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Covenant of Mayors: 2019 Assessment

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Contents

Abstract

Cities and local authorities are key players in addressing climate change. The Covenant of Mayors for Climate and Energy (CoM) has been the first initiative of its kind addressing local authorities to endorse their efforts in the implementation of sustainable energy and climate policies and to provide them with a harmonised data compilation, methodological and reporting framework, supporting them in translating mitigation and adaptation goals into reality.

This report provides a scientific assessment of CoM regarding the pillars of mitigation and adaptation of climate change. The assessment describes the plans submitted by signatories, examines planned and implemented policies and gives an overview on the progresses in terms of energy consumption, GHG emission reduction and resilience increase. The key findings show that the overall commitment to reducing GHG emissions by signatories is 30% by 2020 and 47% by 2030, compared to baseline emissions projected to 2005. These commitments are more ambitious than the minimum requested targets.
The adaptation pillar shows a recent reporting framework, therefore, further analysis in the future is needed once the number of signatories increases. The hazards reported the most in EU cities are extreme heat and droughts while the sectors at risk of impacts are reported to be water and health. Nevertheless, a clear gap exists between the hazards impacting specific sectors and sectors where actions are planned and implemented. A further development of the structure of the adaptation pillar and reporting system in place may support in bridging this gap.

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Executive summary

Policy context

Cities and local authorities are key players in addressing climate change. The Paris Agreement sets the ambitious goal of keeping global temperature rise well below 2°C and promotes individual and collective action on adaptation with the aim to enhance climate resilience and reduce climate vulnerability. Moreover, it officially included for the first time non-Party stakeholders in the climate dialogue, recognising the role of local authorities in the challenge.

Already, in 2008, acknowledging the role of local authorities, the European Commission (EC) launched the Covenant of Mayors (CoM) initiative to which the Joint Research Centre (JRC) has been providing scientific, methodological and technical support. The CoM has later evolved in 2015 into the Covenant of Mayors for Climate and Energy, stepping up the mitigation target (from 20 % of CO_2 emissions reduction by 2020 to the 40 % by 2030) and integrating two more pillars besides mitigation: the adaptation and access to energy. In 2017, CoM developed into a global initiative, the Global Covenant of Mayors, bringing together the EU Covenant of Mayors and the Compact of Mayors. The Global Covenant of Mayors is now an international alliance of cities and local governments with a shared long-term vision of promoting and supporting voluntary action to combat Climate Change and move to a low-emission resilient society.

The Covenant of Mayors for Climate and Energy has been the first initiative of its kind addressing local authorities to endorse their efforts in the implementation of sustainable energy and climate policies and to provide them with a harmonised data compilation, methodological and reporting framework, supporting them in translating mitigation and adaptation goals into reality. One of the peculiarities of the CoM, compared to other alike initiatives, is the participation of small and medium-sized towns with less than 50 000 inhabitants (90% from the total signatories).

As already mentioned, the initiative is built around three pillars:

- Mitigation (at least 40 % emission reduction target by 2030 for EU cities, corresponding to EU NDC)
- Adaptation to Climate Change
- Secure, sustainable and affordable energy.

To translate the commitments into actions, signatory local authorities commit to develop a Sustainable Energy and Climate Action Plan (SECAP) which includes a comprehensive set of actions that local authorities plan to undertake to reach their climate mitigation and adaptation goals. The plan is based on the results coming from the previous assessments: the Baseline Emission Inventory (BEI), that measures the GHG emission level in a base year according to a common methodological approach; and the Risk and Vulnerability Assessments (RVAs) that assess climate risks and vulnerabilities within the local territory.

The Covenant of Mayors' integrated approach is in line with a number of EU priorities not only concerning mitigation and adaptation but also in terms of access to affordable energy, embracing a robust transparency framework for the implementation of the Paris agreement.

Scientific Approach

The aim of this document is to assess the CoM initiative approach and results from 2008 to 2019 regarding both the mitigation and adaptation to climate change pillars. The analysis addresses the signatories to the Global Covenant of Mayors that reported through the *MyCovenant* reporting platform, based in the European Union, in Eastern Partnership countries, in Europe-non-EU and in Southern Mediterranean region. The report is divided in two parts, the first related to mitigation and the second to adaptation to climate change.

Mitigation Pillar

Status

At the cut-off date of the analysis at the end of August 2019, the number of CoM signatories reporting via *MyCovenant* platform, totalled 9693[1] (94 % from the EU), covering 312.5 million inhabitants (75 % in the EU representing 47 % of the total EU population in 2005). While the 74 % of the signatories are committed

[1] In 2016 the number of signatories was 6201. See Kona et al. (2017).

exclusively to the initial target of CoM (20 % reduction in CO_2 emissions by 2020), a growing number of signatories is committing to 2030 (24 % of signatories, covering 37 % of the CoM population).

Up to August 2019, 1845 signatories, which cover a population of 97.5 million inhabitants (30 % of signatories and 48 % of the population with a submitted Climate Action Plan) had reported on the implementation of their plan by presenting a so-called "full report", i.e. a monitoring report including a Monitoring Emission Inventory (MEI). Out of these progress reports, 1802 (i.e. 98 % of the overall) monitoring reports are from signatories in the European Union, of which 125 reports were submitted by signatories with 2030 commitments.

Main Findings

The signatories overall commitment to reducing GHG emissions is **30 %** by 2020, compared to baseline emissions projected in 2005, i.e. 10 percentage points above the minimum requested target of 20 %.

Following the evolution of the CoM initiative, a growing number of signatories is committing to 2030. Preliminary results on 2030 targets (5 % of the climate actions plans submitted mainly from the European Union) reveal an ambitious GHG emission reduction target of **47 %** by 2030, compared to baseline emissions projected in 2005.

The mitigation commitment of the Covenant signatories is mainly related to the emissions associated with energy consumption in sectors which can be influenced by the local authority (housing, services and urban transport), leaving out other emitters such as the Emissions Trading System (ETS) industry and transport outside the mandate of the local authority (e.g. highways).

Results from signatories in the European Union on monitoring reports (98% of overall progress reports) show that the absolute reductions achieved from baseline inventories (projected to 2005) to monitoring inventories (projected to 2017) correspond to **25 %**. Although the minimum commitment made by these signatories was 20 % by 2020, they have set an even more ambitious target, corresponding to a 30 % emission reduction by 2020 – and are on track to reach it.

Committed emission reductions from the EU Covenant signatories (98 % of the total signatories and 34 % of the EU population in 2005) **may represent 28** % **of the European Union** overall GHG emission reduction projections by 2020 compared to 2005.

Key Conclusions

The highlighted results underline the interconnected nature of climate mitigation, energy efficiency actions and renewable energy sources adopted at the local level. This report shows that the combination of effective urban energy policies and the coordination between national and local governments is crucial for increasing the potential of mitigation of climate change at local level. The role of local authorities in leveraging sustainable development and mitigation and adaptation measures is crucial. Developing a 'Sustainable Energy and Climate Action Plan' that requires the setting up of a Baseline Emission Inventory and the implementation of policy measures, is the first step towards an effective, transparent system for tracking progress and concrete results.

The robust open source methodological framework developed by the JRC in collaboration with city networks offers municipalities a comprehensive tool to support the development of climate and energy policies.

Adaptation Pillar

Status

Up to November 2019, 2221 signatories of the Global Covenant of Mayors that reported through the *MyCovenant* reporting platform (based in the European Union, in Eastern Partnership countries, in Europe-non-EU and in Southern Mediterranean region) have become signatories of the CoM for climate and energy (2030 target) that includes providing information on adaptation. From these total number of signatories, 1922 belong to EU28+EFTA countries and 299 to non-(EU28+EFTA). Out of 2221, only 429 (370 from EU28+EFTA and 59 non-EU28+EFTA) have already provided information regarding their adaptation goals, risk and vulnerability assessments or action plans. The statistics presented in the following sections are based on these 429 signatories.

Main Findings

The study has been developed following the structure of *MyCovenant* Platform, and the following results are summarised accordingly.

Goals: Even though the meaning of the word *goal* has been misinterpreted by a number of signatories, 54% of signatories have reported climate adaptation goals for EU28+EFTA countries and 46% for non-(EU28+EFTA). This fact could be explained as a consequence of 1) many signatories may not have adaptation goals established yet and/or 2) many signatories do not desire to share that information. Moreover, experience shows that local authorities focus on mandatory fields when reporting and the adaptation goals are tagged as "not mandatory" in the Covenant reporting framework.

Stakeholders and citizens engagement: The involvement of stakeholders and citizens in environmental decision-making has a long tradition and its benefits are well known. Around 43-44% of the signatories have reported stakeholders and citizen participation in their adaptation plans. For both groups of signatories, a high-level of participation is mainly reached for local authority's staff, while external stakeholders at local level reaches mainly a medium-level of participation.

Financing: According to the data provided to the CoM platform, the percentage of municipalities that have reported funding is 69% for EU28+EFTA and 54% for non-(EU28+EFTA). The funding sources are mainly governmental (grants, international and EU funding, national, regional and local budgets) and private (foundations, real estate developers, companies). In both groups of signatories, EU funding is the most relevant source of funding, followed by local budget.

Barriers: The percentage of signatories reporting barriers to climate adaptation is 84% for EU28+EFTA signatories and 34% for non-EU28+ EFTA. The main barrier identified by signatories in the platform is "limited financial sources". "Immature or high cost technologies" is also common to both groups of countries.

Climate hazards: All the signatories in the two groups have reported climate hazards for the present and future. Signatories have identified as most relevant hazards for the present and the future: extreme heat and droughts. While the sea level rise is considered as the less important hazard, extreme precipitation, forest fires, flood and storms are relevant for both groups of countries.

Vulnerabilities: Despite being a key dimension of the risk assessment, the percentage of signatories reporting vulnerabilities is lower than 50%.

Impacts: Around 95-98% of signatories have reported impacts on socioeconomic sectors and the environment for the present and future. The sectors to be reported the most at risk of impacts are water and health.

Actions: Around 59-66% of signatories have reported adaptation actions. However, the structure of the reporting platform (open field) does not give the chance to classify the actions in the following classes: adaptation, *maladaptation, adaptigation* and in some cases even mitigation.

Key Conclusions

The analysis shows that the adaptation pillar of the Covenant of Mayors for Climate and Energy will require further investigation once the number of signatories increases, since the reporting framework for this pillar is very recent. From a reporting point of view, it has been highlighted that signatories tend to neglect not mandatory fields in the reporting platform and that some fields required aggregated figures that, otherwise, cannot be fully analysed (stakeholders engagement).

From a scientific perspective, the outcomes of the assessments show that in some cases the low percentage of signatories reporting is related to their starting level in the policy cycle. Moreover, it has to be noted that in some cases signatories have included actions that are not related to the identified risks and that do not tackle adaptation or adaptigation (as desired). This gap shows that further developing is needed on the adaptation pillar structure, methodologies implemented and reporting system in place. The authors have provided a list of measures that could be of use for improving the reporting of climate adaptation-related information.

1 Introduction

The need for immediate action at global level to reduce greenhouse gas (GHG) emissions and increase climate resilience was highlighted in the 5th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) and confirmed during the 21st meeting of the Conference of the Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC) in Paris in December 2015. The Paris agreement adopted at COP 21 sets the ambitious goal of keeping global temperature rises below 2°C, in accordance with the recommendations of the Intergovernmental Panel on Climate Change (IPCC) (IPCC, 2014). Moreover, the agreement promotes individual and collective action on adaptation with the aim to enhance climate resilience and reduce climate vulnerability. The agreement also recognises the key role of non-Party stakeholders in addressing Climate Change, including cities, other subnational authorities, civil society, the private sector and others who are invited to scale up their efforts and support actions to reduce emissions, build resilience and decrease vulnerability to the adverse effects of Climate Change ([2]).

Urban energy consumption generates about three-quarters of global carbon emissions. Cities and towns play a crucial role in terms of mitigation and adaptation to climate change, by offering potential to implement policies towards sustainable development with an integrated approach. Cities are the place where effective and innovative policies to reduce energy consumption can be implemented. However, cities are also experiencing the most climate change impacts, which calls for action to adapt to the adverse effects and increase their resiliency.

Tackling Climate Change is a priority for the European Union, who has set targets for reducing greenhouse gas emissions progressively up to 2050. In 2008, acknowledging the role of local authorities, the European Commission (EC) launched the Covenant of Mayors (CoM) initiative to endorse their efforts in the implementation of sustainable energy and climate policies. The initiative is consistent with the targets of the Paris Agreement and it is aligned with the key EU priorities and strategies. Since its launch, the CoM has evolved into the Covenant of Mayors for Climate and Energy in 2015 and developed into a global initiative, the Global Covenant of Mayors in 2017.

The initial GHG emissions reduction commitments were stepped up and the adaptation to Climate Change and secure, sustainable and affordable energy were integrated as the second and third pillars. Therefore, local authorities who sign the CoM for Climate and Energy commit voluntarily to accelerating the decarbonisation of their territories, strengthening their capacity to adapt to unavoidable climate change impacts and allowing their citizens to access secure, sustainable and affordable energy. In 2017, with the merge of the Covenant of Mayors and the Compact of Mayors, the Global Covenant of Mayors for Climate and Energy was launched. This international alliance of cities and local governments already counts more than 9000 towns and cities representing a population of more than 800 million people. To translate the commitments into actions, signatory local authorities commit to develop a Sustainable Energy and Climate Action Plan (SECAP) which includes a comprehensive set of actions that local authorities plan to undertake to reach their climate mitigation and adaptation goals. The plan is based on the results coming from the previous assessments: the Baseline Emission Inventory (BEI), that measures the GHG emission level in a base year according to a common methodological approach; and the Risk and Vulnerability Assessments (RVAs) that assess climate risks and vulnerabilities within the local territory.

With the launch of the Global Covenant of Mayors, to ensure a common framework and the harmonisation of measurements and reporting procedures, a Common Reporting Framework (CRF) has been developed by a team of experts from GCoM partners ([3]).

The European Commission's Joint Research Centre (JRC) provides scientific, methodological and technical support to the Covenant of Mayors initiative. JRC has been developing methodologies collaborating with city networks and practitioners from local and regional authorities, energy agencies and academia. This work has resulted in the publication of guidebooks on how to develop a Sustainable Energy Action Plan (Bertoldi, 2018), (Bertoldi, Bornas Cayuela, Monni, & Piers De Raveschoot, 2010). The JRC also carries out individual SEAP and SECAPs analyses, providing feedback to cities and in-depth evaluations of selected SEAPs. Specific aspects of the Covenant are also explored in specific studies (e.g. multi-level governance models in the Covenant (Melica et al., 2018); review of reporting platforms (Bertoldi, Kona, Rivas, & Dallemand, 2018); projections towards Paris Agreement targets (A. Kona, Bertoldi, Monforti-Ferrario, Rivas, & Dallemand, 2018) and on methods on indirect emission accounting (A. Kona, Bertoldi, & Kılkış, 2019). Since 2013, the JRC has

([2]) https://ec.europa.eu/clima/policies/strategies_en Accessed in May 2018

([3]) Common Reporting Framework Available at https://www.globalcovenantofmayors.org/our-initiatives/data4cities/common-global-reporting-framework/

published a series of assessment reports on the Covenant of Mayors status (Cerutti et al., 2013), (A. Kona et al., 2016), (A. Kona et al., 2017) in order to track the overall progress of the initiative on the basis basis of the most recent updates from plans and progress reports transmitted by Covenant cities to the EC.

