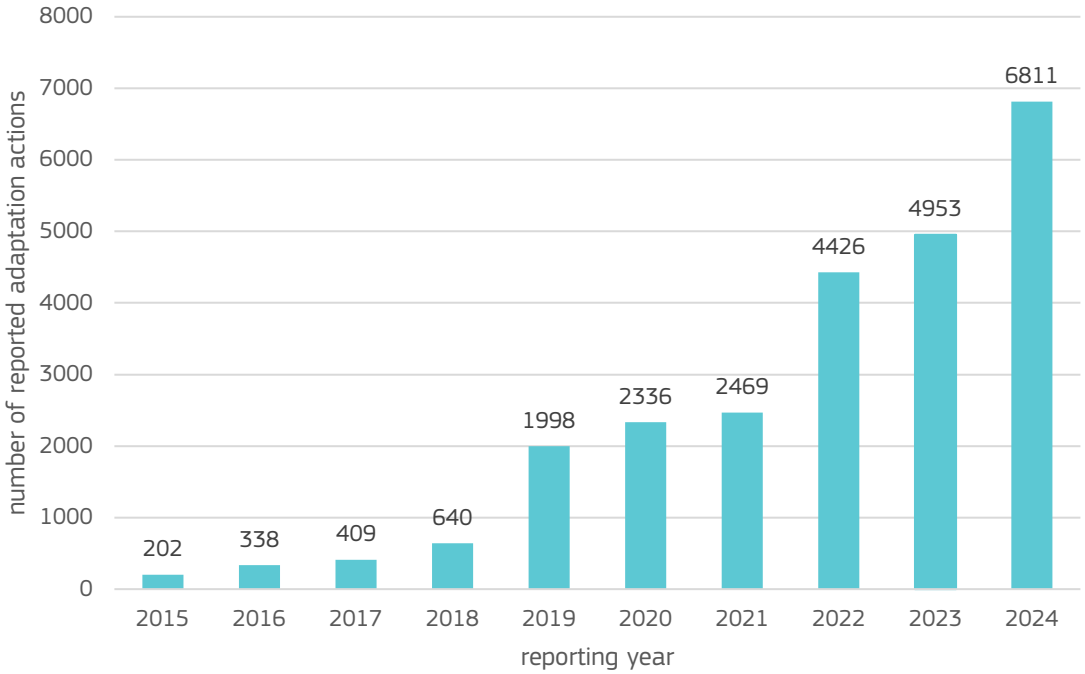
Future analyses could categorise these goals to assess their validity and relevance to true adaptation efforts, as well as explore their regional distribution and thematic focus.

6.3. Climate adaptation actions

More than 24 600 adaptation actions are reported by municipalities; among them, 12.1 % (2 982) are reported by municipalities as both mitigation and adaptation actions, and 2.2 % (540) are reported as both energy poverty and adaptation actions (see section 8 for further insights on synergies).

As shown in **Figure 48**, since the explicit inclusion of adaptation in the Covenant of Mayors initiative, the number of actions implemented has grown every year from 2015 up to 2021, with an accelerated increase from 2021 to 2024.

Figure 48. Climate change adaptation actions by reported year [50].



Source: JRC elaboration based on GCoM data

6.3.1. Actions and most addressed climate hazards

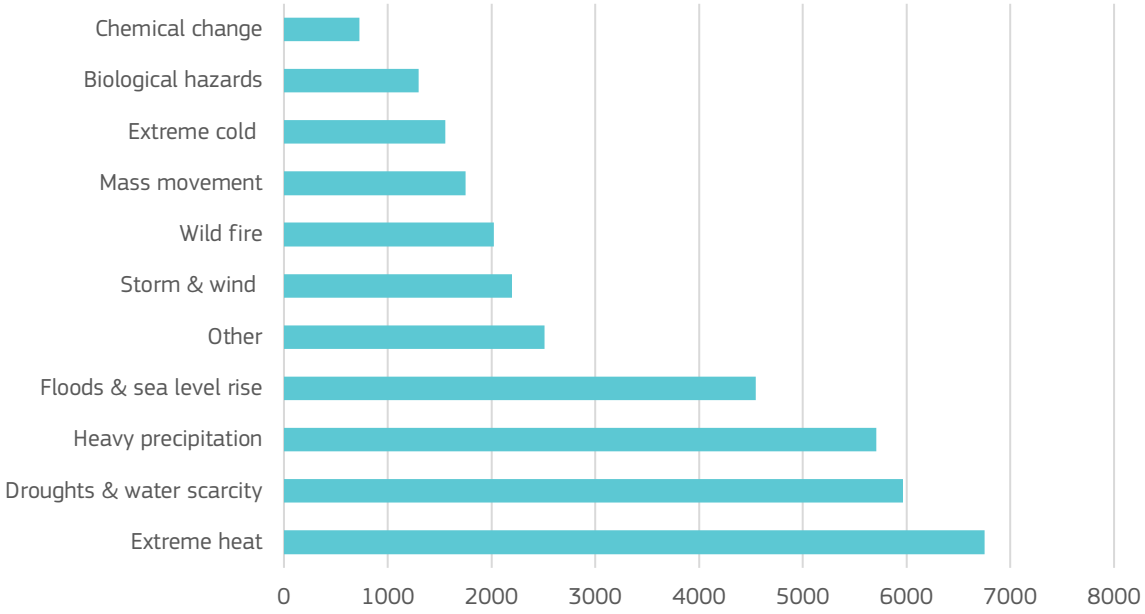
A total of 13 920 out of 24 641 climate change adaptation actions (56 %) report which climate hazard(s) they are addressing. Multiple hazards can be selected for each action.

According to the data shown in **Figure 49**, the most frequently addressed hazards are 'extreme heat', 'droughts & water scarcity', 'floods & sea level rise', and 'heavy precipitation'.

This slightly differs from the most reported hazards in the RVA (see also 6.1.1).

[50] A small share of climate change adaptation actions was reported before 2015.

Figure 49. Adaptation actions and most frequently addressed climate hazards.



Source: JRC elaboration based on GCoM data

As introduced in section 5.2.2 and used on the previous sections on RVA, the second approach to analysing the actions and the most addressed climate hazards is to examine their recurrence in municipalities by reviewing each municipality's action plan (see **Table 21**), and noting whether the hazards were mentioned. This methodology helps eliminate bias, and confirms the top addressed hazards, albeit with a slight difference in their ranking (e.g., 'wildfires' is more preponderant in this analysis).

Table 21. Climate hazards addressed across municipal action plans.

Climate hazard addressed by actions	Count of municipalities' action plans addressing that hazard	Share of municipalities [%]
Extreme heat	1 464	79 %
Droughts & water scarcity	1 446	78 %
Heavy precipitation	1 246	67 %
Floods & sea level rise	1 121	60 %
Other [51]	828	45 %
Wildfires	771	42 %
Mass movement	635	34 %
Storm & wind	617	33 %
Extreme cold	584	31 %
Biological hazards	409	22 %
Chemical change	274	15 %
Total municipalities with an action plan targeting climate hazards	**1 857**	**100 %**

Source: JRC elaboration based on GCoM data

6.3.2. Actions and most targeted vulnerable sectors

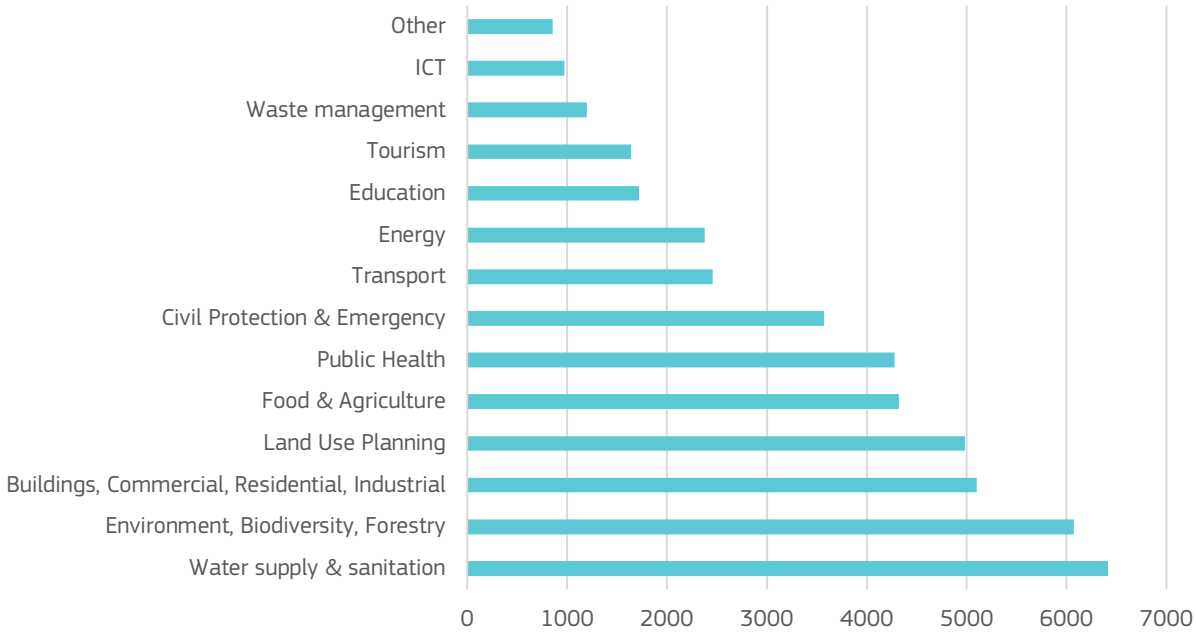
98 % of adaptation actions (24 046 out of 24 641) report which sector they are targeting. This information is mandatory for all actions in the current version of the common reporting framework (GCoM 2023). Multiple sectors can be selected.

According to the data shown in **Figure 50**, the most targeted sectors are 'water supply & sanitation', 'environment, biodiversity, forestry', and 'buildings, commercial, residential, industrial'.

That slightly differs from the most reported sectors in the RVA (see also 6.1.2).

[51] Refer to footnote 31 of tableTable **16** for further details on the 'Other' category.

Figure 50. Adaptation actions and most targeted vulnerable sectors.



Source: JRC elaboration based on GCoM data

As introduced in section 5.2.2 and used on the previous sections, the second approach to analysing the actions and the most addressed climate hazards is to examine their recurrence in municipalities by reviewing each municipality's action plan (see **Table 22**) and noting whether the sectors were mentioned. This methodology helps reducing bias, allows, and confirms the top addressed sectors, albeit with a slight difference in their ranking.

Table 22. Vulnerable sectors addressed across municipal action plans.

Vulnerable sectors addressed by actions	Count of municipalities' action plans addressing that sector	Share of municipalities [%]
Water supply & sanitation	1 787	81 %
Food & Agriculture	1 518	69 %
Environment, Biodiversity, Forestry	1 504	68 %
Buildings, Commercial, Residential, Industrial	1 488	68 %
Land Use Planning	1 485	67 %
Public Health	1 386	63 %
Civil Protection & Emergency	1 302	59 %
Transport	883	40 %
Energy	833	38 %
Education	729	33 %
Tourism	634	29 %
Waste management	585	27 %
ICT	456	21 %
Other	234	21 %
Total municipalities with an action plan targeting vulnerable sectors	**2 201**	**100 %**

Source: JRC elaboration based on GCoM data

6.3.3. Actions and most targeted vulnerable population groups

Only 26 % of climate change adaptation actions (6 435 out of 24 641) report which vulnerable population group they are targeting [52]. This information is optional in the current version of the CRF (GCoM 2023).

According to the data shown in **Figure 51**, the most targeted population groups are [53] 'children & youth', 'elderly', and 'other' [54],

That slightly differs from the most reported vulnerable population groups in the RVA (see also 6.1.3).

Figure 51. Climate change adaptation actions and most targeted vulnerable population groups.

Source: JRC elaboration based on GCoM data reported via MyCovenant platform

Another approach to analysing the actions and the most addressed vulnerable groups is to examine their recurrence in municipalities by reviewing each municipality's action plan (see **Table 23**) and

[52] In the current version of the dataset, the CDP-ICLEI Track data does not include vulnerable population groups associated with climate actions; consequently, this analysis relies solely on MyCovenant data.

[53] The reporting platforms allows selecting 'all' and other categories at the same time (multi-choice option). 5 805 records are reported as 'all' in the vulnerable population groups section of the action template, but they have been discarded for purpose of this analysis.

[54] In the analysis, entries from RVAs and actions were matched based on the category 'other', where a hazard impacting 'other' was aligned with an action targeting 'other'. However, these matches may not always represent true alignment; for example, an RVA might classify a hazard affecting farmers under 'other', while the corresponding action could be aimed at migrants, also classified under 'other'.

noting whether the groups were mentioned. This methodology helps eliminate bias, and confirms the top addressed vulnerable population groups, albeit with a slight difference in their ranking.

Table 23. Vulnerable population groups addressed across municipal action plans.

Vulnerable group addressed by Actions	Count of municipalities' action plans addressing that group	Share of municipalities [%]
All	751	81 %
Children & youth	344	37 %
Elderly	321	34 %
Other	233	25 %
Persons with chronic diseases	211	23 %
Low-income households	205	22 %
Persons living in sub-standard housing	169	18 %
Persons with disabilities	153	16 %
Marginalised groups	92	10 %
Women & girls	87	9 %
Unemployed persons	61	7 %
Total municipalities with an action plan targeting vulnerable groups	**932**	**100 %**

Source: JRC elaboration based on GCoM data reported via MyCovenant platform

6.4. Adaptation 'gap' and potential incoherence among RVA and actions

Section 6.1 provided a comprehensive analysis of RVAs, focusing on the climate hazards, vulnerable sectors, and population groups identified. Sections 6.3.1, 6.3.2, 6.3.3 detailed the actions undertaken to address these identified risks. This section conducts a critical examination of the consistency between the hazards and vulnerabilities outlined in climate action plans, which encompass RVAs and actions.

