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CoM EAST Overall assessment and in-depth SECAPs analysis

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Abstract

Cities and local authorities are key players in addressing climate change. The Covenant of Mayors for Climate and Energy in the European Eastern Partnership countries (CoM EAST) is an active initiative that continues to raise interest. The initiative covers six countries (Armenia, Azerbaijan, Belarus, Georgia, Republic of Moldova, and Ukraine) and counts more than 400 signatories who are committed to tackle climate change's causes and impacts in their territories, through the implementation of local actions.

This study provides an overview and assesses CoM EAST signatories commitments and plans, examines planned and implemented policies, covering both mitigation and adaptation pillars of the initiative for the first time in the region.

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We also thank the Covenant of Mayors Office EAST for their valuable work with signatories.

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Executive summary

The CoM initiative in the Eastern Neighbourhood countries (CoM EAST) counts today more than 400 signatories committed to achieving climate change mitigation and adaptation targets. In the first phase (2011-2015) eleven countries of Eastern Partnership and Central Asia regions were involved. Since 2017 the initiative is tailored to the specific needs of six Eastern Partnership countries: Armenia, Azerbaijan, Belarus, Georgia, Republic of Moldova and Ukraine. It is part of the Global Covenant of Mayors (GCoM), and operates as one of its local chapters, thereby allowing for adjustments to regional contexts and local realities.

This document provides a scientific assessment of CoM EAST signatories, their ambitions and actions towards a more sustainable future. It is the first document that includes the climate change adaptation pillar in the EAST region. The analysis addresses CoM EAST signatories reporting through the MyCovenant reporting platform.

Policy context

Climate Change is a priority of the European Union (EU) who recognises the essential role of cities as main actors of the climate action. In the framework of the EU Green Deal, in 2021 EU has set the new EU net emission reduction target for 2030 of at least 55% compared to 1990, in line with the commitments under the Paris Agreement (Fit for 55 package; The European Green Deal). This renewed ambition has been also reflected into the Covenant of Mayors (CoM), a pan-european initiative supporting local authorities in their climate and sustainability paths. Local authorities commit to take action to decarbonise and increase the resilience of their territories by 2030, by developing and submitting a climate action plan that includes the strategies and actions to achieve the target.

Main findings and Key conclusions

The analysis of more than 250 climate action plans submitted by CoM EAST signatories shows high ambitions and significant efforts undertaken in both pillars. Signatories are willing to move towards sustainability and reduce impacts of climate change. From the analysis of their assessments a clear contribution to GHG emissions of stationary energy and transport sectors and the relevance on fossil fuels emerged, while the hazards with higher probability of happening identified by signatories were Drought, Extreme precipitation and Extreme heat. Actions were numerous and well differentiated covering all sectors, with particular focus on buildings and transport. The implementation of these actions will lead on average to a slightly higher emission reduction than the minimum required (22% for signatories of CoM 2020 and 33% for signatories of CoM 2030). More complete data on the adaptation pillar will allow for further and more developed analysis in the future. The limited number of monitoring reports highlights the need to reinforce the monitoring and progress review phase.

Related and future JRC work

The JRC provides scientific, methodological and technical support to the Covenant of Mayors EAST initiative with manifold activities, including the methodological development, consistency and scientific robustness, and the evaluation of the plans. CoM EAST is a key reference for local authorities in the region. This is confirmed by the high number of signatories and their commitments. The number of cities willing to contribute to the green transition and sustainable challenge, while tackling climate change, is increasing. The number of submitted climate action plans to be analysed is expected to grow, in addition to the ones not yet submitted by signatories. The requirements of the third pillar of the GCoM are under finalisation, therefore the energy access and poverty will be integrated in the methodological development. The increased number of plans and, hence, data reported will allow for further and in-depth analysis of the status and progresses of CoM EAST signatories in the future.

Quick guide

This report is the most recent of this series covering the CoM East region, providing a scientific assessment on both the mitigation and adaptation of climate change pillars. Chapter one provides an introduction of CoM and policy context, chapter 2 describes the CoM EAST initiative and its framework. The methodological approach for building the dataset is reported in chapter 3, Signatories description and general statistics are covered in chapter 4. Finally chapter 5 describes the outcomes of the assessment phase (Baseline Emission Inventory, Risk and Vulnerability Assessment) and chapter 6 examines planned and implemented policies.

Note The present document has been prepared in December 2021 and data refers to the timeframe 2018/2021. CoM related work on the region in the future might be subjected to changes and adaptation.

1 Introduction

The Paris agreement adopted at COP 21 officially recognised local authorities and cities as key actors in the fight against climate change (UNFCCC, 2015; Kern, 2019; Palermo *et al.*, 2020). Not only cities are negatively affected by climate change impacts requiring immediate adaptation actions, but are also largely contributing to GHG emissions in the atmosphere. However, cities represent a unique environment where respond to this challenge through experimental and innovative approaches.

Climate Change is a priority of the European Union (EU) who recognises the essential role of cities. In the framework of the EU Green Deal, in 2021 EU has set the new EU net emission reduction target for 2030 of at least 55% compared to 1990¹, in line with the commitments under the Paris Agreement (Fit for 55 package; The European Green Deal). This renewed ambition has been also reflected into the Covenant of Mayors (CoM) commitments, calling Mayors and local leaders to renew their climate ambitions, and step up their actions in a mid- and longer-term perspective to keep global temperature rise below 1.5°C degrees.

Moreover, acknowledging that the impacts of climate change are already occurring today, the new EU strategy on adaptation to climate change² aims to make adaptation smarter, swifter and more systemic and to increase support for international climate resilience. 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 to every single local authority, company and household (Melica *et al.*, 2022).

The Covenant of Mayors has been following the evolutions of the EU policies since its origins. Launched in 2008 by the European Commission, acknowledging the role of local authorities, the Covenant of Mayors supported local authorities who committed to achieving and exceeding at least the European 20% reduction target by 2020 of the total emissions objective compared to the baseline, by implementing a Sustainable Energy Action Plan (SEAP).

In 2014, the European Commission launched the Mayors Adapt initiative. Based on the same principles as the Covenant of Mayors, this initiative's main focus was on adaptation to climate change. Mayors Adapt invited local governments to demonstrate leadership in adaptation, and was supporting them in the development and implementation of local adaptation strategies.

In 2015 the Covenant of Mayors for Climate and Energy was launched stepping up the mitigation commitment to 40% reduction by 2030, integrating the pillars of adaptation and secure and accessible energy; it also introduced the Sustainable Energy and Climate Action Plan (SECAP) to include the changes required in the new developments. Since its origins, the initiative has evolved and developed, extending to the Eastern European Partnership countries, to the South and to Sub-Saharan African countries. In 2017, the Global Covenant of Mayors (GCoM) was launched bringing together all the commitments of local governments who previously joined through the Compact of Mayors³, pre-existing Regional/National Covenants of Mayors, and the new Regional/National Covenants. With the aim of operating under a common and shared vision to be adapted to specificities of the regions, a Common Reporting Framework (CRF) has been developed by a team of experts from GCoM partners, ensuring a common framework and the harmonisation of measurements and reporting procedures.

The CoM initiative in the Eastern Neighbourhood countries (CoM EAST) was launched in September 2011. In the first phase (2011-2015) 11 countries⁴ of Eastern Partnership and Central Asia regions were involved. Since 2017 the initiative has been tailored to the specific needs of six Eastern Partnership countries: Armenia, Azerbaijan, Belarus, Georgia, Republic of Moldova and Ukraine. It is part of the Global Covenant of Mayors, and operates as one of its local chapters, thereby allowing for adjustments to regional contexts and local realities.

Covenant signatories benefit from the support by the Joint Research Centre (JRC) of the European Commission. The JRC provides scientific, methodological and technical support to the Covenant of Mayors initiative. JRC contributes to the methodological basis of the initiative including: the development of Guidebooks for local authorities, the contribution to the Common Reporting Framework, the overall methodological consistency and scientific robustness, and the methodological adaptation to the different regions of the world, with the aim of taking into high consideration regional and local needs under an

¹ <https://www.consilium.europa.eu/en/policies/green-deal/>

² COM(2021) 82 final

³ Active between 2014 and 2016, the Compact of Mayors was a global coalition of city leaders and officials committing to addressing climate change by greenhouse gas emissions reduction and resilience to future impacts

⁴ Five Central Asian countries: Tajikistan, Kyrgyzstan, Kazakhstan, Uzbekistan, Turkmenistan and six countries covered by the Eastern Partnership: Azerbaijan, Armenia, Belarus, Georgia, Republic of Moldova, and Ukraine

harmonised framework. The JRC, as an independent body, is in charge of the evaluation of the SEAPs/SECAPs providing tailored feedbacks to the local authorities and in-depth evaluations of selected plans. The JRC also offers a Helpdesk dedicated to technical inquiries. This multifaceted work results in a number of publications and guidance material: the Guidebook on how to develop SEAP/SECAP in Europe and in the other regions (Bertoldi, P (ed), 2018; Kona *et al.*, 2018; Rivas *et al.*, 2018; Palermo *et al.*, 2019), methodological approaches and specific studies (Melica *et al.*, 2018; Bertoldi *et al.*, 2018; Palermo and Hernandez, 2020).

Since 2013, the JRC has published a series of assessment reports on the Covenant of Mayors status that tracks the progresses on the basis of most recent updates from signatories. The latest assessment study on CoM EU is the “Covenant of Mayors: 2019 Assessment” (Bertoldi *et al.*, 2020) and on CoM EAST was “Covenant of Mayors in the Eastern Partnership Countries: 2019 Assessment” (Kona and Bertoldi, 2020). This report is the most recent of this series covering the CoM East region, providing a scientific assessment on both the mitigation and adaptation of climate change pillars. The assessment describes the outcomes of the assessment phase (Baseline Emission Inventory, Risk and Vulnerability Assessment), examines planned and implemented policies and gives an overview on the progresses in terms of energy consumption, GHG emission reduction and adaptation approaches. The analysis addresses CoM EAST signatories reporting through the MyCovenant reporting platform, data refers to the timeframe 2018/2021.

2 The Covenant of Mayors EAST framework

The CoM East initiative was launched in September 2011. The first phase of the project (2011-2015) covered 11 countries of Eastern Partnership and Central Asia regions. The second phase of the project (2016-2020) covers 6 countries of Eastern Partnership region: Azerbaijan, Armenia, Belarus, Georgia, Republic of Moldova, and Ukraine. The initiative aimed at introducing the CoM EU initiative to the Eastern Partnership countries and supports local authorities in their path towards a sustainable future, by implementing sustainable energy policies, increasing the resilience to climate change impacts, and addressing energy poverty.

Signatories from CoM EAST who joined the Covenant of Mayors before October 2016 (2020 target), committed to reducing their CO₂ emissions by at least 20% by 2020 and to developing and implementing a Sustainable Energy Action Plan (SEAP). Signatories who joined more recently, commit to reducing CO₂ emissions by 30% by 2030 and enhancing resilience by adapting to the impacts of climate change. Their commitments are translated into the Sustainable Energy and Climate Action Plan (SECAP). 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.

The Baseline Emissions Inventory (BEI) and Climate Risk and Vulnerability Assessment (RVA) serve as the basis for defining a comprehensive set of actions that local authorities plan to undertake in order to reach their climate mitigation and adaptation goals. Signatories commit to report on their progress every three years.

2.1 The regional context

According to the IPCC Fifth Assessment report, in 1990 the Eastern Europe and former Soviet Union (EIT) was the world's highest emitter of GHG emissions at 19% of global total. By 2010, the distribution had changed with the rapid increase of East Asia countries and the CO₂ emissions in EIT decreased by around 30% in comparison to 1990 (Agrawala, S., Klasen, S. Acosta Moreno, R. Barreto, L. Cottier, T. Guan, D. Gutierrez-Espeleta, E. Gámez Vázquez and Jiang, L. Kim, Y. Lewis, J. Messouli, M. Rauscher, M. Uddin, N. Venables, 2014). Country specific data from International Energy Agency (⁵) confirm the reduction trend, that reaches 73% in Armenia in comparison to 1993 data.

The table and figures below give an overview of the national CO₂ emissions in the six countries and the main energy sources.

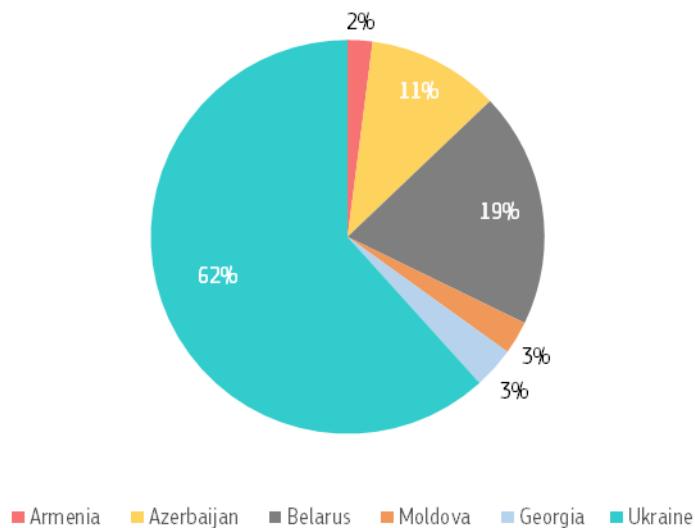
Table 1. CO₂ emissions in 2018

	CO ₂ emissions [MtCO ₂]
Armenia	6.0
Azerbaijan	32.0
Belarus	57.0
Moldova	8.0
Georgia	10.0
Ukraine	182.0
Total	295.0

Source: Data elaborated from IEA

⁵ Source: IEA Greenhouse Gas Emissions from Energy <https://www.iea.org/data-and-statistics/data-product/co2-emissions-from-fuel-combustion>

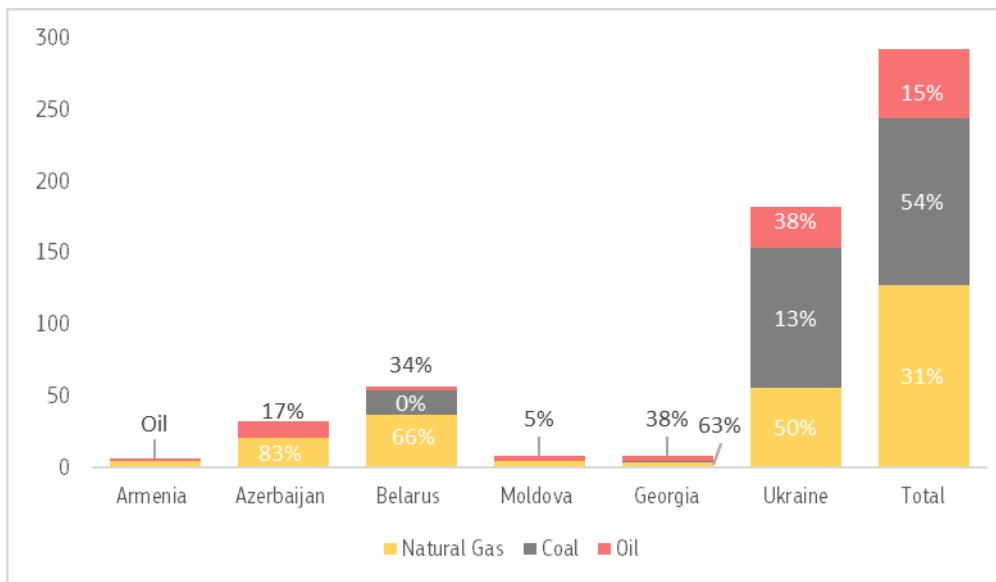
Figure 1. Share of CO₂ emissions (fuel combustion only) per country in 2018



Source: JRC own elaboration. Data from IEA

Data shows that natural gas is the main source of CO₂ emissions, coal is still present in Ukraine, Georgia and Belarus. In Armenia 83% of emissions comes from natural gas, the share decreases in Azerbaijan where 71% of CO₂ emissions are from natural gas the rest oil, in Belarus (65%), Moldova (62%), Georgia (50 %) and Ukraine (30.7%). In Ukraine, coal still represents a large share of emissions (54%).

Figure 2. Total CO₂ emissions by energy source per country in 2018 [Mt CO₂]



Source: JRC own elaboration. Data from IEA

The sectors mainly responsible for emissions are energy and agriculture.

The six countries mainly belongs to Continenatl and Northern Europe in the sub-regional classification of Europe developed in the IPCC Fifth Assessment report. The report highlights that extrem heat and changes in hydrology of river basins are happening and expected in the region. The most recurrent higlighted hazards in the region refer to floods, drought and water deficiency.

The boxes below summarise the main mitigation and adaptation features of each country.

Box 1. Azerbaijan

Azerbaijan has a population of around 10 million people (2020) and on average contributes 0.15% of total global greenhouse gas (GHG) emissions, averaging 5.5 tCO₂e per capita (in 2015 including land use and forestry). The sectors having the largest emissions contribution are energy and agriculture.

The country is sensitive to the impacts of climate change. Extreme weather events, flooding, drought, heat stress are expected to increase in frequency.

Source: EU4Climate

Box 2. Belarus

Belarus has a population of around 9.5 million (2019), and on average contributes to 0.18%, of total global greenhouse gas (GHG) emissions. In 2018, emissions per capita were 6.5 tCO₂e (in 2015 including land use and forestry). The country's Nationally Determined Contribution (NDC), includes unconditional quantified emission reduction target of at least 28% by 2030, compared to 1990. Energy and agriculture are the two sectors with the largest GHG emission shares.

Temperatures, floods, droughts, precipitation have begun to diverge from historical patterns, which will impact multiple sectors. Water's quality may deteriorate due to increased flooding, extreme rain events, and changes in runoff patterns.

Source: EU4Climate

Box 3. Georgia

Georgia has a population of around 3.73 million (2018), and contributes 0.03% to the total global greenhouse gas (GHG) emissions averaging 3.5 tCO₂e per capita (in 2015 including land use and forestry). Energy and agriculture are the two sectors with the largest GHG emission shares.

Georgia is considered highly vulnerable to the effects of climate change, facing threats that include increased frequency and severity of droughts, flooding, and landslides.

Source: EU4Climate

Box 4. Moldova

Moldova has a population of around 3.15 million (2019), and contributes 0.04% to the total global greenhouse gas (GHG) emissions with per capita value of 5 tCO₂e (in 2015 including land use and forestry).

The key emitter sectors are energy transport and agriculture

Moldova is highly vulnerable to climate change effects particularly related to droughts, floods, hail.

Source: EU4Climate

Box 5. Ukraine

Ukraine has a population of around 42 million (2019), and contributes 0.61% of total global greenhouse gas (GHG) emissions, with CO₂e emissions of 7 tCO₂e per capita (in 2015 including LULUCF/LUCF). The energy sector is the most significant contributor to GHG emissions in Ukraine, with industrial processes contributing about 16% and the agriculture sector 13%.

Ukraine is highly vulnerable to the impacts of climate change. It has identified agriculture and soil, biodiversity, water resources, energy, transportation and infrastructure, public health, forests, fisheries, cities and territorial communities, tourism and coastal zone management as the key adaptation priorities.

Source: EU4Climate

Box 6. Armenia

Armenia has a population of around 3 million (2020) and 0.02% to the total global greenhouse gas (GHG) emissions with per capita value of 3.0 tCO₂e (in 2015 including LULUCF/LUCF). Energy and agriculture are the two sectors with the largest GHG emission shares.

Climate change hazards identified in Armenia are annual temperature increase (higher than the global average) and a significant decrease in precipitation. The most vulnerable sectors are agriculture, human health, water resources, forestry, transport, and energy infrastructure.

Source: EU4Climate

2.2 CoM EAST approach to mitigation

The methodological approach for mitigation has not changed since the launch of the initiative in 2011, with the exception of the more ambitious target for 2030. Signatories assess the current status in terms of mitigation through their Baseline Emissions Inventory (BEI) which includes the energy consumption and GHG emissions in the key sectors under the management of the local authorities in a base year according to a common methodological approach (Bertoldi P., 2018). On the basis of the BEI outcomes, actions to reduce the energy consumption and decrease the carbon emissions for those areas of activity relevant to the local authority's mandate are planned to reach the target.

Moreover, local authorities have the opportunity to set their overall CO₂ emissions reductions target either in relation to the base year (as 'absolute reduction' or 'per capita reduction') or in relation to a business-as-usual (BAU) scenario. According to the former, the GHG reductions target can be set as an 'absolute' percentage or a 'per capita' target of at least 30% from the results reported in the BEI. With respect to the latter, the GHG reductions target is an 'absolute' percentage of at least 30% from the results of a BAU scenario. The target set on the basis of a BAU scenario implies the chance for countries (and local authorities) under an economic growth phase, to limit the increase of their GHG emissions through the implementation of adequate climate and energy policies. The BAU scenario indicates that no measures are taken into account for the future emission trends and projects the evolution of energy and emissions levels until 2030, under the hypothesis of continuing current trends in population, economy, technology and human behaviour, without the implementation of a SECAP or any other national or local policy measures.

The key aspects of the mitigation approach are summarised below, further information can be retrieved from the guidebook (Bertoldi, 2018).

Signatories can choose to calculate their GHG emissions using the standard IPCC approach, the Life-Cycle Assessment (LCA) approach or National/sub-national emission factors which have been validated by a public body.

Signatories may report carbon dioxide emissions (CO₂) and/or emissions of methane (CH₄) and nitrous oxide (N₂O), converted into CO₂-equivalents (CO₂-eq) according to their global warming potential.

The CoM inventories account for direct emissions (also referred to as Scope 1 emissions) generated within the territory of the local authority (e.g., from the combustion of fossil fuels) and for indirect emissions (also referred to as Scope 2 emissions) associated with the consumption of grid-supplied energy (electricity or district heating and cooling) irrespective of where the energy generation actually occurs.