This report is the most recent of this series, providing a scientific assessment of CoM regarding the pillars of mitigation and adaptation of climate change. The assessment describes the plans submitted by signatories, examines planned and implemented policies and gives an overview on the progresses in terms of energy consumption, GHG emission reduction and resilience increase. The analysis addresses the signatories to the Global Covenant of Mayors that reported through the *MyCovenant* reporting platform, based in the European Union, in Eastern Partnership countries, in Europe-non-EU and in Southern Mediterranean region. In particular, this report is divided in two parts:

- Part 1 addresses the mitigation pillar, including the description of the database and methodology in chapter 1, the analysis of the SEAPs and SECAPs submitted with insights on the planned policies and the analysis of the implementation reports in chapter 2. Conclusions and recommendations are provided in chapter 3.
- Part 2 relates to the adaptation pillar, including the general description of the methods and of results in chapter 1, with insight on the stakeholder engagement, on the assessment of risks and vulnerabilities and on adaptation measures. Discussion and conclusions follow in chapters 2 and 3.

The approach of the two pillars differs in terms of methodology. As a consequence, the extraction of data upon which the assessment is based, has been developed with different timelines, as explained in the specific sections.

1.1 The Covenant of Mayors approach

The Covenant of Mayors was launched in 2008 with a 2020 target for local authorities who committed to achieving and exceeding at least the European 20 % reduction of the total emissions objective compared to the baseline, by implementing a Sustainable Energy Action Plan (SEAP).

In 2015, the Covenant of Mayors for Climate & Energy was launched with a 2030 target and the integration of the adaptation pillar. The key document to translate the vision of local authorities for both mitigation and adaptation to climate change is the Sustainable Energy and Climate Action Plan (SECAP).

Within two years from signing up to the initiative, local authorities have to define a minimum GHG emission reduction by 2020/2030 and approve and submit a Sustainable Energy and Climate Action Plan (SECAP). The SECAP is the key document through which the Covenant signatory presents its vision and target, together with the measures to be implemented to achieve its objectives.

The SECAP covers the geographical area under the jurisdiction of the local authority and includes actions by both public and private sectors.

The SECAP has to contain a clear outline of the actions that the local authority intends to take in order to ensure Low Emission Development or GHG emission reduction, taking into account the country's Nationally Determined Contributions (NDCs). 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, to be comparable with the NDC. For Europe the target is aligned to the EU NDC under the Paris Agreement which is to reduce greenhouse gas emissions by at least 40 % by 2030 compared to 1990. The SECAP also includes the assessments of climate risks and vulnerabilities within the territory and a set of adaptation actions to increase the resilience of the local authority sectors and vulnerable groups.

For a successful planning, local authorities may distinguish between:

- A vision, with long-term strategy and goals until 2030 and/or beyond, including firm commitments in areas like land-use planning, transport and mobility, public procurement, standards for new/renovated buildings etc.
- Detailed measures for the next 3-5 years, which translate the long-term strategy and goals into real actions.

Following the launch of the new Covenant of Mayors for Climate and Energy, an integrated monitoring and reporting framework with guidance ([4]) was released in July 2016. The Sustainable Energy and Climate Action

([4]) http://www.covenantofmayors.eu/Covenant-technical-materials.htm

Plan (SECAP) template and comprehensive reporting guidelines were developed together with practitioners from local and regional authorities and other key stakeholders. The framework aims to support new signatories in their energy and climate planning and to help them track progress on the implementation of their commitments. It enables signatories to report on their 2030 mitigation targets and actions and on climate adaptation.

For mitigation, the methodological approach remains the same as it was for the SEAPs, i.e. the development of a mitigation action plan is based on the BEI. At the same time, the signatories are required to review their mitigation action plans in order to include measures to achieve the 40% CO_2 (and possibly other GHG) emissions reduction target by 2030.

For adaptation, the reporting requirements are built on the various steps of the adaptation policy cycle, such as a climate risk and vulnerability assessment (RVA), identifying, assessing and selecting adaptation options and implementing, monitoring and assessing progress. The SECAP adaptation component is based on a comprehensive climate RVA which provides an analysis of the current situation.

The BEI and climate 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.

Specific data and information on emission inventories and action plans must be reported by the signatories via *MyCovenant* online template ((http://www.covenantofmayors.eu/), which accurately reflects the content of the official SECAP document, while the coherence of certain key figures is checked by the JRC.

Box 1. Covenant of Mayors: from pledges to actions

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

- Setting ambitious and quantified emission reduction targets;

- Measuring their GHG emission level in a base year according to a common methodological approach;

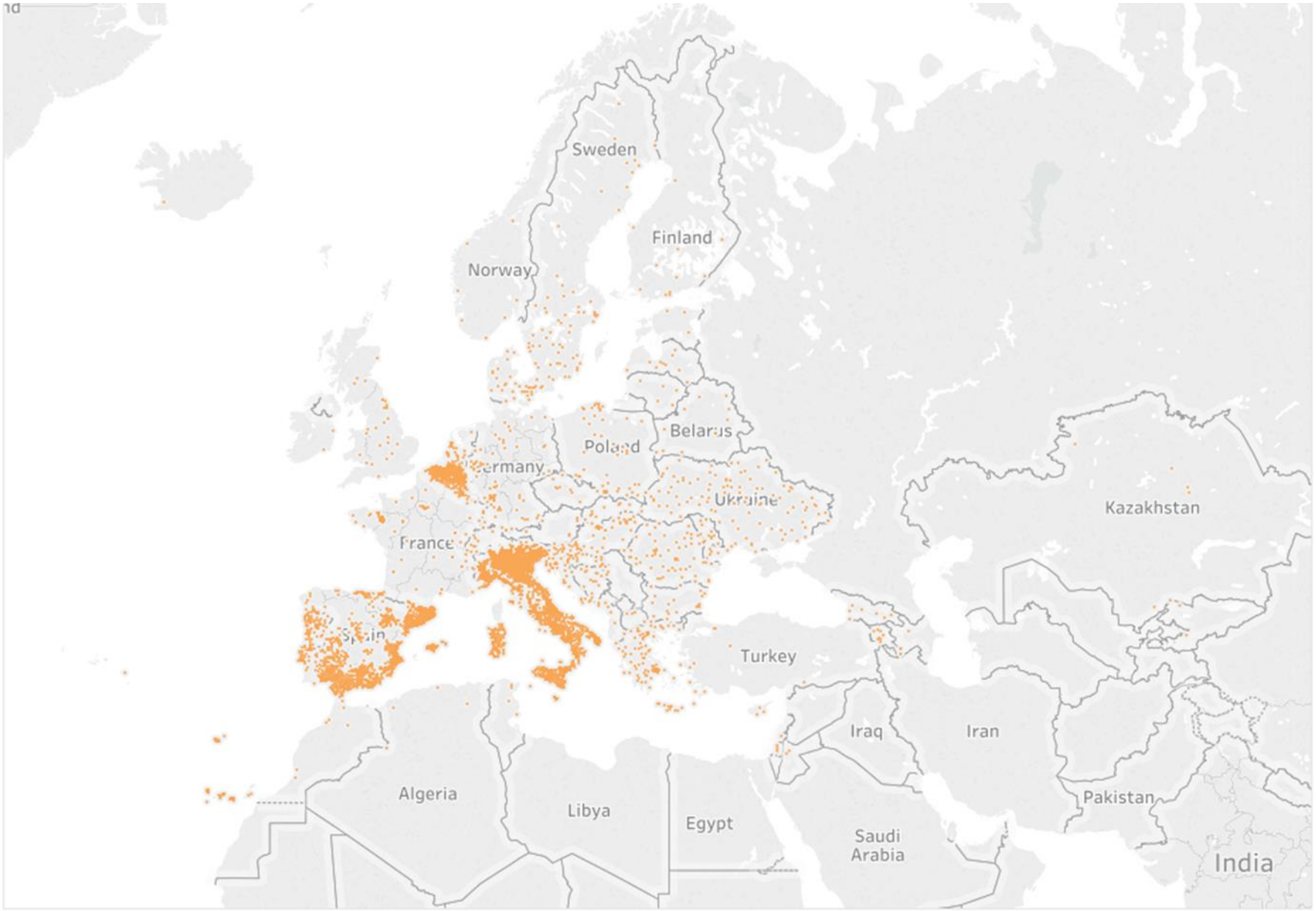
- Assessing climate risks and vulnerabilities in their territories;

- Defining a strategy and concrete actions to mitigate and adapt to climate change;

- Approving and making their action plan publicly available;

- Regular reporting (both qualitatively and quantitatively) to the EC on the implementation of their action plan;

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



Map of signatories of the Global Covenant of Mayors initiative adhering in the MyCovenant platform as of August 2019

PART 1 – MITIGATION PILLAR

1 Approach and methodology

1.1 The Covenant of Mayors Approach for mitigation

By developing a Baseline Emission Inventory (BEI) a local authority is measuring its GHG emission level in a base year, according to a common methodological approach. It identifies the principal anthropogenic sources of CO_2 (and other GHGs) emissions and prioritises the reduction measures accordingly. In these guidelines, the requirements for emission inventories and reporting outlined in the common reporting framework under the Global Covenant of Mayors for Climate & Energy (GCoM) ([5]) are explained and advice and recommendations for compiling the BEI and successive Monitoring Emission Inventories (MEIs) under the GCoM are provided.

Similar to the UNFCCC, the recommended baseline year for reporting is 1990, or the closest subsequent year for which the most comprehensive and reliable data can be provided (for example 2005). Signatories are given various options to calculate emission inventories.

They can choose either the standard IPCC approach or the Life-Cycle Assessment (LCA) approach. In the former, emission factors are based on the carbon content of fuels. GHG emitted by installations covered by the EU Emissions Trading System (EU ETS) [4] should not be included. Signatories can report also emissions of methane (CH_4) and nitrous oxide (N_2O), converted into CO_2-equivalents (CO_2-eq.) according to their global warming potential [3].

The Covenant of Mayors inventories are mapped in the main non-ETS trading sectors (such as households, transport, services) and sub-sectors, as described in Table 1[(6)]. Direct emissions in urban areas derive mainly from two sectors: buildings and transport. In addition to these two sectors, signatories have the option to report emissions (and emission-reduction targets) for other sectors which can be influenced by the local authority (waste, wastewater treatment, agriculture and the non-ETS industrial sector). The CoM inventories also account for indirect emissions associated with the consumption of electricity and heat/cold as a final product. In this case, a certain portion of the emissions computed in the inventories and addressed via the SECAP do arise from ETS plants. Notation keys may be used to accommodate limitations in data availability and differences in emission sources between local governments. Where notation keys are used, an accompanying explanation shall be provided.

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

([5]) The common reporting framework can be found at: https://www.globalcovenantofmayors.org/common-global-reporting-framework/.
([6]) Adapted from the "'The Covenant of Mayors for Climate and Energy Reporting Guidelines" '.

Table 1. Description of the online data on GHG emissions per sector in the BEI template

Sector	IPCC (ref no.)	Subsector	Description
Stationary Energy / Buildings	1A4a	Municipal buildings, equipment/facilities	Energy consumption and GHG emissions in buildings and facilities owned by the local authority. Facilities refer to energy-consuming entities that are not buildings, such as wastewater treatment plants.
		Public lighting	Public lighting owned or operated by the local authority (e.g. street lighting and traffic lights). Non-municipal public lighting is included in the 'Tertiary buildings, equipment/facilities' sector.
		Tertiary buildings, equipment/facilities	Energy consumption and GHG emissions in buildings and facilities of the tertiary sector (services); e.g. offices of private companies, banks, commercial and retail activities, hospitals, etc.
	1A4b	Residential buildings	Energy consumption and GHG emissions in buildings that are primarily used as residential buildings. Social housing is included in this sector.
	1A1, 1A2	Industries	Non-ETS: Energy consumption and GHG Emissions in manufacturing and construction industries not covered in the EU Emissions Trading Scheme (EU-ETS).
			ETS: Energy consumption and GHG emissions to manufacturing and construction industries covered in the EU-ETS. Integrating them into emission inventories is not recommended, unless such plants were included in previous energy plans and in the local authority's CO_2 emission inventories.
	1A4c	Agriculture/Forestry/Fisheries	Energy consumption and GHG emissions in buildings, facilities and machinery in the primary sector (agriculture, forestry and fisheries); e.g. greenhouses, livestock facilities, irrigation systems, farm machinery and fishing boats.
Transportation	1A3a 1A3b 1A3c 1A3d 1A3e	Municipal fleet	All GHG emissions from fuel combustion and use of grid-supplied energy for transportation within the city boundary shall be reported and disaggregated by mode: on-road, rail, waterborne navigation, aviation and off-road: - 1A3b: on-road transportation: urban street network under the competence of the local authority; - 1A3b: on-road transportation serving a larger area and/or not under the competence of local authority (e.g. highways) may be included if mitigations actions are planned in that area - 1A3e: off-road transport: off road traffic of vehicles/mobile machinery in any activity sector - 1A3c: rail transportation: local transport (metro, tram and local trains); long-distance trains, intercity trains, regional and cargo rail transportation may be included if mitigations actions are planned in that area - 1A3d: waterborne navigation: local ferries in public and private transport acting on the local territory - 1A3a: aviation: local governments may choose to report GHG emissions from the in boundary component of domestic and/or international aviation (such as the landing and take-off cycle for aviation), or assume these are all out of boundary emissions and use the notation key "Included Elsewhere"
		Public transport	
		Private and commercial transport	
Waste	4A	Solid waste disposal	All emissions from solid waste that are disposed of at managed sites (e.g. sanitary landfill and managed dumps) and unmanaged sites (e.g. open dumps, including above-ground piles, holes in the ground and dumping into natural features such as ravines).
	4B	Biological treatment	All emissions from biological treatment of waste, including composting and anaerobic digestion of organic waste.
	4C	Incineration and open burning	All emissions from waste that are burned either in a controlled, industrial, process or in an uncontrolled, often illicit, process. The former is often referred to as incineration and the latter as open burning. Note that this excludes emissions from waste incineration for the purposes of energy generation, also known as energy recovery.

	4D	Wastewater treatment	All emissions from the treatment process of wastewater, either aerobically or anaerobically
Energy supply	1A1	Electricity-only generation	All activity data and GHG emissions from energy (both renewable and non-renewable) consumption for the purpose of generating grid-supplied electricity in power plants that solely generate electricity.
		CHP generation	In the case of CHP plants, which generate heat and electricity simultaneously, or any other plants not listed, the amount of electricity produced, both from renewable and non-renewable energy sources shall be reported.
		District heating/cooling generation	All activity data and GHG emissions from energy (both renewable and non-renewable) consumption for the purpose of generating thermal energy in district heating/cooling plants
		Distributed local renewable energy generation	All activity data and GHG emissions from local energy generation (electricity, heat, etc.) facilities not grid-connected.