As noted in the previous sections, there is a slight incoherence among hazards and vulnerabilities reported in SECAPs, which include goals, RVAs, and actions. The major differences between the hazards reported in RVA and those targeted by actions are as follows (see **Table 24**):

— The top four climate hazards reported in RVAs ('extreme heat', 'droughts & water scarcity', 'floods & sea level rise', and 'heavy precipitation') are also the top four addressed hazards in adaptation actions. However, when considering high-risk hazards (defined as climate hazards with both high probability and high impact, as identified in 6.1.1), the order changes slightly, with 'heavy precipitation' and 'wildfires' switching positions, as well as with ' heavy precipitation' and 'droughts & water scarcity'.

— Although 'wildfires' are among the top five high-risk hazards in RVAs, they are not ranked among the top five hazards targeted by adaptation actions, which instead focus on the 'other' category.

Table 24. Comparative analysis of hazards and vulnerabilities in RVA and actions.

Ranking	Hazards in RVA	High-risk hazard in RVA	Hazards in Actions	Vulnerable sectors in RVA	Vulnerable sectors in Actions	Vulnerable group in RVA	Vulnerable group in Actions
I	Extreme heat	Extreme heat	Extreme heat	Environment, biodiversity, forestry	Water supply & sanitation	Elderly	All
II	Heavy precipitation	Droughts & water scarcity	Droughts & water scarcity	Public health	Food & Agriculture	All	Children & youth
III	Droughts & water scarcity	Heavy precipitation	Heavy precipitation	Food & agriculture	Environment, Biodiversity, Forestry	Children & youth	Elderly
IV	Floods & sea level rise	Wild fire	Floods & sea level rise	Buildings, commercial, residential, industrial	Buildings, Commercial, Residential, Industrial	Persons with chronic diseases	Other
V	Wild fire	Floods & sea level rise	Other	Water supply & sanitation	Land Use Planning	Persons living in sub-standard housing	Persons with chronic diseases

Source: JRC elaboration based on GCoM data

When considering vulnerabilities identified in RVA and targeted in the actions:

- While 'environment, biodiversity, forestry' is the most reported vulnerable sector in RVAs, it is not the most addressed sectors in the action plans, where 'water supply & sanitation' is prioritised. 'Public health', second most reported vulnerable sector in RVA is not a top sector addressed in actions.
- 'Buildings, commercial, residential, industrial' and 'food & agriculture' are both a top vulnerable sector and addressed sector in RVAs.
- While 'persons living in sub-standard housing' is among the most reported vulnerable groups in RVAs, it is not among the top groups addressed in the action plans, where the focus is more on 'all' and 'children & youth'.

Discrepancies in developing actions for certain hazards and sectors can be attributed to several challenges faced by municipalities. Addressing wildfires, for example, requires coordinated efforts that often exceed municipal capacities, necessitating regional or national collaboration. Similarly, in sectors like 'agriculture and forestry', local authorities in some municipalities in the EU-27 are limited by regional or national regulations, restricting their ability to implement actions. In contrast, areas such as building codes, land use planning, and public education are where municipalities can exert more influence. Public health ranks second in RVA but is not in the top 5 for the actions, while being a key issue where municipalities can have influence on.

Inconsistencies between vulnerable population groups identified in RVAs and those targeted in actions often result from prioritising politically visible groups or those easier to address with available resources. Broader actions targeting more vulnerable groups are sometimes implemented

due to limited data or the complexity of systemic vulnerabilities, leading to a mismatch with RVA findings.

Resource constraints, including limited funding and expertise, compel municipalities to focus on feasible actions rather than more urgent vulnerabilities. Political priorities and public perception may shift focus towards visible issues. Furthermore, infrastructural limitations and the pursuit of actions with multiple benefits can lead to prioritising less urgent areas, diverging from RVA urgencies.

The following sections delve deeper into the consistency between RVAs and actions, evaluating the extent to which the hazards, vulnerable sectors, and vulnerable groups identified in the RVAs are also addressed by corresponding actions.

6.4.1. Climate hazards in RVA and actions

Considering 'high-risk hazards', **Figure 52** shows the proportion of municipalities reporting a 'high-risk hazard' and at least one matching action: those that are covered in the action plan are shown in green, while those reported in RVA but not mentioned in the action plan are in orange:

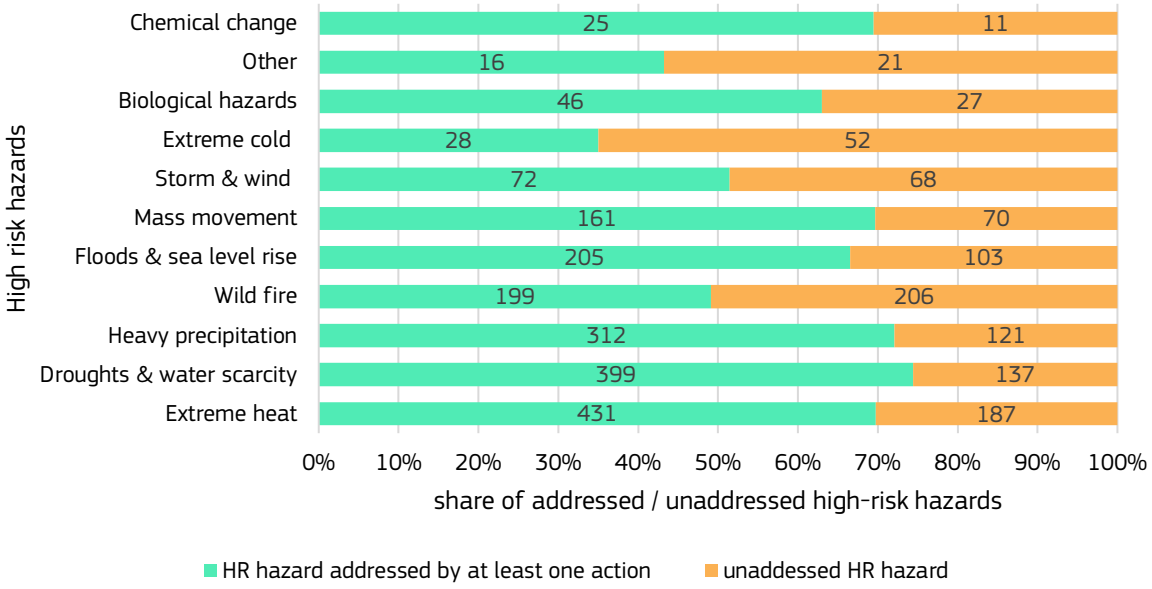
— Overall, among all the high-risk hazards (2 287) reported in RVA by municipalities, 65 % of them (1 894) are already addressed by at least one adaptation action.

— 'Droughts & water scarcity' (74 %), 'heavy precipitation' (72 %) and 'extreme heat' (70 %) are the hazards that, when identified as high-risk, have the highest proportion of being addressed by at least one adaptation action.

— 'Extreme cold' (35 %), 'other' (43 %) and 'wildfires' (49 %) are less frequently addressed by at least one action.

This result could be linked to the fact that while actions addressing extreme heat, droughts and floods are available and popular among municipalities, adaptation strategies for wildfires are more difficult to plan for local authorities.

Figure 52. Share of 'high-risk' (HR) hazard reported in RVA also reported with at least one matching action.



In green: number of reported high-risk hazards covered in action plans.
In orange: number of reported high-risk hazards not yet addressed in submitted action plans. Hazards are ordered by the number of municipalities reporting them as high-risk in their RVAs.

Source: JRC elaboration based on GCoM data

Considering the overall number of municipalities reporting high-risk hazards (1 202): 77 % (920 out of 1 202) of municipalities' RVAs reporting at least one high-risk hazard are also reporting at least one matching action to address it. While there is a gap between the overall climate hazards identified and the actions taken, it can be noted that when it comes to high-risk hazards, most action plans appear well designed to address them.

6.4.2. Vulnerable sectors in RVA and actions

Looking at the sectors reported in RVA, it is possible to analyse how many of them are targeted by planned actions. **Figure 53** shows the proportion of vulnerable sectors in RVA addressed by at least one matching action: those that are covered in the action plan are shown in green, while those reported in RVA but not mentioned in the action plans are in orange:

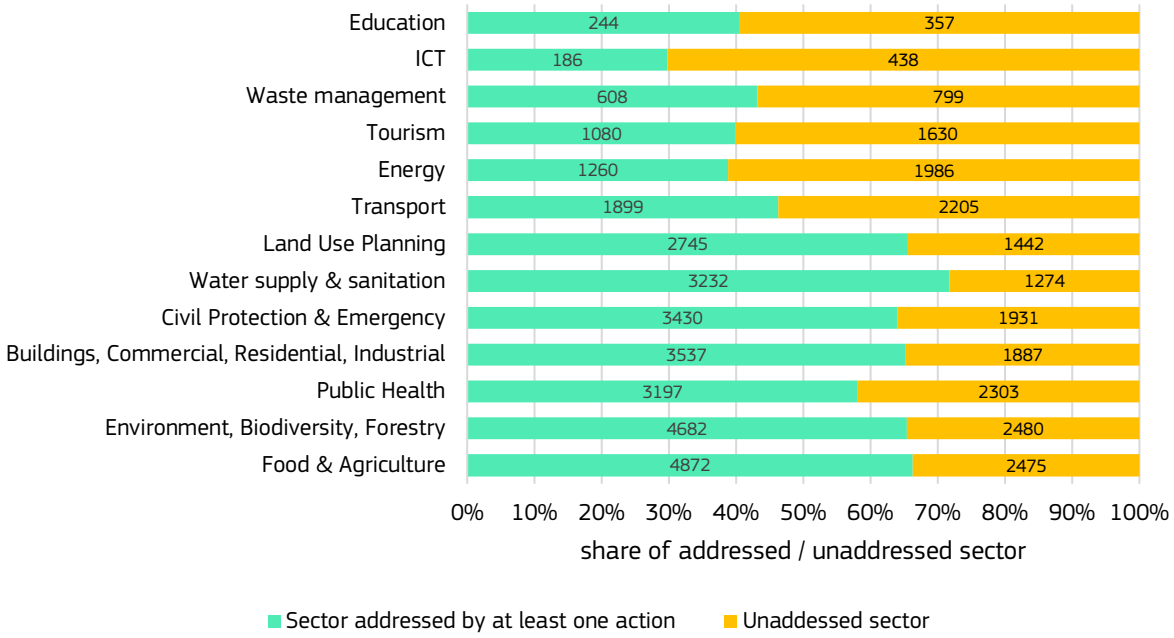
— Overall, among all the vulnerable sectors reported in RVA by municipalities (51 756), 59 % (30 972) are already addressed by at least one adaptation action;

— 'Water supply & sanitation' is the vulnerable sector from RVAs most frequently addressed by at least one adaptation action (72 %);

— 'ICT' is the least addressed (30 %).

Despite the fact 'buildings' is not among the top three vulnerable sectors, when reported as vulnerable, it is mostly addressed by at least one action. This is probably linked to the fact that acting on 'buildings' is in the remit of most municipalities of the GCoM (i.e. promoting sustainable building codes, resilient retrofitting of public owned buildings, etc.).

Figure 53. Share of sectors reported as vulnerable/impacted in RVA also reported in at least a matching action.



In green: number of reported vulnerable sectors covered in action plans.
In orange: number of reported vulnerable sectors not yet addressed in submitted action plans. Sectors are ordered by the number of municipalities reporting them as vulnerable in their RVAs.

Source: JRC elaboration based on GCoM data

Considering the overall number of municipalities reporting vulnerable sectors (2 233):1 866 (84 % of 2 233) of municipalities' action plans that report at least a vulnerable sector in their RVA have also planned at least one matching action to address it.

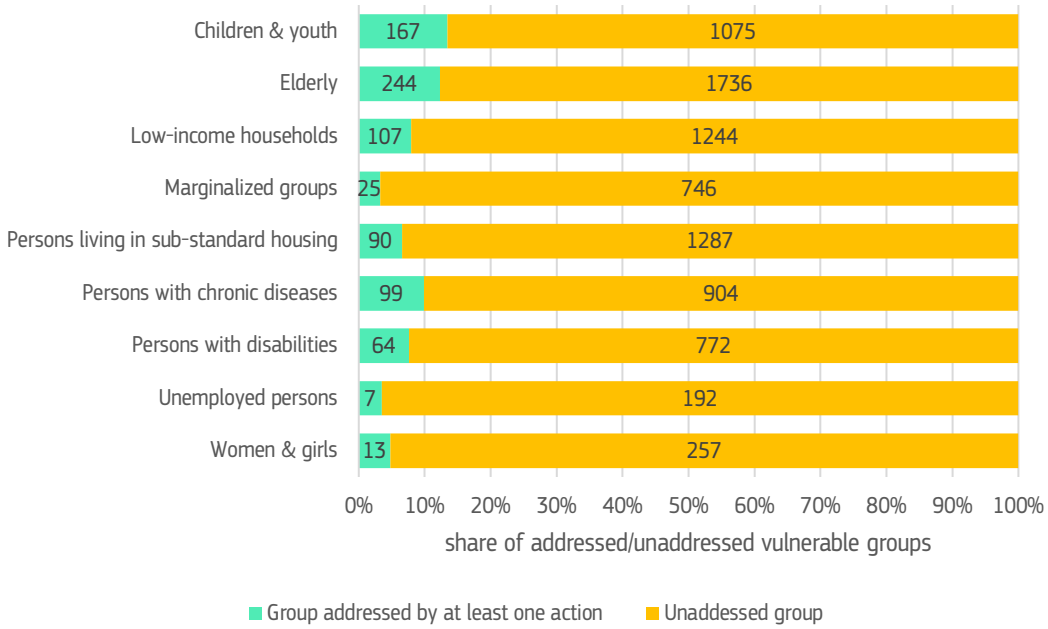
6.4.3. Vulnerable population groups in RVA and actions

Looking at the vulnerable groups reported in RVAs, it is possible to analyse how many of them are targeted by planned actions. **Figure 54** shows the share of vulnerable groups in the RVA also reported in at least one matching action: those that are covered in the action plan are shown in green, while those reported in RVA but not mentioned in the actions are in orange

- Overall, among all the vulnerable groups reported in RVA by municipalities (9 029), only 9 % of them (816) are addressed by at least one adaptation action [55];
- 'Children & youth' and 'elderly' show the highest shares, 13 % and 12 % respectively.
- 'marginalised groups' show the lowest share (3 %) of vulnerable groups covered by at least one adaptation action.