The baseline emission inventories need to include the following mandatory sectors and related sub-sectors: Stationary energy, transport and waste. Activity data and GHG emissions associated with energy supply are also calculated and reported in the context of the CoM inventories. However, they are not included in the total emissions since they are already captured through indirect emissions from grid-supplied energy.

Notation keys may be used to accommodate limitations in data availability and differences in emission sources between local governments (**Table 2**).

Table 2. Notation keys.

"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.

Source: Detail available in the CRF and CoM EAST guidebook

2.3 The Covenant of Mayors' approach to adaptation

The methodological framework for adaptation includes a sound assessment of the current conditions in terms of risks, vulnerabilities and impacts. On this basis the adaptation goals are defined and related adaptation actions planned. Through the climate risk and vulnerability assessment (RVA), local authorities can identify faced current climate hazards and how these are expected in the future. The approach for the Risk and Vulnerability Assessment follows the IPCC fifth assessment report framework. The MyCovenant reporting platform in alignment with the CRF requires that the following information are reported:

- Type of climate hazard and the related current probability and impacts.
- The expected change in hazard intensity, expected change in hazard frequency and timeframe(s).
- Vulnerable sectors and vulnerable population groups potentially affected by the identified climate hazards
- Adaptive capacity

The climate hazards signatories may report on are listed below:

- Extreme heat
- Extreme cold
- Heavy precipitation
- Storms
- Floods & sea level rise
- Droughts & water scarcity
- Mass movement
- Wild Fires
- Biological hazard
- Chemical change
- Other

The sectors potentially affected might be *Buildings, Transport, Energy, Water, Waste, Land Use Planning, Agriculture & Forestry, Environment & Biodiversity, Health, Civil Protection & Emergency, Tourism, Education, ICT (Information & communication technologies) and others.*

Vulnerable population groups include: *Women and girls, Children, Youth, Elderly, Marginalized groups, Persons with disabilities, Persons with chronic diseases, Low-income households, Unemployed persons, Persons living in sub-standard housing, Migrants and displaced people, Other.*

By joining the initiative, signatories commit to voluntarily developing a comprehensive local adaptation strategy, develop suitable adaptation actions, as well as reporting their progresses. It is expected that key adaptation actions refer to hazards with high intensity and frequency.

Notation keys can be employed for the adaptation pillar as well (see table 2).

3 Approach and methodology

The data analysed and elaborated in this report is a sample of the CoM reference dataset (Baldi *et al.*, 2021). This dataset only includes GCoM signatories, coming from all parts of the world, who registered their commitment and reported their data contained in their SE(C)APs through MyCovenant reporting platform (<https://mycovenant.eumayors.eu/>). Signatories reporting to the CDP-ICLEI URS or through offline reporting tools are not part of the dataset and, therefore, not analysed in this report.

The data reported through the platform include the energy data, emissions inventories (i.e., the signatories' baseline emissions and the monitoring emissions inventories), the risk and vulnerability assessment information (i.e. hazards types and related impacts, vulnerable sectors and population groups), adaptation goals, planned mitigation and adaptation actions by sectors and hazards along with relevant information (GHG emission reduction estimations).

Since within the CoM framework cities voluntarily report their own data, a certain level of uncertainty is present. This may refer to biased estimations, evident typo and mistakes in reporting, missing information or lack of coherence. In order to address this issue, a revision of the dataset has been undertaken by the JRC, aiming at harnessing the quality of the available information on the cities' emissions and commitments. Consequently, a structured reference dataset is available at the European Data Portal (<https://data.europa.eu/en>).

The general methodology for extracting and harnessing the reference GCoM datasets from the full set of raw submissions consists of two parts, namely data extraction and data cleaning. The former refers to the extraction and management of the data from the full MyCovenant set of submissions, the latter included analysis, screening and cleaning the data from outlier observations. Detailed explanation of this procedure can be found in Melica *et al.* (2022), while a more general summary is reported below.

With regards to the energy consumption and supply and to actions, the procedure followed some internal-consistency general rules; for the cities' GHG emissions inventories, a more detailed analysis was performed that included an outlier screening process and the calculation of GHG emissions from energy data by multiplying the activity data (MWh) by the corresponding emission factor. Since signatories also report their own estimation of the emissions, the emission factors used for computing the reported emissions were also validated.

On the commitments and mitigation actions included in the signatories' energy and climate action plans, the validation process consisted of an initial screening aiming at detecting evident inconsistencies in the reported data. This was followed by further analysis developed by action sectors, e.g., checking that the CO₂ reduction estimates by sector did not exceed the total reported emissions, or by computing an implicit factor between the estimates of CO₂ reduction and the sum of energy savings and production. Finally, the estimated mitigation impact of CO₂ reduction was validated against the targeted CO₂ reduction estimates.

A similar approach was used for harnessing adaptation data from the datasets. For adaptation information, additional quality scrutiny steps were required on the information provided as text fields. In EU, signatories are required to submit their plans in English, but the information is often reported in national or local language. Language barrier, therefore, affected the quality scrutiny process and data analysis for adaptation. CoM EAST signatories are allowed to report their data in English and also in Russian. Data from the sample in both languages has been analysed.

4 Signatories and commitments

4.1 General statistics

At the cut-off date for the analysis (end of May 2021), there was a total of 481 CoM signatories, covering a total CoM population of 32,664 million inhabitants, representing the 45% of the aggregated population of the six countries (about 73 millions in 2020). Figure 3 shows the increase in CoM signatories in the region since 2008.

Figure 3. Number of CoM East Signatories since 2008



Source: JRC own elaboration

Signatories per countries and related population are summarised in Table 3. The table shows that the majority of Com EAST signatories (61%) is from Ukraine covering 67% of signatories' population, followed by Moldova (14% of signatories covering 6% of population) and from Belarus (12% of signatories covering 13% population). Signatories from Armenia, Azerbaijan and Georgia together represent 12% of CoM East signatories covering 15% of inhabitants.

Table 3. Signatories in the CoM East per country as of November 2021

Countries	Number of signatories	Population (inventory year)
Armenia	28	1,756,833
Azerbaijan	8	788,325
Belarus	58	4,151,014
Georgia ⁶	24	2,297,635
Moldova	68	1,945,852
Ukraine	295	21,724,483
Total	481	32,664,142

Source: JRC own elaboration

From **Table 3** is also possible to highlight the differences in terms of number of inhabitants of considered local authorities. Aligned with other studies related to CoM, also in this report signatories have been classified

⁶ Two groups of signatories joined the initiative jointly.

according to their number of inhabitants (**Table 4**). The number of inhabitants is considered as a crucial information as it may be representative of multiple implications (i.e. social, economic and financial, sustainable) for the local authority governance, quality of life of citizens and for the strategies and choices adopted towards the energy and climate target, reported in the SECAP itself.

Table 4. Classification of signatories according to their population

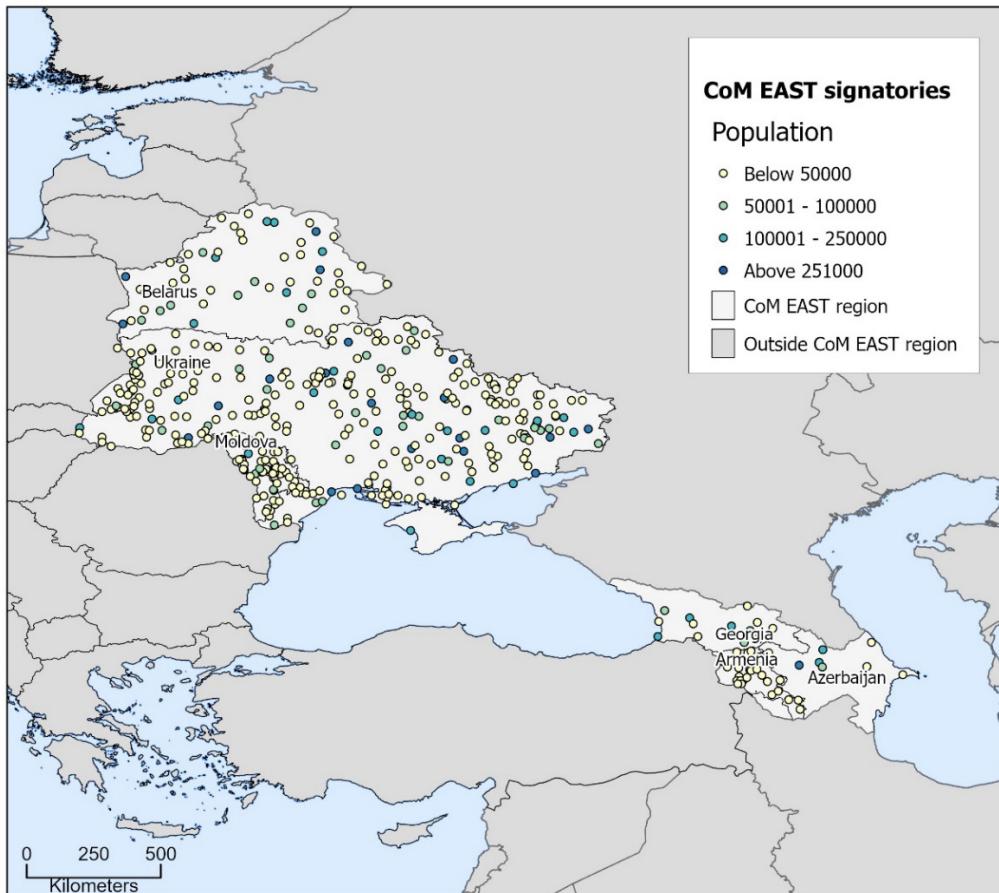
Criteria - population	Signatories
n. inhabitants below 50,000	Small and medium towns
n. inhabitants between 50,001 – 100,000	Small centres
n. inhabitants between 100,001 – 250,000	Medium centres
n. inhabitants above 250,001	Large centres

Source: JRC own elaboration

The geographic distribution of signatories is shown in **Figure 4**.

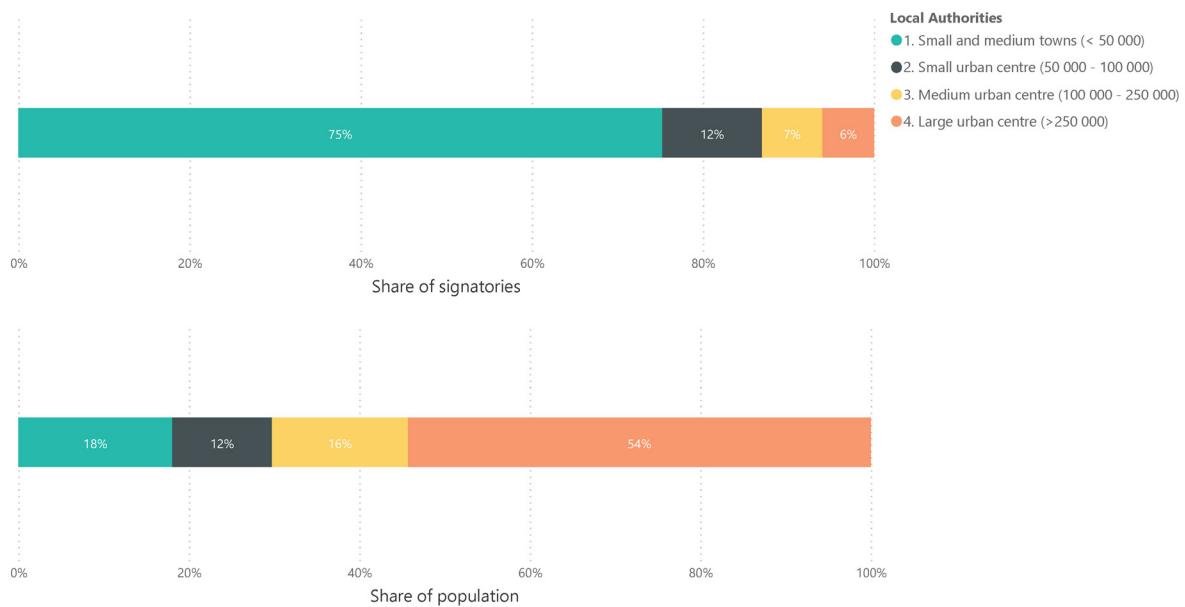
The total number of inhabitants covered by the CoM East initiative at the cut-off date is 32,664,142. Most of the CoM East signatories (75%) are small- and medium-sized towns with a population of less than 50 thousand inhabitants. As can be seen in Figure 5, the majority of CoM East signatories' inhabitants (54%) lives in large urban centres with a total population of over 17.5 million inhabitants. Kyiv, classified as large urban centre, with a population of 2.8 million inhabitants, represents alone 8.5% of the total population of CoM East signatories.

Figure 4. Geographic distribution of signatories



Source: JRC own elaboration

Figure 5. Share of signatories (N=481) and population for different city sizes



Source: JRC own elaboration

In terms of commitments, 29% of signatories joined only the first phase of the initiative (2020 targets), 58% joined in the second phase (2030 target) and the remaining renewed the commitments after 2015 (**Table 5**).

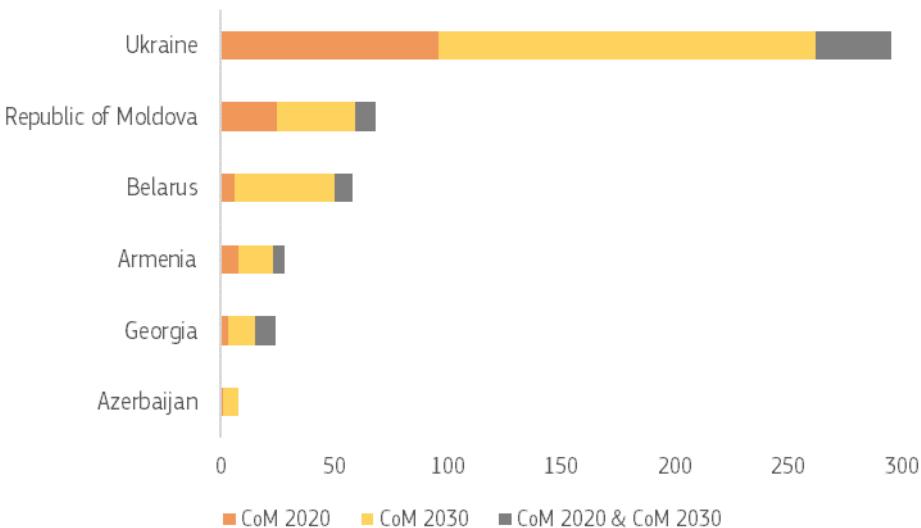
Figure 6 shows the share per country.

Table 5. COM EAST signatories' commitments

	CoM 2020	CoM 2030	CoM 2020 & CoM 2030	Total
Signatories commitments	139	278	64	481

Source: JRC own elaboration

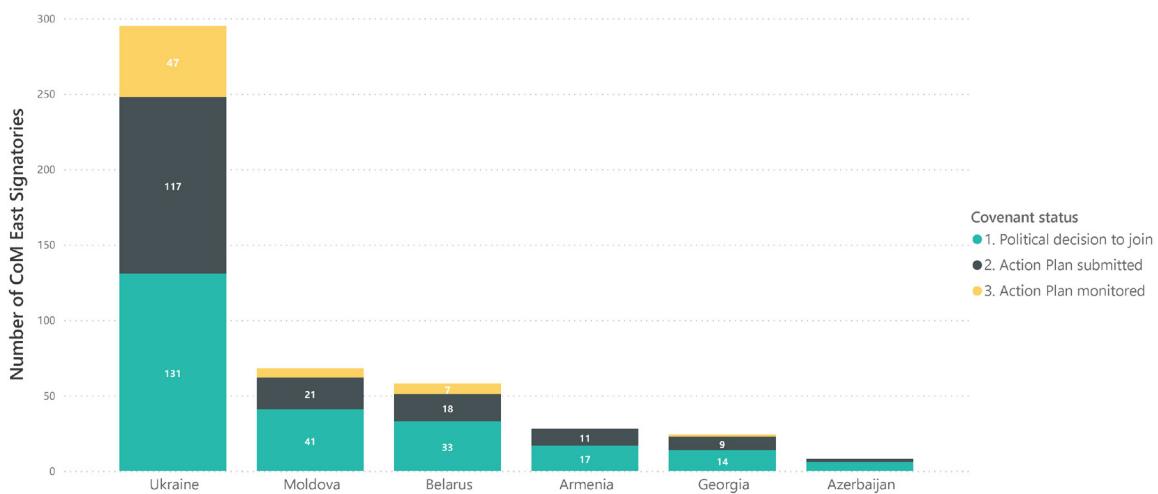
Figure 6. Distribution of signatories and related commitments per country



Source: JRC own elaboration

In terms of the status of Covenant signatories in the dataset, at the cut off date 231 signatories (48% of signatories covering 63% of total inhabitants) have submitted their plan (SEAP/SECAP). Eight signatories (6 from Ukraine and 2 from Belarus) were excluded from the analysis due to incomplete data. The number of signatories and submitted climate action plans per country is presented in Table 6, while Figure 7 presents the Covenant status of CoM East signatories as of mid May 2021.

Figure 7. Number of CoM East Signatories (N=481) by covenant status



Source: JRC own elaboration

Table 6. Signatories per country with a SEAP/SECAP submitted as of May 2021.

Country	Number of Signatories	Signatories/inhabitants	No. of SEAPs/SECAPs	Share of SEAPs/SECAPs	Population covered in the BEI	Share of population of SEAPs/SECAPs
Armenia	28	1,756,833	11	39%	1,469,714	84%
Azerbaijan	8	788,325	2	25%	104,866	13%
Belarus	58	4,151,014	23	40%	1,665,826	40%
Georgia	24	2,297,635	10	42%	1,912,000	83%
Moldova	68	1,945,852	27	40%	444,614	23%
Ukraine	295	21,724,483	158	54%	14,881,865	69%
Total	481	32,664,142	231	48%	20,478,885	63%

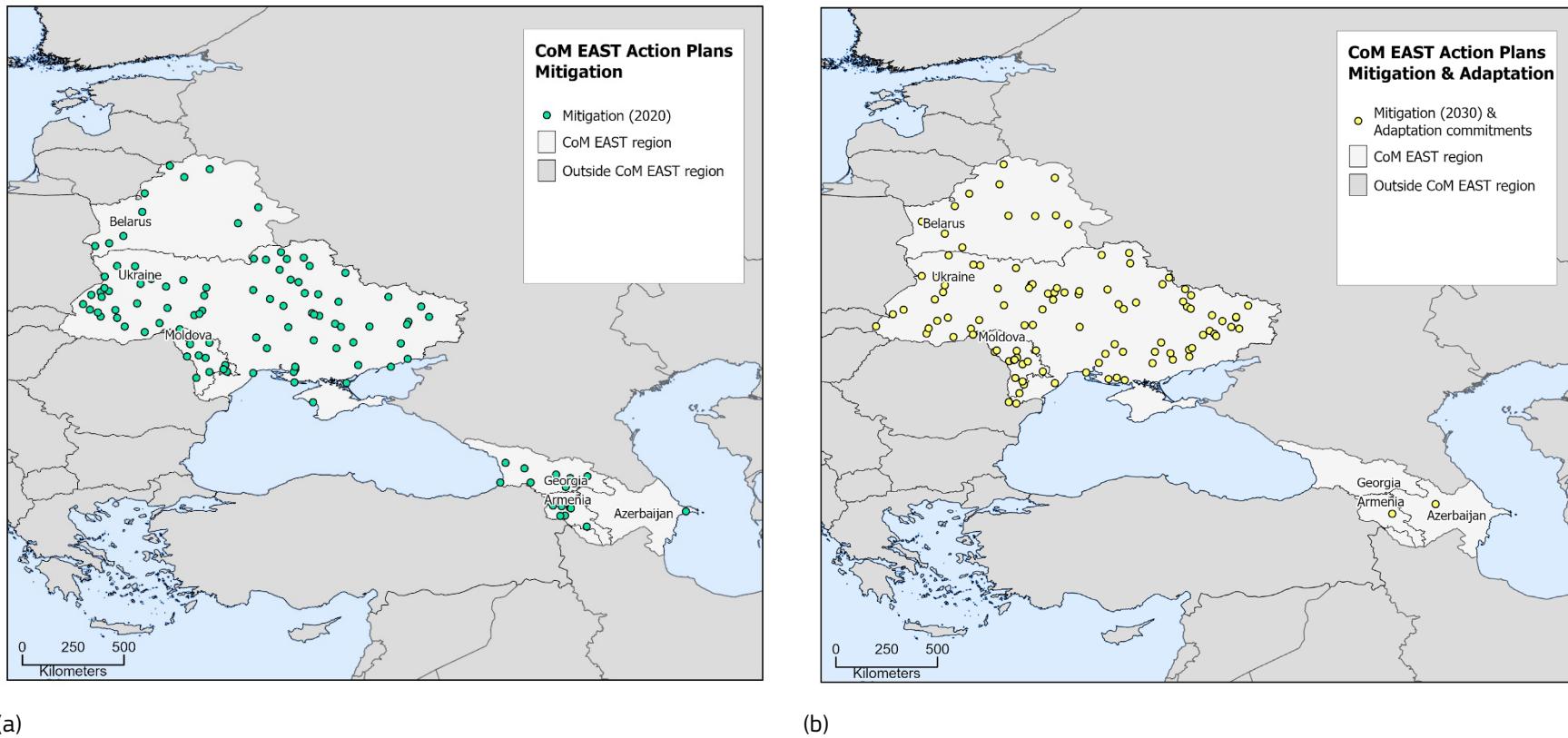
Source: JRC own elaboration

As presented in **Table 6** above, 158 Climate Action Plans were submitted by Ukraine signatories, covering 69% of Ukraine population. In other countries, the share of Climate Action Plans submitted is approximately 40%, with the exception of Azerbaijan where only 25% of signatories has submitted SEAPs/SECAPs (2 signatories out of total 8, covering 13% of total country population).