1.2 Statistical Analysis

The EU CoM signatories are requested to report on their climate action plans, including the baseline inventory of the emissions and planned actions, within two years after signing the Covenant. They also have to provide monitoring emission inventories every two years after the submission of the SECAP. The information is reported in specific online templates on the CoM website https://www.covenantofmayors.eu/en/.

Experience has shown that, due to the voluntary nature of the initiative, the difficulty of adapting sometimes local specificities to the CoM reporting framework, and the occurrence of material inputting errors, not all the data collected on the Covenant platform can be considered complete and reliable. Moreover, only a subset of the signatories which should have already provided a full monitoring report do so by the cut-off date.

For these reasons, the JRC has developed a methodology in order to:

i) Build a robust and reliable sample of GHG emission inventories by removing the outliers;

ii) Estimate GHG emission reduction for the whole set of signatories, which have provided at least one baseline emission inventory by end of August 2019, for the years 2005 and 2017.

The corresponding statistical approach and projection model are described in the following, while results are reported in chapter 2.

At the analysis cut-off date (end of August 2019), there was a total of 9693 CoM signatories (see section 2.1), 6287 of which had already provided a SEAP. The corresponding 'CoM dataset 2019' includes the following GHG emissions: CO_2, CH_4 and N_2O gases, expressed in CO_2-eq. As also explained in the previous section, the inventories were built using either the IPCC or the LCA inventory approach. In order to aggregate emission data from both methods, a multiplying factor (0.885), which is considered to be representative of the fraction of direct emissions embedded in LCA inventories (Cerutti et al., 2013), was applied to the LCA data. Finally, since it is not possible to perform a conversion to reconcile different reporting units (CO_2 and CO_2-eq) all the data reported are considered as CO_2-eq.

As a first check, the CoM baseline emissions were compared with national emissions per capita from several international inventories (Eurostat, European Environment Agency (EEA) and EDGAR [7]) (EEA, 2018). Although such a direct comparison can be useful to highlight potential data inconsistencies, it can be misleading to some extent. Indeed, the CoM collects bottom-up data at local level, while the other databases collect data at national level and at the local level project their broader-scale results using a top-down approach. Therefore, per capita values can significantly deviate from national averages, especially in urban areas. Setting validity ranges of per capita emissions, based only on the national or international inventories, may lead to the exclusion of an unnecessarily high number of emission inventories or, conversely, to accepting an excessive number of outliers.

([7]) Emissions Database for Global Atmospheric Research (EDGAR) is a joint project of the EU-JRC and the Netherlands Environmental Assessment Agency (PBL). It provides past and present global anthropogenic emissions of GHGs and air pollutants by country on a spatial grid (https://edgar.jrc.ec.europa.eu/).

For this reason, the preference is to rely on a self-consistent methodology for the identification and exclusion of outliers, based on the statistical principles currently accepted in literature, using the comparison with external data sources simply as a first broad check at the national level.

A two-step methodology has been developed in order to build a robust data sample of signatories with time coherent inventories:

- In the first step, a statistical method was applied to check the internal consistency of the inventories. The method for identifying and removing the outliers is based on the Generalised Extreme Studentized Deviate procedure which is highly recommended in the literature (Seem., 2007), (Bernard, 2016) and (Gant., 2013). The procedure iteratively identifies the extreme values in the dataset before choosing to remove those observations which are higher than the extreme values with a confidence level of 95 %.
- Subsequently, since the CoM emission inventories have different baseline years, 2005 have been chosen in this phase as the reference years for baselines and 2017 as the reference year for monitoring the progress. Hence, GHG emissions per capita reported in the CoM dataset by country were projected to 2005 and 2017, using the national GHG emission trajectories ((EEA, 2018) (Crippa et al., 2019)) in the CoM sectors from the BEI year to 2005 and from the MEI year to 2017. In cases were the BEI year anteceded 2005, the annual rate reduction of the target declared has been used for the projections of the baseline inventories to 2005. Similarly for the monitoring inventories, GHG emission reported in years that anteceded 2017, were projected in 2017, using the national GHG emission trajectories from the MEI year to 2017.

As a result of the original inventory containing 6287 entries was reduced to a clean dataset of 6200 signatories (i.e. 98% of the original data), referred to hereafter as the "CoM dataset 2019". Table 2 compares the main descriptive parameters of the original and the 'clean' datasets.

Table 2. Statistical parameters of the CoM dataset 2019

	All data CoM dataset 2019	Clean data CoM dataset 2019
Number of signatories	6287	6200
Total population in BEIs [Million inhabitants]	218.5	210.9

The procedure adopted for data validation excludes observations that are not acceptable according to the relevant literature and international guidelines. Investigation into the excluded inventories revealed that the majority of these signatories (72 % of the total excluded signatories) were small- and medium-sized towns (less than 50 000 inhabitants) mainly from Spain and Italy. A few signatories may have misinterpreted the type of fuel to be associated with reported data while some cities have only reported data on energy consumptions, inserting zero in the emission fields. This can relate to lack of information for specific sectors in the local territory. In addition, in some cases erroneous data might have been inserted due to misinterpretation of the units (e.g. $ktCO_2$ instead of tCO_2, kWh instead of MWh, etc.).

Box 2. JRC harmonised CoM dataset 2019

Based on the reports submitted online by the signatories by end of August 2019, processed using a JRC methodology for data cleaning, the following datasets have been built, divided into two subsets:

- CoM BEI dataset 2019: 6200 signatories, 183.8 million inhabitants, data on the baseline inventories;

- CoM MEI dataset 2019: 1845 signatories, representing 97.5 million inhabitants, were the EU monitoring subset is covering 1802 signatories, 88.8 million inhabitants, data on the reported monitoring inventories;

2 Results

The different categories of signatories and commitments, as of end of August 2019, are described in section 2.1. The findings relating to GHG emissions in the baseline year and the committed reductions by 2020, as derived from the clean CoM BEI dataset 2019, (6200 signatories) are provided in section 2.2. Analysis of the emission reductions achieved by the 1845 signatories who provided monitoring reports is presented in section 2.3.1. The estimated overall potential reduction for the complete EU CoM MEI dataset (1802 signatories) is discussed in section 2.3.2.

2.1 Signatories and commitments

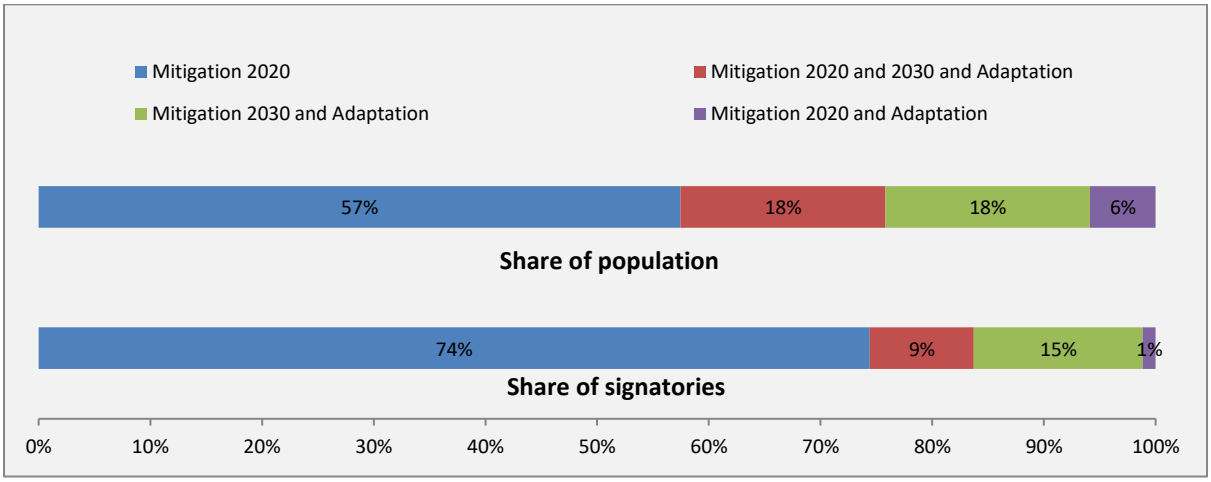
At the cut-off date for the analysis (end of August 2019), there was a total of 9693[8] CoM signatories (original full dataset), covering a total CoM population of 312.5 million inhabitants.

As a result of the new longer-term target towards 2030 announced in October 2015 and integration of the adaptation in the CoM methodological framework[9], the total number of signatories was split into different categories. In fact, according to the moment of adhesion, the signatories' commitment varies and includes a combination of all three: 20% mitigation target until 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, 40% until 2030 (the New Covenant for Energy and Climate).

Figure 1 shows the distribution (in %) of the signatories and population covered as a function of the commitment(s) (mitigation, adaptation) and target year(s) (2020, 2030).

- Mitigation 2020: The majority of the signatories are those which committed to the initial minimum target of a reduction in CO_2 of 20 % by 2020: 7213 signatories representing 176.6 million inhabitants, are committed exclusively to the 2020 mitigation targets.
- Mitigation 2020 and 2030 and Adaptation: refer to those signatories (903), representing 57.3 million inhabitants, which previously committed to the 2020 mitigation target and have now renewed their commitment to 2030, both in terms of mitigation and adaptation.
- Mitigation 2030 and Adaptation: refers to 1466 new signatories which joined the CoM initiative after October 2015, committing to the 2030 target, including adaptation
- Mitigation 2020 and Adaptation: The last category refers to two types of signatories (i) those signatories (91) representing 15.5 million inhabitants, that have committed to the 2020 mitigation target and (ii) those signatories (20) representing 2.8 million inhabitants, having committed to develop an adaptation plan but they have not yet committed to any mitigation target.

Figure 1. Share of signatories and population covered by commitments and target years



JRC own elaboration

([8]) 9693 signatories of which 1297 have adopted joint action plans.
([9]) 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.

Table 3 below shows the number of signatories in the original full dataset and their population categorised by region. The large majority (94 %) (9085 signatories, covering 75 % of inhabitants) are from the EU's 28 Member States followed by signatories in the Eastern Partnership region (431 signatories covering 11 % of the total CoM population); signatories from EFTA countries, Western Balkans and Turkey (93 signatories representing 9% of the total CoM population); signatories in the Southern Mediterranean region (77 signatories representing 3 % of the total CoM population) and signatories from the rest of the world (7 signatories covering 3 % of the total CoM population).

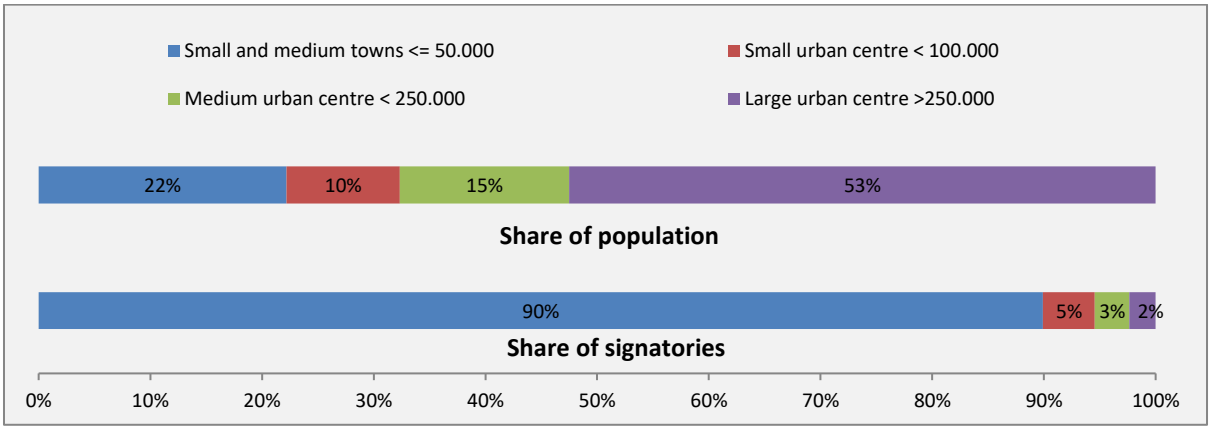
Table 3. Signatories per region as of August 2019

Region	Number of signatories	Signatories' inhabitants
European Union	9085	233,627,087
Eastern Partnership (CoM-EAST) ([10])	431	34,224,267
Europe-non-EU ([11])	93	27,339,241
Southern Mediterranean (CoM –South) ([12])	77	8,383,409
Rest of the world	7	8,979,160
Total	9693	312,553,164

The total number of inhabitants covered by the Covenant of Mayors initiative at the cut-off date is 312 553 164. Most of them (53 %) live in large urban centres, i.e. with a total population over 250 000 inhabitants (see Figure 2), and one global city: London (7.8 million inhabitants), which alone represents 2 % of the total population of CoM signatories.

Most of the Covenant of Mayors signatories (90 %) are small- and medium-sized towns (SMSTs). This large involvement of small municipalities in climate change mitigation and adaptation action is one of the main specificities of the Covenant initiative. Nevertheless, SMSTs only account for a limited share of energy consumption and CO_2 emissions. Since the regional context appears to be the most important common factor for these municipalities, in order to maximise its potential, the CoM initiative encourages the development of joint action plans and promotes the role of Covenant Territorial Coordinators (CTCs).

Figure 2. Shares of CoM signatories and population as a function of the size of the urban centre, as of August 2019



JRC own elaboration

([10]) Armenia, Azerbaijan, Belarus, Georgia, Republic of Moldova, Ukraine
([11]) Switzerland, Norway, Iceland, Lichtenstein and non-EU Western Balkan countries and Turkey
([12]) Algeria, Egypt, Israel, Jordan, Lebanon, Morocco, Palestine, Tunisia

Detailed data on number of signatories per country, population coverage can be found in Annex I.

Box 3. Covenant signatories and their commitments

9 693 signatories and 312.5 million inhabitants by end of August 2019.

74 % are still committed exclusively to the initial target proposed (20 % reduction in CO2 emissions by 2020);

A growing number of signatories are committing to 2030 (24 % of signatories, covering 37 % of the CoM population);

The Covenant is still mainly a European initiative (75 % of the population), although its extension beyond the EU borders continues to grow;

The high participation of small and medium-sized towns (90 % of the signatories) confirms the important role of small municipalities in climate change mitigation;

In terms of population, the highest share of inhabitants (53 %) belongs to large urban centres (more than 250 000 inhabitants) and a global city (London).

2.2 Sustainable Energy Action Plans

This section analyses the baseline years (2.2.1), greenhouse gas emissions (2.2.2) and committed emission reductions by 2020/2030 (2.2.3-4) reported in the CoM dataset 2019 (6200, i.e 64 % of the signatories, covering 67 % of the signatories population) (Table 4), built according to the 'Statistical Analysis' described in section 1.2. Figure 3 shows the map of the EU signatories per Member States with a SEAP submitted as of August 2019.