[55] Category 'all' is excluded from this analysis.

Figure 54. Share of population groups reported as vulnerable in RVA also reported in at least a matching action.



In green: number of reported vulnerable groups covered in action plans.
In orange: number of reported vulnerable groups not yet addressed in submitted action plans. Groups are ordered by the number of municipalities reporting them as vulnerable in their RVAs.

Source: JRC elaboration based on GCoM data

Considering the overall number of municipalities reporting vulnerable groups (1 096): 450 (41 %) of municipalities' action plans that report at least one vulnerable group are also reporting at least one matching action to address it.

Vulnerable population groups remain often unaddressed by adaptation actions, which is partly motivated by the fact that reporting on vulnerable population groups is not mandatory as per the CRF. From **Figure 54**, actions do not seem to prioritise some specific vulnerable population groups compared to others.

6.5. Monitoring

During the monitoring phase, municipalities can update all reported information, with particular emphasis on updates to the RVA, the implementation of actions, and the achievement of adaptation targets. This section focuses specifically on analysing the implementation of actions. RVA updates are infrequent within short time frames, and the dataset has limited monitoring reports available. Additionally, there is a scarcity of monitored adaptation goals. As noted in section 6.2 and per CRF guidelines, adaptation goals should be quantitatively defined to facilitate the monitoring and reporting progress towards targets. Future analyses could examine these quantitative goals and their associated monitoring data, once available, to assess progress over time and understand whether municipalities are on track to meet their adaptation targets.

Therefore, the focus has been shifted to the implementation status of adaptation actions [56], which shows that 40 % of adaptation actions are reported as 'ongoing' while 38 % are 'not started'. Only 12 % of the reported actions are reported as 'completed'.

[56] Data homogenisation was performed to reclassify the implementation status to the 4 categories: ongoing, completed, cancelled and not started.

7. Preliminary analysis on energy poverty

The GCoM third pillar refers to Energy access and energy poverty (EAPP), structured using three energy attributes, i.e., secure energy, sustainable energy, affordable energy (GCoM 2023). CoM EU signatories focus on energy affordability, specifically addressed through the lens of energy poverty. Municipalities start their journey to tackle energy poverty by developing an energy poverty assessment. The energy poverty assessment let municipalities understand the status of energy poverty within the local context, including its extent, underlying causes, and contributing factors, to inform effective action planning (Pittalis et al. 2025a). To reflect the multidimensional aspects of energy poverty, the assessment is structured across six macro-areas and 56 indicators are at disposal of municipalities to describe their status of energy poverty (EP). The six macro-areas are:

- Climate.
- Facilities and housing.
- Mobility.
- Socio-economic.
- Policy and regulatory framework.
- Participation and awareness raising.

The indicators aim at supporting municipalities to identify, measure and monitor as many aspects as possible to understand the energy poverty conditions across households and territories and to identify areas of intervention and prioritise them.

Municipalities can get support in the assessment of energy poverty by the Energy Poverty Advisory Hub (EPAH), the leading Commission's initiative to tackle energy poverty in the EU. Reporting on energy poverty has become mandatory as of January 2025, therefore, the data analysed and reported in this section are to be considered as preliminary for two reasons. Firstly, as shown in the following sections, few signatories started working on energy poverty and, most importantly for the scope of this work, reported complete data. As shown in the next paragraphs, however, numerous municipalities have already developed integrated actions considering energy poverty when dealing with either mitigation or adaptation, which shows commitment and interest in this aspect. Secondly, given the timeline described above and the limited data availability, the reported data has not yet undergone any cleansing procedure by the JRC.

7.1. Methodological notes

CoM signatories can report on energy poverty action through the MyCovenant either in their action plan templates, or their monitoring report templates[57]. Given no cleansing procedures were performed, the analysis of the actions (section 7.3) focused only on actions reported through the action plan template, to avoid any risk of duplication and incorrect categorisation. While reporting on the energy poverty pillar became mandatory in 2025, energy poverty actions could be reported in combination with mitigation or adaptation actions for many years. Therefore, many analysed

[57] MyCovenant includes "Reporting templates" to report data. These refer to the action plan and to the monitoring phases.

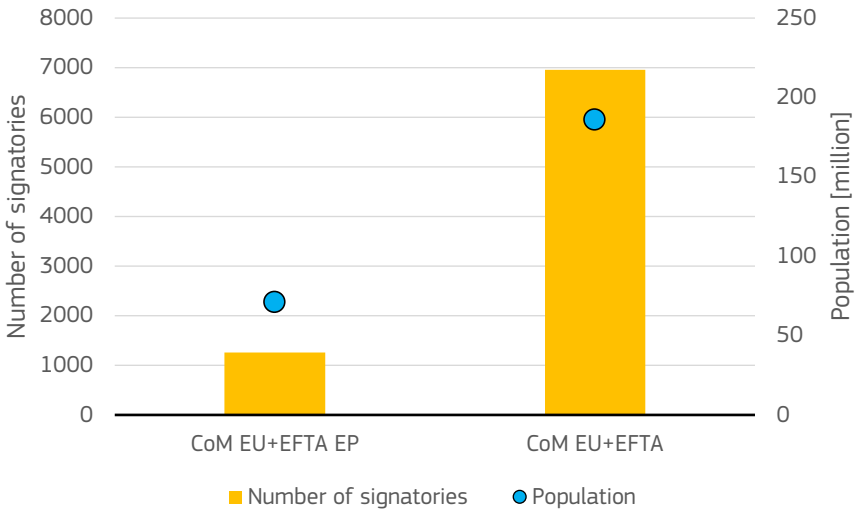
energy poverty actions had been reported through time as integrated to mitigation and adaptation actions. Notably, this is reflected in the adoption rate, as for this figure, it is considered that a signatory reported its action plan once one action is reported.

7.2. Key indicators selected for the assessment

By the end of 2024, 1 257 municipalities have reported at least one of the three energy poverty reporting steps, i.e., the energy poverty goal, the energy poverty assessment and energy poverty actions, covering approximately 71 million people. Of these, 53 are CNC cities, which account for a total population of around 29 million people.

When looking at the overall EU-27 + EFTA numbers of signatories, there were 6 957 municipalities having reported at least in one step in mitigation, adaptation or energy poverty, accounting approximately for 186 million people. This means an energy poverty adoption rate of around 18 % regarding the number of signatories, and a coverage rate of around 38 % in terms of EU-27 + EFTA population reached (**Figure 55**).

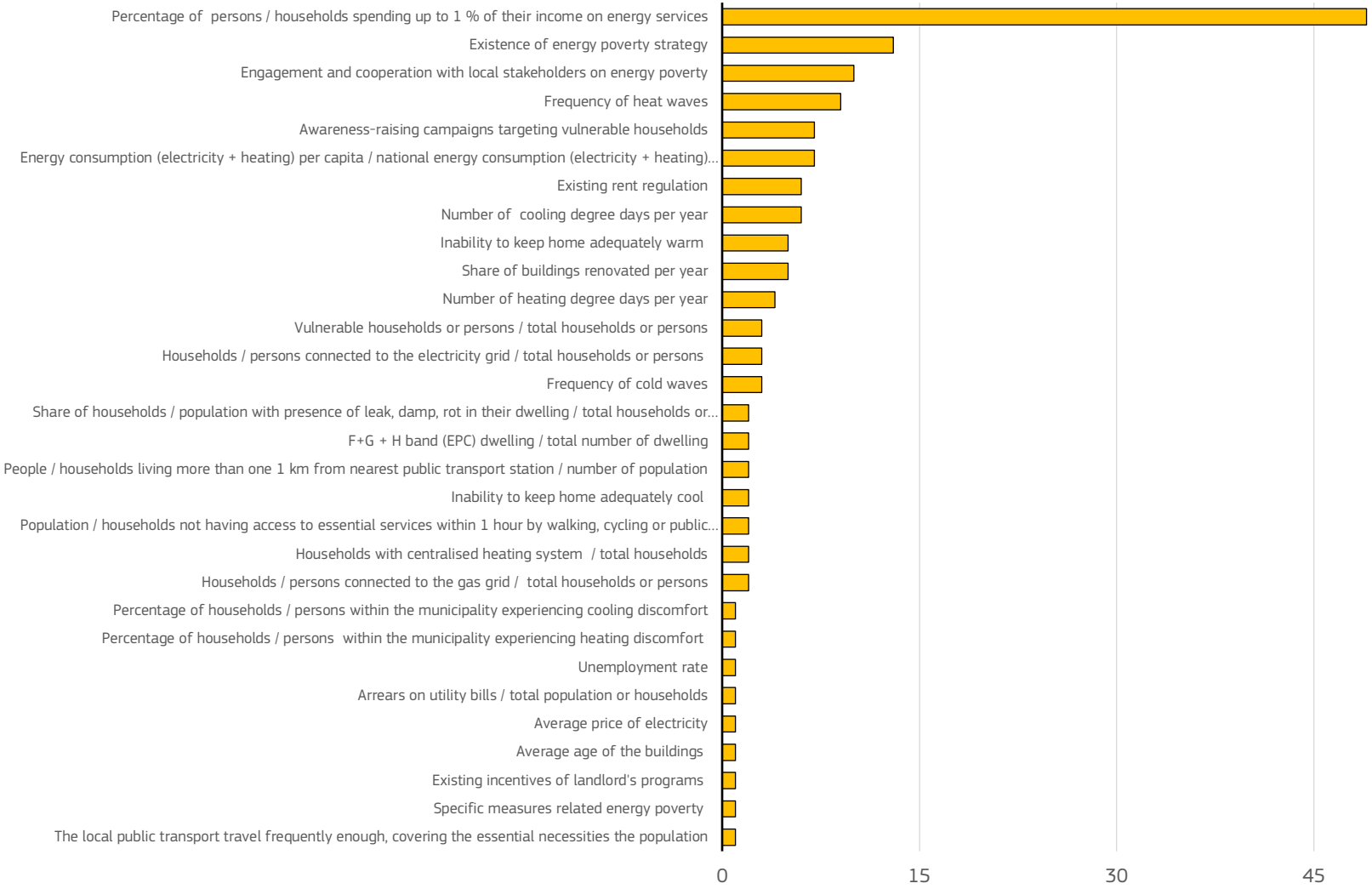
Figure 55. Population and number of municipalities having undertaken at least one energy poverty reporting step.



Source: JRC elaboration based on GCoM data

Within the group of 1 257 municipalities having reported against at least of energy poverty step, 56 signatories had a completed action plan, and 52 reported information for the energy poverty assessment. This last group of 52 signatories used the large set of indicators available to carry out the assessment. In fact, from the overall 56 energy poverty indicators available, 30 indicators were used by the municipalities. The level of usage of each indicator varied substantially as some were used more frequently than others. For example, the indicator considered as minimum requirement to carry out the energy poverty assessment "Percentage of persons / households spending up to X % of their income on energy services" was used by 49 municipalities, the indicator "Existence of energy poverty strategy" was used by 13 municipalities, and a range of 16 indicators was used by only one or two municipalities. Overall, 153 data points were reported, indicating that on average municipalities used around three indicators each to provide information on their energy poverty conditions (**Figure 56**).

Figure 56. Number of municipalities using energy poverty indicators.



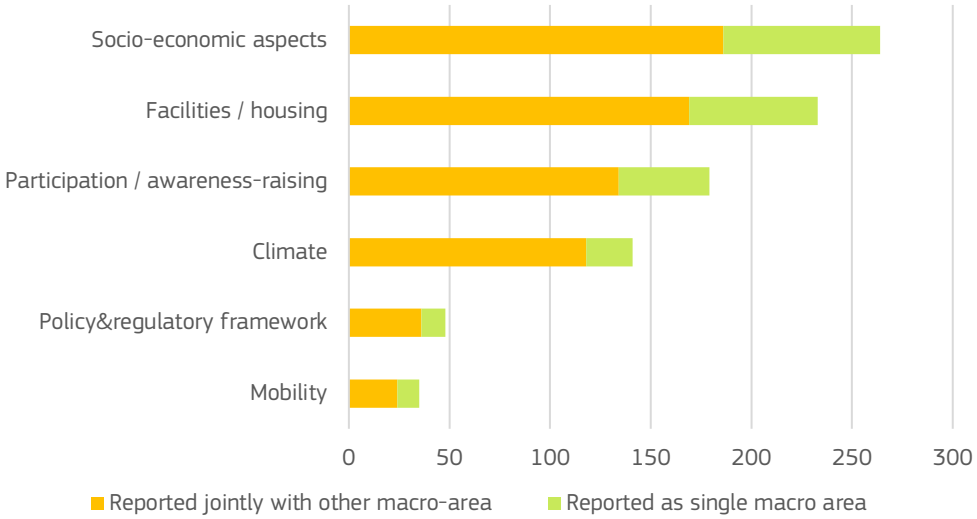
Source: JRC elaboration based on GCoM data via MyCovenant platform

7.3. Energy poverty actions

This report analyses data since 2023, year when the reporting on energy poverty became available (voluntarily). Signatories can report actions targeting only energy poverty, but can also choose to report integrated actions having synergies with the other two pillars. When reporting energy poverty actions, signatories are required to report also the targeted macro-areas by the actions.