4.2 Signatories with a submitted SEAP/SECAP

As mentioned in the previous section, at the cut-off date there are 231 signatories that have submitted their SEAPs/SECAPs, representing 20.5 million inhabitants, 63% of the total CoM East population. An overview of the signatories with a submitted action plan is provided in Figure 8.

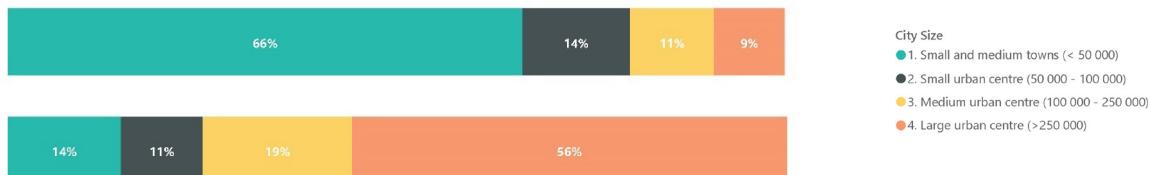
Figure 8. Overview of signatories with a submitted action plan covering only mitigation until 2020 (a) or both mitigation until 2030 and adaptation (b).



Source: JRC own elaboration

The majority of signatories with submitted SEAPs/SECAPs are small and medium towns, representing 66% of the total number of signatories as of May, 2021 (see Figure 9). This suggests that small cities can play an important role in climate change mitigation effort. In terms of population, the highest share (56%) of signatory's inhabitants belongs to large urban centres with a population of over 250,000 inhabitants.

Figure 9. Share of signatories (N=231) and population for different city sizes



Source: JRC own elaboration

As a result of the new longer-term target towards 2030 announced in October 2015, and integration of the adaptation in the CoM methodological framework⁷, the total number of signatories was organised into different categories. According to the moment of adhesion, the signatories' commitment varies and includes a combination of all the following: 20% mitigation target by 2020 (signatories of the Covenant up to October 2015), commitment to adaptation (Mayors Adapt signatories up to October 2015) and combined adaptation with mitigation target, 30% and Adaptation until 2030 (the Covenant of Mayors for Climate and Energy).

Figure 10 shows the distribution in percent of the signatories and population covered as a function of the commitment(s) (mitigation, adaptation) and target years (2020, 2030).

Mitigation 2020: The majority of the signatories having submitted a Climate Action Plan are those committed to the initial minimum target of reducing CO₂ by 20% by 2020: 118 signatories representing 14.8 million inhabitants, are committed exclusively to the 2020 mitigation targets.

Mitigation (2030) and Adaptation: refers to 102 signatories representing 5.2 million inhabitants having committed to the second phase of the initiative and submitted a SECAP

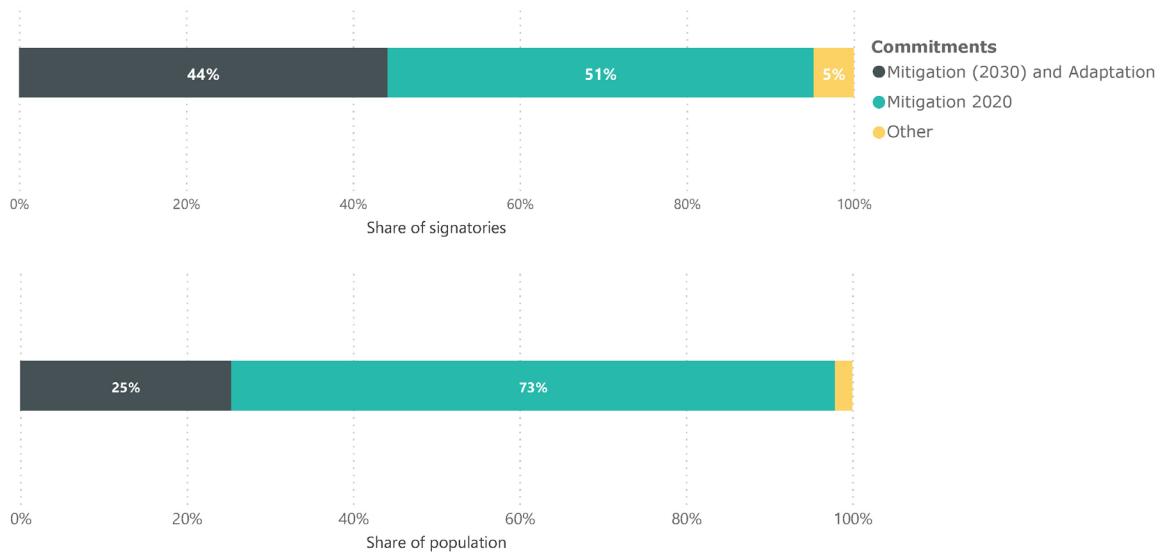
Mitigation 2020 and 2030: refer to 4 signatories, representing 0.22 million inhabitants, which previously committed to the 2020 mitigation target and have now renewed their commitment to 2030 for both mitigation and adaptation

Mitigation 2030: refers to 6 signatories committing to the 2030 target representing 0.2 million inhabitants not having yet submitted the adaptation part of their SECAP.

Mitigation (2020) and Adaptation: refers to 1 signatory that has committed to mitigation 2020 and adaptation only.

⁷ In October 2015, the EU-funded CoM initiative announced a new longer-term vision, and the inclusion of the adaptation was the result of the merging of Mayors Adapt and the Covenant of Mayors.

Figure 10. Share of signatories (N=231) and population covered by commitments and target year



Source: JRC own elaboration

As presented in **Figure 10**, 51% of signatories are committed exclusively to the 2020 mitigation targets, which represents 73% of the total population of signatories with SEAPs/SECAPs submitted.

4.2.1 Mitigation targets

Statistics on committed emission reductions for signatories with submitted SEAP/SECAP are presented in Table 7. Although the target requirement in the CoM East (2020 target) was to reduce CO₂ emissions by 20% by 2020, on average CoM 2020 signatories in this region have committed on the whole to a slightly higher target of 22% compared to baseline emissions.

Preliminary results of the analysis of 112 CoM 2030 signatories covering 5.6 million inhabitants, confirm the trend of 2020, with a slightly higher average emission reduction target of 33% compared to baseline emissions.

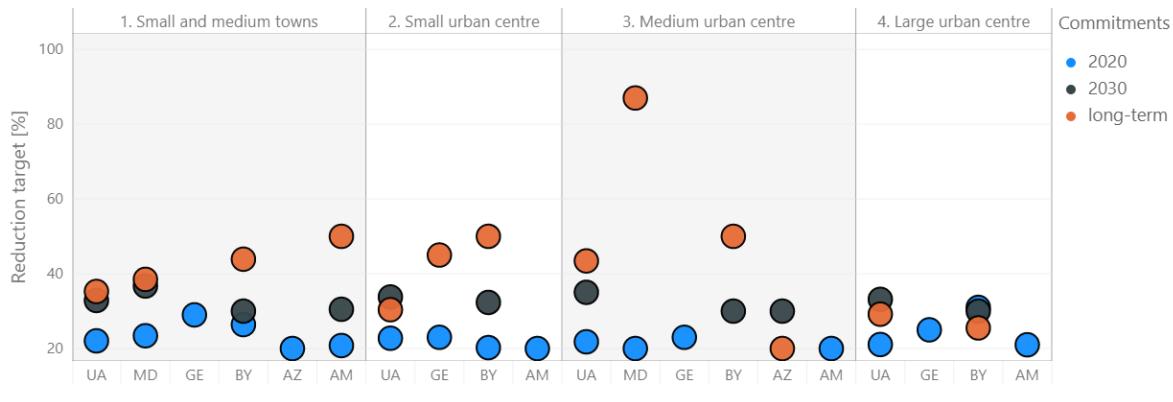
Table 7. Share of GHG emission reductions (N=231)

Number of action plans	commitments 2020	123
	commitments 2030	112
	long-term	85
Population [inhabitants]	commitments 2020	15,090,877
	commitments 2030	5,608,760
	long-term	9,088,722
Share of GHG emission reduction [% by 2020/2030] compared to baseline emissions (average)	commitments 2020	22%
	commitments 2030	33%
	long-term	37%

Source: JRC own elaboration

Figure 11 presents the average and long-term reduction targets committed by 2020/2030 for various countries and local authorities population groups. The largest average estimated emissions reduction among countries refers to the medium centres of Moldova (87% in long-term), while among signatories, the highest emission target refers to Nikopol, Ukraine (100% in long-term).

Figure 11. Average mitigation targets by commitments



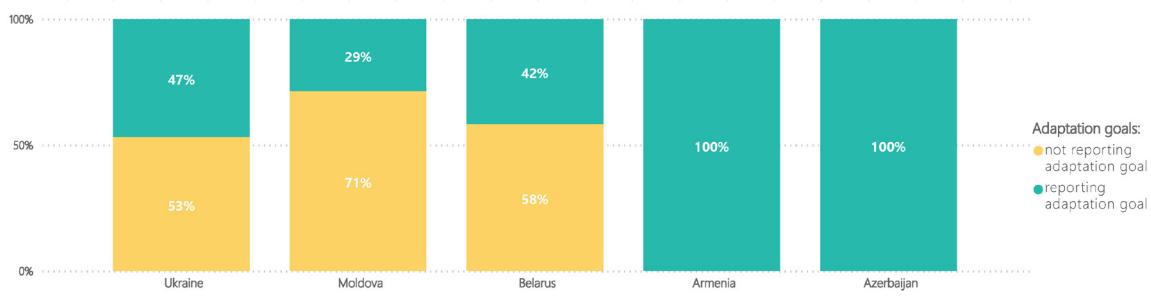
Source: JRC own elaboration

Based on the analysis performed for different city size groups, it can be concluded that among the signatories with 2020 targets, the largest average emission reduction refers to the signatories from small and medium towns (22.75 %). For commitments to 2030, the largest average target refers to small urban centres (33.42%). Among long-term targets, the highest average emission reduction refers to medium urban centres (46%). Among countries, the largest average emission reduction refers to signatories from Georgia and Belarus with commitments to 2020 (24.40%), from Moldova with commitments to 2030, and long-term commitments (36.71% and 55%, respectively).

4.2.2 Adaptation goals

As of May 2021, 107 signatories provided information on the adaptation pillar. However, only 48 signatories provided information on their adaptation goals. This is due to the structure of the reporting platform and to the “mandatory” reporting requirements. Starting from April 2020 reporting at least one adaptation goal became mandatory. The share of signatories reporting climate adaptation goals for each country is presented in Figure 12.

Figure 12. Share of signatories having reported adaptation goals



Source: JRC own elaboration

The 100% coverage in Armenia and Azerbaijan is related to the fact that there are only two signatories (one in Armenia and one in Azerbaijan) and both have reported their adaptation goal as shown in the figure above. In Ukraine, 37 signatories out of total 79 and in Belarus 5 out of 12 reported adaptation goals. None of signatories in Georgia committed to the CoM 2030 and therefore, reported adaptation goals.

Box 7. Covenant signatories and their commitments

481 signatories representing 32.6 million inhabitants by mid May2021.

High participation of small and medium-sized towns (75 % of the signatories)

48% signatories (231 signatories accounting for 20.5 million inhabitants) submitted SEAPs/SECAPs.

5 Assessments and monitoring

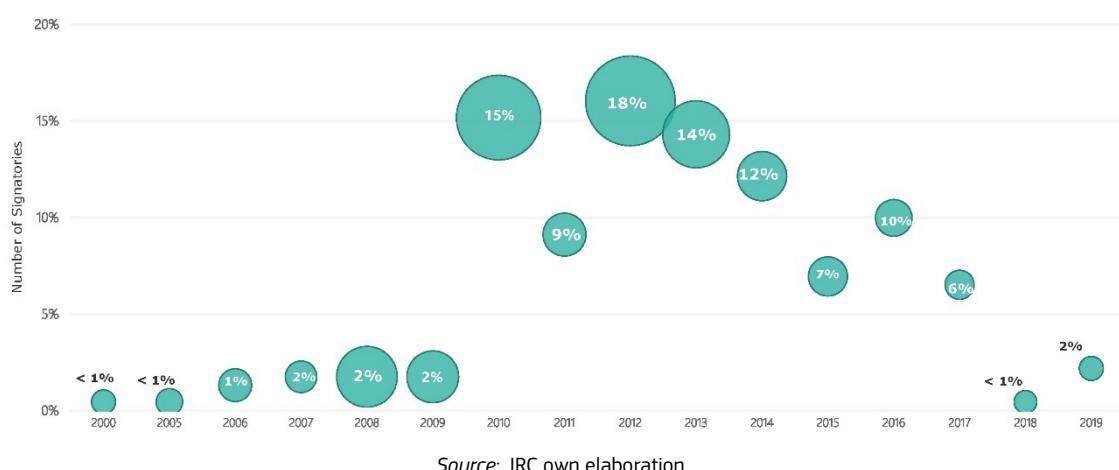
This chapter presents the analysis of statistical data reported in BEI and discusses the progress made by the signatories in terms of reporting on the monitoring of their emission inventory and emissions reduction achieved. The following sections focus on the 231 signatories who have submitted SEAP/SECAP documents.

5.1 Baseline emissions inventories

5.1.1 Reference year in the BEIs

Within the CoM framework signatories can select their baseline year, on the basis of data availability, against which setting their mitigation targets. The baseline emission inventory accounts the energy consumption and the GHG emissions recorded in the baseline year in the key CoM sectors. Figure 13 shows the years selected as baseline by signatories. 8% of signatories chose the BEI year between 2000 and 2009. The years between 2010–2016 have been selected as baseline years by more than 80% of CoM East signatories. Most of the signatories used the reference year for the BEIs between 2010 and 2014 (68% of signatories representing 71% of inhabitants). Since by setting the baseline year recently it becomes more challenging to reach the target, a low percentage of signatories selected the years 2018 and 2019 as baseline. In-depth analysis performed at the national level for various sizes of signatories did not show any additional patterns in choosing the reference years for the BEIs.

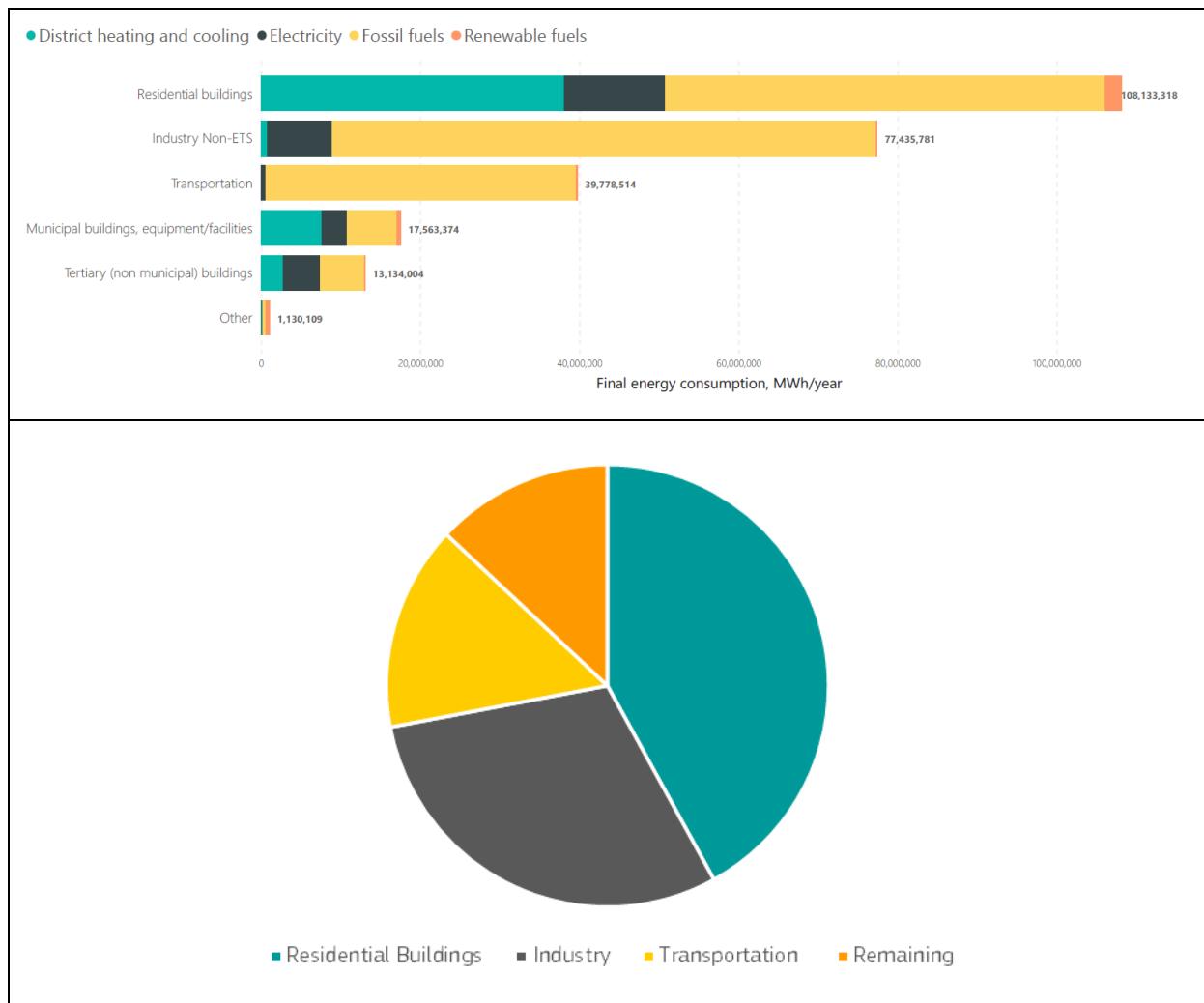
Figure 13. The number and percentage of the SEAPs/SECAPs per reference year in BEIs (N=231).



5.1.2 Final energy consumptions

The total final energy consumption reported by 231 signatories in their BEIs is 251.8 TWh/year, with a preponderant contribution from fossil fuels representing a combined 68.2% of the total. This is followed by the district heating and cooling (18.9%), electricity (11.5%), and renewables (1.4%). The residential buildings macro-sector represents 42% of total energy consumption. The Industry sector represents 30% of total energy consumption, followed by the transport sector accounting for 15%. A breakdown of final energy consumption by macro sectors is presented in the following Figure 14.

Figure 14. Final energy consumption in macro-sectors by energy carriers in BEIs. Including Energy sources (a) sectors' share (b)



Source: JRC own elaboration

Total final energy consumption of signatories according to their commitments and target years is presented in Table 8.

Table 8. Final energy consumption by signatories' commitments and target years

Commitment year/type	Signatories with commitments 2020	Signatories with commitments 2030	Signatories with commitments 2020 & 2030
Total final energy consumption in BEIs [MWh/year]	198,462,812	51,108,813	2,214,844
Average per capita [MWh/year]	1.34	0.82	0.94

Source: JRC own elaboration

5.1.3 Greenhouse gas emissions in the BEIs

Based on the performed analysis, the total GHG emissions in BEIs are 79.42 Mt CO₂-eq/year, with a preponderant contribution from the Stationary Energy (85 %) sector, followed by the Transportation (13 %) macro-sector and Other (2 %). It might be worth noting that this sector distribution does not follow the one of energy consumption. Absolute and per capita GHG emissions per country are presented in Table 9.

From the table it is also evident that in Ukraine, per capita emission values are high but the average per city is lower, which implies that local authorities are not highly populated. In Georgia, the average emission values per signatories are among the highest, however, per capita values are not very high. Georgian signatories have a high number of inhabitants.

The emissions reported in the BEIs by signatories represent the 7% of reported emissions by aggregated CoM Europe and CoM EAST signatories with 2020 targets and 8.7% of reported emissions by aggregated CoM Europe and CoM EAST signatories with 2030 targets.

Table 9. GHG emissions in the BEIs per country

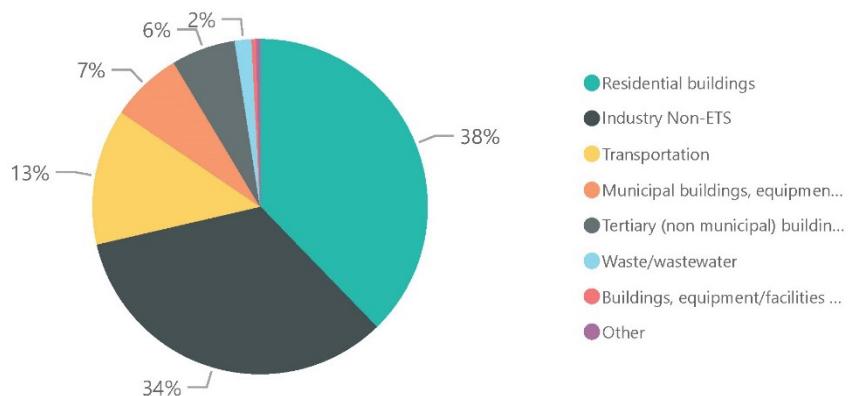
Country	N. action plans	Population of signatories	GHG emissions in BEIs [Mt CO ₂ -eq/year]	Average GHG emissions per capita in BEIs [t CO ₂ -eq/year/per capita]	Average GHG emissions per signatory in BEIs [t CO ₂ -eq/year/per signatory]
Armenia	11	1,469,714	1.18	0.80	107.06
Azerbaijan	2	104,866	0.12	1.14	59.60
Belarus	23	1,665,826	4.33	2.60	188.09
Georgia	10	1,912,000	3.50	1.83	350.25
Moldova	27	444,614	0.93	2.09	34.45
Ukraine	158	14,881,865	69.36	4.66	439.01
Total / Average	231	20,478,885	79.42	3.87	343.808

Source: JRC own elaboration

Table 10 illustrates the overall GHG emissions in the CoM macro-sectors reported in the BEIs. The three most emitting macro-sectors are responsible for 29.51 Mt CO₂-eq/year (Residential buildings), 27.23 Mt CO₂-eq/year (Industry non ETS) and 10.29 Mt CO₂-eq/year (Transportation) of the total CO₂-eq emissions.