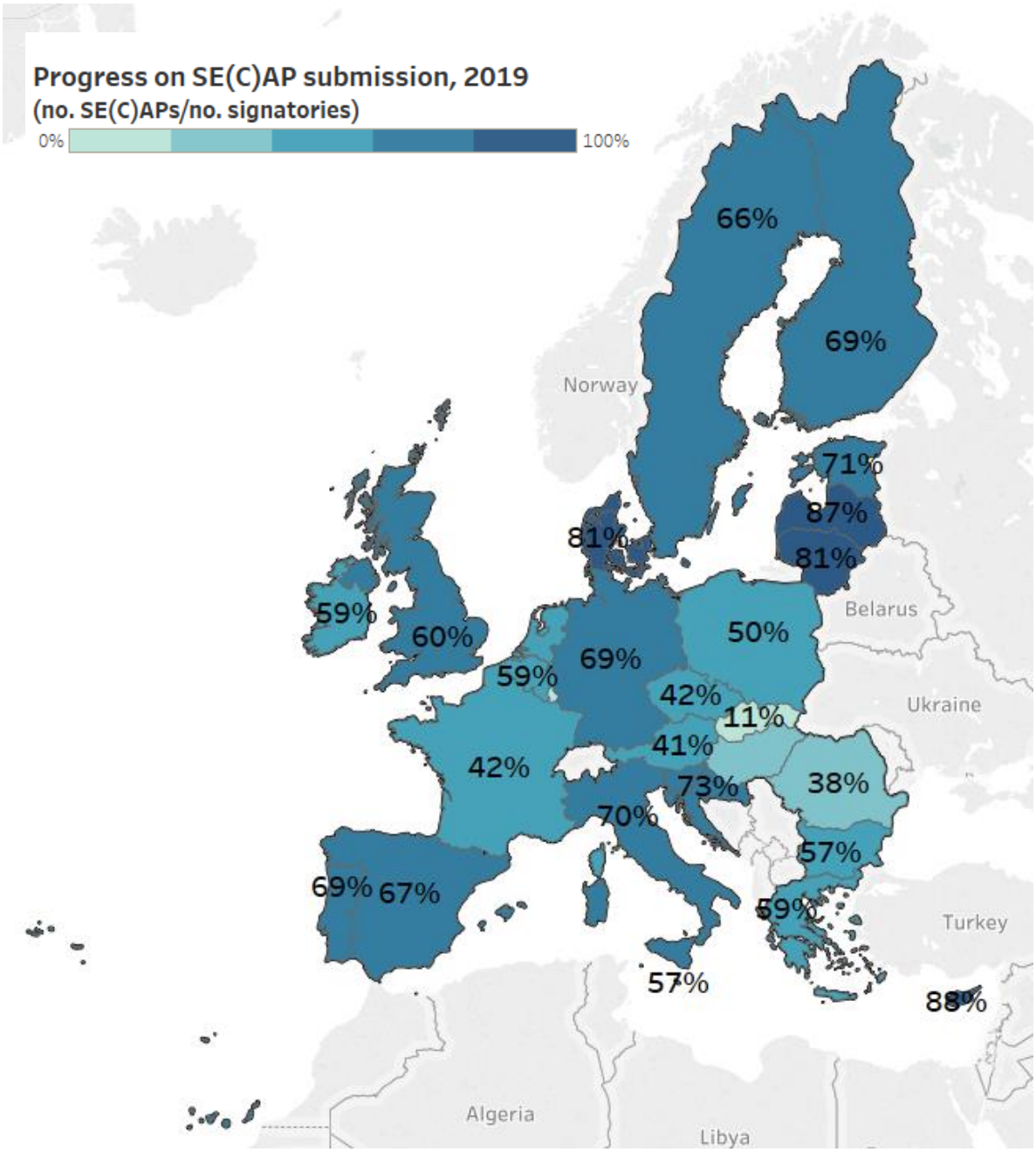
Table 4. Signatories per region with a SEAP submitted as of August 2019

Region	Number of signatories	Signatories' inhabitants	No. of SEAPs in the sample	No. of SEAPs in the sample/ No. of Signatories	Population covered in the Baseline Emission Inventory	Share of population of SEAPs in the sample/ Population of Signatories
European Union	9085	233,627,087	5,959	66%	169,680,00	73%
Eastern Partnership (CoM-EAST)	431	34,224,267	167	39%	17,626,000	52%
Europe-non-EU	93	27,339,241	51	55%	19,326,000	71%
Southern Mediterranean (CoM –South)	77	8,383,409	23	30%	4,232,000	50%
Rest of the world	7	8,979,160	-	-	-	-
Total	**9693**	**312,553,164**	**6,200**	**64%**	**210,864,000**	**67%**

2.2.1 Reference year for the BEI

In the guidebook 'How to develop a Sustainable Energy Action Plan' (Bertoldi, 2018), a general recommendation was made to use 1990 as the BEI year, which is the reference year for which the reduction target was defined. Nevertheless, signatories are allowed to choose the closest subsequent year for which reliable data can be gathered. As a result, different BEI years have been chosen by the signatories.

Figure 3. Shares of EU CoM signatories per Member State with a SEAP submitted, as of August 2019



JRC own elaboration

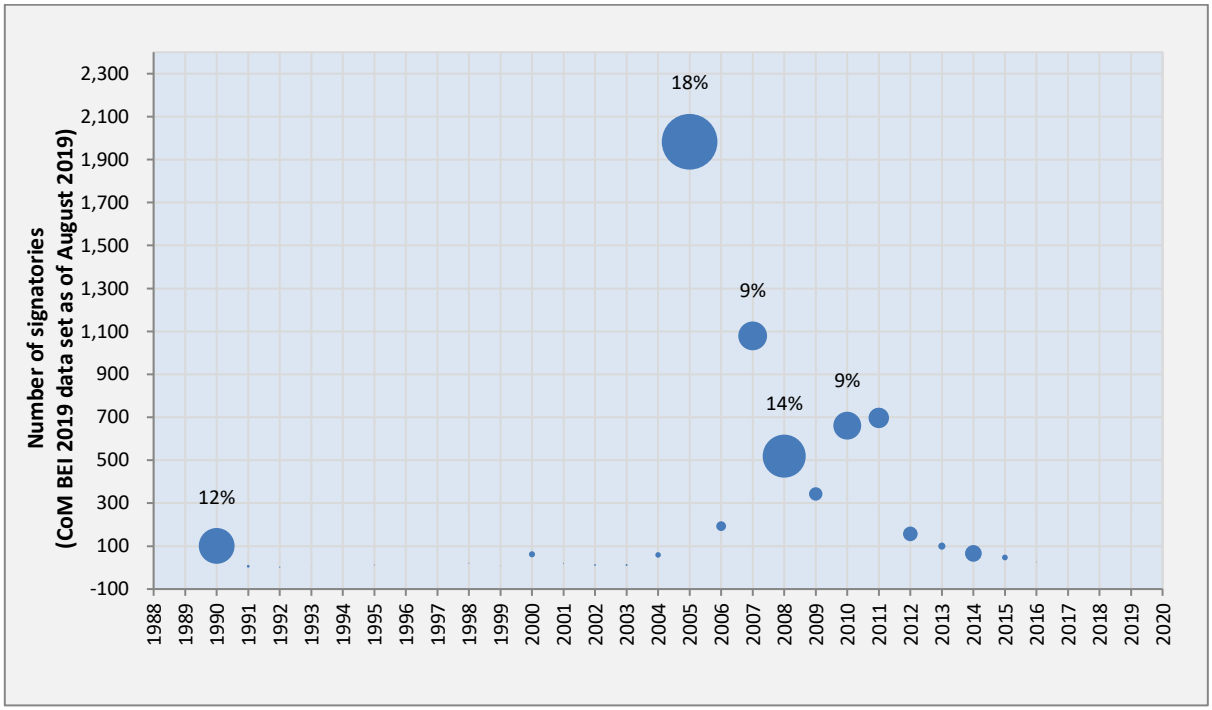
Figure 4 shows that only 2 % of the signatories chose 1990 as the baseline year, while most of them decided to use 2005 (32 %), 2007 (17 %), or more recent years (42 %). The 101 local municipalities which adopted 1990 as the reference year include 27 large urban centres (such as Berlin, Munich and Brussels-Capital) and cover 12 % of the total inhabitants in the CoM BEI dataset 2019. From 2005 onwards, the BEIs cover 95 % and 81 % of the CoM signatories and population, respectively.

These average patterns are driven by the small and medium-sized urban centres (94 % of the signatories, 81 % of which are located in Italy or Spain) and differ according to the size of the city and country. These patterns reflect the fact that the data on 1990 is not available to all municipalities, but mainly to those which started to manage their emissions/energy consumption long before the Covenant, and thus already had a plan or series of plans which they submitted as a SEAP/SECAP after they had become Covenant signatories.

These results also suggest that a significant proportion of those signatories choosing later BEI years, such as in Italy and Spain, also did the data collection more recently, i.e. after their commitment time. Indeed, data availability may be difficult due to the lack of, or incompatible electronic archiving systems, or lost knowledge following the retirement of many municipal/energy officials who were familiar with the situation in 1990. In such situations, the general recommendation to use 1990 does not apply, since the compilation of 1990 inventories would have to rely on assumptions to fill in data gaps, and therefore would reduce the accuracy of the BEI.

Using 2005 instead of 1990 at the EU level could mean a more ambitious 20 % reduction target by 2020, because of the reduction already achieved between 1990 and 2005. However, it is worth noting that this might not always be the case on national and local scales, or for a given emitting sector, according to the trends in GHG emissions since 1990.

Figure 4. Reference years in BEIs in the CoM BEI dataset 2019 (N=6200). The population covered in the corresponding SEAPs is represented in relative terms by the size of the bubble.



JRC own elaboration

2.2.2 Greenhouse gas emissions in BEI

Statistics on emission have been calculated for the direct and indirect emissions reported by the signatories in the CoM platform. Table 5 shows the overall absolute emissions and per average per capita emissions in the Covenant Regions and their standard error (95 % confidence).

Figure 5 shows the overall GHG emissions in the CoM macro-sectors reported in BEI data after around eleven years of CoM activity. The total GHG emissions are 1080 Mt CO_2-eq/year, with a preponderant contribution from the Stationary Energy (72.5 %) followed by the Transportation (26 %) macro-sector and Waste (1.5 %).

The distribution of GHG emissions into the different CoM sub-sectors (Table 1) is presented in Figure 5. The three most-emitting building sub-sectors are responsible for 28.3 % (residential buildings), 15.4 % (tertiary buildings) and 15.4 % (non-ETS industries) of the total CO_2-eq emissions, respectively. All those emissions in the building sector without a classification in a specific sub-sector are grouped under 'Agriculture, Forestry, Fisheries and other stationary energy not allocated', representing 11 % of the total CO_2-eq emissions.

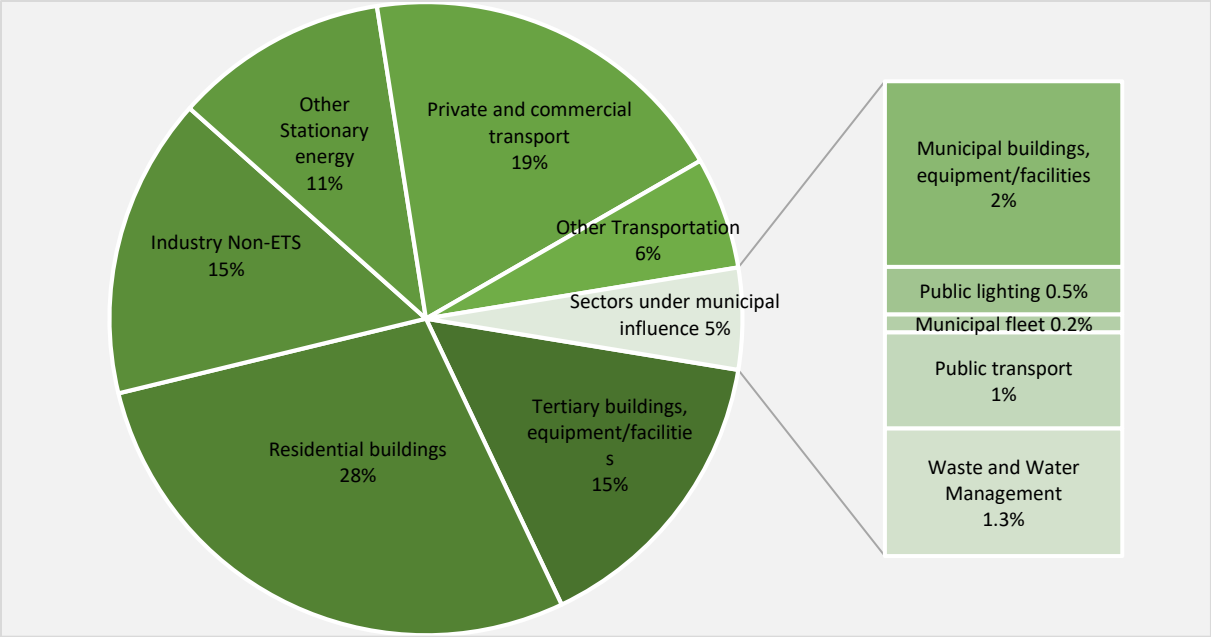
The emissions in the transport macro-sector are largely dominated by the private and commercial transport sub-sector, which contributes to 73 % of the GHG emissions from transportation and to 19 % of total GHG emissions. All the emissions in the transport sector which are not classified in a specific sub-sector are grouped under 'Other Transportation, representing 5.7% of the total CO_2-eq emissions.

Table 5. GHG emission per Covenant Regions as of August 2019: CoM BEI dataset 2019 (N=6200)

	Number of action plans	Population of signatories [Million inhabitants]	GHG emissions in BEIs [Mt CO_2-eq/year]	Average GHG emissions per capita in BEIs [t CO_2-eq/year/per capita]
European Union	5959	169.7	967.8	5.9 ±0.0016
Eastern Partnership	167	17.6	48.8	4.36±0.12
Europe-non-EU	51	19.3	54.8	4.38±1.16
Southern Mediterranean	23	4.2	8.9	2.10±1.06
Total	6200	210.9	1080	5.12±0.06

The 'Sectors under municipal influence' (5 % of the total emissions) groups the emissions which include municipal buildings and facilities (2.5 %), municipal fleet (0.2 %), public transport (1 %), waste management and water management (1.3 %). Comparing these statistics with the previous assessment report (Kona et al., 2016) shows an increase of 12 % in the GHG emissions reported in the BEIs over the last 3 years, which reveals the Covenant's ever-increasing coverage.

Figure 5. GHG emissions in CoM sub-sectors reported in BEIs in the CoM dataset 2019



JRC own elaboration

2.2.3 Committed emission reductions by 2020/2030

Statistics on emission and reduction commitment by 2020 have been calculated for the direct and indirect emissions reported by the signatories in the CoM platform. Table 6 shows the overall absolute emissions and committed reductions.

Table 6. Share of GHG emission reductions: CoM BEI dataset 2019 (N=6200)

	Number of action plans		Population [million inhabitants]		Share of GHG emission reduction [% by 2020/2030], compared to baseline emission projected to 2005	
	commitments to 2020	commitments 2030	commitments to 2020	commitments 2030	commitments to 2020	commitments 2030
European Union	5683	276	157.73	11.95	31%	47%
Eastern Partnership	127	40	15.26	2.4	26%	40%
Europe-non-EU	49	2	14.61	4.7	3%	9%
Southern Mediterranean	21	2	4.00	0.232	13%	49%
Total	**5880**	**320**	**191.59**	**19.3**	**30%**	**42%**

Although minimum commitment requirement in the CoM is to reduce the emissions by 20% by 2020, on average, the CoM signatories have committed to a significantly higher target of **30 %**, compared to baseline emission projected to 2005.