A total of 1 908 energy poverty actions targeting energy poverty were reported within signatories' action plans in the MyCovenant platform. This amount includes actions focusing only on energy poverty (123) and actions already reported as integrated with mitigation and adaptation before the energy poverty pillar was formally introduced. See section 8 for further details on integrated actions. When reporting energy poverty actions, municipalities indicate the macro-areas the action pertains to (at least one). At the cutoff date of this report, 500 energy poverty actions indicated at least a macro-area The 'socio-economic aspects' (29 %), followed by 'facilities/housing' (26 %) are those most frequently targeted by the actions. Most of the actions target more than one macro-area (54 %). In particular, 81 % of actions targeting 'climate' macro area also focus on other macro-areas (**Figure 57**).

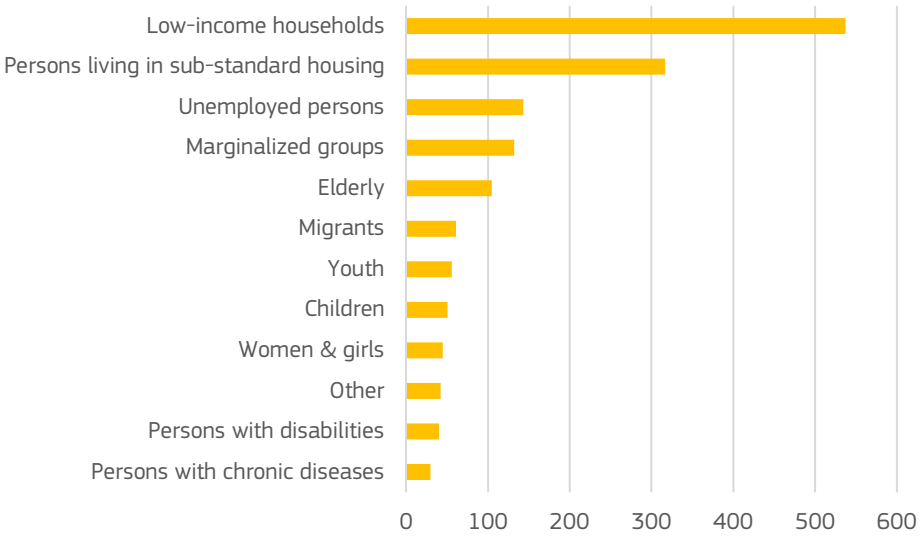
Figure 57. Actions on energy poverty pillar – targeted macro-areas.



Source: JRC elaboration based on GCoM data reported via MyCovenant platform

Signatories may also choose to report on the vulnerable population targeted by their energy poverty actions. From 658 energy poverty actions that reported at least one vulnerable group, **Figure 58** shows that mostly, actions target low-income households (537 actions), followed by 'persons living in sub-standard housing' (317 actions). The underrepresented groups, with less than 10% of actions, are 'migrants', 'youth', 'children', 'women & girls', 'other', 'persons with disabilities' and 'persons with chronic diseases'.

Figure 58. Actions on energy poverty pillar – targeted vulnerable population groups.



Source: JRC elaboration based on GCoM data reported via MyCovenant platform

8. Cross-pillar actions

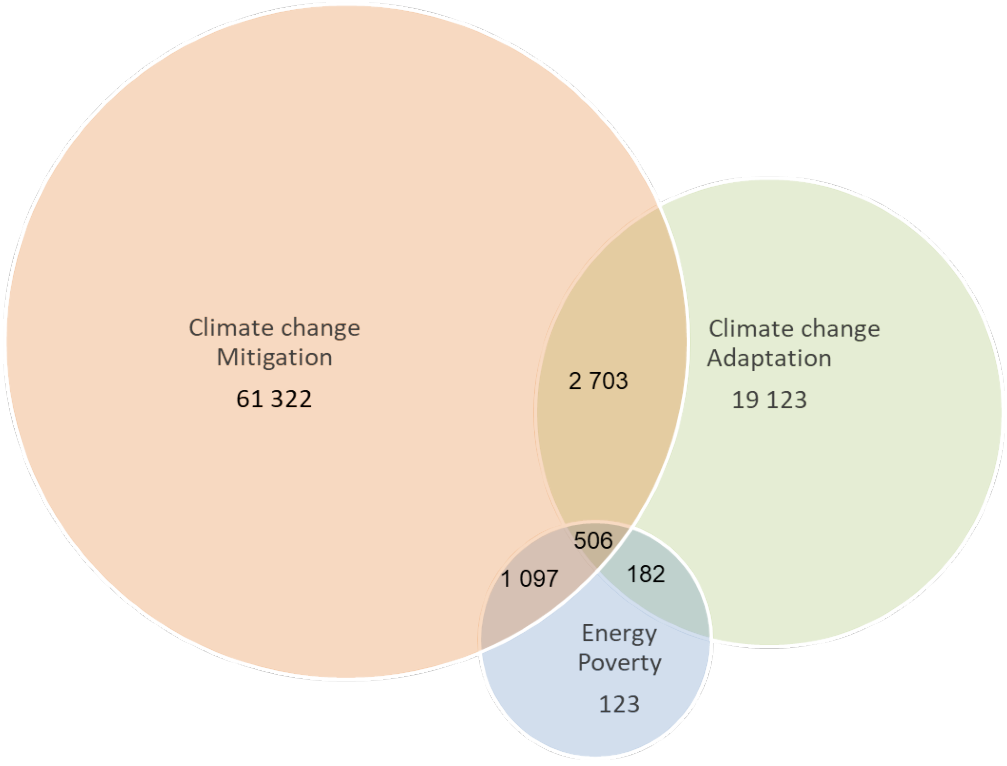
Actions reported by municipalities in MyCovenant, within the GCoM initiative, can be linked to one or more pillars among 'mitigation', 'adaptation', and 'energy poverty/access'. From the actions reported by signatories committing in 2030 and 2050, integrated actions (covering all three pillars) are still not frequently reported (less than 1 %) (**Figure 59**).

Mitigations actions (65 628) are those that are more frequently reported only in one pillar, with 93 % of actions only for mitigation, 4 % reported as both mitigation and adaptation actions and 2 % marked as both mitigation and energy poverty actions.

Of the actions reported as adaptation (22 514), 85 % are reported only for adaptation and 12 % as both mitigation and adaptation actions. Only 0.8 % of adaptation actions are reported as both energy poverty and adaptation.

For the energy poverty actions (1 908), the preliminary analysis shows a different trend: most of the actions reported (94 %) are integrated with at least one other pillar. This might be due to the recent inclusion of this pillar in the reporting requirements and to the fact that municipalities have initially tackled energy poverty in synergy with mitigation or adaptation. Yet, the high presence of integrated actions shows that actions on energy poverty may be already in place by many signatories, even if not specifically designed for or reported under this pillar.

Figure 59. Actions' distribution among the three GCoM pillars.



Source: JRC elaboration based on GCoM data reported via MyCovenant platform

9. Conclusions

As climate change continues to pose significant threats to urban and rural communities alike, local climate action to reach net-zero emissions by 2050 and robust strategies to enhance adaptation and resilience become increasingly necessary. More than 10 800 municipalities in the EU-27 and EFTA countries are signatories to the Covenant of Mayors and committed to taking bold climate action. The Covenant of Mayors has been instrumental in supporting these municipalities and putting at their disposal approaches and methodological frameworks for developing sound and scientifically based climate plans at the local level. These can complement action and programmes occurring at other levels of governance, including countries' National Energy and Climate Plans (NECPs), thereby contributing to the 2050 EU climate neutrality target and to climate objectives at international level. A common but flexible approach to reporting local data allows assessing local efforts in a consistent manner and evaluating the collective level of ambition and achievements of signatories of different sizes, geographies and backgrounds.

This report is based on data collected through MyCovenant and CDP-ICLEI Track until January 2025 and December 2024 respectively, for Europe EU-27 and EFTA countries. It provides a detailed analysis of the current landscape of climate change mitigation and adaptation efforts put in place by thousands of CoM municipalities as well as preliminary analysis on energy poverty.

9.1. Main findings

The initiative counts on 10 825 committed municipalities in EU-27 and EFTA countries, covering a total population of 247.7 million inhabitants.

Box 2. Signatories and commitments

While this report focuses on municipalities from EU-27 and EFTA, for completeness an overview of signatories from the other regions has been presented. Most of the signatories (10 787 covering 244.1 million inhabitants) come from the EU-27, followed by the Eastern Partnership countries (540 signatories, 31.48 million inhabitants) and by Western Balkans and Türkiye (196 signatories, 56.3 million inhabitants). MyCovenant platform is mostly used by signatories from Europe or from countries where the EU has been supporting the initiative since 2011.

Many of the signatories in the EU-27 and EFTA (almost 51.8 %, covering 31.1 % of the population) remain committed only to the 2020 mitigation targets, while 47.6 % (representing about 65 % of the CoM population) are committed to a climate change mitigation target by 2030 and/or by 2050 combined with climate change adaptation goal. The remaining less than 1 % has a commitment to adaptation only or adaptation combined with a 2020 mitigation target.

The collective achievements of EU-27 + EFTA municipalities were analysed based on a subset of 7 000 signatories having submitted at least one action plan was defined, covering almost 144.6 million inhabitants.

Box 3. Action plans and commitments

Looking at the action plans by pillar, 66.5 % of signatories with action plans address the mitigation pillar alone and 33.3 % address simultaneously climate change mitigation and adaptation. This also reflects the fact that adaptation pillar was introduced more recently in the initiative compared to mitigation.

66 % of the mitigation plans have a commitment, 29 % of the mitigation plans (covering 34 % of the CoM population) have a 2030 target, either combined with a 2020 target or not; 5 % of the plans (covering 8 % of the CoM population) have a plan consistent with the CoM 2050 commitment, i.e. with a climate neutrality target to 2050, showing a great increase compared to previous figures for 2023 (i.e., 0.5 % of the plans, 1 % of the CoM population).

In terms of reporting on the action plan's implementation, 2 997 signatories, covering 77.1 million inhabitants, have submitted at least one monitoring report. Out of these, 1 508 (covering nearly 49.8 million inhabitants) submitted a monitoring report flagged as "complete", i.e., including at least one monitoring emission inventory.

Signatories have made a commitment beyond the minimum 40 % target originally set for EU signatories, and based on their targets, are close to collectively meet the EU level 55 % reduction target by 2030 and are aligned with the EU ambition for climate neutrality in 2050. The 2030 forecasts based on implementation reports however identify a delivery gap of 9 percentage points compared to targeted emissions in 2030 Box 4.

Box 4. Climate mitigation: baseline emissions, overall ambition by 2030 and achievements

Based on the targets and on the results of baseline emissions inventories reported by 2 339 municipalities with data considered valid according to the procedure described in Section 0, the overall committed GHG emissions reduction by 2030 is 51 % and by 2050 is 91 % (compared to a baseline level of 347 Mt CO_2-eq).

Direct (Scope 1) emissions represent 62 % of the total GHG emissions, followed by 37 % indirect (Scope 2) emissions, associated with the consumption of grid-supplied energy. Scope 3 emissions represent only 1 % of the total GHG emissions.

Looking at 1 134 signatories in EU-27 with a valid target for 2030, with a BEI and at least one MEI, a 48.5 % reduction by 2030 is forecasted, while the targeted mean reduction is 57 %. This insight suggests that greater effort is necessary for signatories to advance in the implementation of their action plans and achieve the emission reduction targets they have set.

Almost 66 000 climate change mitigation actions were reported by signatories through both platforms and over 62 000 through MyCovenant only, corresponding to an average of 27 mitigation actions/measures per action plan with a time horizon to 2030 and 2050.

Box 5. Climate mitigation actions and measures

As regards EU-27 signatories, most of the actions target the building sector (55 %), followed by the transport sector (20 %) and the waste & other sector (12 %). The buildings sector is the main contributor (34 %) followed by transport (29 %). Electricity production has also a significant share, with 22 % of total planned emission reduction associated with this sector, although it only represents 8 % of the actions reported. In the stationary energy sector, most of the actions for which an area of intervention is indicated, targets energy efficiency in the appliances. Almost one fourth of the expected emission reduction from actions in the stationary energy are "integrated action", meaning that they target in a holistic way the building system. Triggering behavioural changes is also a prominent area of intervention and a significant

share of actions concern information and communication technologies (ICT). In terms of policy instruments, energy management is associated with 31 % of reported actions, mainly addressing municipal buildings. The second preferred instrument is awareness-raising and training, targeting in particular the residential sector (22 %). Grants and subsidies are also a quite common instrument, followed by public procurement, energy certification/labelling and building standards.