The distribution of GHG emissions into the different CoM sub-sectors is presented in **Figure 15**.

Figure 15. GHG emissions in CoM sub-sectors reported in BEIs



Source: JRC own elaboration

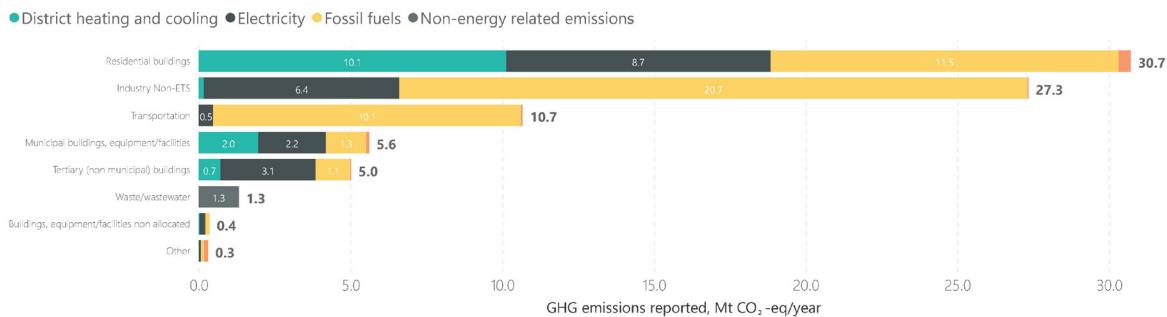
Table 10. GHG emission in macro-sectors reported in BEIs

Sector	Macro-sector	GHG emissions in BEIs [Mt CO2-eq/year]	Shares, %
BUILDINGS, EQUIPMENT, FACILITIES & INDUSTRIES	Municipal buildings, equipment/facilities	5.52	7.0 %
	Tertiary buildings, equipment/facilities	4.89	6.2 %
	Residential buildings	29.51	37.2 %
	Industry non ETS	27.23	34.3 %
	Industry-ETS	0.00	0.0 %
	Buildings, equipment/facilities non allocated	0.35	0.44 %
TRANSPORT	Transportation	10.29	13.0 %
OTHER	Waste/wastewater	1.32	1.6 %
	Other	0.30	0.38 %
TOTAL		79.42	100.0 %

Source: JRC own elaboration

Analysis of aggregated GHG emissions with regards to energy sources in various sub-sectors shows that 55% of the total emissions are from fossil fuels, followed by 26% from electricity and 16% from district heating and cooling. A breakdown of the GHG emissions by macro-sectors is presented in Figure 16.

Figure 16. Aggregated GHG emissions by macro-sectors and energy carriers in BEIs



Source: JRC own elaboration

Information on total GHG emissions of signatories according to their commitments and target years is presented in Table 11. The table provides the information both for signatories that have applied BEI and BAU approach for GHG emissions reduction target calculation. Table 12 presents the share of signatories having applied the BAU approach.

Table 11. Total GHG emissions by signatories' commitments and target years

Commitment year/type	Signatories with commitments 2020	Signatories with commitments 2030	Signatories with commitments 2020 & 2030
Total GHG emissions in BEIs [tCO ₂ -eq/year]	62,326,798	16,373,078	719,939

Source: JRC own elaboration

Table 12. Total GHG emissions n BEI of signatories with a BAU approach⁸

Country	Number of action plans	Population of signatories	GHG emissions in BEIs [t CO ₂ -eq/year]
Armenia	4	1,151,068	958,456
Georgia	9	1,791,200	3,368,176
Ukraine	1	15,074	60,088
Total	14	2,957,342	4,386,720

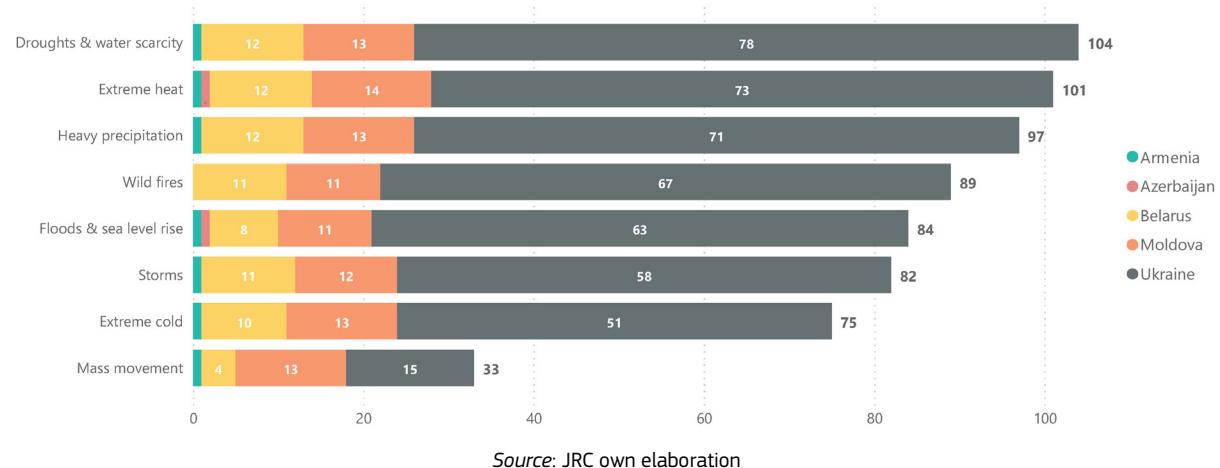
Source: JRC own elaboration

⁸ Signatories have not always reported data on BAU, therefore the information reported in the table is not to be considered as complete and final.

5.2 Risk and Vulnerability Assessments

A total of 107 signatories provided information on adaptation. Given that reporting climate hazards is mandatory and key to adaptation planning, 100% of signatories reported this information. The frequency of the most common climate hazards with high probability reported by each country is presented in Figure 17.

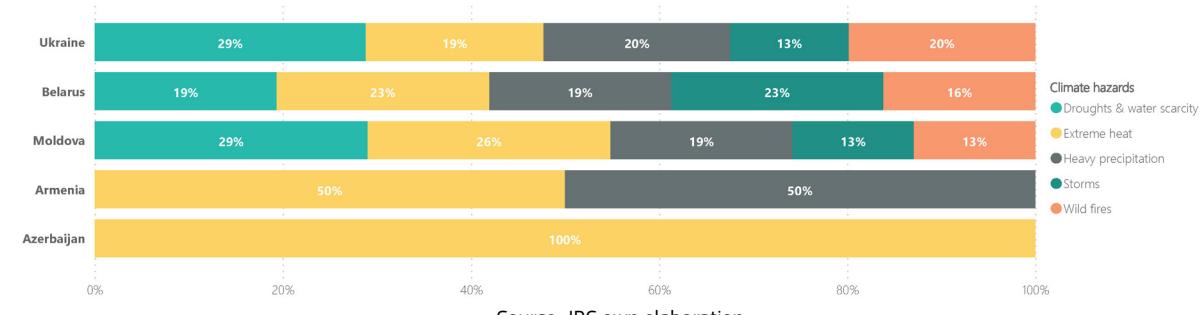
Figure 17. Number of signatories who reported top nine climate-related hazards with high probability



Source: JRC own elaboration

As can be seen in the figure above, substantial attention is given to *Droughts & water scarcity*, *Extreme heat*, and *Heavy precipitation*. Additional analysis performed for each of CoM East country shows that the most commonly mentioned hazards have a similar distribution for different countries (with the exception of the signatories from Azerbaijan and Armenia), as demonstrated in Figure 18. This figure provides the percentage of hazards reported by signatories in each country.

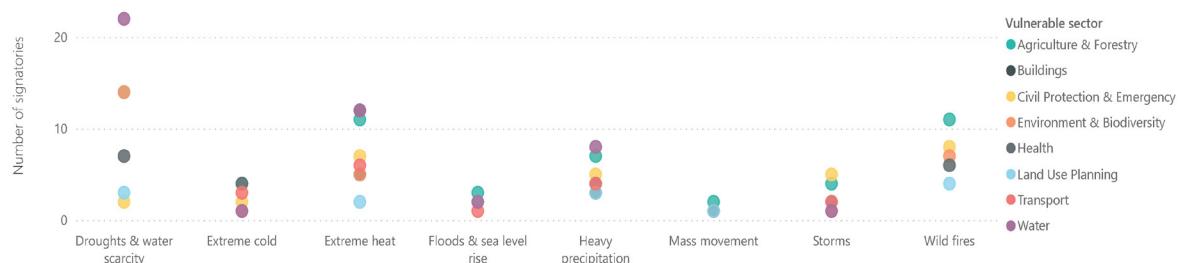
Figure 18. Frequency of most reported climate-related hazards by signatories for each country



Source: JRC own elaboration

The percentage of signatories reporting vulnerabilities is relatively low. Only 49 signatories out of the total have provided this information, even though vulnerabilities are a key dimension along with hazard and exposure for the climate risk assessment. The most common sectors to which a high level of vulnerability has been assigned by signatories for the mentioned climate-related hazards are: Agriculture & Forestry, Water, and Health.

Figure 19. Number of climate-related hazards by vulnerable sectors



Source: JRC own elaboration

5.3 Monitoring and implementation

This chapter assesses the overall progress made by CoM East Signatories in terms of achieved emissions reduction. The results on progress towards the reduction targets are based on currently available dataset of 22 signatories representing a population of 2.693 million inhabitants (which is 10% of signatories and 13% of the population with a submitted SEAP/SECAP).

Annex 1 provides detailed information on the signatories with MEIs subjected to the analysis in terms of monitoring and implementation reported in this section.

The majority of signatories chose 2010 as baseline year , while the MEIs submitted so far mainly refer to 2016 and 2017, as seen in

Figure 20.

Figure 20. The number and percentage of the SEAPs/SECAPs per reference year in BEIs and MEIs (N=22).

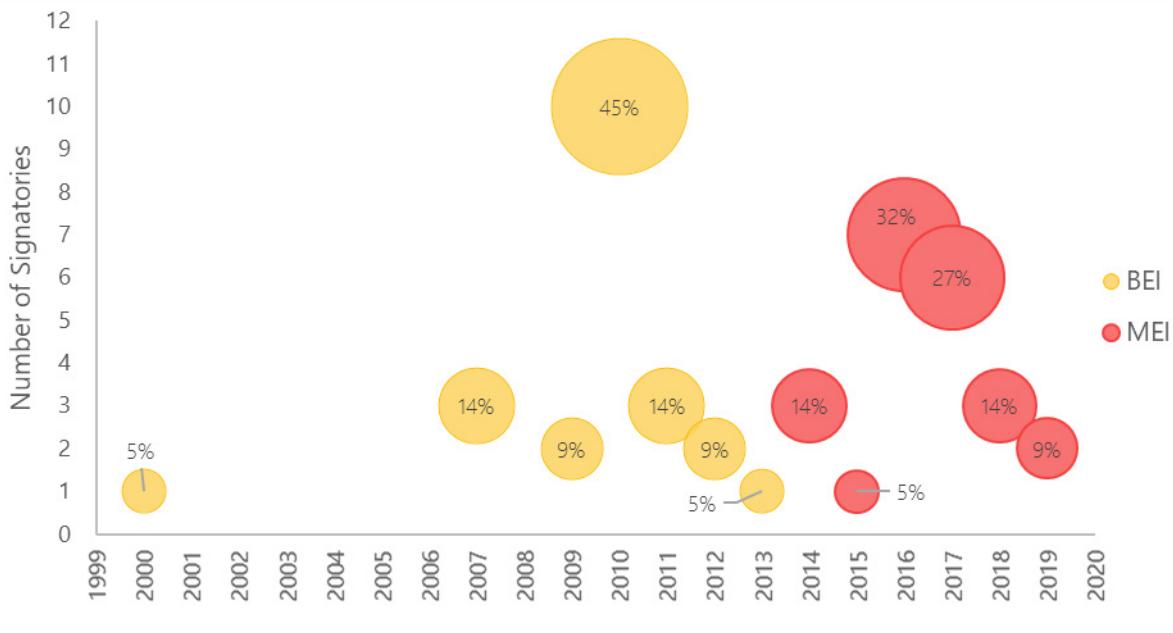


Table 13 shows the MEIs already provided by signatories per country in terms of the percentage of SEAPs submitted and Table 14 presents the MEI of signatories having adopted the BAU approach.

Table 13. Statistics of monitoring reports per country (N=21) using BEI approach

Country	Number of progress reports [MEIs]	% signatories with a MEI on total signatories with SEAPs/SECAPs	Population of signatories with progress reports [Million inhabitants]	% population of signatories with a MEI total population of signatories with SEAPs/SECAPs	GHG emissions in BEIs [Mt CO ₂ -eq/year]	GHG emissions in MEIs [Mt CO ₂ -eq/year]
Belarus	5	22%	0.227	14%	0.614	0.615
Moldova	2	7%	0.019	4%	0.021	0.014
Ukraine	14	9%	1.311	9%	3.920	3.047
Total	21	9%	1.556	7.6%	4.555	3.676

Source: JRC own elaboration

Table 14. Statistics of monitoring reports per country (N=1) using BAU approach

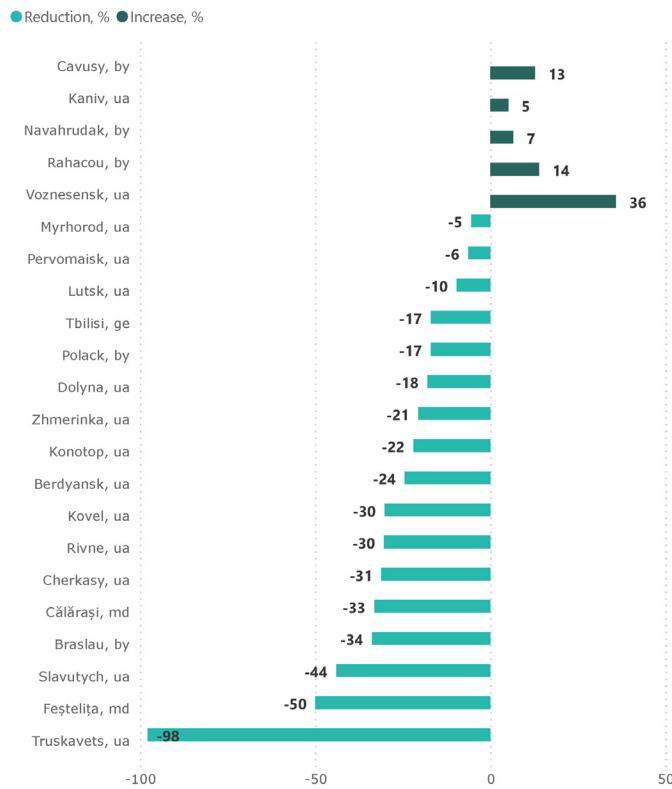
Country	Number of progress reports [MEIs]	% signatories with a MEI on total signatories with SEAPs/SECAPs	Population of signatories with progress reports [Million inhabitants]	% population of signatories with a MEI total population of signatories with SEAPs/SECAPs	GHG emissions in BAU 2020 [Mt CO ₂ -eq/year]	GHG emissions in MEI [Mt CO ₂ -eq/year]
Georgia	1	<1%	1.137	5.6%	4.063	3.371
Total	1	<1%	1.137	5.6%	4.063	3.371

Source: JRC own elaboration

The analysis shows a total decrease in GHG emissions of 18%, based solely on the difference between BEI/BAU and MEI. In some cases, the analysis shows an increase in GHG emissions compared to the BEI as seen in Figure 21.

Moreover, for some signatories, where indicated reduction in GHG emissions is higher than 40%, the achievement can only be confirmed by additional analysis of the monitoring report.

Figure 21. GHG emissions reduction/increase for each Signatory



Source: JRC own elaboration

Analysis shows that total GHG emissions in the MEIs amounted to 7.047 MtCO₂/year, with a predominant contribution from the buildings, equipment, facilities & industries (57 %) and transport (33%), followed by other sectors (10%).

The largest reduction in GHG emissions is observed in District heating and cooling (by 39%) and non-energy related emissions (by 17%), while the largest increase is observed with regard to fossil fuels (by 13%). Table

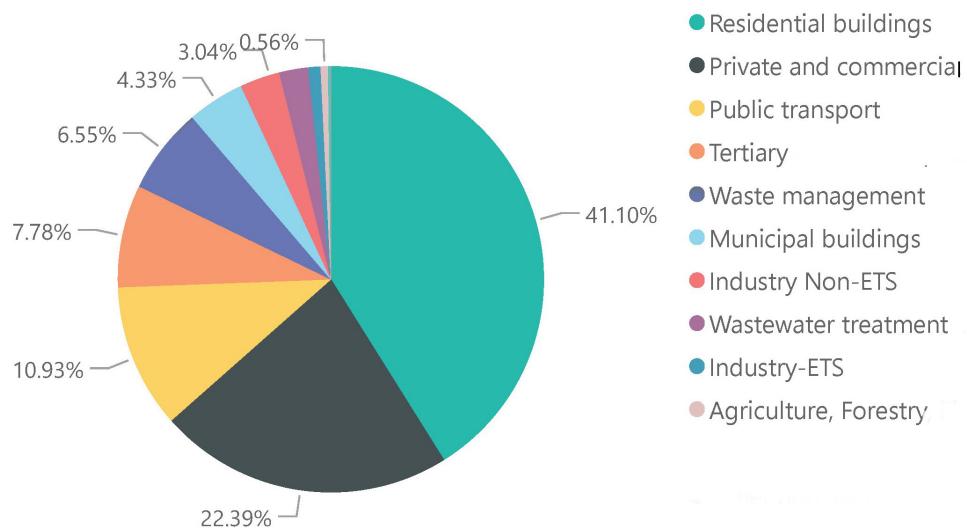
15 illustrates the overall GHG emissions in the CoM macro-sectors reported in the MEIs. The contribution of GHG emissions by macro-sectors is presented in Figure 22.

Table 15. GHG emission in macro-sectors reported in MEIs

Sector	Macro-sectors	GHG emissions in MEIs [Mt CO2-eq/year]	Shares
BUILDINGS, EQUIPMENT, FACILITIES & INDUSTRIES	Municipal buildings, equipment/facilities	0.305	4.33 %
	Tertiary buildings, equipment/facilities	0.548	7.78%
	Residential buildings	2.896	41.10%
	Industry non ETS	0.214	3.04%
	Industry-ETS	0.066	0.93%
TRANSPORT	Municipal fleet	0.015	0.21%
	Private and commercial transport	1.578	22.39%
	Public transport	0.770	10.93%
OTHER	Waste management	0.462	6.55%
	Wastewater treatment and discharge	0.154	2.19%
	Agriculture, Forestry, Fisheries	0.039	0.56%
TOTAL		7.047	100.00 %

Source: JRC own elaboration

Figure 22. Distribution of GHG emissions by macro-sectors reported in MEIs



Source: JRC own elaboration

Based solely on the difference between BEI/BAU and MEI, a conclusion on the progress of each city in achieving the emission reduction target was made and presented in Table 16 and Annex 1.

Table 16. Assessment of Signatories' progress on reaching the GHG emission reduction target

Country	Number of progress reports [MEIs]	Number of signatories on the right track	Share of signatories on the right track	Number of signatories not on the right track	Share of signatories not on the right track
Belarus	5	2	40%	3	60%
Georgia	1	1	100%	0	0%
Moldova	2	2	100%	0	0%
Ukraine	14	10	71%	4	29%
Total	22	15	68%	7	32%

Source: JRC own elaboration

6 Sustainable Energy and Climate Action Plans

This chapter is dedicated to the analysis of the actions reported in the climate Action Plans of CoM EAST. An aggregated overview of actions reported in 103 recently evaluated Climate Action Plans is provided. This analysis complements and updates previously developed studies included in other CoM EAST reports. A more detailed analysis of a sample of 38 SECAPs with best practice examples follows at section 6.2.

6.1 Policies and actions

The data reported in the MyCovenant platform from the whole sample of 231 CoM EAST SEAPs and SECAPs counts more than 9000 actions, with a major share dedicated to mitigation. Table 17 shows the total number of actions per pillar and the average values per plan.

Table 17. Number of actions per pillar and average per plan

Pillar	Number of actions	Number of actions (% out of total)	Number of plans (with actions)	Average number of actions per plan
Mitigation (only)	8,138	90%	230	35.4
Adaptation (only)	683	7%	93	7.3
Integrated (mitigation & adaptation)	234	3%	25	9.4

Source: JRC own elaboration

The first step of analysis consisted in the classification of mitigation and adaptation actions into the main CoM sectors such as buildings, transport, industry, energy supply and waste. Moreover, when reporting their mitigation actions, signatories assign the sector and the policy instrument to which the action refers and belongs to. For adaptation actions, sectors and vulnerable population groups are indicated. The list of sectors and most recurring policy instruments in the dataset for mitigation actions is reported in Table 18. Annex 3 presents the full list of sectors and policy instruments for mitigation actions, and vulnerable sectors and population for adaptation actions.