Preliminary results on the signatories (320 signatories covering 19.27 million inhabitants) with target by 2030 shows an overall estimated emission reduction target of **42 %,** compared to baseline emission projected to 2005.

An analysis of the share of GHG emission reduction in the different categories in urban centres based on the population size shows that more than 62 % of the reduction would result from actions/measures planned by 2020 in large urban centres (of more than 250 000 inhabitants).

Box 4. Covenant GHG emission reduction commitments by 2020/2030

Covenant signatories have committed to ambitious GHG emission reduction targets by 2020, compared to baseline emission projected to 2005: the overall commitment of 30 %, is ten percentage points higher than the minimum target;

Preliminary results shows that Covenant signatories are committing to ambitious GHG emission reduction targets also by 2030, compared to baseline emission projected in 2005: the overall commitment of 42 %;

Total emissions in the baseline inventories: 1080 Mt CO2-eq as reported by 6200 signatories (211 million inhabitants);

The buildings sector is the most representative with 72.5 % from the total emissions in the BEIs, followed by the transport sector with 26 %.

2.2.4 Committed emission reductions by 2020/2030 in the European Union

This chapter reports the overall CoM initiative's performance on EU GHG emissions and reductions, as expressed in absolute reductions. They are then reported and discussed as compared to EU emission data and reduction commitments.

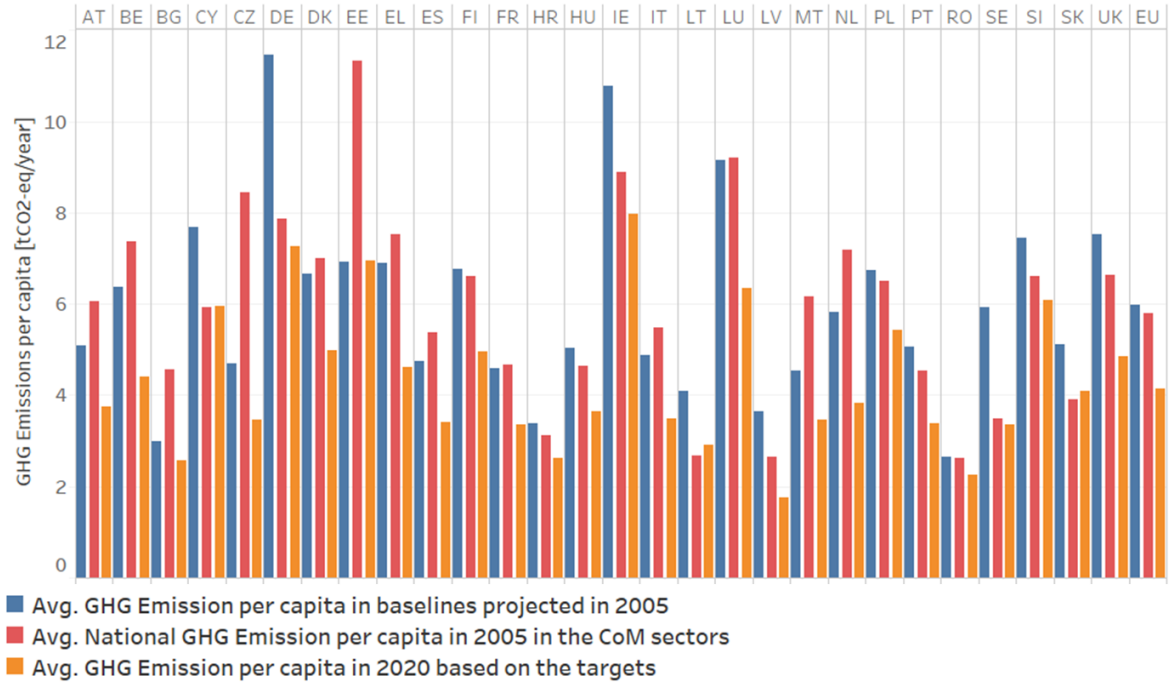
The performance indicators in indicate the EU GHG emissions per capita of 5.97 tCO_2-eq/cap, in 2005 while the EU average for GHG emissions in all CoM sectors in 2005 are 5.8 tCO_2-eq/cap (EEA, 2018). The GHG emission reduction by 2020, compared to baseline emissions projected in 2005, committed by EU CoM signatories, corresponds to a share of 31 % (Table 7).

Table 7. GHG emissions and reductions in the EU CoM signatories': CoM EU BEI dataset 2019 (N=5959)

	EU-all	Signatories with Commitment to 2020	Signatories with Commitment to 2030
Number of action plans	5959	5683	276
Population of signatories [Million inhabitants]	170	158	11.9
GHG emissions in baseline inventories projected in 2005 [Mt CO_2-eq/year]	1016	952.2	63.7
Projected GHG emission by 2020/2030, based on the target [Mt CO_2-eq]	703.2	658.4	33.8
Share of GHG emission reduction by 2020/2030, compared to 2005 [%]	**31%**	**31%**	**47%**

Preliminary results based on the signatories with a submitted climate action plan for 2030 (276 signatories, covering 11.9 million inhabitants), shows a GHG emission reduction by 2030, compared to baseline emissions projected in 2005, of 47 % (Table 7). Figure 6 shows the GHG emissions per capita in EU Member States[13] according to the BEIs and estimated emission reductions in 2020.

Figure 6. GHG emissions per capita in EU Member States according to BEIs projected in 2005 and estimated emission reductions by 2020



JRC own elaboration

([13]) See http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Country_codes for the country codes.

Box 5. Covenant EU GHG emission reduction commitments by 2020/2030

EU Covenant signatories have committed to ambitious GHG emission reduction targets by 2020: the overall commitment of **31 %,** compared to 2005, is almost 11 percentage points higher than the minimum target by 2020;

Preliminary results shows that EU Covenant signatories are committing to ambitious GHG emission reduction targets also by 2030: the overall commitment of **47 %,** is seven percentage points higher than the minimum target;

Total emissions in the baseline inventories: 1006 Mt CO2-eq as reported by 5959 signatories (170 million inhabitants);

The buildings sector is the most representative with 72.5 % from the total emissions in the BEIs, followed by the transport sector with 26 %.

An attempt has also been made to assess the contribution of local actions towards achieving EU GHG emission reduction targets (Table 8) and their projections. According the EU Member states projections in 2017-18' Greenhouse gas emissions in the EU are expected to decrease further by 2020 to 26% below 1990 levels with the current measures that are already in place.

The emission reduction needed at the EU level to achieve its 20% reduction target by 2020 has been calculated using EEA data for 2018 (EEA, 2018).

The emission reduction committed by 2020 by the CoM signatories of the EU Member States (312 MtCO2-eq) represents 98% of the overall reduction committed by all CoM signatories;

By achieving their commitment, the EU Member State CoM signatories would achieve **28 % of the EU's overall emission reduction EU MS projections by 2020**, compared to 2005 including all sectors.

Table 8. CoM contribution to the EU 2020 target in terms of GHG emission reductions

EU GHG emissions in 2005 [$MtCO_2$-eq]	5351
EU GHG emission target by 2020 [$MtCO_2$-eq]	4576
EU GHG emission projections with existing measures by 2020 [$MtCO_2$-eq]	4218
Covenant of Mayors in the EU region: estimated GHG emission reduction by 2020, compared to 2005 [$MtCO_2$-eq]	312
CoM potential contribution to EU 2020 GHG emission projections compared to 2005 [%]	**28**

Box 6. EU perspective on the Covenant commitments for 2020

5959 SEAPs submitted by CoM signatories from the EU, covering 169.7 million inhabitants (34 % from the total EU population in 2005);

Emission reductions by the Covenant signatories from the EU (96 % of the total signatories and 34 % of the EU population in 2005) **may represent 28 % of the EU** GHG emission reduction projections by 2020, compared to 2005.

2.3 Monitoring and implementation

This chapter presents the progress made by the signatories in terms of reporting on the monitoring of their emission inventory (2.3.1) and the emissions reduction achieved. The interim results on progress towards their reduction target (section 2.3.2) are based on currently available data from 1845 signatories.

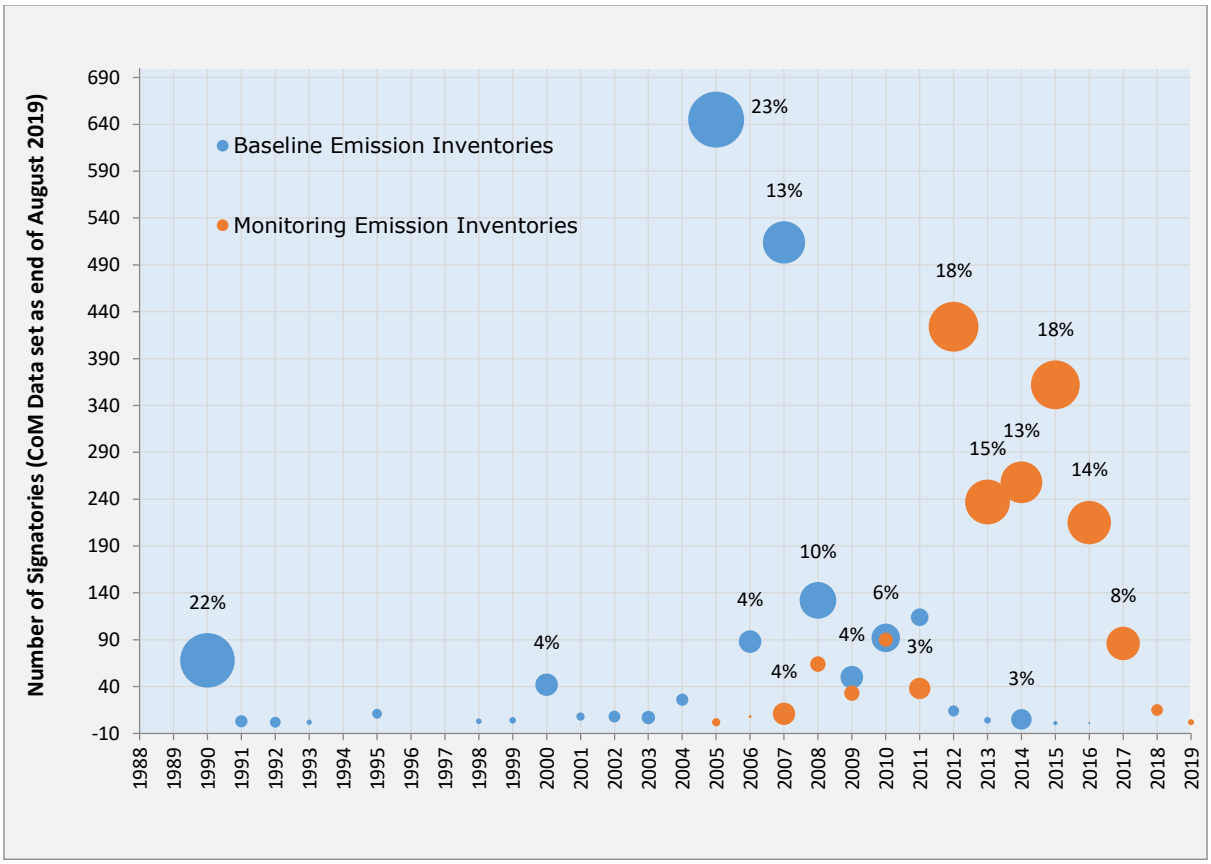
2.3.1 Progress on monitoring reporting

Up to August 2019, 1845 signatories, which covers a population of 97.5 million inhabitants (30 of signatories and 48 of the population with a submitted SEAP) had reported on the implementation of their SEAP by presenting a so-called full report, i.e. a monitoring report including an MEI (see Annex I).

For those signatories which have already presented a full monitoring report, Figure 7 shows that many have chosen which baseline and monitoring year with their respective populations (bubble size). The majority of populations (23) among CoM signatories have chosen the inventory year 2005 for their BEI (blue bubbles).

The MEIs already provided (orange bubbles) refer mainly to the years 2012, 2013 and 2015, which represent 18 , 15 and 18 of the total population in the monitoring subset, respectively.

Figure 7. Years in BEIs and MEIs in the CoM MEI dataset 2019 (N=1845)



JRC own elaboration

Table 9 shows the MEIs already provided by each country in terms of percentage of SEAPs submitted (CoM MEI dataset 2019).

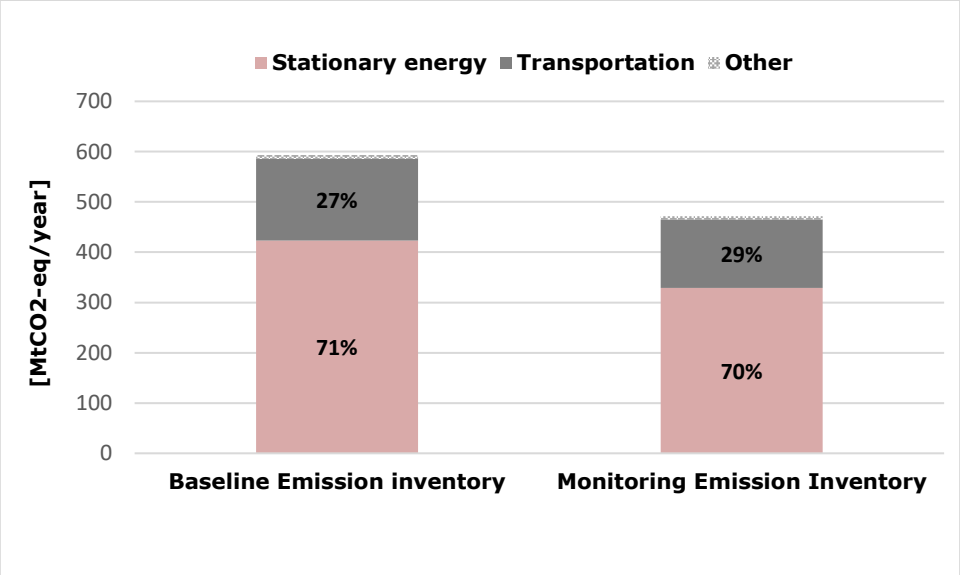
The progress made by those 1845 signatories which have provided at least one full monitoring report is assessed as follows: the emissions in their BEIs are compared to those reported in their latest MEIs, having been aggregated by sector. The absolute reductions achieved from BEI emission to MEI emission, correspond to 21 %. Although the minimum commitment made by these signatories was 20 % by 2020, they have set an even more ambitious target, corresponding to a 28 % emission reduction by 2020, compared to baseline emission inventories.

Table 9. Statistics of monitoring reports per Covenant Regions – CoM MEI dataset 2019 (N=1845)

	Number of progress reports [MEIs]	Share of signatories with a MEI on the total number of signatories with a SEAPs	Population of signatories with progress reports [Million inhabitant]	Share of population of signatories with a MEI on the total population of signatories with a SEAPs	GHG emissions in BEIs [Mt CO_2-eq/year]	GHG emissions in MEIs [Mt CO_2-eq/year]
European Union	1802	30%	88.85	52%	563.56	448.61
Eastern Partnership	25	15%	3.16	18%	9.660	6.714
Europe-non-EU	18	35%	5.55	29%	20.297	16.181
Total	**1845**	**30%**	**97.56**	**46%**	**593.52**	**471.51**

The results (Figure 8) show the sharpest decrease in GHG emissions since the BEI year for the building sector (22 %). The reduction in the transport sector is much less pronounced (16 %), followed by the 'other' sectors (see definition in chapter 1).