In the transport sector, the large majority of the actions (51.6 %) concerns cleaner/efficient vehicles, showing that local authorities rely to a great extent on the gradual improvement of the fleet of vehicles, which are bound by European standards, and might also depend on national incentives and economic performance; local authorities then try to promote electric vehicles and to encourage a shift towards active mobility or towards public transport and to promote eco-driving. As to the policy instruments adopted in the transport sector, preference seems to be given to awareness-raising and training (19 %), followed by mobility planning regulation (18 %), by public procurement (to renew municipal fleet and vehicles used in public transport) (11 %) and then by grants and subsidies (which may include tax reduction or subsidies for more efficient vehicles or incentives for the purchase of electric bikes).

Being a challenging component of the climate adaptation journey of CoM municipalities, the definition of adaptation goals is present in 64 % of signatories. However, the 1 580 municipalities having identified goals, have reported on average 2.8 goals each, and almost 86 % of the reported goals have quantitative or numerical targets. Most frequently, the goals aim at addressing "Extreme heat', 'Droughts & water scarcity' and 'Floods & sea level rise. The primary objectives are centred around enhancing resilience in water management and sanitation, including water supply and conservation, stormwater management, and wastewater management. Additionally, there is a strong emphasis on urban greening and nature-based solutions (NBS).

The definition of climate risks and vulnerabilities (RVA) has reached a fairly developed phase with more than 18 044 climate hazards reported with a good level of information, and 5 789 (32 %) specifying a level 2 sub-hazard definition in the analysed 2 444 RVAs. Despite it being optional information in the reporting requirements, signatories reported vulnerable population groups exposed to climate hazards in 1 096 RVAs. This shows that information on social vulnerabilities is considered essential in developing complete RVAs that can inform policy actions.

Box 6. Overall reported climate risks and vulnerabilities

Based on the data analysed, the most frequently reported climate hazards in municipalities' RVAs are extreme heat (15.5 %), heavy precipitation (15 %), droughts & water scarcity (14.7 %), and floods & sea level rise (13.8 %). In addition, 91 % of municipalities have included 'extreme heat' in their RVAs, 87 % 'heavy precipitations' and 86 % 'drought and water scarcity'. Overall, nearly half of the municipalities with an RVA (49 %) have identified at least one high-risk hazard, defined as climate hazards with both high probability and high magnitude/impact. Most recurrent high risk climate hazards are 'extreme heat' 'heavy precipitations' and 'drought and water scarcity'.

The most reported vulnerable sectors are: 'food & agriculture' and 'environment & biodiversity' reported as most vulnerable to 'droughts & water scarcity' and 'extreme heat', 'public health' reported as most vulnerable to 'extreme heat', 'civil protection & emergency' reported as most vulnerable to 'floods & sea level rise' and 'heavy precipitation', 'building' sector reported as most vulnerable to 'floods & sea level rise and 'heavy precipitation.

The most reported vulnerable population groups are: 'elderly', reported as most vulnerable to 'extreme heat'; 'low-income households' reported as most vulnerable to 'floods & sea level rise'; 'persons living in sub-standard housing' reported as most vulnerable to 'heavy precipitation'.

Data shows potential incoherencies or 'gaps' among the hazards reported in the RVAs and the hazards most addressed by actions. At the same time, the most reported vulnerable sectors are not the most targeted sectors by actions. However, the gap can be also linked to difficulties by signatories in developing actions in sectors in which they have limited jurisdictional competence or financial capacity.

Box 7. Adaptation actions

The most frequently addressed hazards are 'extreme heat', 'droughts & water scarcity', 'heavy precipitation', and 'floods & sea level rise'.

The most targeted sectors are: 'water supply & sanitation', 'environment, biodiversity, forestry', and 'buildings, commercial, residential, industrial'.

The most targeted population groups are: 'children & youth', 'elderly', and 'other'.

Considering the overall number of signatories reporting high-risk hazards in their RVAs (2 287), 65 % of them (1 894) are already addressed by at least one adaptation action. Among all the vulnerable sectors reported in RVA by municipalities (51 756), 59 % of them (30 972) are already addressed by at least one adaptation action.

Looking more closely at the vulnerabilities identified in RVA and targeted in the actions, it is observed that:

— While 'environment, biodiversity, forestry' is the most reported vulnerable sectors in RVAs, it is not the most addressed sectors in the action plans, where 'water supply & sanitation' is prioritised. 'Public health', second most reported vulnerable sector in RVA is not a top sector addressed in actions.

— 'Buildings, commercial, residential, industrial' and 'food & agriculture' are both a top vulnerable sector and addressed sector in RVAs.

— While 'persons living in sub-standard housing' is among the most reported vulnerable groups in RVAs, it is not among the top groups addressed in the action plans, where the focus is more on 'children & youth'.

However, among all the vulnerable groups reported in RVA by municipalities (9 029), only 9 % of them (816) are addressed by at least one adaptation action.

Despite its early stage, energy poverty has seen a growing trend with municipalities that started including this pillar in different phases of their climate action journey (18 % of adoption rate). The majority of municipalities have integrated energy poverty in their actions targeting also other pillars (94 %). This shows a deep holistic approach in climate action by Covenant municipalities which have already started reflecting on and tacking actions to alleviate energy poverty even before the pillar became officially required (Palermo and Pappalardo 2022). Further, future analysis will delve deeper into this aspect as well as into the energy poverty assessment.

9.2. Concluding remarks

The Covenant of Mayors has been instrumental in creating a community of almost 11 800 municipalities in Europe and beyond, committed to fighting climate change. Over time, it has positioned itself as a key initiative, in Europe and globally, supporting local climate action through guidance, technical assistance, sharing of best practices and peer learning opportunities. At the same time, it has helped consolidate practices to monitor and report on energy consumption and GHG emissions as well as risks and vulnerabilities at the local level, allowing decision-makers to identify priority sectors, set emission reduction targets and adaptation goals and plan relevant

measures. The recent inclusion of the energy poverty pillar, with its harmonised reporting framework and methodological guidance, is expected to further consolidate local efforts in the climate challenge. All these are considered key strengths of the initiative where the JRC has played a major role in continuously maintaining and fortifying its technical bases.

While many CoM signatories are still committed to a 2020 climate change mitigation target, not including adaptation and energy poverty, the number of signatories with a 2030 target and those that have recently stepped up their commitment with a 2050 target have significantly increased.

EU-27 signatories with a 2030 climate change mitigation plan have an overall commitment of 51 % emission reduction by 2030, close to the EU 2030 climate target. A subset of 103 SECAPs shows a targeted emissions reduction of 91 % by 2050, in alignment with the EU climate neutrality target. The forecasts for 2030, based on monitoring emission inventories submitted so far by 1 134 signatories, however, indicate a delivery gap of 9 percentage points in comparison to the overall targeted reduction.

On adaptation, the analysis reveals that while substantial progress has been made in identifying climate hazards and vulnerable sectors, there remains a critical need for more comprehensive and targeted adaptation actions. While committed signatories and climate change adaptation action plans are less numerous than for climate change mitigation, figures are steadily growing.

The better alignment of risk and vulnerability assessments with the plans' adaptation actions is essential to effectively mitigate high-risk climate hazards and protect vulnerable populations. Furthermore, regional disparities in adaptation efforts underscore the importance of tailored strategies that address specific local challenges.

The energy poverty pillar of the CoM is still in its preliminary phase; however, CoM municipalities demonstrate growing interest in addressing this aspect, despite the reporting being still voluntary within the timeframe of the data analysed in this report.

This report provides a basis for policymaking and informs future reflections, building on the initiative's core strengths to deliver more tangible results on the ground. While work is already underway to provide guidance to signatories and improve reporting platforms for easy high-quality reporting, municipalities are still in need of support to strengthen their mitigation actions to reach the GHG emission targets, to improve their climate adaptation strategies and to adopt integrated planning approaches. It is also essential to bridge the adaptation gap by enhancing municipal capacity for comprehensive risk assessments and fostering the exchange of regional best practices to build community resilience. Improving the collection of high-quality information and harmonizing data reporting will provide a better understanding of the issues municipalities face. Gaining a clearer picture of these challenges will allow for more targeted and effective support, fully tapping into the potential of municipalities to address the climate challenge.

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List of abbreviations and definitions

Abbreviations	Definitions
BEI	Baseline Emission Inventory
CAP	Climate Action Plan
CDP	Carbon Disclosure Project
CoM EU	Covenant of Mayors for Climate and Energy
CoM-East	Covenant of Mayors East (Eastern Partnership countries)
CoM-South	Covenant of Mayors South (Southern Mediterranean Partner countries)
CoM-SSA	Covenant of Mayors in Sub-Saharan Africa
CRF	Common Reporting Framework
DG ENER	European Commission's Directorate-General for Energy
DG CLIMA	European Commission's Directorate-General for Climate Action
EC	European Commission
EEA	European Environment Agency
EFFIS	European Forest Fires Information System
EFTA	European Free Trade Association
EI	Emission Inventory
EPAH	Energy Poverty Advisory Hub
EU	European Union
EU-27	European Union with 27 Member States
GCoM	Global Covenant of Mayors for Climate and Energy
GHG	Greenhouse gas
GWP	Global Warming Potential
ICLEI	International Council for Local Environmental Initiatives
ICT	Information and Communication Technologies
IPCC	Intergovernmental Panel on Climate Change
JRC	Joint Research Centre
MEI	Monitoring Emission Inventory
NbS	Natural Based Solutions
NUTS	Nomenclature of Territorial Units for Statistics
NUTS2	Level 2 regions based on the Nomenclature of Territorial Units for Statistics
NUTS3	Level 3 regions based on the Nomenclature of Territorial Units for Statistics
RVA	Risk and Vulnerability Assessment
SECAP	Sustainable Energy and Climate Action Plan

TWG	Technical Working Group
UHI	Urban Heat Island
UNFCCC	United Nations Framework Convention on Climate Change
VPG	Vulnerable Population Group

List of boxes

Box 1. Covenant of Mayors: from pledges to actions 10

Box 2. Signatories and commitments 98

Box 3. Action plans and commitments 99

Box 4. Climate mitigation: baseline emissions, overall ambition by 2030 and achievements 99

Box 5. Climate mitigation actions and measures 99

Box 6. Overall reported climate risks and vulnerabilities 100

Box 7. Adaptation actions 101

List of figures

Figure 1. Structure of the report 12

Figure 2. Signatories from EU-27 and EFTA countries, by population range (a) and share of signatories by population range per Member State and EFTA countries (b). 19

Figure 3. Share of country population covered by the CoM, for EU-27 and EFTA 20

Figure 4. Number of signatories and population covered by commitment (EU-27+EFTA). 22

Figure 5. Number of signatories and population covered by commitment (EU-27 only). 22

Figure 6. Overview of signatories with a submitted action plan according to the pillar covered 24

Figure 7. Overview of signatories with a submitted action plan covering only mitigation until 2020 (a) or both mitigation until 2030 or 2050 and adaptation (b). 25

Figure 8. Signatories with action plans and population covered as a function of the pillar addressed (EU-27 and EFTA). 26

Figure 9. Number of signatories and population covered as a function of the commitment of their action plans (EU-27 and EFTA). 27

Figure 10. Overview of signatories with at least one submitted monitoring report, either qualitative (a) or quantitative, with MEI (b). 30

Figure 11. Number of action plans with a 2030 time horizon and population coverage as a function of the level of ambition of the GHG emission reduction target declared by signatories in the EU-27 (n. 2 325) and EFTA (n. 9) 33

Figure 12. Number of action plans with a 2050 time horizon and population coverage as a function of the level of ambition of the GHG emission reduction target declared by signatories in the EU-27 (n. 100) and EFTA (n. 3). 34

Figure 13. Frequency of BEIs for the different base years regarding 2030 time horizon in EU-27, along with the population (in millions) and emissions per capita (t CO_2-eq) for every year. 36

Figure 14. Frequency of BEIs for the different base years regarding 2050 time horizon in EU-27, along with the population (in millions) and emissions per capita (t CO_2-eq) for every year. 37

Figure 15. GHG emissions by sector in the municipalities' latest EIs for SECAPs in EU-27 (a) and in EFTA (b) 39

Figure 16. GHG emissions by scopes in the municipalities' latest EIs for SECAPs in EU-27 and in EFTA 39

Figure 17. GHG emissions by sector in the municipalities' latest EIs for SECAPs in EU-27 (a) and in EFTA (b) 40

Figure 18. GHG emissions by energy carrier in the municipalities' latest EIs for SECAPs in EU-27 (a) and EFTA (b) 41

Figure 19. Number of years elapsed between the SECAP and the signatories' first monitoring report, light (a) and complete (b), and between the BEI and the first MEI (c) 42

Figure 20. Frequency of MEIs. 42

Figure 21. Frequency of MEIs for the different years in EU-27, along with the population (in millions) and emissions per capita (t CO_2-eq) for every year 43

Figure 22. Aggregate GHG emission forecasts and committed targets 44

Figure 23. Share of actions per sector and contribution to GHG emission reduction in SECAPs from the EU-27. 45

Figure 24. Stationary energy sector – Number of actions by area of intervention (a) and share of actions and contribution to GHG emission reduction (b) in SECAPs from the EU-27. 46

Figure 25. Transport sector – Number of actions by area of intervention (a) and share of actions and contribution to GHG emission reduction (b) in SECAPs from the EU-27 47

Figure 26. Energy production sector – number of actions/measures by area of intervention (a) and share of actions and contribution to GHG emission reduction (b) in SECAPs from the EU-27 . 48

Figure 27. Waste and others sector – number of actions by area of intervention (a) and share of actions and contribution to GHG emission reduction (b) in SECAPs from the EU-27. 49