Table 18. List of sectors and policy instruments in SEAP/SECAPs

Sectors	Most recurrent policy instruments
Municipal buildings/facilities	Energy management, Building standards, Other
Residential buildings/facilities	Energy management, Building standards, Grants and subsidies, Other
Tertiary (non-municipal) buildings/facilities	Energy management, Building standards, Other
Industry	Energy certification labelling, Energy management, Grants and subsidies, Third party financing
Transport	Other, Mobility planning regulation, Grants and subsidies
Local heat/cold production	Other, Energy suppliers obligations, Grants and subsidies
Waste	Other, Land use planning regulation

Source: JRC own elaboration

The data extraction process indicated several issues related to data deficiency. In certain cases, the description of the planned activities was not detailed enough, and often signatories (especially larger cities) tended to group actions. This affected the results' analysis and the comparison of activities between the cities.

With regards to climate change adaptation, a specific additional issue is related to the reporting requirements, according to which it is not mandatory to link the adaptation actions to the hazard they are tackling, with the exception of key actions⁹. Only few signatories indicate them on the platform.

The 103 SECAPs evaluated between 2019 and 2021 belong to six countries in CoM EAST region, with the exception of Georgia, for which no SECAPs have been received in the indicated timeframe. The table below shows the distribution of SECAPs per country.

Table 19 Number of plans per country and population covered

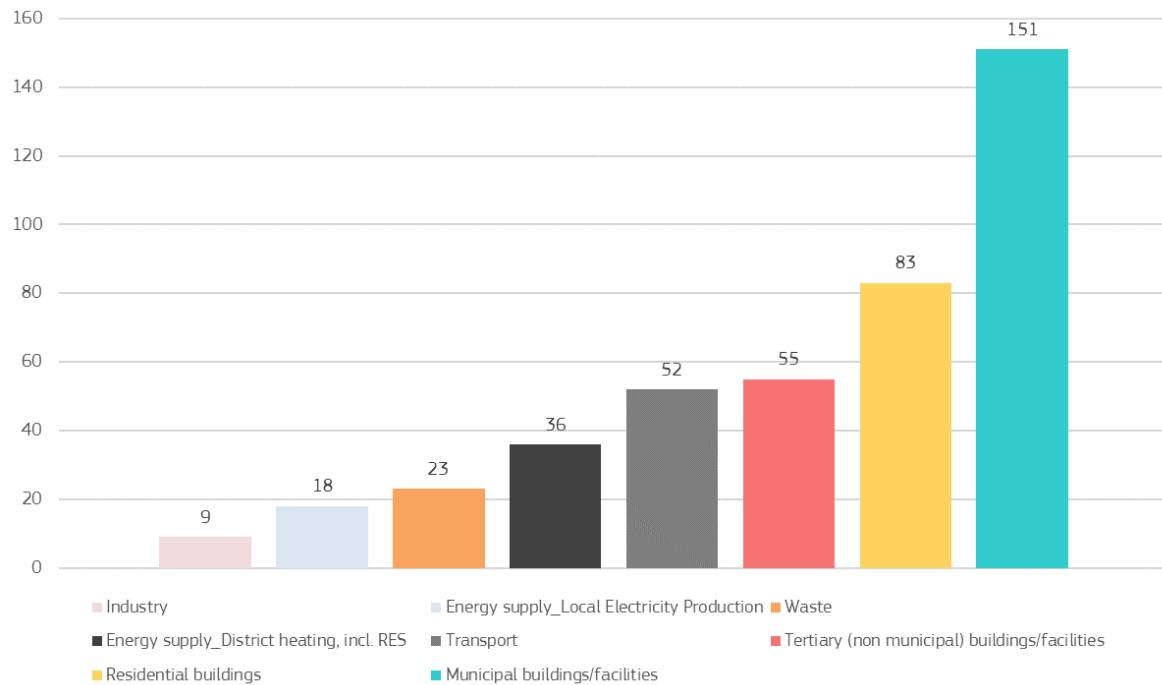
Country	Number of plans	Signatories' inhabitants
Armenia	1	19 900
Azerbaijan	1	102 861
Belarus	15	967 181
Moldova	7	65 767
Ukraine	79	7 531 466
Total	103	8 687 175

Source: JRC own elaboration

For mitigation the majority of actions refers to Buildings (Municipal buildings, followed by residential and tertiary). Actions in the transport sector are also common. The details are shown in Figure 23.

⁹ Signatories are required to indicate Key actions for both adaptation and mitigation pillars. For these actions, several additional fields are generated and some fields become mandatory.

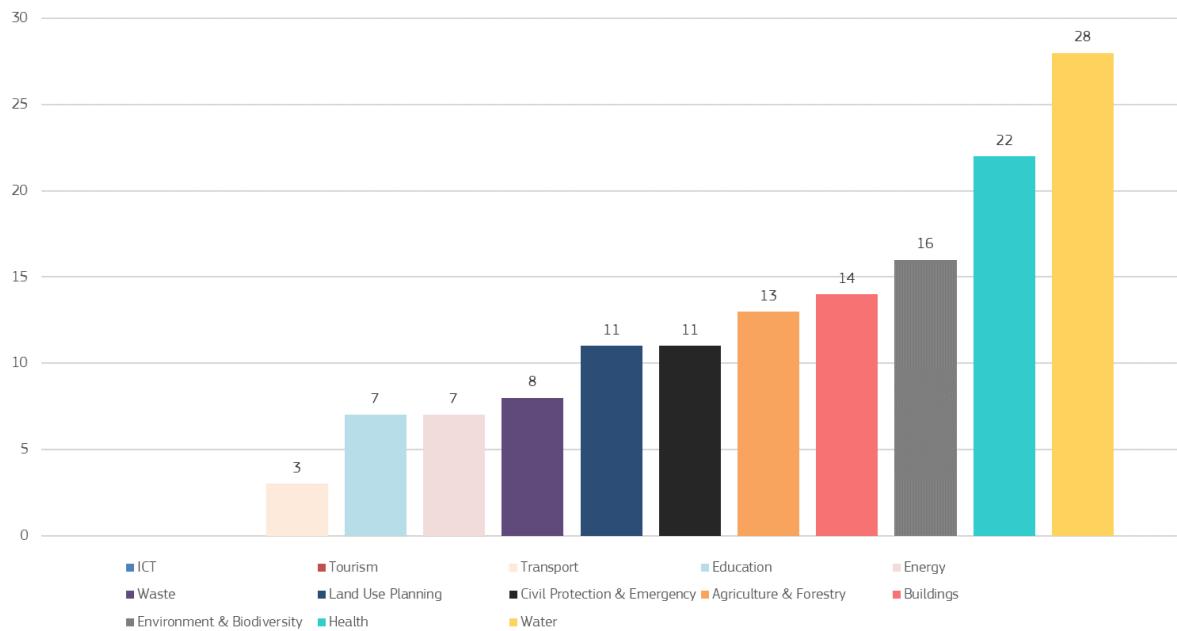
Figure 23. Climate change mitigation actions per sector in SECAPs



Source: JRC own elaboration

Water, health, and Environment and biodiversity are the sectors to which the majority of climate change adaptation actions refer to, as shown in Figure 24.

Figure 24 Climate change adaptation actions per sector in SECAPs



Source: JRC own elaboration

6.2 In-depth analysis of selected SECAPs

The present section shows the results of the detailed analysis of a sample of action plans submitted by signatories in the region with different ranges of population. The selected sample counts 38 plans selected within the dataset taking into account the commitment to both pillars for all countries, with the exception of Ukraine where four SEAPs have also been included for medium and large urban centres population categories. The climate action plans in the sample have been selected with the aim of taking into account both the share of signatories per country and the population covered by the signatories.¹⁰

Table 20 below summarises the sample of the selected signatories. As previously mentioned, the selection has also taken into consideration the population covered by the signatories. In alignment to the geographical distribution of signatories and submitted plans within CoM EAST, also in this sample the majority of plans has been submitted by local authorities from Ukraine.

Table 20. Number of plans per country and population covered

Country	Number of plans	Signatories' inhabitants
Armenia	1	19,900
Azerbaijan	1	102,861
Belarus	9	788,276
Moldova	7	65,767
Ukraine	20	6,149,359
Total	38	7,126,163

Source: JRC own elaboration

Figure 25 shows the geographical distribution of the plans selected in the sample classified according to the population groups. The figure shows that 18 out of the total 38 signatories chosen for this analysis belong to small and medium towns, 9 are small urban centre and 6 signatories are classified as medium urban centres. Although large urban centres represent 13% of the total number of signatories, they cover 77% of the total population of the sample. The full list of signatories within the sample is presented in Annex 2.

The sample covers policies and actions across all sectors including cross-cutting policies and actions covering different sectors as well. The estimates in total number of actions per pillar and average values per plan related to the 38 selected signatories are indicated in the table below (Table 21). A total of 584 actions has been analysed.

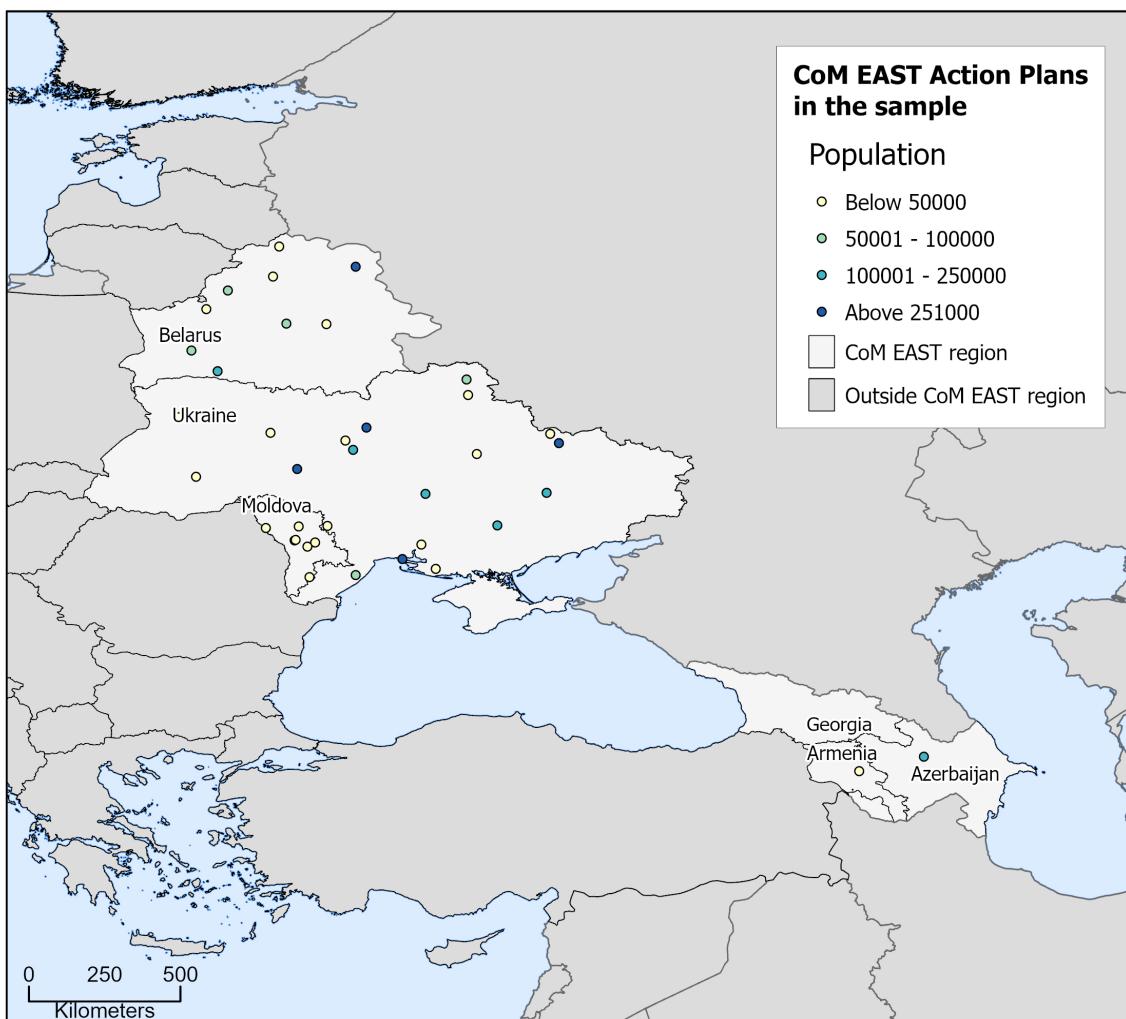
Table 21. Number of actions per pillar and average per plan

Pillar	Number of actions	Number of actions (% out of total)	Number of plans (with actions)	Average number of actions per plan
Mitigation (only)	437	75%	7	62.4
Adaptation (only)	129	22%	31	4.2
Integrated (mitigation and adaptation)	18	3%	31	0.6
Total	584	100%	38	15.4

Source: JRC own elaboration

¹⁰ Georgia is not represented in this sample as no plans from Georgian signatories have been submitted recently covering both pillars.

Figure 25. Geographical distribution of signatories with SECAPs in the sample

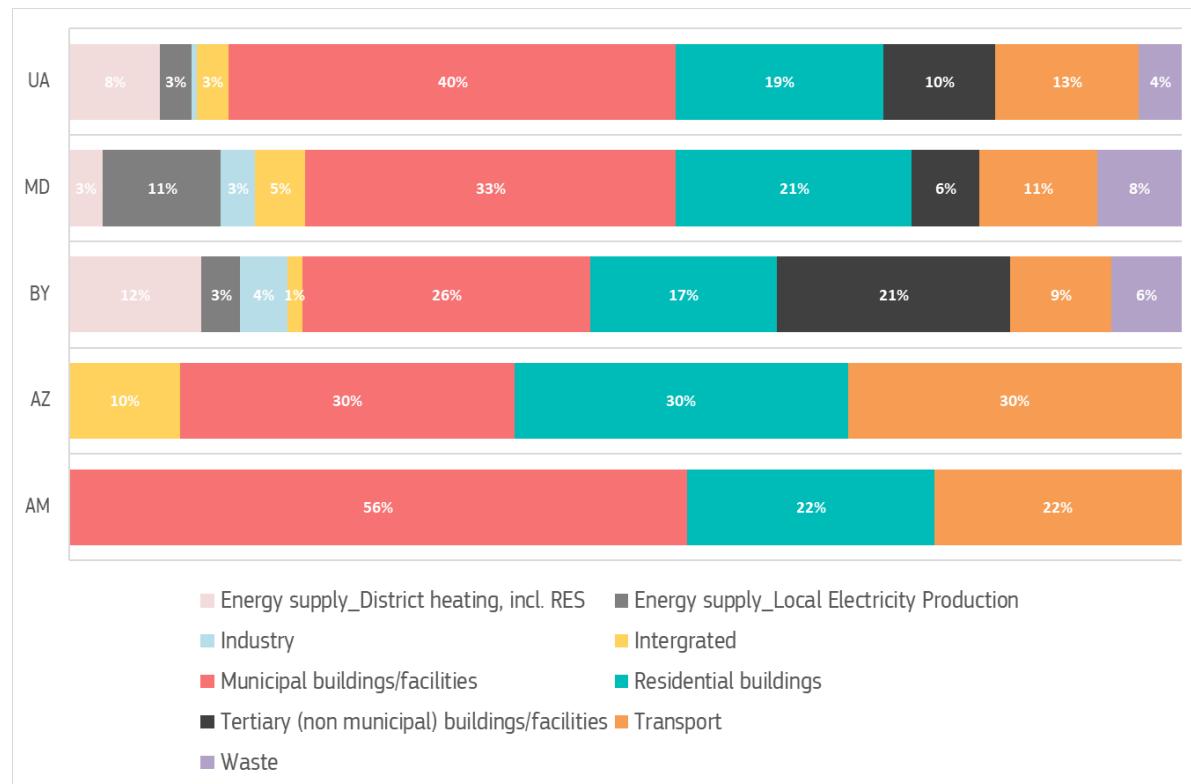


Source: JRC own elaboration

6.2.1 Mitigation Pillar

Signatories have planned mitigation actions to reduce energy consumption and GHG emissions mainly on Municipal buildings and facilities, followed by Residential and tertiary buildings, as shown in **Figure 26**.

Figure 26. Frequency of mitigation actions per sector



Source: JRC own elaboration

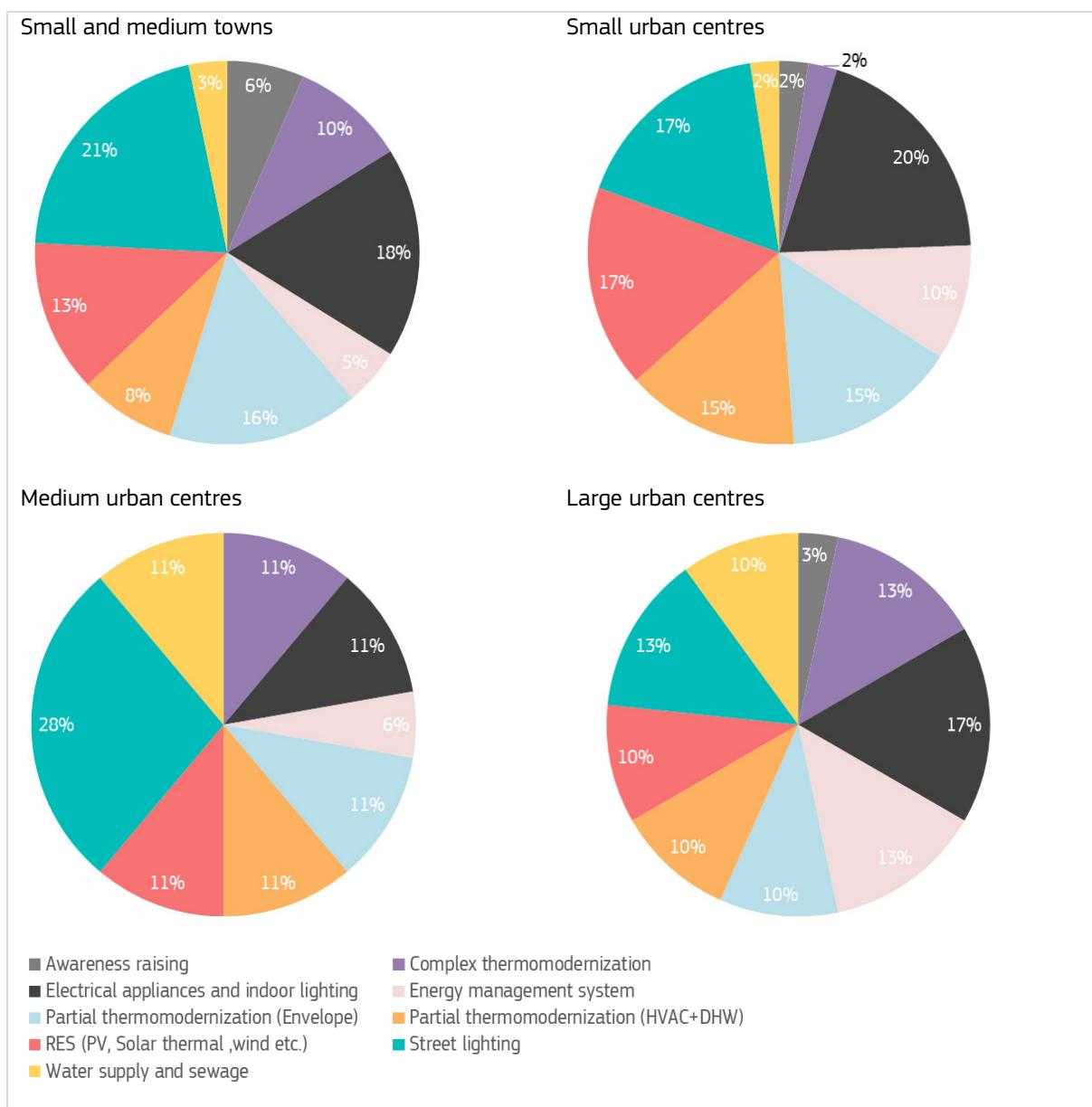
Based on the performed analysis, small urban centres are planning the majority of actions in Municipal buildings/facilities and Residential buildings. Medium urban centres group follows the same tendency including also numerous measures in the Transport sector. The sectors with most measures for Large urban centres are Municipal buildings/facilities, Residential buildings, Tertiary buildings/facilities and Transport.

For the mentioned sectors within all size groups of signatories the most frequently reported actions belong to Energy Management and Other.

6.2.1.1. Municipal buildings, equipment/facilities sector

Within the Municipal buildings, equipment/facilities sector, the most recurrent mitigation actions include the following: partial and complex modernization of buildings (33% of actions), modernization of street lighting system (19% of actions), efficient electrical appliances and indoor lighting (17% of actions) and integration of renewable energy systems (13% of actions). The frequency of specified actions for the different population classes of signatories is shown in Figure 27 below.

Figure 27. Frequency of mitigation actions in Municipal buildings, equipment/facilities sector for signatories grouped in population classes



Source: JRC own elaboration

As shown in the figure, the distribution is similar for all population classes, with the predominance of buildings modernisation. While it should be noted that Water supply and sewage sector shows higher share for medium and large urban centres. Based on the experience from Ukraine signatories, centralised water supply and sewage systems are not well implemented yet.

Moreover, within the “modernisation of buildings”, it is possible to distinguish between simpler activities, mainly concentrated on the building envelopes, typically occurring in less populated local authorities and more complex and complete interventions on buildings for medium and large urban centres.

For Municipal buildings, equipment/facilities sector, the most recurrent policy instruments are “energy management” and “other” for all population classes of signatories. The good practices for actions within this sector are provided below for different Signatories.