Figure 8. Evolution of GHG emissions per sector from baseline to monitoring emission inventories



JRC own elaboration

2.3.2 Reported progress in the European Union

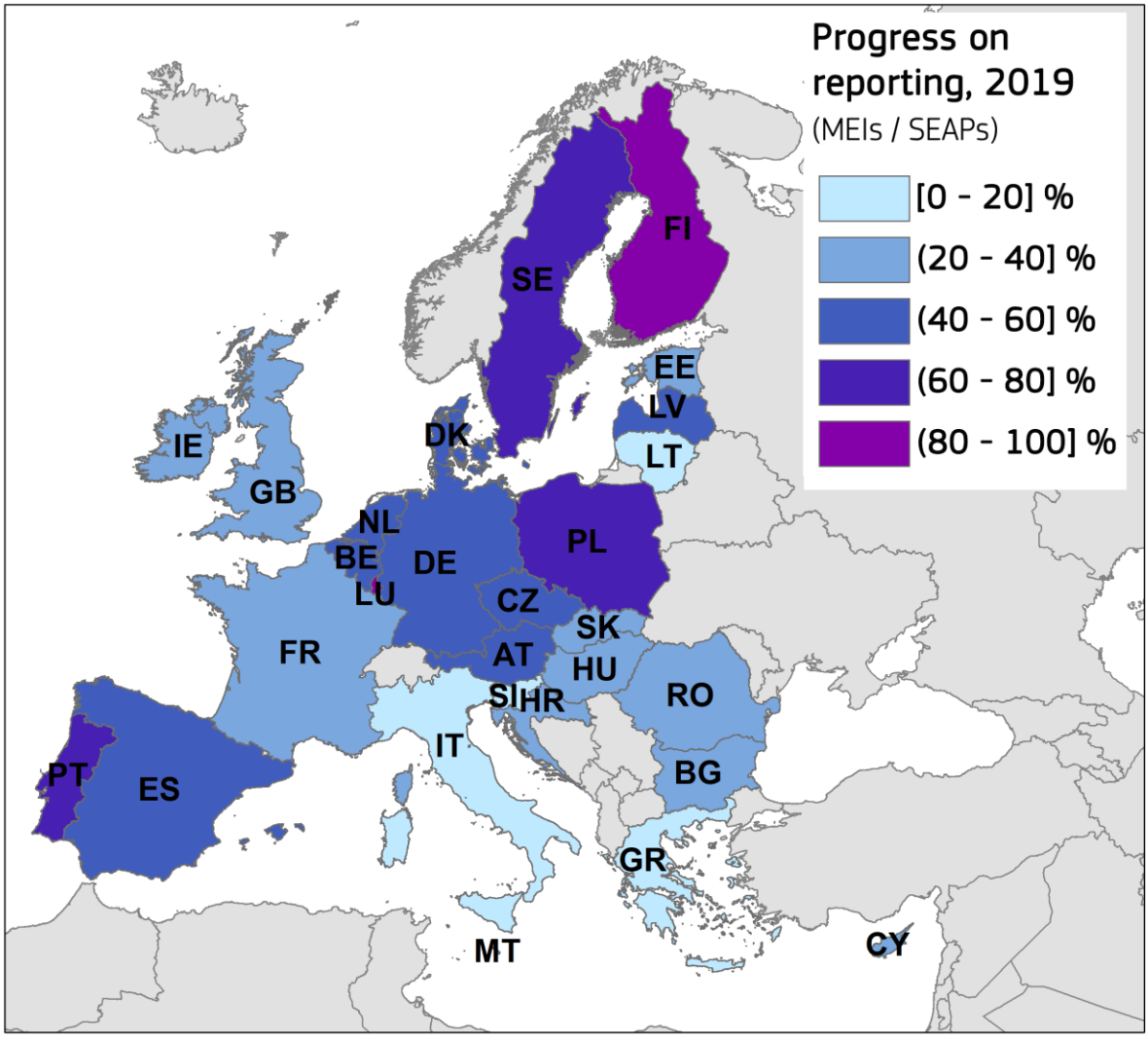
As of end of August 2019, 1802 signatories, which covers a population of 88.85 million inhabitants (30 % of signatories and 52 % of the population with a submitted SEAP) had reported on the implementation of their SEAP by presenting a monitoring report including an inventory on emissions MEI.

While these are encouraging results, the representativeness of the sample should be considered before drawing general conclusions for the whole SEAP sample. Indeed, on average these 1802 signatories are bigger cities than those in the SEAP sample (30 % of the signatories with a BEI, submitted also a progress report (MEI), representing 52 % of their population). In addition, they are often more advanced cities, i.e. with greater experience in terms of local climate and energy planning.

Figure 9 shows the MEIs already provided by each EU country in terms of percentage of SEAPs submitted (CoM MEI dataset 2019). Analysing the EU CoM monitoring subset of the MEI dataset, at the national level shows that Spain and Italy are the countries with the highest number of monitoring reports (689 and 646 respectively) covering a fraction of the population (66 % and 39 % respectively).

It suggests that local authorities in some countries (e.g. Italy) that have enthusiastically joined the initiative and submitted their SEAPs (thanks also to the support provided by regional authorities acting as CTCs), might now be facing some challenges in the implementation phase. The reasons for this should be further investigated in order to provide a definitive answer and to identify potential needs regarding target support by local authorities facing such a situation.

Figure 9. Share of monitoring reports on number of SEAPs per country in the EU CoM MEI dataset 2019 (N=1802)



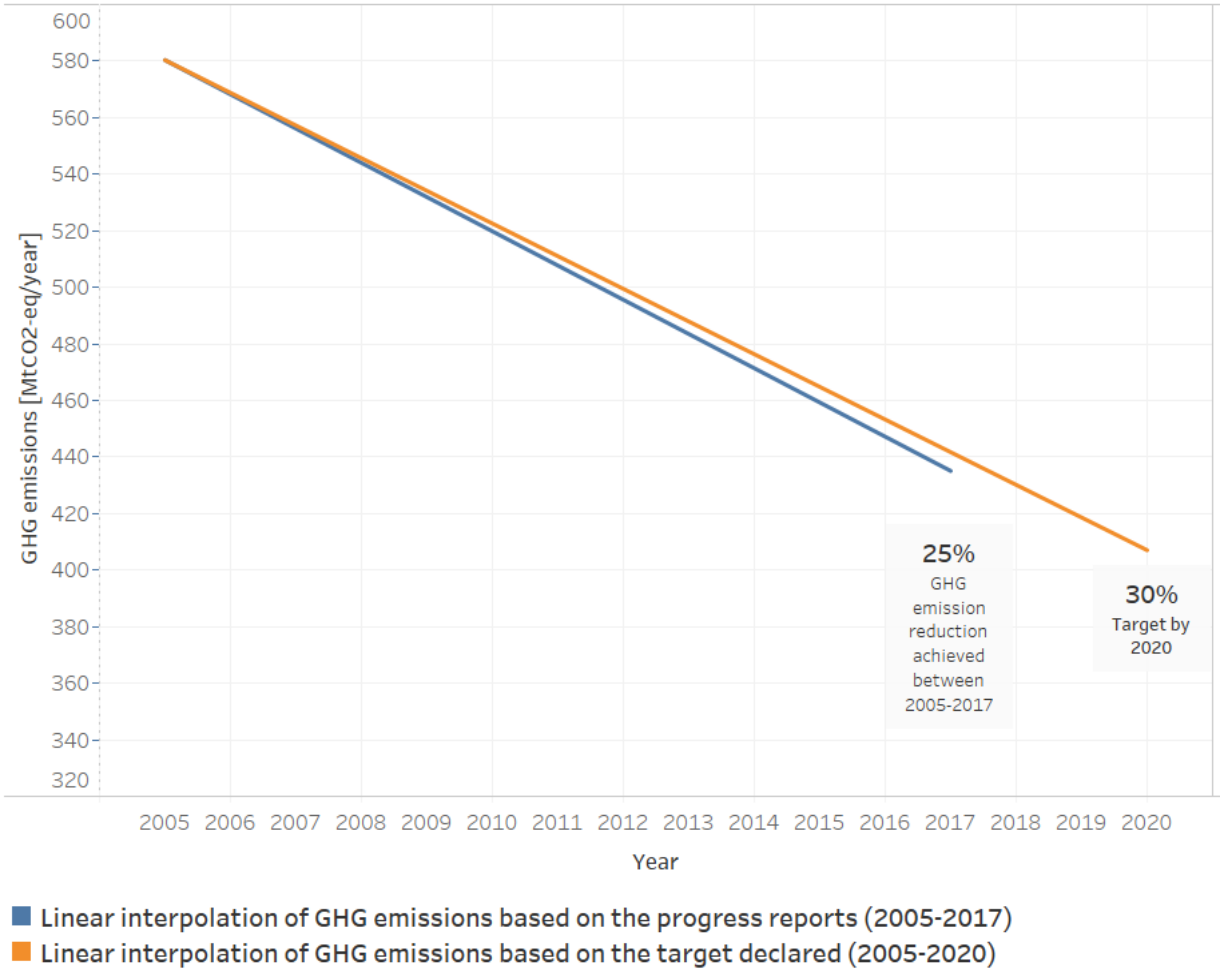
JRC own elaboration

Figure 10 shows the GHG emissions in BEI (2005) 580 Mt CO_2-eq/year, in MEI year (2017) 435 Mt CO_2-eq/year), and the 2020 commitment 405 Mt CO_2-eq/year). In addition, the green line represents the linear interpolation of GHG emissions based on the progress reports from 2005 to 2017.

Figure 10 shows that monitoring data in 2017 (435 Mt CO2 eq/year) are lower than the expected value, based on the linear interpolation (441 Mt CO_2 eq/year) between the 2005 data and the 2020 commitment (i.e. 24%). Therefore, those signatories that submitted a monitoring emission inventory are well on track to reach their target by 2020.

The absolute reductions achieved from BEI (2005) to MEI (2017) in the EU correspond to **25 %**. Although the minimum commitment made by these signatories was 20 % by 2020, they have set an even more ambitious target, corresponding to a 30 % emission reduction by 2020 – and are on track to reach it.

Figure 10. EU GHG emissions in the baseline year (2005) in the monitoring year (2017) and in 2020



JRC own elaboration

Box 7. GHG emission reduction achieved in 2017

Overall, ***a reduction of 21 % has been achieved,*** from the baseline year inventory (BEI) to the year of the last submitted monitoring report (MEI), as reported by 1845 signatories, representing 97.5 million inhabitants;

In the EU Covenant signatories, ***a reduction of 25 % has been achieved,*** from the baseline year inventory (BEI-2005) to the year of the last submitted monitoring report (MEI-2017), as reported by 1802 signatories, representing 88.8 million inhabitants;

The drop in emissions is more obvious in the ***buildings sector with a decrease of 22 %*** from BEI to MEI but less pronounced in the ***transport sector with an 16 % reduction from BEI to MEI***;

EU Signatories which submitted monitoring emission inventories have an overall target of 30 % for 2020, compared to 2005 and ***are on track to reach it***.

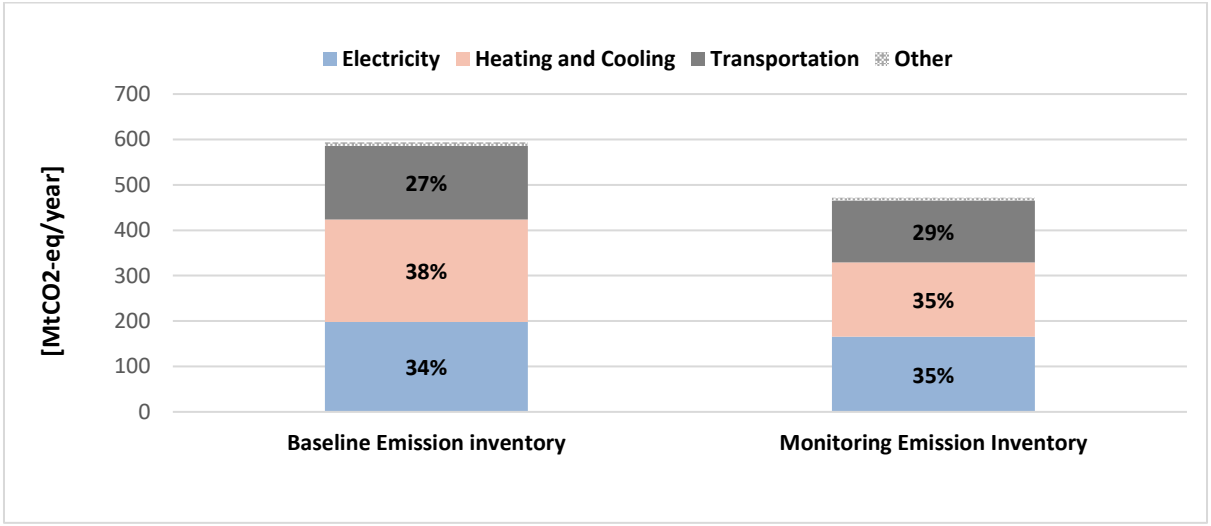
The reduction in GHG emissions between the baseline and monitoring emission inventories resulted from the combination of several factors such as improvements in energy efficiency, an increase in renewables, demographic variation, variations in weather conditions, economic growth, etc.

The decrease in GHG emissions in the EU between the baseline and monitoring years was driven by (Figure 11):

- GHG emission due to electricity consumption decreased by 16 % from baseline to monitoring years driven by a less-carbon-intensive fuel mix and more efficient electricity generation power plants (EEA, 2014);
- GHG emissions for heating and cooling in buildings fell by 27 % from baseline to monitoring years, driven by improved energy efficiency in buildings and subsequent lower energy consumption levels, more efficient local heat production from district heating networks, and by increasing the share of renewable sources in decentralised local heating production.
- GHG emissions in the transport sector fell by 16 % from baseline to monitoring years, driven by lower energy consumption from fossil fuels and an increase in the share of biofuels, and a shift towards public transportation and electric mobility.

These results underline the interconnected nature of climate mitigation and energy efficiency actions adopted at the local level. The CoM signatories have adopted a range of policies and measures for improving energy efficiency through building regulations, increasing the share of renewable energy, integrating district energy systems and a gradual transformation to more efficient and sustainable transportation.

Figure 11. Evolution of EU GHG emissions per sector from baseline to monitoring emission inventories



JRC own elaboration

The results presented in this report demonstrate that the combination of effective urban energy policies and better coordination between national and local governments is crucial for the potential of the urban mitigation of global climate change.

3 Conclusions

3.1 Overall considerations

This report has illustrated how the Covenant of Mayors, the world's largest urban climate and energy initiative, involving thousands of local and regional authorities, facilitates and accelerates the implementation of effective actions to fight climate change.