Figure 28. Stationary sector – number of actions per policy instrument. 50

Figure 29. Transport sector – number of actions per policy instrument. 51

Figure 30. Energy production sector – number of actions per policy instrument. 52

Figure 31. Waste and others sector – number of actions per policy instrument. 52

Figure 32. Share of actions/measure by origin. 53

Figure 33. Share of actions according to KTM. 54

Figure 34. Actions reported by sector, according to their main key type of measures. 54

Figure 35. Number of GCoM municipalities reporting information per reporting platform. 56

Figure 36. Most reported L1 climate hazards (inner circle) and L2 sub-hazards (outer circle) . 63

Figure 37. Most reported climate hazards in RVAs after addressing duplication. 64

Figure 38. Probability of occurrence of the climate hazard in the present 66

Figure 39. Impact/consequence of the climate hazard in the present . 67

Figure 40. Future expected change in hazard frequency. 68

Figure 41. Future expected change in hazard intensity. 68

Figure 42. Timeframe of reported climate hazards . 69

Figure 43. Climate hazards and their attributes 70

Figure 44. Most reported vulnerable sectors. 72

Figure 45. Vulnerable sectors and climate hazards. 74

Figure 46. Share of most reported vulnerable population groups. 76

Figure 47. Vulnerable population groups and climate hazards. 77

Figure 48. Climate change adaptation actions by reported year 80

Figure 49. Adaptation actions and most frequently addressed climate hazards. 81

Figure 50. Adaptation actions and most targeted vulnerable sectors. 83

Figure 51. Climate change adaptation actions and most targeted vulnerable population groups. 84

Figure 52. Share of 'high-risk' (HR) hazard reported in RVA also reported with at least one matching action. 88

Figure 53. Share of sectors reported as vulnerable/impacted in RVA also reported in at least a matching action. 89

Figure 54. Share of population groups reported as vulnerable in RVA also reported in at least a matching action. 90

Figure 55. Population and number of municipalities having undertaken at least one energy poverty reporting step. 93

Figure 56. Number of municipalities using energy poverty indicators. 94

Figure 57. Actions on energy poverty pillar – targeted macro-areas. 95

Figure 58. Actions on energy poverty pillar – targeted vulnerable population groups. 96

Figure 59. Actions' distribution among the three GCoM pillars. 97

Figure 60. Statistical methodology for the estimation of the cities' emissions. 133

List of tables

Table 1. Overview of signatories and expected action plans. 17

Table 2. CoM signatories by region and by commitment 21

Table 3. Population covered by region and by commitment 21

Table 4. Number of signatories with a submitted action plan per pillar 23

Table 5. Number of inhabitants of signatories with a submitted action plan per pillar. 23

Table 6. Number of submitted action plans for each commitment. 23

Table 7. Number of signatories with at least one submitted monitoring report 29

Table 8. Number of inhabitants in cities with submitted monitoring reports 29

Table 9. Baseline GHG emissions in t CO_2-eq projected to 2005 based on signatories' submitted action plans. 34

Table 10. Overall emission reduction by 2030, based on submitted action plans. 35

Table 11. Overall emission reduction by 2050, based on submitted action plans. 35

Table 12. Aggregated GHG emissions in the municipalities' latest EIs related to 2030 and 2050 time horizons commitments, by sector and scope – EU-27 (in t CO_2-eq/year). 38

Table 13. Aggregated GHG emissions in the municipalities' latest EIs related to 2030 and 2050 time horizons commitments, by sector and scope – EFTA (in t CO_2-eq/year). 38

Table 14. GCoM municipalities and adaptation action plans by region. 57

Table 15. Summary table with the number of attributes examined in each section. 59

Table 16. Climate hazards reported: L1 hazards and L2 sub-hazards. 60

Table 17. Climate hazards reported in municipal RVAs, with alternative approach. 65

Table 18. High-risk climate hazards reported in municipal RVAs. 71

Table 19. Sectors reported as vulnerable/impacted in municipalities' RVAs. 75

Table 20. Population groups reported as vulnerable/impacted in municipalities' RVAs. 78

Table 21. Climate hazards addressed across municipal action plans. 82

Table 22. Vulnerable sectors addressed across municipal action plans. 83

Table 23. Vulnerable population groups addressed across municipal action plans. 85

Table 24. Comparative analysis of hazards and vulnerabilities in RVA and actions. 86

Table 25. Number of signatories and population covered by country in the EU-27 and EFTA 117

Table 26. Signatories by country and commitment in the EU-27 and EFTA 118

Table 27. Population covered by country and commitment in the EU-27 and EFTA. 119

Table 28. Baseline emissions projected to 2005 based on signatories' submitted action plans per country. 120

Table 29. Overall emission reduction by 2030, based on submitted action plans per country in the EU-27 and EFTA. 121

Table 30. Overall emission reduction by 2050, based on submitted action plans per country in the EU-27 and EFTA. 122

Table 31. Description of the sectors and sub-sectors for GHG emission inventories in the CoM context 123

Table 32. Areas of intervention correlation MyCovenant reporting versus this report 135

Table 33. Policy instruments correlation MyCovenant reporting versus key type measures used in this report 136

Annexes

Annex 1. Signatories and population covered by country

Table 25. Number of signatories and population covered by country in the EU-27 and EFTA

Country	Number of signatories	Population covered by country
Andorra	1	24 000
Austria	29	2 382 626
Belgium	551	13 404 203
Bulgaria	49	3 492 036
Croatia	193	2 694 929
Cyprus	31	538 692
Czechia	270	3 346 132
Denmark	50	3 970 046
Estonia	8	604 173
Finland	17	2 473 329
France	188	30 929 581
Germany	90	21 040 332
Greece	234	9 543 434
Hungary	346	8 105 229
Iceland	2	138 010
Ireland	21	3 289 849
Italy	4 941	52 751 932
Latvia	24	1 258 863
Lithuania	16	1 446 214
Luxembourg	12	150 402
Malta	36	243 906
Netherlands	36	5 491 224
Norway	23	2 206 774
Poland	86	7 618 393
Portugal	188	8 483 361
Romania	189	11 212 419
Slovakia	40	1 097 636
Slovenia	71	1 224 153
Spain	3 001	42 321 013
Sweden	69	5 041 820
Switzerland	13	1 237 419
Total	**10 825**	**247 762 130**

Source: JRC elaboration based on GCoM data

Table 26. Signatories by country and commitment in the EU-27 and EFTA.

Country	CoM 2020	Mayors adapt	CoM 2030	CoM 2050
Andorra				1
Austria	27	1	4	2
Belgium	277	25	499	67
Bulgaria	43	2	3	6
Croatia	76	3	43	109
Cyprus	25		10	8
Czechia	13		85	195
Denmark	44	4	18	13
Estonia	7	1	2	
Finland	10		14	3
France	161	6	40	18
Germany	76	11	23	15
Greece	172	14	80	21
Hungary	60	2	177	136
Iceland	1		2	1
Ireland	12	1	11	3
Italy	4 337	68	1 207	322
Latvia	21	2	8	3
Lithuania	14		2	2
Luxembourg	11		1	1
Malta	36			
Netherlands	28	2	12	3
Norway	8		18	3
Poland	70	1	18	6
Portugal	138	15	56	38
Romania	144	2	48	22
Slovakia	13	2	27	2
Slovenia	36	2	26	16
Spain	1 820	22	1 360	628
Sweden	64	1	21	7
Switzerland	12		5	3
Total	**7 756**	**187**	**3 820**	**1 654**

Source: JRC elaboration based on GCoM data

Table 27. Population covered by country and commitment in the EU-27 and EFTA.

Country	CoM2020	Mayors Adapt	CoM 2030	CoM 2050
Andorra				24 000
Austria	2 164 976	1 914 743	2 034 620	224 294
Belgium	7 503 095	2 694 173	9 630 354	1 783 454
Bulgaria	3 140 774	261 288	1 506 564	321 889
Croatia	1 994 431	24 998	1 710 664	751 180
Cyprus	526 492	718 120	172 484	165 214
Czechia	1 651 905	445 000	2 280 638	2 417 576
Denmark	3 645 669		1 270 455	899 710
Estonia	594 573		454 600	
Finland	2 061 897		2 248 859	334 470
France	19 259 533	1 336 022	10 672 585	14 888 328
Germany	18 849 297	4 818 546	11 131 695	7 922 275
Greece	7 105 400	570 989	4 533 563	1 632 087
Hungary	3 050 886	64 078	6 568 633	1 414 117
Iceland	118 427		138 010	118 427
Ireland	1 807 452	332 015	2 315 718	458 395
Italy	44 267 321	2 947 305	23 830 680	10 755 696
Latvia	1 139 948	66 257	944 312	723 314
Lithuania	1 380 409		65 805	641 494
Luxembourg	128 302		22 100	22 100
Malta	243 906			
Netherlands	49 64 707	749 271	2 687 151	1 360 311
Norway	1 511 683		1 931 717	407 654
Poland	4 866 773	122 000	5 101 404	3 224 463
Portugal	6 469 455	913 342	4 644 358	2 886 631
Romania	8 703 543	4 387 173	1 262 447	69 041
Slovakia	579 215	512 313	475 755	46 9647
Slovenia	831 058	626 109	403 882	13v700
Spain	30 657 769	24 757 485	14 712 300	5 497 607
Sweden	4 910 869	3 138 347	2 099 802	124 935
Switzerland	1 107 404	1 055 663	734 288	
Total	**185 237 169**	**130 374 059**	**73 065 553**	**24 153 077**

Source: JRC elaboration based on GCoM data

Table 28. Baseline emissions projected to 2005 based on signatories' submitted action plans per country.

Country	Number of action plans	Base year emissions in 2005
Austria	1	65 903.93
Belgium	377	51 152 934.55
Bulgaria	2	259 571.57
Croatia	37	2 438 816.66
Cyprus	2	649 552.77
Czechia	30	17 347 661.10
Denmark	11	4 766 052.34
Estonia	1	4 288 406.00
Finland	8	3 304 982.17
France	11	15 940 140.41
Germany	7	41 473 629.06
Greece	41	15 482 366.86
Hungary	60	15 744 418.99
Iceland	1	158 711.00
Ireland	5	7 660 328.04
Italy	701	72 554 156.05
Latvia	3	205 612.71
Luxembourg	1	168 554.42
Netherlands	4	2 787 140.05
Norway	3	1 725 714.61
Poland	10	8 194 668.07
Portugal	44	18 567 941.79
Romania	18	2 783 404.84
Slovakia	1	234 240.73
Slovenia	7	1 883 909.43
Spain	938	50 268 278.46
Sweden	10	3 934 723.43
Switzerland	5	3 226 303.03
Total	**2339**	**347 268 123.07**

Table 29. Overall emission reduction by 2030, based on submitted action plans per country in the EU-27 and EFTA.

Country	Number of action plans	Base year emissions in 2005	Targeted emissions 2030	Committed reduction by 2030
Austria	1	65 903.9	39 542.4	40 %
Belgium	376	51 086 882.5	27 611 894.6	46 %
Bulgaria	2	259 571.6	233 477.2	10 %
Croatia	36	2 358 662.9	1 168 723.9	50 %
Cyprus	2	649 552.8	398 707.6	39 %
Czechia	30	17 071 359.2	9 225 347.8	46 %
Denmark	11	2 752 466.3	1 383 678.8	50 %
Estonia	1	4 288 406.0	2 573 043.6	40 %
Finland	8	3 304 982.2	1 328 221.6	60 %
France	11	15 940 140.4	8 660 957.4	46 %
Germany	7	41 473 629.1	14 880 181.7	64 %
Greece	41	15 482 366.9	6 669 910.9	57 %
Hungary	60	15 744 419.0	7 547 399.6	52 %
Iceland	1	158 711.0	72 141.4	55 %
Ireland	5	7 660 328.0	3 989 613.5	48 %
Italy	698	72 210 982.7	37 747 999.0	48 %
Latvia	3	205 612.7	127 310.6	38 %
Luxembourg	1	168 554.4	59 765.6	65 %
Netherlands	4	2 787 140.0	1 245 373.6	55 %
Norway	3	1 725 714.6	403 276.9	77 %
Poland	10	8 194 668.1	4 850 035.0	41 %
Portugal	43	16 300 324.1	836 0132.0	49 %
Romania	18	2 783 404.8	1 456 696.9	48 %
Slovakia	1	234240.7	124 458.0	47 %
Slovenia	7	1 883 909.4	922 488.9	51 %
Spain	938	50 268 278.5	24 522 591.4	51 %
Sweden	10	3 934 723.4	618 458.4	84 %
Switzerland	5	4 376 303.0	2 596 538.0	41 %
Total	**2 333**	**343 371 238.4**	**168 817 966.3**	**51 %**

Source: JRC elaboration based on GCoM data

Table 30. Overall emission reduction by 2050, based on submitted action plans per country in the EU-27 and EFTA.

Country	Number of action plans	Base year emissions in 2005	Targeted emissions 2030	Committed reduction by 2030
Belgium	13	758 141.3	98 597.63	87 %
Croatia	5	407 821.4	21 350.24	95 %
Czechia	3	276 301.9	4 387.808	98 %
Denmark	6	2 253 448	99 223.2	96 %
Germany	2	29 960 995	1 465 000	95 %
Greece	5	1 762 377	111 662.6	94 %
Hungary	3	746 247.1	61 025.8	92 %
Italy	18	2 723 410	192 333.5	93 %
Latvia	1	42 476.18	10 434.01	75 %
Norway	1	247 707.4	12 385.37	95 %
Portugal	16	10 729 253	1 158 873	89 %
Romania	2	433 903.5	87 500.92	80 %
Spain	25	1 352 514	248 778	82 %
Sweden	1	1 864 100	0	100 %
Switzerland	2	1 114 602	99 000	91 %
Total	**103**	**54 673 297**	**3 670 552**	**93 %**

Countries such as Spain, Italy and Belgium exhibit high levels of engagement, with 959, 706 and 364 municipalities reporting RVAs, respectively. This contrasts with countries like Malta, Austria, Luxemburg, Cyprus, Lithuania, Estonia, Iceland, Slovakia, and Bulgaria where engagement in adaptation remains comparatively lower, with a handful of signatories reporting RVAs.