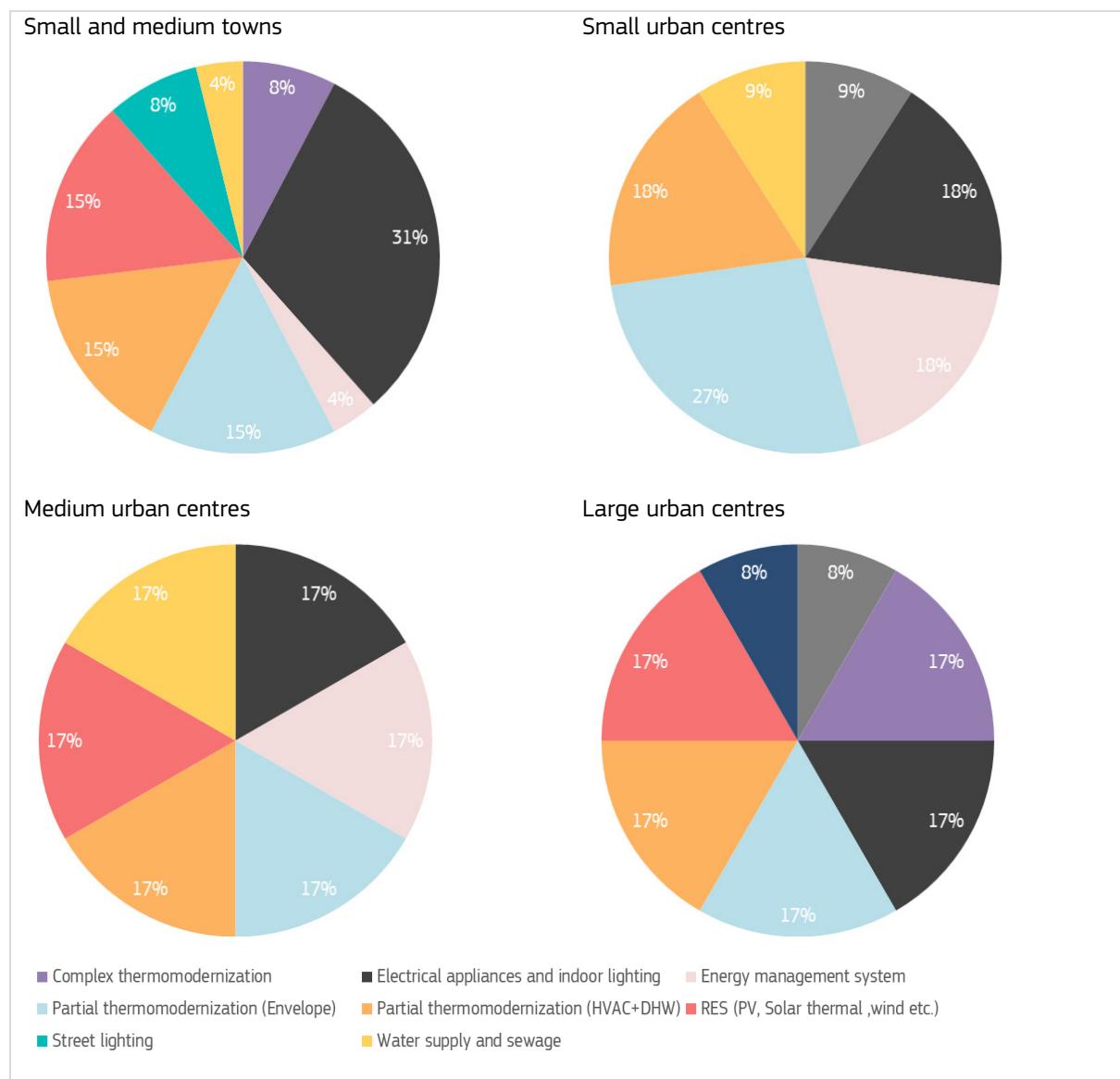
Signatory: Bila Tserkva	Country: Ukraine	Population: 209,815	Adhesion: 2016
Outdoor lighting system modernization Comprehensive modernization of the outdoor lighting system in order to improve energy efficiency and reduce greenhouse gas emissions will include the following activities: gradual replacement of incandescent and sodium lamps with modern LED lamps; implementation of dispatching and control system; use of solar panel for lighting of 400 pedestrian crossings; increasing the level of illumination of the city streets due to the installation of additional LED light points. Action implementation period: 2017-2020 <u>Investment costs:</u> 1.7 million euros <u>Energy savings:</u> 1,216 MWh/a <u>CO₂ reduction:</u> 1,452 tCO ₂ /a			
Signatory: Ialoveni			
Country: Republic of Moldova			
Population: 15,300			
Adhesion: 2016			
Elaborate and display energy certificates on municipal buildings which have to be retrofitted Display of energy certificates at the entrances of public buildings will raise awareness of the population on the energy issues and can support the administration of the building in management of energy consumption. Action implementation period: 2018-2019 <u>Investment costs:</u> 15.5 thousand euros			
Signatory: Kropyvnytskyi	Country: Ukraine	Population: 242,900	Adhesion: 2013
Carrying out energy monitoring and analysis of consumption of energy resources and energy carriers. City of Kirovograd introduced energy management software "Energoplan" in order to monitor, analyze and present data on the use of energy resources, water, funds in the buildings of subordinated institutions. This analysis allows to: <ul style="list-style-type: none"> - determine the energy efficiency of buildings and compare it using the reports; - analyse the consumption of all building resources; - compare the consumption of the organization and the building; - identify various changes in the dynamics of energy consumption; - compile a rating of buildings for energy audit; - assess the impact of weather conditions on energy consumption; - monitor compliance with the use of limits. Action implementation period: 2016-2020 <u>Energy savings:</u> 1,300 MWh/a <u>CO₂ reduction:</u> 596 tCO ₂ /a			
Signatory: Zolochiv AC, Kharkiv region	Country: Ukraine	Population: 25,113	Date of adhesion: 2019-04-24
Complex thermal modernization of public building. Investment projects in public buildings: replacement of wooden windows and doors with energy-saving ones; installation of local ventilation systems with recuperation; insulation of the roof and basements; insulation of external walls; reconstruction of heating systems; installation of solar panels to meet the needs of hot water; replacement of boilers with new ones with higher efficiency; conversion of boiler houses to alternative fuels. Improving energy efficiency in public buildings, Use of renewable energy sources Action implementation period: 2019-2027 <u>Investment costs:</u> around 10.97 million euros <u>Energy savings:</u> 3,808 MWh/a <u>Renewable energy:</u> 534.8 MWh/a <u>CO₂ reduction:</u> 1,1027.5 tCO ₂ /a			

6.2.1.2. Tertiary (non municipal) buildings, equipment/facilities sector

The most recurrent mitigation actions within this sector for all sizes of signatories include partial and complex modernization of buildings (42% of actions), efficient electrical appliances and indoor lighting (24% of actions), and integration of renewable energy systems (13% of actions).

The frequency of specified actions for different population class is shown in Figure 28. As shown in the Figure below, the distribution of actions changes in the different classes of cities. For instance, there are no actions related to renewable energy sources in tertiary buildings in the plans of small urban centres. Awareness raising has not been indicated as mitigation action for small and large urban centres, and energy management is missing as action for large urban centres.

Figure 28. Frequency of mitigation actions in Tertiary (non municipal) buildings, equipment/facilities sector for signatories grouped in population classes



Source: JRC own elaboration

Within the modernization of buildings, it can be concluded that for all groups of signatories the most common action relates to partial thermomodernization, in particular, the insulation of the envelope.

The most frequently indicated policies for mitigation actions for Tertiary (non municipal) buildings, equipment/facilities sector for all groups of signatories are Energy Management and Other.

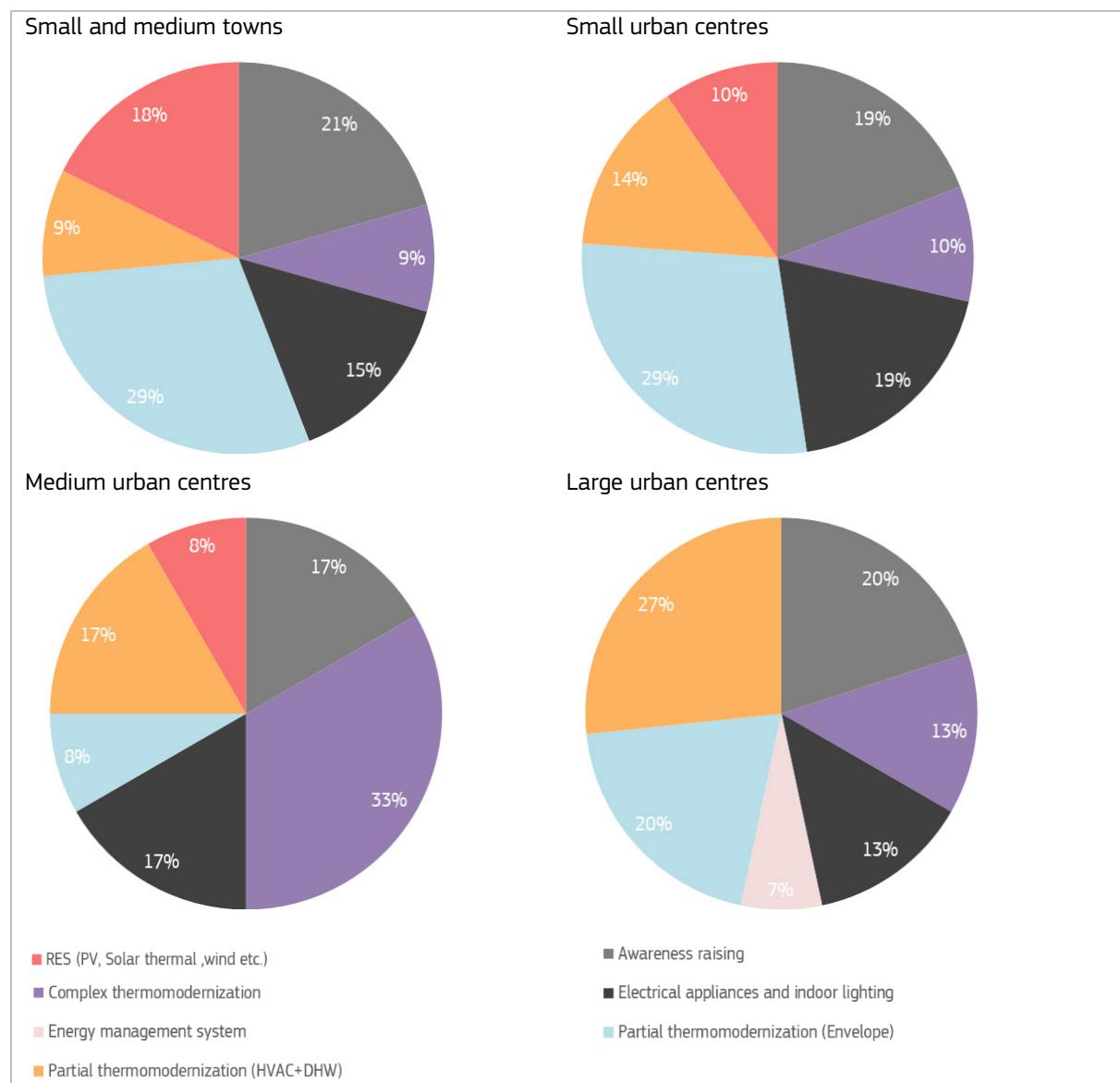
A good practice example within this sector is provided in the box below.

Signatory: Pinsk City	Country: Belarus	Population: 150,000	adhesion: 2018
<p>Energy efficiency improvements in Tertiary buildings Implementation of modern energy efficient operating technologies, processes, equipment and materials in production Action implementation period: 2013-2017 <u>Investment costs:</u> 3.3 million euros <u>Energy savings:</u> 13,761 MWh/a <u>CO₂ reduction:</u> 6,129 tCO₂/a</p>			

6.2.1.3. Residential buildings sector

Within the residential sector, the most recurrent mitigation actions for all classes of signatories include partial and complex modernization of buildings (52% of actions), awareness raising (20% of actions), efficient electrical appliances and indoor lighting (16% of actions) and integration of renewable energy systems (11% of actions). The frequency of specified actions for different groups is shown in Figure 29 below.

Figure 29. Frequency of mitigation actions in the Residential buildings sector for signatories grouped in population classes



Source: JRC own elaboration

In the residential buildings sector a significant attention is focused on raising awareness. The share of integration of renewable energy sources is relatively small (with the exception of small and medium towns with 18% of the action frequency) and in large urban centres the action is not represented at all. Moreover, Energy Management and Other are the most frequently indicated policies for mitigation actions. In the boxes below, good practices related to residential sector are provided.

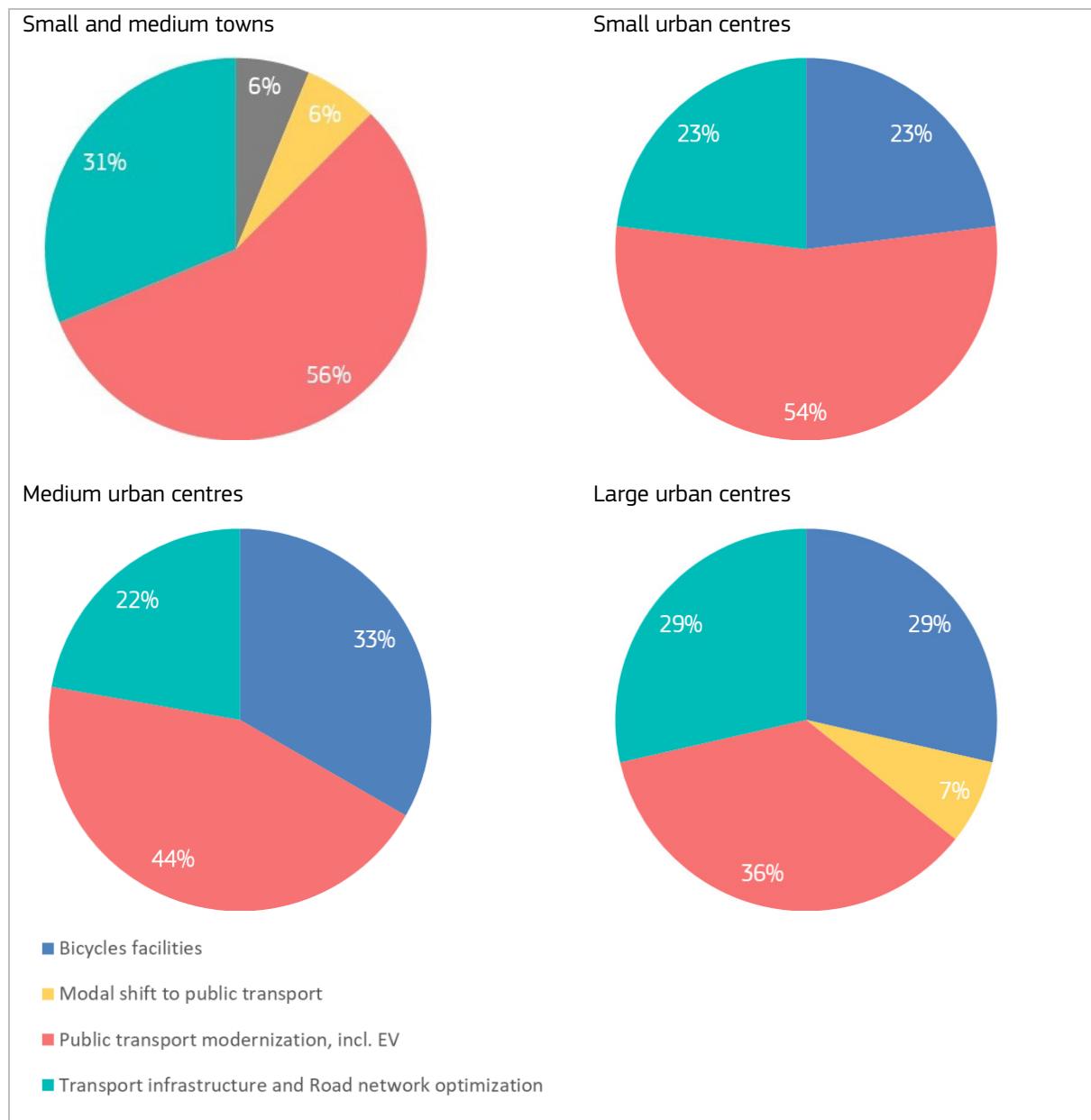
Signatory: Bila Tserkva	Country: Ukraine	Population: 209,815	adhesion: 2016
<ul style="list-style-type: none"> — Increasing energy efficiency in residential building sector — encouraging individuals, condominiums and housing and communal services to participate in the state energy efficiency program that provides partial repayment of loans for energy efficient equipment and materials; — adoption of a city program to support condominiums, which will provide additional financial support for energy efficiency measures in apartment buildings at a rate of 40% of the cost of energy efficient equipment and materials; — installation of heat metering devices at the expense of the city budget and funds provided in investment programs of heat supply company, to ensure 100% accounting; — providing information support on opportunities to participate in international energy efficiency programs in buildings; — conducting informational and educational activities on energy saving opportunities in homes. — Promoting behavioural changes for energy savings in everyday life <p>Action implementation period: 2017-2030 <u>Investment costs:</u> 0.4 million euros <u>Energy savings:</u> 7,514 MWh/a <u>CO₂ reduction:</u> 8,967 tCO₂/a Installation of heat energy metering and regulation (heat and hot water supply) in multi-apartment buildings Action implementation period: 2017-2018 <u>Investment costs:</u> 1.9 million euros <u>Energy savings:</u> 47,341 MWh/a <u>CO₂ reduction:</u> 11,735 tCO₂/a Thermal modernization of multi-apartment buildings Action implementation period: 2017-2030 <u>Investment costs:</u> 204 million euros <u>Energy savings:</u> 185,544 MWh/a <u>CO₂ reduction:</u> 46,940 tCO₂/a</p>			

Signatory: Kličaŭ	Country: Belarus	Population: 15,148	adhesion: 2016
<p>Complex of measures for residential buildings sector</p> <ul style="list-style-type: none"> — Increasing the thermal resistance of building envelopes and structures; — Introduction of heating systems façade control in buildings with different orientations (allows to reduce heat consumption due to more complete use of solar radiation, and also provides additional heat supply only in rooms located on the windward facade of the building using heat consumption regulators); — Awareness raising works with the population (electricity); — Introduction of energy efficient lighting equipment. <p>Actions implementation period: 2010-2030 <u>Investment costs:</u> 0.695 million euros <u>Energy savings:</u> 5,758 MWh/a <u>CO₂ reduction:</u> 4,064 tCO₂/a</p>			

6.2.1.4. Transport sector

Within the transport sector, the most recurrent typical mitigation actions for all groups of signatories include public transport modernization including electrical vehicles (48% of actions), transport infrastructure and road network optimization (27% of actions), and implementation of bicycle facilities (21% of actions). The frequency of specified actions for different population groups is shown in **Figure 30** below.

Figure 30. Frequency of mitigation actions in Transport sector for signatories grouped in population classes



Source: JRC own elaboration

As can be seen in the Figure above, the distribution of activities changes according to the size of signatories. For instance, only small towns and large urban centre groups indicated actions related to the modal shift to public transport with a frequency of 7% out of the total of actions. In addition to the mentioned trend, it can be concluded that the share of public transport modernization (including EV) is the highest in small and medium towns (56% out of total actions) and decreases in the other groups (54%, 44% and 36% for small urban centres, medium and large urban centres respectively).

Within the Transport sector, the most recurrent mitigation actions for all population classes of signatories are Other and Grants and subsidies.

In the boxes below, good practices related to the transport sector are provided.