The Covenant of Mayors' integrated approach is in line with a number of EU priorities not only concerning mitigation and adaptation but also in terms of embracing a robust transparency framework for the implementation of the Paris agreement. It is the first initiative of its kind addressed to local authorities which requires signatories to define a binding target, commit to developing an action plan addressing mitigation and adaptation and to monitoring the results on a regular basis in order to track progress towards their targets.

At the cut-off date of the analysis, end of August 2019, the number of CoM signatories totalled 9693 (94 % from the EU), covering 312.5 million inhabitants (75 % in the EU representing 47 % of the total EU population in 2005).

Box 8. Covenant of Mayors for Climate and Energy: signatories and commitments

The initiative has 9693 local authorities as signatories, covering 312.5 million inhabitants as of end of August 2019.

Significant participation by small and medium-sized towns (90 % of the signatories) confirms the important role of small municipalities in climate change mitigation.

In terms of population, the ***highest share*** of inhabitants comes from ***large urban centres*** and a global city (53 %).

The Covenant remains a mainly ***European initiative*** (75 % of the Covenant population), although its ***extension beyond the European Union borders*** continues to grow.

The majority of the signatories (74 % of the signatories) are still committed exclusively to the initial target proposed (20 % reduction in CO_2 emissions by 2020). A growing number of signatories are committing to 2030 (24 % of signatories, covering 37 % of the CoM population).

Based on a robust scientific analysis, the report has first determined and described the most appropriate methods and methodological approach used to identify the subset of cities used for the analysis. It has then analysed the results in terms of absolute and per capita GHG emission reductions resulting from the commitments and monitoring reports of the SEAPs.

Consequently, in order to project the emissions in 2005 and 2017, for 6200 inventories and 1845 monitoring reports, it has used the national GHG emission trajectories to harmonise the different baseline and monitoring inventories to 2005 and 2017.

3.2 Main findings

According to the moment of adhesion, the commitment made by the signatories varies and includes: a 20% mitigation target by 2020 (signatories of the Covenant up to October 2015), commitment to adaptation (Mayors Adapt signatories) and combined adaptation with the mitigation target, and 40% by 2030 (signatories of the New Covenant for Energy and Climate).

In terms of overall emissions reported in baseline emission inventories, the analysis shows an increase of 12 %, from 951 $MtCO_2$ (Kona et al., 2016) to 1080 $MtCO_2$, over the last 3 years, compared to the previous assessment report which indicates the Covenant's coverage is continuing to increase.

Box 9. Covenant commitments for 2020/2030 and the EU perspective

6200 Sustainable Energy Action Plans in the JRC harmonised CoM dataset 2019 (98 % of the total SEAPs submitted), covering 211 million inhabitants.

Total GHG emissions in the baseline inventories in the JRC harmonised CoM dataset 2019: 1080 Mt CO_2-eq and an overall estimated reduction of 273 Mt CO_2-eq by 2020, and 32 Mt CO_2-eq by 2030

The majority of EU Covenant signatories have committed to ambitious GHG emission reduction targets by 2020, compared to 2005: ***overall commitment of 31 %***

Preliminary results of EU Covenant signatories commit to ambitious GHG emission reduction targets by 2030, compared to 2005: ***overall commitment of 47 %***

Emission reductions for the EU Covenant signatories (98 % of the total signatories and 34 % of the EU population in 2005) **may represent 28 % of the European Union** GHG emission reduction projections by 2020 compared to 2005.

In this context, it is important to highlight the fact that, while the CoM inventories and commitment refer to only a part of the total CO_2 emissions on their territory, the EU CoM signatories may contribute 28 % to the overall European Union GHG emission reduction MS estimates by 2020.

Analysis of the CoM monitoring dataset 2019, based on the 1845 monitoring reports and 97.5 million inhabitants, shows an achievement of a 21 % overall emission reduction in relation to the 28 % committed by 2020, compared to baselines.

Box 10. Achieved GHG emission reduction in 2017

Overall achieved reduction of 21 % between the baseline year and the last submitted monitoring report, based on 1845 signatories with a submitted monitoring emission inventory, representing 97.5 million inhabitants.

The drop in emissions is more pronounced in the ***buildings sector with a decrease of 22 %*** and less steep in the ***transport sector with a 16 % reduction*** from the baseline inventories to progress reporting, through a combination of effective national and local policies on:

- Projecting the results achieved by 1802 EU signatories in 2005 and 2017, the overall ***GHG emission reduction resulted in a share of 25 %***

- EU Signatories (1802) which submitted monitoring emission inventories ***have an overall target of 30 % for 2020 and are on track to reach it.***

3.3 Final conclusions

The report demonstrates that the combination of effective urban energy policies and better coordination between national and local governments is crucial for the potential of the urban mitigation of climate change.

The results of this report show how climate mitigation and sustainable energy actions adopted at the local level are interconnected. The role of local authorities in leveraging sustainable development and mitigation and adaptation measures is crucial. Developing a Sustainable Energy and Climate Action Plan that requires the establishment of a baseline emission inventory and the adoption of policy measures is already a tangible achievement for cities. This is the first step towards an effective, transparent system for tracking progress and concrete results. The robust open source methodological framework developed by the JRC in collaboration with city networks offers municipalities a comprehensive tool to support the development of climate and energy policies.

As shown by the experience of the Covenant of Mayors in the EU's Eastern and Southern Neighbourhoods, this framework can be successfully replicated and adapted in other regions of the world.

PART 2 – ADAPTATION PILLAR

1 Results

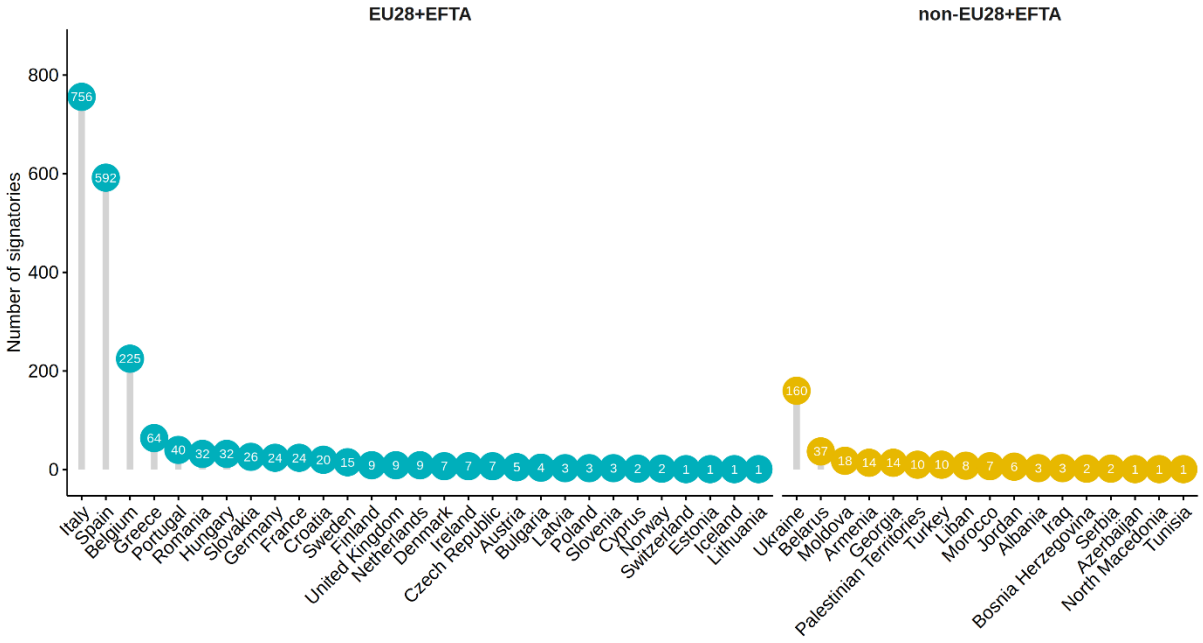
1.1 Background information: number of signatories per country

In total, up to November 2019, 2 221 municipalities have become signatories of the Global Covenant of Mayors and reported through *MyCovenant* platform, that includes providing information on adaptation. From these total number of signatories, 1 922 belong to EU28+EFTA countries and 299 to non-(EU28+EFTA) (see Fig. 12).

Regarding the EU28+EFTA, the large majority of the signatories (82%) are from Italy, Spain and Belgium, with respectively a total number of 756, 592 and 225 local authorities. Similarly, Ukraine, Belorussia and Moldavia sum up to 72% of all non-(EU28+EFTA) signatories.

However, only 429 signatories out of 2221 (370 from EU28+EFTA and 59 non-EU28+EFTA) have already provided information regarding their adaptation goals, risk and vulnerability assessments or action plans. The statistics presented in the following sections are based on these 429 signatories.

Figure 12. Number of signatories. EU28+EFTA (left) and non-(EU28+EFTA) (right)



Source: My Covenant Platform.

1.2 My Strategy

1.2.1 Adaptation goals

Even though there is no universal accepted definition for the term "goal" (Keeney and Raiffa, 1975), some definitions can be found in specialised literature. For example, according to Keeney and Raiffa (1975, p. 62) goals and objectives are different concepts, being an objective "the 'direction' in which one should strive to do better", whereas "a goal is different from an objective in that it is either achieved or not". Thus, an example of an objective could be "minimize total transit time for a given category of mail", whereas its corresponding goal could be "deliver at least ninety percent of the parcels and letters within two days" (Keeney and Raiffa, 1975, p. 62). In the same line, Munda (2008, p. 6) defines a goal as (synonymous of target) is something that can be either achieved or missed (e.g. reducing nitrogen pollution in a lake by at least 10%)". A more vague definition is given by Forman (1990, p. 306), who establishes a goal as "a statement of the overall objective". In this report, the definitions given by (Keeney and Raiffa, 1975) and Munda (2008) will be followed.[14]

([14]) Adaptation goals are not defined so far in any covenant publication (GCoM, 2018; Neves et al., 2016).

Having introduced the definition of goals, it is presented in Fig. 13 the share of signatories reporting climate adaptation goals for both groups of countries. First, it has to be noted that the goals established by the signatories cannot all be assumed as such, since many of them are treated as "objectives", i.e. not all the "goals" indicated can be achieved or missed. Secondly, if we consider all the goals reported in *MyCovenant* as goals and not as objectives, only 54% of signatories have reported climate adaptation goals for EU28+EFTA countries and 46% for non-(EU28+EFTA). This fact could be explained as a consequence of 1) many signatories may not have adaptation goals established yet and/or 2) many signatories do not desire to share that information. Note that in the Covenant reporting framework the adaptation goals are tagged as "not mandatory". Experience shows that local authorities focus on the mandatory fields when submitting the data into the system.

Figure 13. Percentage of signatories reporting adaptation goals. EU28+EFTA (left) and non-(EU28+EFTA) (right)

Source: My Covenant Platform. *Legend*: the green area represents the percentage of signatories that have reported adaptation goals, whereas the grey area represents the percentage of signatories that have not.

1.2.2 Stakeholder and citizen engagement

Stakeholder and citizen engagement entails the process of taking on board sectors and people who are potentially affected by climate change and have concerns in adaptation throughout the policy cycle (EEA, 2014). The stakeholders usually involved in climate adaptation policy-making are the following (EEA, 2012, 2014, 2015, 2016):

- Government officials at national level (e.g. policymakers, public administration, government agencies).
- Government officials at subnational level (including provincial, regional and local levels).
- The private sector.
- Interest groups (e.g. farmers' associations, public health services, meteorological services, hospitals and other medical institutions, schools, kindergartens, transport companies, mass media, local environmental protection organisations).
- Scientists/researchers.
- The general public.

The involvement of stakeholders and citizens in environmental decision-making has a long tradition and its benefits are well known. Thus, one of the most relevant benefits of involving stakeholders in climate change adaptation planning is related to the co-production of knowledge. For example, stakeholder engagement offers access to key knowledge, facilitating mutual learning (EEA, 2018) and shared information (EEA, 2009), as well as the reinforcement of social innovation (EEA, 2016). Similarly, enhancing stakeholder participation in research projects might bridge the gap between scientists, policy-makers and the community (EEA, 2009).

It has also been highlighted that stakeholder engagement enriches the coherence between climate change adaptation and disaster risk reduction (EEA, 2017c), since the involvement of interest groups becomes a coordination process (EEA, 2014). Furthermore, their participation in adaptation planning might be useful to avoid duplication of work, while addressing potential conflicts, and avoiding unnecessary delays in decision-making (EEA, 2009, 2016). Contrary to what one might think, participatory processes do not require additional municipal financial resources (EEA, 2017a).

Unfortunately, even though good governance includes stakeholder engagement and public participation, only sporadic adaptation case studies have adopted meaningful participatory processes in Europe (EEA, 2016), being more widespread in the initial steps of adaptation planning (EEA, 2014).

According to the CoM reporting framework, there are four key steps embedded in the adaptation policy cycle: 1) climate risk assessment, 2) identifying adaptation options, 3) implementation and 4) monitoring and evaluation. Stakeholder engagement is more effective when stakeholders are incorporated throughout all the previous steps (EEA, 2014, 2018). However, the monitoring and evaluation steps have not so far adopted in-depth stakeholder involvement, even though their participation is an essential part of this last step (EEA, 2014). The importance of stakeholder engagement throughout the policy cycle is summarised in Table 10.

Table 10. The importance of stakeholder engagement in adaptation planning.

Step	**Advantages of public participation**
Climate risk assessment	Make urban adaptation more equitable to vulnerable groups (EEA, 2016).
Identifying adaptation options	New visions could emerge (EEA, 2018).
	Ensure wider awareness, ownership and involvement of citizens when developing creative solutions (EEA, 2017a).
	Improve the consistency of adaptation actions and enhance adaptive capacity (EEA, 2017b).
Implementation	Improve the understanding of local knowledge and practices and public awareness, essential for successful implementation of adaptation actions, avoiding maladaptation (EEA, 2009).
	Takes in the views of the most vulnerable communities when designing and implementing adaptation responses (EEA, 2016).
	Ensure that urban adaptation policies and actions are transparent and legitimate, and to make sure that stakeholders are devoted to implementing them (EEA, 2016).
	Promote funds from private contributions such as crowdfunding or donations (EEA, 2017a).

Fig. 14 presents the percentage of signatories that have reported stakeholder and citizen participation in their adaptation plans.

On the one hand, it is remarkable the low number of signatories implementing public participation, i.e. around 43-44% of the signatories have involved stakeholders and citizens in the adaptation process. Considering that the prevision of stakeholders and its corresponding level of engagement is a mandatory field in the *MyCovenant* platform, the low rate of responses is produced as a consequence of the high number of signatories that are still in the initial steps of the policy cycle.