Annex 2. MyCovenant Dataset

Sector and sub-sector description

Table 31. Description of the sectors and sub-sectors for GHG emission inventories in the CoM context.

Sector	IPCC (ref no.)	Subsector	Description
Stationary Energy / Buildings	1A4a	Municipal buildings, equipment/ facilities	Energy consumption and GHG emissions in buildings and facilities owned by the local authority. Facilities refer to energy-consuming entities that are not buildings, such as wastewater treatment plants.
		Public lighting	Public lighting owned or operated by the local authority (e.g., street lighting and traffic lights). Non-municipal public lighting is included in the 'Tertiary buildings, equipment/facilities' sector.
		Tertiary buildings, equipment/ facilities	Energy consumption and GHG emissions in buildings and facilities of the tertiary sector (services); e.g., offices of private companies, banks, commercial and retail activities, hospitals, etc.
	1A4b	Residential buildings	Energy consumption and GHG emissions in buildings that are primarily used as residential buildings. Social housing is included in this sector.
	1A1 1A2	Industries	Non-ETS: Energy consumption and GHG emissions in manufacturing and construction industries

Sector	IPCC (ref no.)	Subsector	Description
			not covered in the EU ETS.
			ETS: Energy consumption and GHG emissions in manufacturing and construction industries covered in the EU-ETS. Integrating them into emission inventories is not recommended unless such plants were included in previous energy plans and in the local authority's CO_2 emission inventories.
	1A4c	Agriculture/ Forestry/ Fisheries	Energy consumption and GHG emissions in buildings, facilities and machinery in the primary sector (agriculture, forestry and fisheries); e.g., greenhouses, livestock facilities, irrigation systems, farm machinery and fishing boats.
Transport	1A3a 1A3b 1A3c 1A3d 1A3e	Municipal fleet	All GHG emissions from fuel combustion and use of grid-supplied energy for transportation within the city boundary shall be reported and disaggregated by mode: on-road, rail, waterborne navigation, aviation and off-road: - 1A3b: on-road transportation: urban street network under the competence of the local authority; - 1A3b: on-road transportation serving
		Public transport	
		Private and commercial transport	

Sector	IPCC (ref no.)	Subsector	Description
			a larger area and/or not under the competence of local authority (e.g. highways) may be included if mitigations actions are planned in that area - 1A3e: off-road transport: off-road traffic of vehicles/mobile machinery in any activity sector - 1A3c: rail transportation: local transport (metro, tram and local trains); long-distance trains, intercity trains, regional and cargo rail transportation may be included if mitigations actions are planned in that area - 1A3d: waterborne navigation: local ferries in public and private transport acting on the local territory - 1A3a: aviation: local governments may choose to report GHG emissions from the in boundary component of domestic and/or international aviation (such as the landing and take-off cycle for aviation), or assume these are all out of boundary emissions and use the notation key "Included Elsewhere"
Waste	4A	Solid waste disposal	All emissions from solid waste that are disposed of at

Sector	IPCC (ref no.)	Subsector	Description
			managed sites (e.g., sanitary landfill and managed dumps), and unmanaged sites (e.g., open dumps, including above-ground piles, holes in the ground, and dumping into natural features such as ravines).
	4B	Biological treatment	All emissions from biological treatment of waste, including composting and anaerobic digestion of organic waste.
	4C	Incineration and open burning	All emissions from waste that are burned either in a controlled, industrial, process or in an uncontrolled, often illicit, process. The former is often referred to as incineration, and the latter as open burning. Note that this excludes emissions from waste incineration for the purposes of energy generation, also known as energy recovery.
	4D	Wastewater treatment	All emissions from the treatment process of wastewater, either aerobically or anaerobically
Energy supply	1A1	Electricity-only generation	All activity data and GHG emissions from energy (both renewable and non-renewable) consumption for the purpose of generating grid-supplied electricity in power

Sector	IPCC (ref no.)	Subsector	Description
			plants that solely generate electricity.
		Combined heat and power (CHP) generation	In the case of CHP plants, which generate heat and electricity simultaneously, or any other plants not listed, the amount of electricity produced, both from renewable and non-renewable energy sources shall be reported.
		District heating/cooling generation	All activity data and GHG emissions from energy (both renewable and non-renewable) consumption for the purpose of generating thermal energy in district heating/cooling plants
		Distributed local renewable energy generation	All activity data and GHG emissions from local energy generation (electricity, heat, etc.) facilities not grid-connected.

Source: (Bertoldi, et al., 2018)

Dataset Notation keys

Notation keys may be used to accommodate limitations in data availability and differences in emission sources between local governments:

- "NO" (not occurring): this notation key applies to an activity or process that does not occur or exist within the city. It may also be used for insignificant sources.
- "IE" (included elsewhere): this notation key may be used for activity sectors whose GHG emissions are estimated and presented in another category in the same inventory, stating where it is added. It may be used where it is difficult to disaggregate data into multiple sub-sectors.
- "NE" (not estimated): this notation key applies to activity sectors whose GHG emissions occur but have not been estimated or reported, with a justification why.
- "C" (confidential): this notation key applies to activity sectors whose GHG emissions could lead to the disclosure of confidential information, and as such, are not reported publicly.

Annex 3. Methodological Overview

Harnessing the information in the GCoM datasets: MyCovenant

The JRC-harnessing procedure of the GCoM datasets followed some specific steps for enhancing the quality of the signatories' reported data. Emphasis was placed on energy consumption and supply together with their associated GHG emissions inventories, and on the declared actions set out to fulfil the signatories' commitments. The harnessing of the supply data and mitigation actions was developed following some internal-consistency general rules that will be explained below, while for the cities' GHG emissions inventories, a more detailed analysis was performed.

For energy consumption and its associated emissions, the first task was to develop a general methodology for screening outlier energy-activity observations with respect to national (per capita) references. In this way, the reported city energy activity was compared with national energy consumption per capita reference values (Eurostat, 2024[58], IEA, 2021[59]). To simplify the analysis, the complete methodology for screening outlier energy activity starts by grouping electricity separately from thermal carriers. For both groups, the industry sector is excluded, and national consumption references are taken for commercial and public services, road and residential sectors. After analysing the result of taking different thresholds, outliers (to the right) are tagged if the declared electricity consumption per capita is greater than five times the maximum threshold, if the declared thermal activity per capita is greater than two times the maximum threshold, or (to the left) if the declared consumption per capita is less than a threshold of 0.01 (MWh/year per capita).

To compute the maximum threshold for each group (by electricity and thermal carriers), countries are clustered together according to their median per capita national energy consumption (following the k-medoids technique). Partitions of 2 to 5 clusters are considered, and a unique partition is identified according to relevant statistical indices measuring the density and separation between clusters (namely the Calinski-Harabasz, C-index, Davies-Bouldin and Dunn indices), also analysing if there are important differences between the respective thresholds and the observations being tagged as outliers. Following this approach, the chosen partition consists of three clusters with maximum thresholds of 2.9, 4.8 and 13.1 (MWh/year per capita), for electricity, and with maximum thresholds of 16.8, 21.8 and 100.4 (MWh/year per capita), for thermal carriers.

After completing the outlier screening process, a more exhaustive analysis is performed on the subset of inventories initially tagged as being outliers. Some outliers might be rare but plausible, and if an evident error is detected, it can be corrected. For example, if the city reports in kWh instead of MWh, or in activity per capita instead of absolute activity. Only if the reported values appear to be incomplete or to make no proper sense, then the inventory is removed. Finally, internal coherence is checked regarding past inventories, verifying that there are no outlier values which cannot be empirically justified.

Once the energy activity data is cleaned from evident outliers, the emissions are estimated by multiplying the activity (MWh) times the corresponding emission factor. Municipalities report their own estimation of the emissions, making it necessary to validate the emission factors they used for computing their reported emissions. When available, those factors are validated against carrier-specific references, taken from the JRC repository (Bastos et al. 2024; Koffi et al. 2017; Lo Vullo et

[58] https://ec.europa.eu/eurostat/web/energy/database
[59] Key World Energy Statistics 2021 – Analysis - IEA https://www.iea.org/reports/key-world-energy-statistics-2021

al. 2022). The values are revised only in case the emission factors reported by the cities are too different from the carrier-specific references (50 % or 100 % off from the national or local electricity factor references, respectively, and 20 % off from their corresponding references for all other energy carriers). On the other hand, signatories might not report on their emission factors, and in that case the corresponding reference values must be inserted. As a result of this emission factor validation process, around 12 % of all signatories reported some emission factors that had to be revised, and missing emission factors had to be inserted for 34 % of all signatories.

Regarding the internal consistency rules applied for cleaning the reported energy supply values, the following was implemented. Firstly, for local heat/cold energy and local-distributed electricity production, an implicit emission factor was computed between the reported supply and emissions, aggregating them by renewable and fossil sources. Setting lower and upper bounds for acceptable emission factors (see again (Koffi et al. 2017; Lo Vullo et al. 2022), emissions were validated only if that implicit emission factor was less than 2 and greater or equal than 0.1 (t CO_2-eq/MWh) for fossil sources (0 for renewables). Secondly, considering renewable energy only for locally distributed electricity production, the reported energy supply was compared with energy consumption, and only if the energy produced was much greater than the consumption (over 150 times the reported consumption), it was taken out from the validated data set.

For certified green electricity purchases, the reported purchases were compared with electricity consumption, and they were validated only if the energy purchased was not greater than 1.05 times the electricity consumption.

On the commitments and mitigation actions included in the signatories' energy and climate action plans (SEAPs/SECAPs), the validation process consisted of an initial screening aiming at detecting evident inconsistencies in the reported data. After an initial assessment of acceptable commitments, they should consist of reasonable GHG targets, both under BEI and business as usual (BAU) scenarios, not greater than a 100 % reduction of the baseline emissions. Then, following an empirical analysis, the proposed GHG reduction estimates were validated only if they were not greater than 2.2 times the targeted baseline emission reduction and less than the total baseline emissions. Likewise, estimated energy savings reported by the municipalities were checked for excluding values that were greater than 1.2 times the energy consumption. Further analysis was developed by action sectors, e.g., checking that the GHG reduction estimates by sector did not exceed the total reported emissions, or by computing an implicit factor between the estimates of GHG reduction and the sum of energy savings and production. Here, if such a factor was greater than 2 or less than 0.01 (t CO_2-eq/MWh), then the action-sector was excluded from the validated data set (again, the limits for acceptable emission factors were based on Lo Vullo et al., 2022; Koffi et al., 2017).

Finally, regarding the actions' details, the estimated impact of GHG reduction was validated against the targeted GHG reduction estimates. It was considered, after empirical analysis, that the mitigation estimated impact could not be greater than two times the targeted GHG reduction estimates. Similarly to the validation of the mitigation sector, which was performed according to the implicit emission factor computed between the (reported) estimated CO_2 reduction and the sum of the estimated energy savings and renewable energy production, an analogous approach was followed for individual actions/measures: the action was validated only if the implicit emission factor was lower than 2 or greater than 0.01 (t CO_2-eq/MWh).

Harnessing the information in the GCoM datasets: CDP-ICLEI Track

Concerning the data reported through CDP-ICLEI Track, the commitments information and emissions values were collected from detailed inventories (by sectors and scope) and total emissions figures (focusing on retrieving, whenever possible, baseline and follow-up emissions inventories), as reported by the cities in the yearly questionnaires, dating from 2018 to 2024. For each signatory, baseline emissions were directly extracted or computed from the available information, e.g., if a "fixed-level target" was selected by the signatory, the percentage target reduction was computed from the fixed target emissions and the first available emissions inventory, or in case of a per-capita target, the baseline emissions and the target were translated into absolute terms. Besides, the most ambitious percentage reduction targets were selected for the target year of 2030 or onwards. When the target year was later than 2030, the corresponding reduction target for 2030 was interpolated on the basis of the baseline and reported target years. As for the emissions, their values were modified if an evident error was detected (outliers deviating too much from national median) and could be directly corrected, for example, if the units of the emissions seemed to be given in per-capita terms, or in GWh or kWh instead of MWh. Correction was done by factor of 10s, from 10^{-5} to 10^{5}, and best reasonable value selected from its distance to national median.

Additionally, internal coherence was checked among the available inventories (and population values), verifying that there were no outlier values which could not be empirically justified. Only the emissions inventories values that passed these checks were included in the analysis. A total number of 188 action plans reported via CDP-ICLEI Track, covering almost 66.6 million inhabitants, were included in the analysis.

To consider both MyCovenant and CDP-ICLEI Track data, the emissions were aggregated by scope and sector, grouping the activity sectors into Residential buildings, Municipal buildings, Tertiary (non-municipal) buildings, Industry, Transport, Waste and Other. Considering the information on local mitigation actions, their action sectors were aggregated into Buildings, Transport, Industry, Electricity, Heat, Waste and Other. Lastly, when a signatory reported in both MyCovenant and CDP reporting platforms, the one holding the most recent submission date was considered.