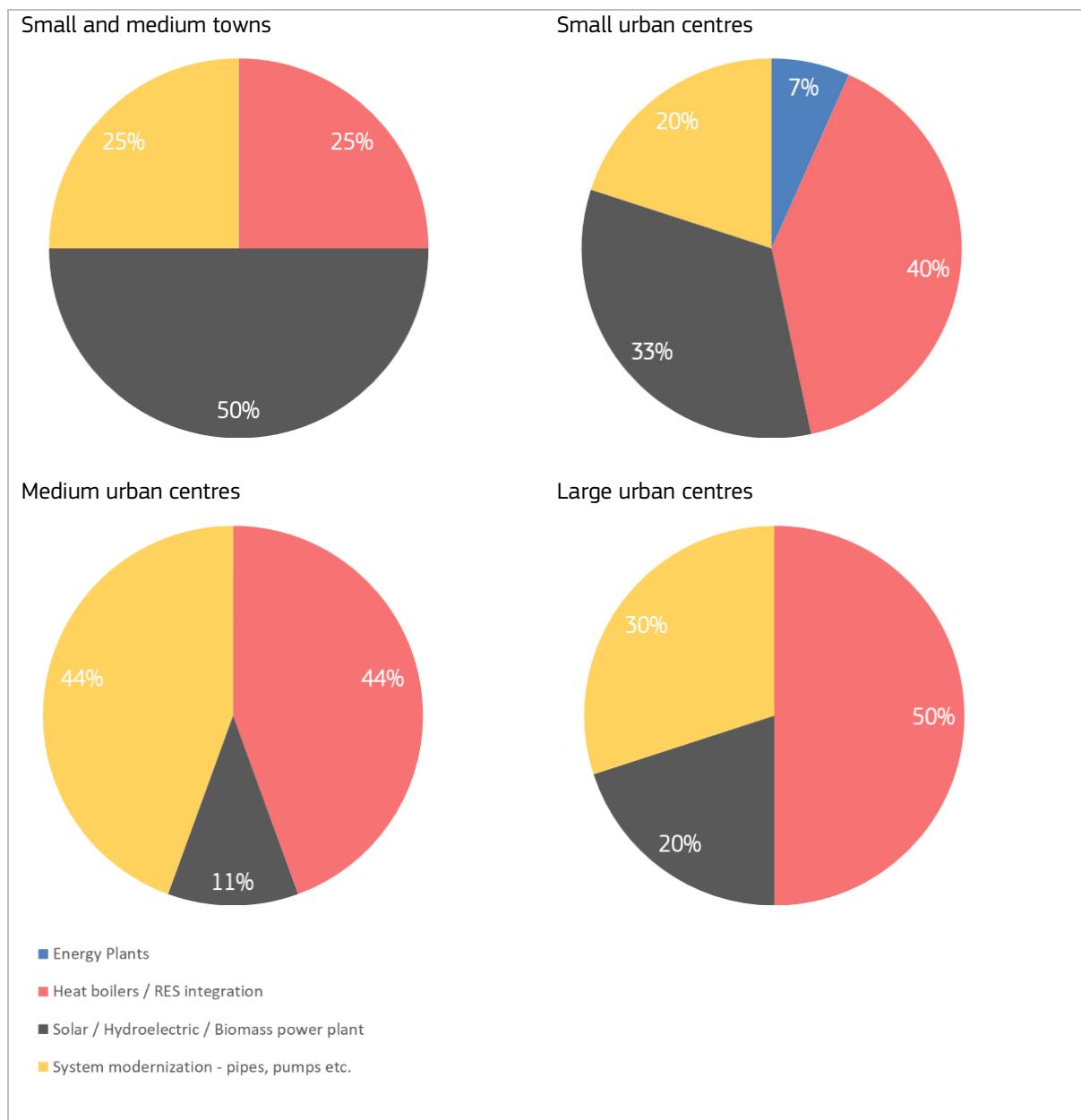
Signatory: Ialoveni	Country: Republic of Moldova	Population: 15,300	adhesion: 2016
<p>Modal shift to public transport. Improvement of the public transport infrastructure; Improvement of trolleybus lines and Park. Ialoveni City Hall has decided to create a Public Transport Network by creating a trolleybus park. The trolleybus park is expected to be formed from 10 trolleybuses. In order to reduce the necessary investments, it was decided that the trolleybuses will be equipped with accumulative batteries and will travel through the City without contact network. From Chisinau contact network up to the furthest distance point in Ialoveni City it is around 5.7km, the total expected travel distance without contact network is around 18 km. The accumulative batteries can maintain autonomy for a distance of 55km. The battery can be fully charged in 25 minutes. In addition, infrastructure has to be adjusted by renewing 22 trolleybus stations. Action implementation period: 2017-2025 <u>Investment costs:</u> 2.343 million euros Energy savings: 670 MWh/a <u>CO₂ reduction:</u> 178.9 tCO₂/a</p>			

Signatory: Fastiv	Country: Ukraine	Population: 47,284	adhesion: 2016
<p>Use of alternative means of transportation. Expanding the use of alternative means of transportation by introducing pedestrian and bicycle traffic (promotion of cycling and construction of bike paths, etc.), the introduction of so-called "Days of the pedestrian zone", "Days without cars". Action implementation period: 2017-2030 <u>Investment costs:</u> around 3.3 thousand euros <u>CO₂ reduction:</u> 26.7 tCO₂/a</p>			

6.2.1.5. Local Electricity and Heat/Cold Production

Within Local Electricity and Heat/Cold Production, the most recurrent mitigation actions include modernization/replacement of heating boilers including the integration of RES (37% out of all actions), Solar PV / Hydroelectric / Biomass power plants constructions (33% out of all actions) and heat supply and distribution system (28% out of all actions) modernization. The frequency of specified actions for different city groups is shown in Figure 31 below.

Figure 31. Frequency of mitigation actions in Local Electricity and Heat/Cold Production sectors for signatories grouped in population classes



Source: JRC own elaboration

As can be seen in the Figure above, the distribution of actions changes according to the size of signatories. Only in small and medium towns there is a significant share of actions related to Solar PV / Hydroelectric / Biomass power plants constructions (50%). Unlike other city size groups, in small urban centres actions related to Energy Plants shows a 7% of the action frequency. The largest share of heat boiler modernization and RES integration actions is observed in large urban centres. Moreover, Other and Third party financing are the most frequently indicated policies for mitigation actions.

In the boxes below, good practices related to Electricity and Heat and cold production are provided.

Signatory: Kyiv	Country: Ukraine	Population: 2,819,566	adhesion: 2011
<p>Complex of mitigation actions for local heat production This good practice includes several measures in heat production, namely: The use of renewable energy sources for heat supply of a residential area Construction of a biofuel boiler house Construction of a biofuel CHP plant Installation of 3 heat pumps in the technological scheme of the CHP plant Installation of heat meters with dispatching unit for residential buildings Action implementation period: 2017-2020 <u>Investment costs:</u> around 53.1 million euros Energy savings/Renewable energy: 489.4 thousand MWh/a <u>CO₂ reduction:</u> 242.5 thousand tCO₂/y</p>			

6.2.1.6. Waste

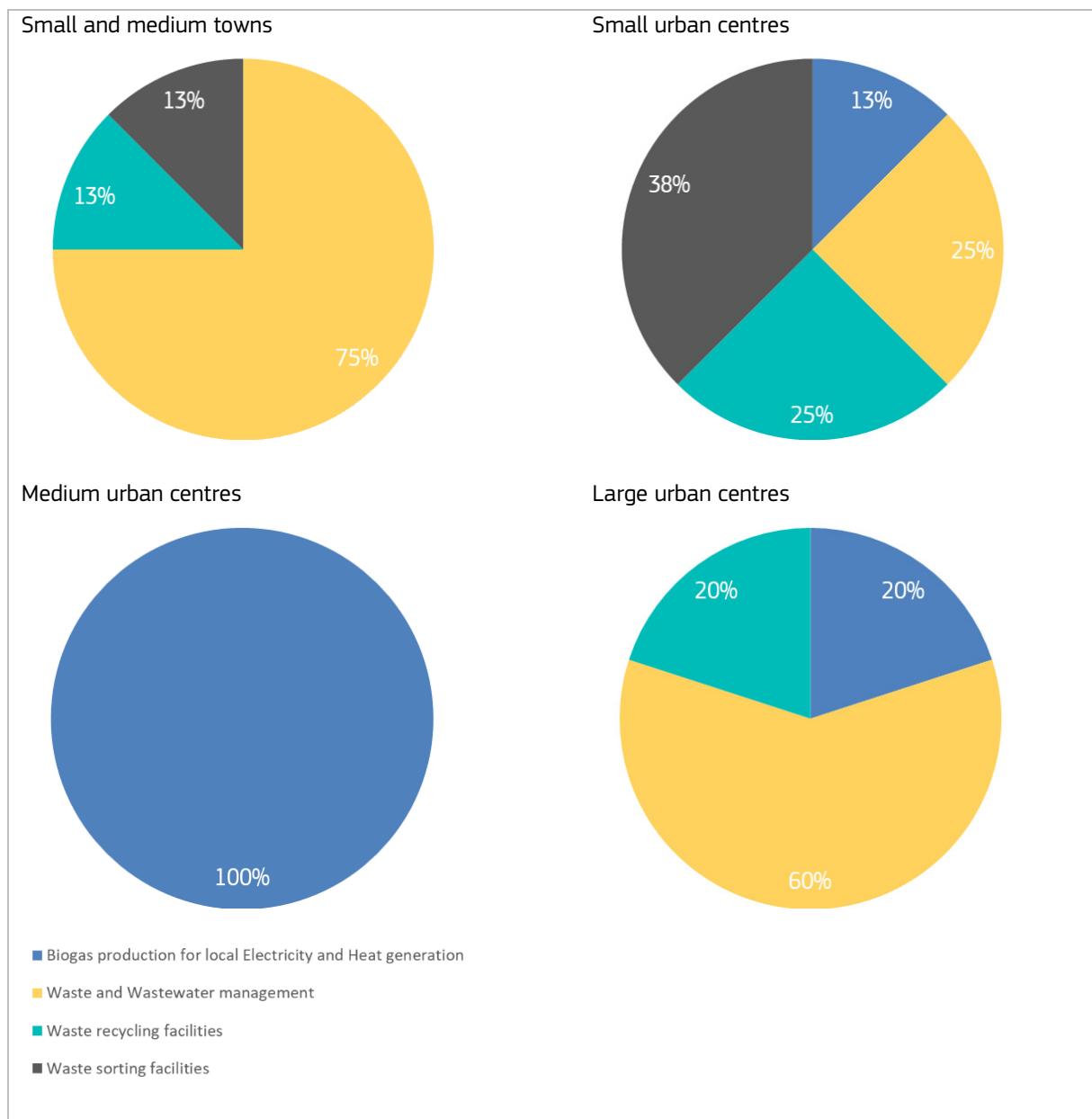
The waste sector became mandatory with the recent developments of the CoM framework, therefore, the number of actions in absolute terms is lower than the other sectors. Within waste, the most recurrent mitigation actions for all groups of signatories include waste and wastewater management (almost 50% out of all actions), waste sorting facilities and recycling facilities (36% out of all actions) and biogas production for local electricity and heat generation (14% out of all actions). The frequency of specified actions for different city sizes is shown in Figure 32.

As can be seen in the figure, the distribution of most actions changes according to the groups of signatories . In small and medium towns, as well as in large urban centres the waste and wastewater management is more frequent. In medium urban centre there is only one signatory with one action related to biogas production for local electricity and heat generation.

Moreover, Other and Land use planning regulations are the most frequently indicated policies for mitigation actions.

Signatory: Puchavičy district	Country: Belarus	Population: 65,984	adhesion: 2017
<p>Construction of biogas complexes The construction of biogas complexes at the wastewater treatment plant in Maryina Gorka will make it possible to utilize sewage sludge, and the use of the resulting biogas will allow the production of up to 0.8 thousand Gcal of thermal energy and up to 0.76 million kWh of electricity. Action implementation period: 2020-2030 <u>Investment costs:</u> 571.3 thousand euros Energy savings/Renewable energy: 1,251 MWh/y <u>CO₂ reduction:</u> 517.6 tCO₂/y</p>			

Figure 32. Frequency of mitigation actions in Waste and water sectors for signatories grouped in population classes



Source: JRC own elaboration

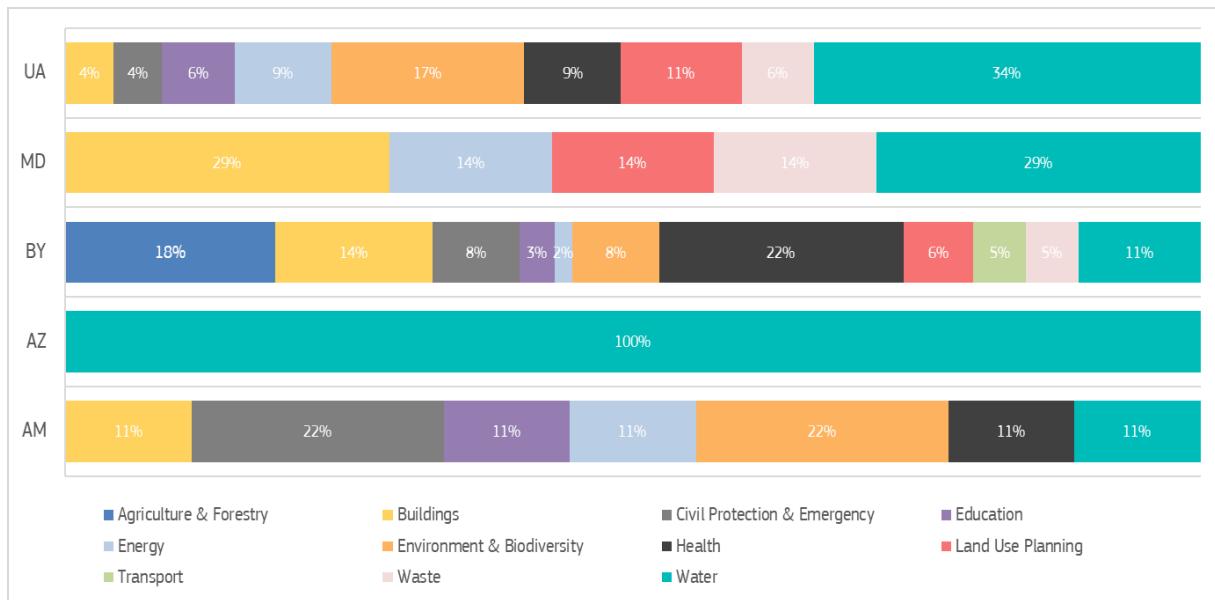
In the boxes below, good practices related to the waste sector are provided.

Signatory: Fastiv	Country: Ukraine	Population: 47,284	adhesion: 2016
Solid waste management			
Construction of a waste processing complex with a capacity of 40,000 tons of solid waste per year using the technology of low-temperature pyrolysis with the production of synthesis gas for its further combustion in cogeneration equipment for obtaining electricity			
Action implementation period: 2017-2025			
<u>Investment costs:</u> around 2.7 million euros			
<u>CO₂ reduction:</u> 23,244.9 tCO ₂ /y			

6.2.2 Adaptation Pillar

22 Signatories from the sample have reported adaptation actions across the five countries. Figure 33 shows the composition of adaptation actions per each country and per sector.

Figure 33. Frequency of Adaptation actions per sector



Source: JRC own elaboration

As shown in the figure above, no specific patterns can be identified on adaptation actions. This is consistent with the context based approach of adaptation concept. The distribution of adaptation actions is not typical and the frequency differs by country. In Ukraine, the largest number of actions is related to the Water and Environment & Biodiversity sectors. In Moldova, the sector addressed by the majority of actions is water, followed by Buildings. The rather high variability of sectors can be observed in the actions planned by signatories from Belarus: Health (22%), Agriculture & Forestry (18%) and Buildings (14%). In Azerbaijan only one signatory reported one adaptation action which refers to the water sector. The largest number of actions from Armenian signatories regards Environment & Biodiversity sector and Civil Protection & Emergency both with a share of 22%.

As previously mentioned, only a small number of signatories has indicated climate hazards to which the action refers on the platform (16% of signatories from the sample). Therefore, it has not been possible to perform a significant and consistent analysis. On the contrary, it is mandatory for signatories to report vulnerable sectors linked to the actions. Hence, for vulnerable sectors, the sample is valid and in the next section a detailed analysis for each sector is reported.

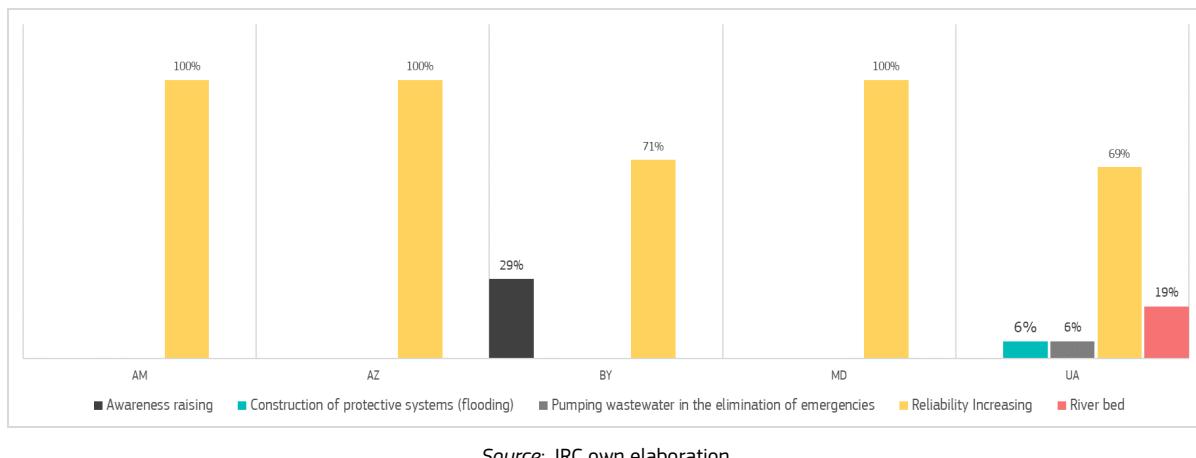
6.2.2.1 Hazards and sectors

This analysis focuses on most common sectors addressed by adaptation actions per country, as actions vary significantly across countries.

6.2.2.1.1 Water

As previously mentioned, Water is the sector to which the majority of actions refers. The most recurrent actions within this sector for all groups of signatories include improving the reliability (almost 75% out of total actions) and return to natural state of river bed (11% of actions).

Figure 34. Frequency of adaptation actions in the water sector



Source: JRC own elaboration

It has to be noted, that there is only one adaptation action indicated within plans of signatories from Armenia, Azerbaijan and Moldova related to the Water sector. 69% of actions indicated in plans from Ukraine relate to increase of reliability followed by 19% of actions related to restoration of the river beds. In Belarus 71% of signatories' actions related to increase of reliability, while 29% on awareness raising.

Best practices related to the water sector are provided in the boxes below.

Signatory: Chortkiv	Country: Ukraine	Population: 29,169	adhesion: 2016
<p>Gradual return of the river valley of the Seret to natural state complete termination of discharge of untreated domestic and industrial wastewater into the river; establishment of complete removal of solid household waste from water protection zones, residential, public and commercial areas; delimitation of coastal protection zones, water protection zones and compliance with the regime of their detention; streamlining and expanding existing, creating new green areas that perform water protection, soil protection, climate regulation, recreational, aesthetic functions; creation of protected objects and territories as a part of regional Mokleliv Landscape Park. <u>Action implementation period: 2018-2025</u> <u>Investment costs: 11 thousand euros</u></p>			

Signatory: Mingachevir	Country: Azerbejan	Population: 102,861	adhesion: 2017
<p>Reconstruction of the old water line along the Kura River and the establishment of an effective irrigation system With the reconstruction of the drinking water supply, the old lines are to be used for providing water for irrigation purposes. Before this project, the water for green areas in the city has been supplied by the potable water network. This solution is expensive and not appropriate for the plants because of the chlorine content of the water. Moreover, due to the lack of metering systems, great losses were estimated (about 2-2.5 million m³ per year). This project suggests the use of existing 6-km line to provide water from the Kur river without the need of pumps, the repair of the line, the construction of connecting pipelines, the replacement of metallic pipes with low diameters of plastic pipes, and the establishment of drip irrigation in the parks. Drip irrigation shall be provided with automatic management program to provide each tree with necessary amount of water.</p>			

6.2.2.1.2 Waste

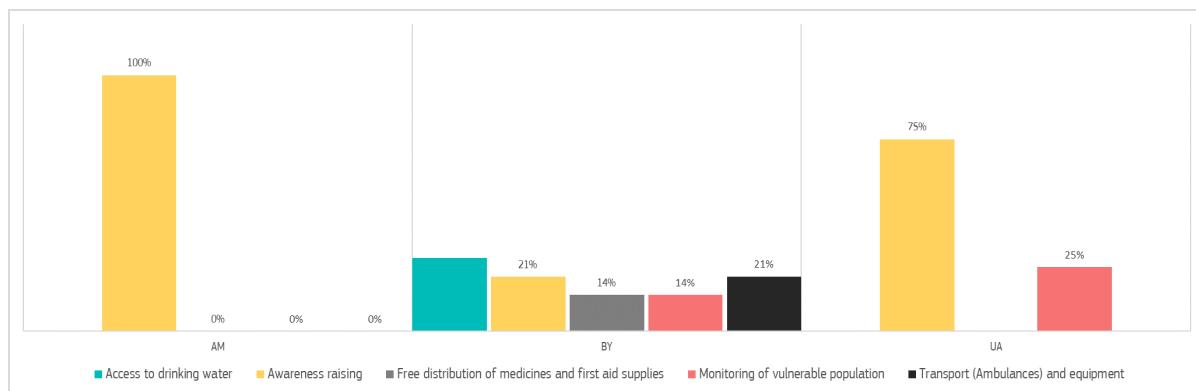
Common among signatories from Ukraine, Moldova and Belarus is the choice of introducing waste sorting in their system and the removal of unauthorised landfills, leading to environmental benefits. Best practices related to the waste sector are provided in the box below.

Signatory: Baranivska amalgamated community	Country: Ukraine	Population: 26,745	adhesion: 2017
<ul style="list-style-type: none">— Measures to improve the collection and storage of municipal solid waste— improvement of the ecological status of the natural environment— detection and elimination of unauthorised landfills on the territory of communities and on the rivers Sluch and Khomora;— purchase of sufficient number of containers for separate collection of solid household waste.			
Action implementation period: 2018-2022			
<u>Investment costs:</u> 30 thousand euros			

6.2.2.1.3 Health

For the health sector, actions mainly relate to awareness raising and monitoring of vulnerable population groups.

Figure 35. Frequency of adaptation actions in the health sector



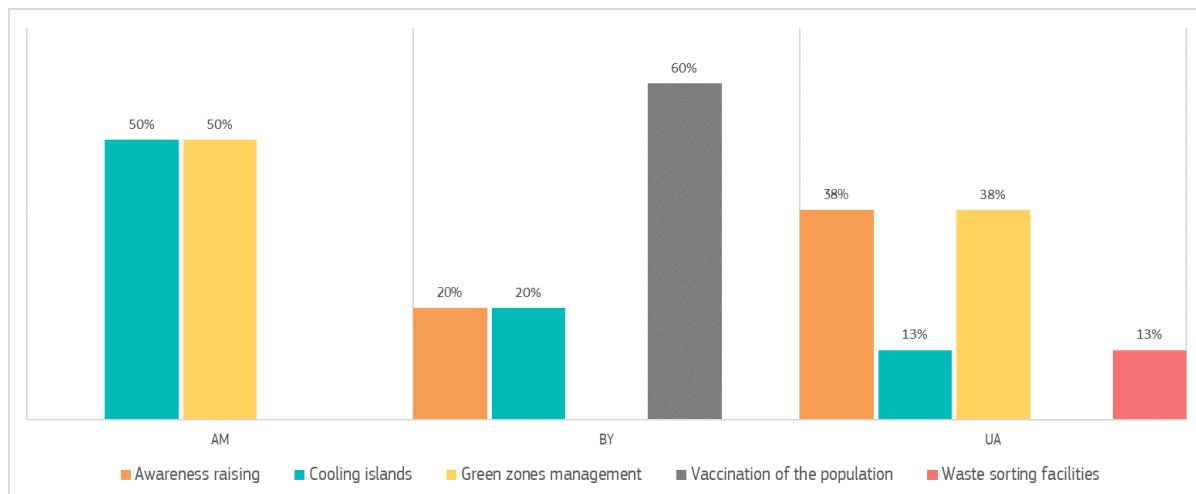
Source: JRC own elaboration

Only one action is reported on the Health sector from one Armenian signatory. The plans of the signatories from Belarus reveal a wide range of actions related to the health sector, including: Access to drinking water, Awareness raising, Free distribution of medicines and first aid supplies, Monitoring of vulnerable population and Transport (Ambulances) and equipment. Signatories from Ukraine gave high relevance to awareness raising for actions within Health sector.

6.2.2.1.4 Environment and biodiversity

In this sector the action planned by signatories include creation of “cooling islands” and management of green zones within the signatories.

Figure 36. Frequency of adaptation actions per sector



Source: JRC own elaboration

As can be seen from the Figure above, cooling islands and green zones management have been selected by signatories from Armenia Ukraine (38% and 13% respectively) and Belarus (20% of actions related to cooling islands). Moreover, signatories from Belarus have indicated vaccination of the population as appropriate adaptation action within the sector.

Best practices related to the environment and biodiversity sector are provided in the boxes below.

Signatory: Smolyhiv AC	Country: Ukraine	Population: 1,771	adhesion: 2018
Measures to adapt the city's green areas to climate change			
<ul style="list-style-type: none">— carrying out an inventory, determine the legal regime, streamline and expand the area of existing green recreation areas in the river valley, as well as in public and residential areas;— promoting the effective operation of the enterprise that provides services of landscaping, care of greenery, cultivation of medicinal, fruit and ornamental plants, processing of organic waste;— carrying out constant gardening of the city (planting of trees, bushes, flowers);— carrying out inventory of green plantings of the city, to develop passports on them;— assigning the separate green zones to organizations, institutions, schools;— consulting with experts to determine the species of trees that better adapt to and contribute to the expected climate change in the region;— carrying out of works with development entities concerning improvement of quality of service of the territories adjoining to objects.			
Action implementation period: 2018-2025			

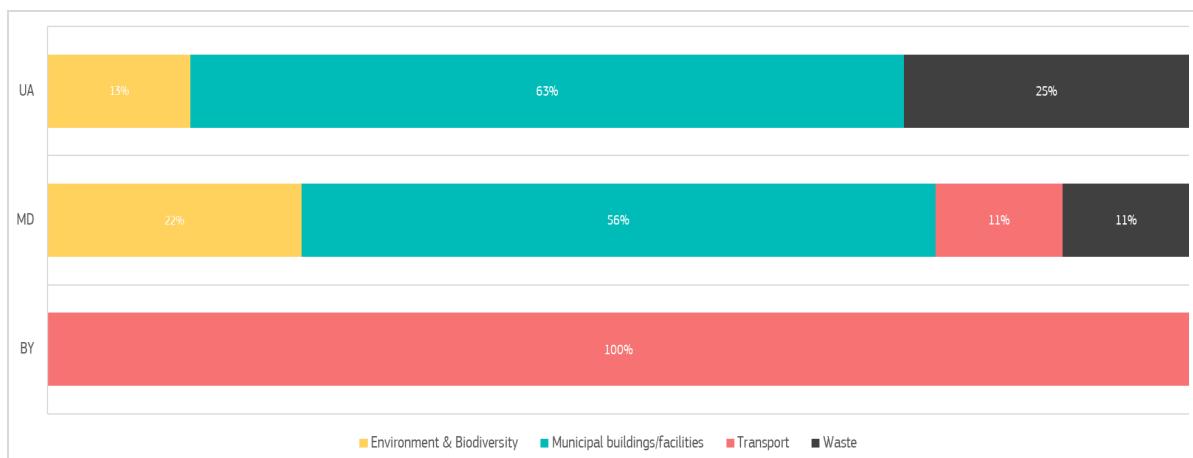
6.2.3 Integrated mitigation and adaptation actions

Some of the actions planned by the Signatories influence both mitigation and adaptation pillars and provide mutual benefit to the environment, as can be seen in Figure 37.

Examples of such actions include the following:

- Complex thermal modernization of the building can contribute to the reduction of greenhouse gas emissions as well as improving the resilience to climate change due to temperature changes and flooding;
- Management of green areas can help in reducing greenhouse gas emissions as well as reducing the heat island effect and contribute to rainwater management;
- Modernization of the water supply and water sewage system can provide substantial energy saving in this sector and increase the reliability of water supply and sewage as well as water quality supplied to the households;
- Modernization of the transport infrastructure provides both fuel and energy saving and helps with resilience of this sector to climate change impacts;
- Construction of power plants using RES reduces greenhouse gas emissions and improves reliability of the energy supply for the citizens.

Figure 37. Frequency of integrated actions per sector



Source: JRC own elaboration

In Belarus, only one integrated action related to the Transport sector has been indicated in the climate action plans. In the action plans of signatories from Ukraine and Moldova the Municipal building and facilities sector shows the majority of integrated actions.

7 Conclusions

This report is based on data collected through MyCovenant until mid-May 2021 related to the CoM East region. The initiative counts 481 committed cities, covering a total population of 32,664 million inhabitants.

The assessment shows that the initiative continues raising interest and is increasing its territorial coverage among local authorities; 58% joined CoM in the second phase with 2030 commitments, in particular smaller ones (75% of all signatories have less than 50,000 inhabitants), and signatories from Ukraine (295). However, only 48% of the signatories has submitted an action plan (SEAP/SECAP), highlighting that there is a high level of commitment but a lower level of implementation and hence, the need to accomplish the ambition by around half of committed signatories. This is, however, common in the other CoM regions with different shares in the number of plan/number of signatories.

From the mitigation pillar's results shown through this study, commitments from signatories' plans are on average slightly higher than the minimum required: reduction target of 22% for CoM 2020 and of 33% for CoM 2030 compared to baseline emissions. Signatories' emissions inventories highlight the high contribution to emissions of Residential Buildings, Industry and Transportation sectors and a strong reliance on fossil fuels.

This is the first study assessing the adaptation pillar's of CoM EAST, and the outcomes show that local authorities are interested in tackling climate change impacts and putting in place adaptation efforts to become more resilient. However, it is evident that the pillar in the region is still under its initial phase and that there is margin of improvement for reported information and reporting framework. While the RVA was fully reported by all signatories committed to adaptation, only 48 signatories provided information on their adaptation goals, and 49 reported on vulnerabilities. The hazards to which high probability of occurrence was assigned are drought and water scarcity, extreme heat and heavy precipitations and the most common sectors to which a high level of vulnerability has been assigned by signatories for the mentioned climate-related hazards are: Agriculture & Forestry, Water, and Health.

Only a 10% of signatories having submitted a plan has sumitted a Monitoring Emission Inventory which has been considered quality relevant to be analysed. This shows the need to reinforce the monitoring and progress review phase. However, despite the low number of MEIs, it was possible to identify a clear path towards emissions reduction. In addition, issues with reporting the BAU approach have been identified. For this reason, only 14 signatories having adopted a BAU approach have been analysed. This will require a review of the climate action plans and of the related section of the reporting platform in order to allow for a more straightforward extraction and evaluation of this information.

Focusing on the action planning, from the mitigation actions analysed in the sample, the stationary energy sector accounts for more than half of the actions. However, the 35% of actions refers to Municipal buildings although the most emitting sector refers to residential buildings. The transport sector follows. Energy supply and waste are scarcely represented. The preference given to Stationary Energy sector is in alignment with the outcomes of CoM EU and many CoM related studies (see the references list for some examples). In the stationary energy sector, the majority of actions/measures refers to energy efficiency (partial and complex modernisation of buildings and efficient electrical appliances and indoor lighting) and to awareness raising. In the transport sector, the large majority of the planned actions concern transport modernization including electrical vehicles, transport infrastructure and road network optimization, and modal shift, including implementation of bicycle facilities. The analysis of the sample also shows that adaptation actions vary without a specific pattern, following the local specificities. Only a small number of signatories has indicated climate hazards to which the action refers on the reporting platform (16% of signatories from the sample), while the main sectors addressed by the actions are Health and Water. Limited, but interesting, attempts of integrating mitigation and adaptaton were pursued by signatories, highlighting their up-to-date and cross cutting approach in dealing with the climate challenge.

Overall CoM EAST signatories are showing high commitments towards sustainability. Given the evolution of the initiative and its timeframe, the mitigation pillar appears more robust, but interests and efforts are also applied to climate change adaptation. This is mainly related to the adopted approach in the adaptation reporting framework. A first step in this direction has been already implemented by making compulsory reporting the adaptation goals. Some further improvements, such as the need to establish clear links between hazards, vulnerabilities and actions, will enable the completion of information. A better integration of mitigation and adaptation is needed in order to have a better understanding of the avoidance of maladaptation in the action plans . Despite the relatively limited reported data, the quality of information received allowed to prepare this preliminary assessment. BAUs approaches and green transition towards renewable energy deserve attention in the future. Plans' submissions and new signatories are expected,

thereby allowing the increase of information on both pillars, and particularly on adaptation, balancing the distribution across the signatories and countries. In addition, the requirements and reporting framework on the third pillar on Energy Access and Poverty are under finalisation. The combination of these elements will allow to further elaborate on this preliminary outcomes and to integrate the energy poverty and equality components in the near future.

The present document has been prepared in December 2021 and data refers to the timeframe 2018/2021.

References

- Agrawala, S., Klasen, S. Acosta Moreno, R. Barreto, L. Cottier, T. Guan, D. Gutierrez-Espeleta, E. Gámez Vázquez, A. and Jiang, L. Kim, Y. Lewis, J. Messouli, M. Rauscher, M. Uddin, N. Venables, A. (2014) 'Regional Development and Cooperation', in *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA., pp. 1083–1140.
- Baldi, M. et al. (2021) 'GCoM - MyCovenant, 2021, First release. [Dataset]'. European Commission, Joint Research Centre (JRC). Available at: pid: <http://data.europa.eu/89h/86ec3e42-f8e1-4cdb-a953-d396251d2029>.
- Bertoldi, P (ed) (2018) *Guidebook 'How to develop a Sustainable Energy and Climate Action Plan (SECAP) – Part 1 - The SECAP process, step-by-step towards low carbon and climate resilient cities by 2030*. Luxembourg: EUR 29412 EN, Publications Office of the European Union. doi: 10.2760/223399.
- Bertoldi, P. et al. (2018) 'Towards a global comprehensive and transparent framework for cities and local governments enabling an effective contribution to the Paris climate agreement', *Current Opinion in Environmental Sustainability*, 30, pp. 67–74. doi: 10.1016/j.cosust.2018.03.009.
- Bertoldi, P. et al. (2020) *Covenant of Mayors: 2019 Assessment*. doi: 10.2760/49444.
- Bertoldi, Paolo (ed) (2018) *Guidebook 'How to develop a Sustainable Energy and Climate Action Plan (SECAP)'*. Edited by P. Bertoldi. Luxembourg: Publications Office of the European Union. doi: 10.2760/68327.
- Kern, K. (2019) 'Cities as leaders in EU multilevel climate governance: embedded upscaling of local experiments in Europe', *Environmental Politics*. Routledge, 28(1), pp. 125–145. doi: 10.1080/09644016.2019.1521979.
- Kona, A. et al. (2018) *Guidebook-How to develop a Sustainable Energy and Climate Action Plan in the Eastern Partnership countries*. Ispra.
- Kona, A. and Bertoldi, P. (2020) *Covenant of Mayors in the Eastern Partnership Countries: 2019 Assessment*. Luxembourg.
- Melica, G. et al. (2018) 'Multilevel governance of sustainable energy policies : The role of regions and provinces to support the participation of small local authorities in the Covenant of Mayors', *Sustainable Cities and Society*. Elsevier, 39(January), pp. 729–739. doi: 10.1016/j.scs.2018.01.013.
- Melica, G. et al. (2022) *Covenant of Mayors: 2021 assessment*. Luxembourg. in press
- Palermo, V. et al. (2020) 'Assessment of climate change mitigation policies in 315 cities in the Covenant of Mayors initiative', *Sustainable Cities and Society*. Elsevier, 60(August 2019), p. 102258. doi: 10.1016/j.scs.2020.102258.
- Palermo, V. and Hernandez, Y. (2020) 'Group discussions on how to implement a participatory process in climate adaptation planning: a case study in Malaysia', *Ecological Economics*. Elsevier, 177, p. 106791. doi: 10.1016/j.ecolecon.2020.106791.
- Palermo, V et al. (2019) *Summary of the guidebook : " How to develop a Sustainable Energy Access and Climate Action Plan (SEACAP) in Sub-Saharan Africa "*. Luxembourg: Publications Office of the European Union. doi: 10.2760/483786.
- Rivas, S. et al. (2018) *Guidebook How to develop a Sustainable Energy and Climate Action Plan (SECAP) in the MENA Region*. Ispra. Available at: JRC113188.
- UNFCCC (2015) *Adoption of the Paris Agreement. Proposal by the President, Paris Climate Change Conference*. doi: <http://doi.org/FCCC/CP/2015/L.9/Rev.1>.

List of abbreviations and definitions

BAU	Business as usual
BEI	Baseline Emission Inventory
CoM	Covenant of Mayors for Climate and Energy
CDP	Carbon Disclosure Project
COP	Conference of Parties
CO ₂	Carbon Emissions
CRF	Common Reporting Framework
EAP	Eastern Partnership
EU	European Union
GCoM	Global Covenant of Mayors for Climate and Energy
ICLEI	ICLEI - Local Governments for Sustainability
IPCC	Intergovernmental Panel on Climate Change
JRC	Joint Research Centre
LCA	Life cycle assessment
MEI	Monitoring Emission Inventory
SEAP	Sustainable Energy Action Plan
SECAP	Sustainable Energy and Climate Action Plan
RVA	Risk and Vulnerability Assessment
URS	Unified Reporting System

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Annexes

Annex 1.

Table 22. CoM signatories with a submitted SEAP/SECAP (incl. BEI) and a submitted full monitoring report (incl. MEI) as of end of November 2021 (N=22)

Country	Signatory	Baseline Emission Inventory			Monitoring Emission Inventory			Difference		Target on CO ₂ emissions reduction, %
		Year	Population	Total emissions of GHG [MtCO ₂ /y]	Year	Population	Total emissions of GHG [Mt]	[Mt]	%	
ua	Lutsk	2007	207,000	0.672	2017	217,000	0.607	0.065	10%	20%
ua	Kovel	2010	67,900	0.196	2016	69,119	0.137	0.059	30%	20%
ua	Dolyna	2010	20,696	0.087	2016	20,213	0.071	0.016	18%	21%
ua	Pervomaisk	2010	68,200	0.028	2014	66,700	0.027	0.002	6%	22%
ua	Voznesensk	2007	38,500	0.217	2017	35,100	0.295	-0.078	-36%	33%
ua	Zhmerinka	2011	35,400	0.097	2019	34,500	0.077	0.020	21%	21%
ge	Tbilisi	2009	1,136,600	4.063	2014	1,175,200	3.371	0.692	17%	25%
ua	Slavutych	2000	25,227	0.097	2018	24,983	0.054	0.043	44%	27%
ua	Konotop	2010	92,570	0.305	2017	91,146	0.238	0.067	22%	20%
by	Polack	2010	80,000	0.102	2016	85,078	0.085	0.017	17%	20%
ua	Cherkasy	2009	288,500	0.669	2017	278,000	0.461	0.208	31%	27%
ua	Rivne	2010	249,800	0.636	2019	246,500	0.443	0.193	30%	20%
ua	Myrhorod	2007	41,609	0.202	2016	41,200	0.191	0.011	5%	20%
by	Rahacou	2012	59,500	0.244	2017	56,046	0.278	-0.034	-14%	21%

md	Călărași	2010	16,000	0.020	2018	16,500	0.013	0.007	33%	20%
by	Navahrudak	2010	49,000	0.122	2016	45,886	0.129	-0.008	-7%	20%
md	Festelița	2011	2,868	0.001	2014	2,868	0.000	0.000	50%	20%
ua	Berdyansk	2011	119,700	0.474	2016	119,200	0.358	0.116	24%	20%
by	Braslau	2013	27,500	0.090	2017	25,508	0.059	0.030	34%	25%
by	Cavusy	2010	11,000	0.056	2016	18,297	0.064	-0.007	-13%	20%
ua	Truskavets	2012	29,600	0.158	2018	28,792	0.003	0.155	98%	21%
ua	Kaniv	2010	25,800	0.081	2015	25,000	0.085	-0.004	-5%	20%

Source: JRC own elaboration

Annex 2.

Table 23. List of the Signatories included in the analysis in chapter 6

Nº	City	Country	Size	Population
1	Ceadir-Lunga	MD	1. Small and medium towns	22,800
2	Lozova	MD	1. Small and medium towns	6,573
3	Pruteni	MD	1. Small and medium towns	2,140
4	Iŭje	BY	1. Small and medium towns	24,758
5	Kličaŭ	BY	1. Small and medium towns	15,148
6	Gavar	AM	1. Small and medium towns	19,900
7	Ialoveni (Double)	MD	1. Small and medium towns	15,300
8	Chortkiv	UA	1. Small and medium towns	29,169
9	Fastiv	UA	1. Small and medium towns	47,284
10	Vorniceni	MD	1. Small and medium towns	5,220
11	Doksycy	BY	1. Small and medium towns	26,828
12	Vierchniadzvinsk	BY	1. Small and medium towns	21,876
13	Smolyhiv Ac	UA	1. Small and medium towns	1,771
14	Velykokopanivska Amalgamated Community	UA	1. Small and medium towns	7,434
15	Voskresenska Ac	UA	1. Small and medium towns	12,350
16	Zolochiv Ac, Kharkiv Region	UA	1. Small and medium towns	25,113
17	Budesti	MD	1. Small and medium towns	5,040
18	Stăuceni	MD	1. Small and medium towns	8,694
19	Shostka	UA	2. Small urban centre	75,909
20	Puchavičy district	BY	2. Small urban centre	65,984
21	Ivacevičy	BY	2. Small urban centre	54,848
22	Smarhoń	BY	2. Small urban centre	52,608
23	Balta	UA	2. Small urban centre	32,943
24	Baranivska amalgamated community	UA	2. Small urban centre	23,870
25	Bilotserkivka	UA	2. Small urban centre	699
26	Hlukhiv	UA	2. Small urban centre	34,826
27	Bilhorod-Dnistrovskyy	UA	2. Small urban centre	50,078
28	Bila Tserkva	UA	3. Medium urban centre	209,815
29	Kropyvnytskyi	UA	3. Medium urban centre	242,900
30	Pavlohrad	UA	3. Medium urban centre	109,994
31	Nikopol	UA	3. Medium urban centre	117,857
32	Mingachevir	AZ	3. Medium urban centre	102,861
33	Pinsk City	BY	3. Medium urban centre	150,000
34	Mykolaiv	UA	4. Large urban centre	494,588
35	Viciebsk	BY	4. Large urban centre	376,226
36	Kyiv	UA	4. Large urban centre	2,819,566
37	Kharkiv	UA	4. Large urban centre	1,443,093
38	Vinnytsia	UA	4. Large urban centre	370,100

Source: JRC own elaboration

Annex 3

Mitigation - Policy instrument

Buildings

Awareness raising / training
Energy management
Energy certification / labelling
Energy suppliers obligations
Energy / carbon taxes
Grants and subsidies
Third party financing. PPP
Public procurement
Building standards
Land use planning regulation
Not applicable
Other

Public Lighting

Energy management
Energy suppliers obligations
Third party financing. PPP
Public procurement
Not applicable
Other

Industry

Awareness raising / training
Energy management
Energy certification / labelling
Energy performance standards
Energy / carbon taxes
Grants and subsidies
Third party financing. PPP
Not applicable
Other

Transport

Awareness raising/training
Integrated ticketing and charging
Grants and subsidies
Road pricing
Land use planning regulation
Transport / mobility planning regulation
Public procurement
Voluntary agreements with stakeholders
Not applicable
Other

Local Electricity Production

Awareness raising / training
Energy suppliers obligations
Grants and subsidies
Third party financing. PPP
Public procurement

Building standards

Land use planning

Not applicable

Other

Local heat/cold Production

Awareness raising / training

Energy suppliers obligations

Grants and subsidies

Third party financing. PPP

Building standards

Land use planning regulation

Not applicable

Other

Other

Awareness raising / training

Land use planning

Not applicable

Other

Adaptation - Sectors

Buildings

Transport

Energy

Water

Waste

Land use planning

Agriculture & forestry

Environment & biodiversity

Health

Civil protection & emergency

Tourism

Education

ICT (Information & communication technologies)

Society, community & cultural heritage

Adaptation - Vulnerable population groups

Women and girls

Children

Youth

Elderly

Marginalized groups

Persons with disabilities

Persons with chronic diseases

Low-income households

Unemployed persons

Persons living in sub-standard housing

Migrants and displaced people

Other

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