In the development of a comprehensive dataset for the GCoM, data from the CDP-ICLEI Track and MyCovenant platforms was methodically integrated to support various analyses. The methodology adopted ensured a systematic consolidation of data from CDP-ICLEI Track and MyCovenant platforms, ensuring its applicability and reliability. To standardise data fields across the two platforms, adaptation tables were structured to include mandatory fields as per the GCoM Common Reporting Framework. This included aligning fields such as climate hazards, probability, impact, and intensity, among others. Conversion tables were developed to reconcile differences in terminology and options between MyCovenant and CDP-ICLEI Track datasets, ensuring consistency and facilitating an accurate merging process.

The initial step involved identifying and accessing datasets from CDP-ICLEI Track, spanning the years 2018 to 2024 (CDP 2024), and the MyCovenant data up to December 2024 (Bezerra et al., 2025) (2025). These datasets were sourced through the CDP Open Data Portal and JRC data catalogue, respectively. The CDP-ICLEI Track data was compiled into a comprehensive dataset by merging data from all available years, with a focus on retrieving the most recent information from all municipalities while ensuring the inclusion of historical data to provide necessary context and continuity. Notably, the CDP-ICLEI Track data is not subject to a cleaning process, whereas the MyCovenant data undergoes a rigorous quality-harnessing procedure by the JRC to ensure data accuracy and coherence (Franco et al. 2024).

Following this, a comparison and merging process with MyCovenant data was initiated. Using the GCoM unique identifier (GCoM ID) as a reference point, CDP-ICLEI Track data was combined with MyCovenant data to create a new consolidated file. In instances where municipality data was present in both platforms, a merging process was employed, systematically removing less recent or incomplete data to maintain the dataset's integrity and accuracy.

To standardise data fields across the two platforms, adaptation tables were structured to include mandatory fields as per the GCoM Common Reporting Framework (CRF). This included aligning fields such as climate hazards, probability, impact, and intensity, among others. Conversion tables were developed to reconcile differences in terminology and options between MyCovenant and CDP-ICLEI Track datasets, ensuring consistency and facilitating an accurate merging process.

The methodology placed a strong emphasis on prioritising data completeness. Where discrepancies in the number of records existed between datasets, the dataset with a higher number of records was prioritised, ensuring the most comprehensive data was utilised. Furthermore, detailed documentation of the data consolidation process was maintained to enable future updates and ensure the replicability of the methodology for analyses in subsequent years.

Additionally, while the primary focus was on integrating common data fields, the methodology also acknowledged the potential of using additional data available only on one platform for future research, detailed analyses, and complementary charts. This comprehensive approach to data integration provided a robust foundation for analysing aggregated GCoM data, offering valuable insights for policymaking and research initiatives.

Annex 4. Prediction statistical methodology

GCoM signatories present their action plans (SEAPs/SECAPs), which include an emission inventory for the base year, i.e., the year against which the achievements of the emission reductions in the target year are measured. Following the plan submission, signatories should present, ideally every two years, a monitoring report with its corresponding MEI, enabling to follow the performance of their proposed actions according to their declared ambitions.

In order to develop the analysis of the signatories' achievements, emissions must be converted into the same units (IPCC, t CO_2-eq). Given the 'GCoM – MyCovenant, 2023' dataset (Baldi 2023), the reported emissions can be aggregated after i) assuming that all emissions are reported in t CO_2-eq. and ii) multiplying LCA inventories by a factor of 0.885, according to the fraction of direct emissions embedded in LCA inventories.

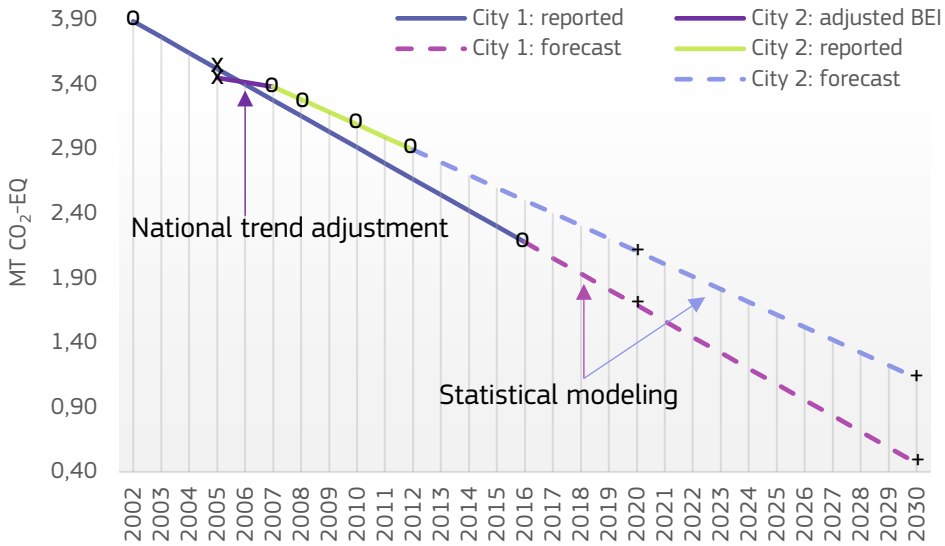
Concerning the analysis of the signatories' accomplishments for their SECAPs, Section 4.3.2 presents the analysis and results for the expected accomplishments of European signatories. Such an analysis focuses only on signatories having submitted at least one monitoring report besides their action plan. The emissions inventories are estimated as follow:

Firstly, the base year is set to 2005, being the reference year for measuring the performance of the cities' mitigation actions. In this way, for cities reporting a base year earlier than 2005, the estimated emissions in 2005 are taken according to the linear equation between the city's reported baseline inventory and its last monitoring inventory (see Figure A1, the 2005 estimation of "city1"). Meanwhile, for cities with a base year occurring after 2005 (see Figure A1, for "city2"), their corresponding baseline emissions are adjusted according to f), which considers$NE_{2005}NE_{base}$), as in

$$f = \frac{NE_{2005}}{NE_{base}}.$$

The models for estimating the cities' emissions in 2030 followed a machine learning methodology, minimising the error over the last known value, as it will be explained below (see also(Franco et al. 2022). The input data for the development of the models consists in the cities' reported emissions for their baseline and the following monitoring inventories, projecting their emissions to 2030, as shown in **Figure 60**.

Figure 60. Statistical methodology for the estimation of the cities' emissions.



Cities report their emission inventories (marked with o) for a given year, and their emissions are estimated for 2005 (marked with x) and forecasted to the target year (marked with +) of 2030.

Source: JRC elaboration

Therefore, each city has a sparse time series with a yearly frequency, being sparse because many years in between the base and the last monitoring years have missing values. Hence, firstly, the imputation of data is performed, building the yearly time series on which the algorithms can learn the stochastic process explaining their behaviour. This is done by continuing the linear trend between the years holding the known emissions values (see again Figure A1). Secondly, the best model is identified for each city (i), according to the minimum error ($error_i$) for the predicted value ($\hat{y}_{it}$), computed over the last known emissions value (y^*_{it}). This last known emissions value consists in the emissions value coming from the city's last MEI. This error was computed for each city, by

$$error_i = \frac{|\hat{y}_{it} - y^*_{it}|}{y^*_{it}}.$$

Therefore, the last known value is left out for validation, and the best model is identified that achieves the minimum prediction error. Then, the complete time series is fitted again under the same functional form of the identified model, and the corresponding prediction is taken for the cities' emissions in the target years.

Under this methodology, the time series are modelled after three different approaches. One approach consisted in a Double Exponential Smoothing (DES) (Box et al. 2016), characterising the level and the trend of the series, according to

$$\hat{y}_{t+1} = L_t + T_t,$$

where L_t and T_t, respectively, stand for the smoothed level and trend of the time series. A second approach consists in an Auto-Regressive Integrated Moving Average process (Box et al. 2016), commonly known as an ARIMA (p,d,q), implementing linear filters to characterise the series, in the form of

$$\hat{y}'_t = Z_t + \sum_{j=1}^{p} \phi_j y'_{t-j} + \sum_{j=1}^{q} \theta_j Z_{t-j},$$

where y' stands for the differentiated series to the order of *d*, and *p* and *q* respectively stand for the number of lagged observations and the number of standard-normal innovations included in the process. The ARIMA (p,d,q) models are validated by the Ljung--Box test (see again Box et al., 2016), checking that no significant correlation among the residuals is left unexplained.

The third and last approach to modelling the series consists in an auto-regressive feed-forward neural network with one hidden layer, estimating non-linear functions with a fair level of complexity (Kurt et al. 1989)(Hornik et al. 1989). This architecture is examined with different number of neurons, namely 3, 5, 7 or 10 neurons in the single hidden layer, receiving as input from 1 to 5 lagged observations (depending on the available data).

Furthermore, models were compared to 'naives' methods, namely: (i) a persistence forecast using the last observed values, (ii) a linear trend extrapolation, (iii) a national-level trend derived from EDGAR country emissions data [60]. When models were underperforming for specific signatories, the best performing 'naives' methods were picked.

To compare predicted values against signatories' ambitions, the reported targets were taken for both 2030 and 2050 commitments. In the case of 2050 commitments, for figures later than 2030, the 2030 targets were interpolated. In addition, when several 2030 targets 'co-exist', the "the target from the plan associated with CoM2030 commitments is given priority, or in the case of two targets for a 2050 commitment (which can happen due to mid-term targets for 2050), the most ambitious one is taken.

The present methodology involves uncertainties arising from both the estimation of 2005 baseline emission inventories (BEI) and the forecasting model itself. Additionally, values are calculated only from available data, specifically the subset of signatories with both BEI and monitored emission inventories (MEI), and the subset of sectors common to both baseline and monitoring periods. Consequently, this analysis provides an indicative assessment of estimated emission reductions rather than definitive measurements.

[60] European Commission, Joint Research Centre (JRC)/Netherlands Environmental Assessment Agency (PBL). Emission Database for Global Atmospheric Research (EDGAR), release version 4.3.1 http://edgar.jrc.ec.europa.eu/overview.php?v=431, 2016

Annex 5. Mitigation actions: data categorisation

This section provides a comparison between how the data is organised and reported in MyCovenant and how it has been presented in this report, thereby, highlighting the differences in data presentation and allowing for the understanding of the data organisation and analysis.

Estimated energy savings and renewable energy production (actions - level):

Climate change mitigation action-level data is presented in section **Error! Reference source not found.**.4. With the aim of enhancing clarity and straightforwardness of results, the categories 'areas of intervention' and 'policy instruments' used in MyCovenant have been simplified, although these categories occur in combination with each other and with the sectors. For instance, for the 'buildings' sector, specific 'areas of intervention' are available, which are linked to their corresponding 'policy instrument', depending on the scope of the action. Ideally, the combinations of sector + area of intervention + policy instrument should be observed jointly to reclassify the actions. In the present report a simplification effort has been explored by contemplating the lists of possible 'areas of intervention' and 'policy instruments' in an isolated manner.

For the 'areas of intervention', the following correlations have been used:

Table 32. Areas of intervention correlation MyCovenant reporting versus this report

My Covenant reporting	This report
Areas of intervention	**Areas of intervention**
Building envelope	Envelope
Energy efficiency in buildings	
Energy efficiency in industrial processes	Energy efficiency (appliances / light / space heating / water)
Energy efficiency in space heating and hot water	
Energy efficient electrical appliances	
Energy efficient lighting systems	
Renewable energy for space heating and hot water	Renewable energy in buildings
Industry renewable energy	
Integrated action	Integrated action
Behavioural changes	Soft measures
Information and communication technologies	
Cleaner efficient vehicles	Efficient vehicles and practices (incl. electric vehicles)
Eco driving	
Electric vehicles	
Modal shift to walking and cycling	Walking and cycling
Car sharing pooling	Public (and shared) transportation
Improvement of logistics and urban freight transport	
Modal shift to public transport	
Mixed use development and sprawl containment	Urban planning
Road network optimisation	
Biomass power plant	Renewables for power and heat
Hydroelectric power	
Photovoltaics	
Wind power	
Combined heat and power	District heating/cooling and CPH
District heating cooling network	
District heating cooling plant	
Smart grids	Distribution and Storage (power and heat)
Agriculture and forestry related	

Tree planting in urban areas	Agriculture and forestry related (incl. Urban regeneration)
Urban regeneration	
Waste and wastewater management	Waste and wastewater management
Industry other	*Other or non-specified (not considered in the analysis)*
Other	
-	

Source: JRC elaboration based on GCoM data

In addition, the actions' categorisation saw the application of a first approach for the introduction of the key type measures (KTMs). According to (Hernandez Moral et al. 2025) four KTMs have been considered: 1) physical and technological, 2) economic and finance, 3) governance and institutional and 4) knowledge and behaviour change. These categories provide a concise overview of how municipalities are structuring their action plans to create an enabling environment, facilitating easier analysis and comparison.

The following correlations have been established between 'policy instruments' (in an isolated manner) and key type measures:

Table 33. Policy instruments correlation MyCovenant reporting versus key type measures used in this report

My Covenant reporting	**This report**
Policy instruments	**Key type measures**
Energy management	Physical and technological
Land use planning (in transport)	
Energy carbon taxes	Economic and Finance
Grants and subsidies	
Third party financing	
Road pricing	
Integrated ticketing and charging	
Energy certification labelling	Governance and Institutional
Energy performance standards	
Public procurement	
Mobility planning regulation	
Voluntary agreements with stakeholders	
Building standards	
Energy suppliers' obligations	
Land use planning (in other sectors)	
Awareness raising training	Knowledge and Behaviour change
-	*Other or non-specified (not considered in the analysis)*
Not applicable	
Other	

Source: JRC elaboration based on GCoM data

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