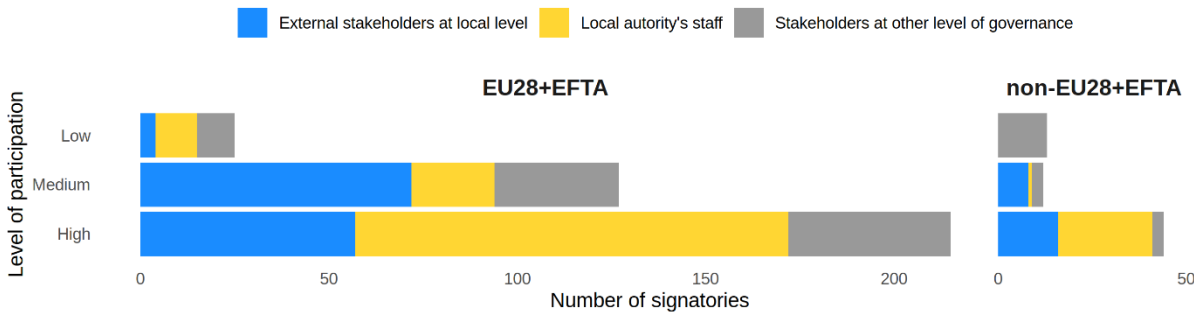
Figure 14. Percentage of signatories reporting stakeholder and citizen engagement. EU28+EFTA (left) and non-(EU28+EFTA)(right)

Source: My Covenant Platform. *Legend*: the green area represents the percentage of signatories that have reported stakeholder and citizen engagement, whereas the grey area represents the percentage of signatories that have not.

On the other hand, it is worth noting that, for both groups of signatories, the high-level of participation (possibly meaning "collaborate" –see Fig. 15–) is mainly reached for local authority's staff, i.e. government officials (e.g. policymakers, public administration, government agencies) at local level. External stakeholders at local level (e.g. private sector, farmers' associations, public health services, meteorological services, hospitals and other medical institutions, schools, kindergartens, transport companies, mass media, local environmental protection organisations, scientists/researchers and the general public) reaches mainly the medium-level of participation (possibly meaning "involve" –see Fig. 15–).

Unfortunately, the citizen participation per each step of the adaptation policy cycle cannot be analysed because the reporting template does not allow the signatories to indicate this information.

Figure 15.Number of signatories reporting stakeholder and citizen engagement. EU28+EFTA (left) and non-(EU28+EFTA) (right)



Source: My Covenant Platform. Legend: even though there is no definition of high, medium, and low level of participation, here it is assumed that high-level might represent "collaborate and empower", medium-level might entails "involve" and low-level might be described as "inform and consult". The definitions of the previous levels are the following (IAP2, 2018): inform (to provide the public with balanced and objective information to assist them in understanding the problem, alternatives, opportunities and/or solutions), consult (to obtain public feedback on analysis, alternatives and/or decisions), involve (to work directly with the public throughout the process to ensure that public concerns and aspirations are consistently understood and considered), collaborate (to partner with the public in each aspect of the decision including the development of alternatives and the identification of the preferred solution), and empower (to place the final decision making in the hands of the public).

1.2.3 Financing

Four different types of funding sources can generally be used to address local adaptation action (EEA, 2017a):

- Government sources: grants, international and EU funding, national, regional and local budgets.
- Banks: either directly or by means of partnership with local retail banks. In general, this option becomes a challenge since many adaptation actions do not produce direct financial returns in the short-term.
- Private sources: foundations, real estate developers, companies (especially those most at risk of climate impacts) and house owners and individuals (through crowdfunding or green bonds).
- Mainstreaming adaptation action into sectoral policies, such as water management, health, nature solutions, etc.

According to the data provided to the CoM platform, the percentage of municipalities that have reported funding is low (see Fig. 16): 69% for EU28+EFTA and 54% for non-(EU28+EFTA). However, it has to be noted that EU28+EFTA signatories tend to provide this information in comparison to non-EU28 signatories. As indicated above, this could be due to 1) many signatories have not allocated resources to adaptation and/or 2) many signatories are not interested in providing this information. The main cause is unknown since, contrary to mitigation, the budget amount is an optional field for adaptation.

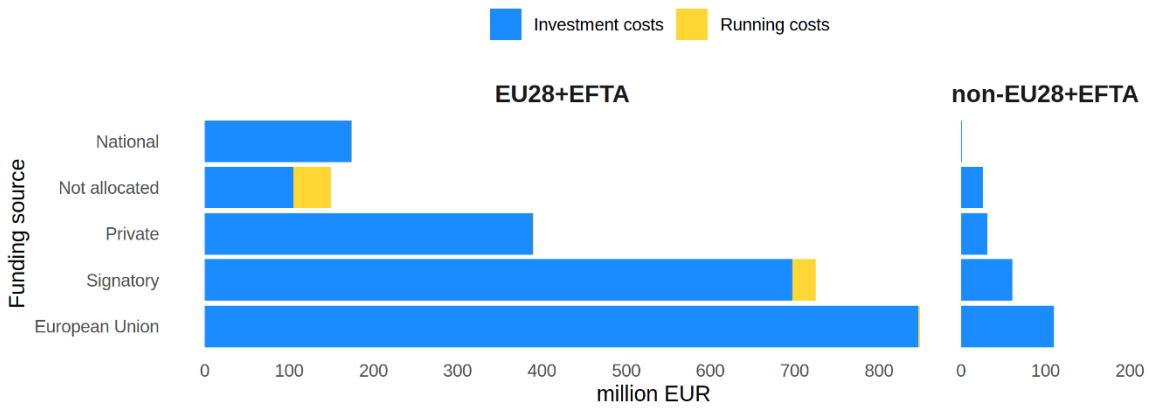
As seen in Fig. 17, the funding sources are mainly governmental and private. In both groups of signatories, EU funding is the most relevant source of funding, followed by local budget. The groups differ on the national funding, which is more important in EU28+EFTA countries than non-EU28+EFTA.

Figure 16. Percentage of signatories reporting allocated funds to adaptation. EU28+EFTA (left) and non-(EU28+EFTA) (right)

Source: My Covenant Platform. *Legend*: the green area represents the percentage of signatories that have reported funds, whereas the grey area represents the percentage of signatories that have not.

The best way to guarantee the successfulness of adaptation actions in European cities is to combine different sources of funding, as well as to mainstream adaptation into land-use planning and infrastructure maintenance (EEA, 2017a). In order to do so, it is also important to allocate personnel with expertise in climate adaptation and funding, especially in small municipalities (EEA, 2017a). Furthermore, small municipalities could cooperate with neighbouring municipalities to bundle together adaptation projects to make them bankable (EEA, 2017a).

Figure 17. Amount of resources allocated to adaptation. EU28+EFTA (left) and non-(EU28+EFTA)



Source: My Covenant Platform. *Legend:* the blue bars represent the investment costs, whereas the orange bars represent the running costs.

1.2.4 Barriers to local adaptation

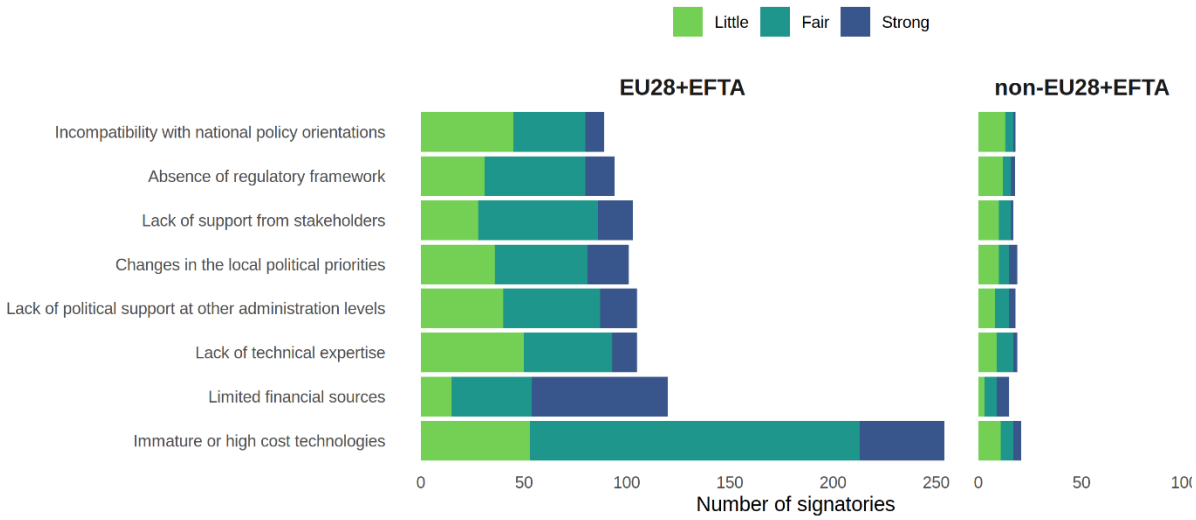
On the one hand, it has to be highlighted that the percentage of signatories reporting barriers to climate adaptation is high (84%) in the case of EU28+EFTA signatories and low (34%) for non-(EU28+ EFTA). However, it is worth mentioning that the rate of answers is much larger than in the previous cases. This indicates that signatories are more willing to make clear the barriers they encounter when addressing climate adaptation.

Figure 18.Percentage of signatories reporting barriers to local adaptation. EU28+EFTA (left) and non-(EU28+EFTA)(right)

Source: My Covenant Platform. *Legend*: the green area represents the percentage of signatories that have reported barriers to local adaptation, whereas the grey area represents the percentage of signatories that have not.

In concrete, and considering only the strong barriers, "limited financial sources" is said to be the main barrier for the signatories of both groups of countries. However, financial resources from different sources are available to municipalities (EEA, 2017a). Thus, the present challenge for municipalities is how to make them aware of all available financing possibilities (EEA, 2017a).

Figure 19. Number of signatories reporting barriers to climate adaptation. EU28+EFTA (left) and non-(EU28+EFTA) (right)



Source: My Covenant Platform.

Secondly, "immature or high cost technologies" is also common to both groups of countries. Moreover, "changes in the local political priorities" and "lack of political support at other administration levels" are relevant for the municipalities belonging to the non-(EU28+EFTA) countries as well.

1.3 Climate Risk Assessment

1.3.1 Climate hazards: present and future

A hazard is "the potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources" (IPCC, 2014a, p. 1766).

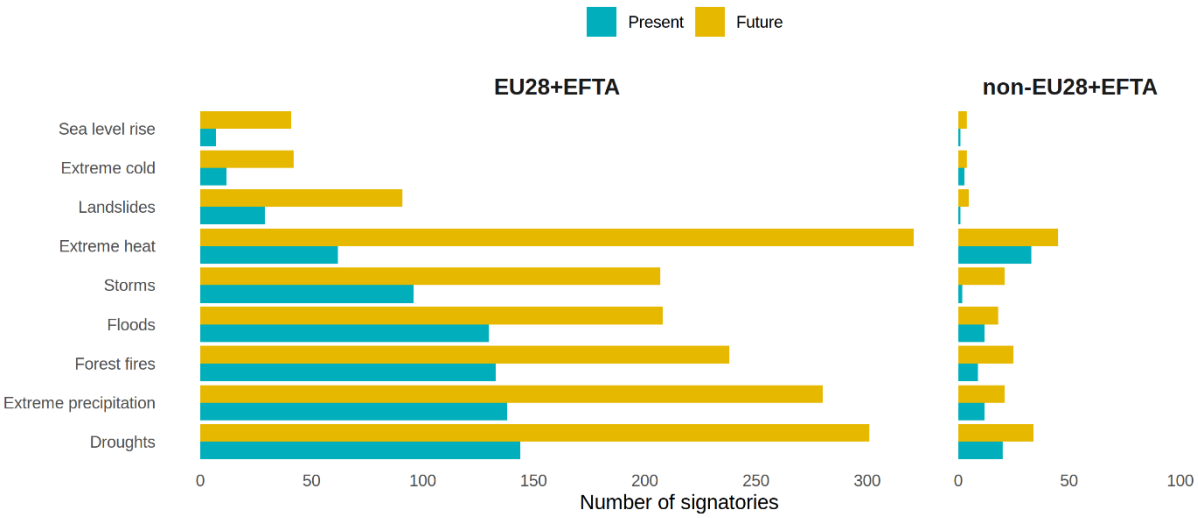
100% of signatories have reported climate hazards for the present and future for both groups of countries. This is due to this information is mandatory and key for adaptation planning.

As seen in Fig. 19, there are common patterns to both groups. First, both extreme heat and droughts reported the most relevant hazards for the present and the future. Second, sea level rise is reported to be the less

important hazard. Third, extreme precipitation ([15]), forest fires, flood and storms are also relevant for both groups of countries.

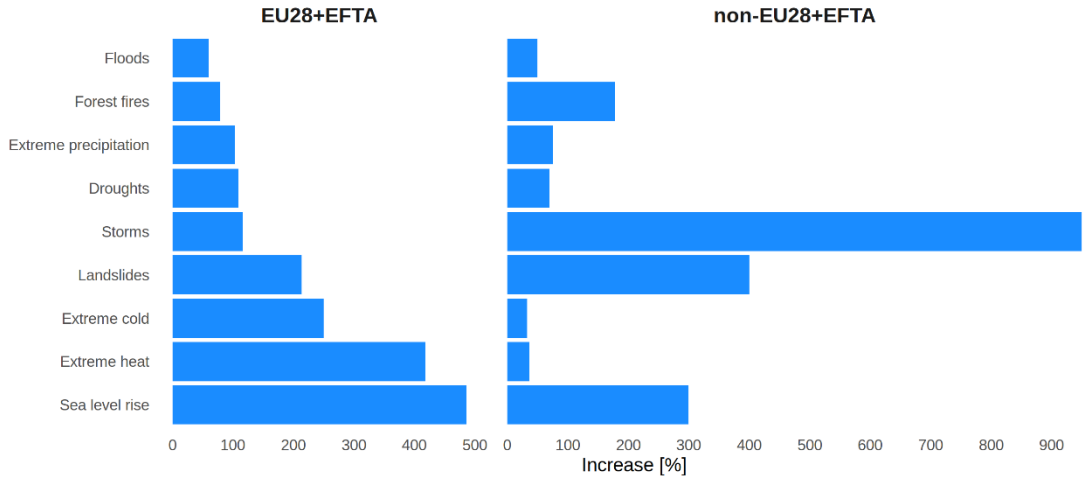
Based on Fig. 20, the percentage of increase from present to future can be calculated. Consequently, in Fig. 21 this increasing figures are shown. In the case of EU28+EFTA municipalities, it seems that sea level rise will have the higher increase in terms of hazardousness, followed by extreme heat. On the opposite side, floods and forest fires are not expected to increase that much, since both are current issues for EU28+EFTA municipalities. Non-(EU28+EFTA) municipalities foresee a larger increase of hazardousness for storms mainly, although landslides and sea level rise are also reported.

Figure 20.Number of signatories reporting climate hazards (by type of hazard). EU28+EFTA (left) and non-(EU28+EFTA) (right)



Source: My Covenant Platform.

Figure 21.Increase from present to future (by type of hazard). EU28+EFTA (left) and non-EU28+EFTA (right)



Source: My Covenant Platform.

([15]) The occurrence of extreme precipitation events is a major hazard that has often led to floods and landslides (https://library.wmo.int/opac/index.php?lvl=notice_display&id=19782#.Wp5li66nGUl.

1.3.2 Vulnerabilities

Vulnerability is "the propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt" (IPCC, 2014a, p. 1775).

As seen in Fig. 22, the percentage of signatories reporting vulnerabilities is low, even though vulnerabilities are a key dimension (along with hazard and exposure) for the climate risk assessment. This low rate of answer have two possible explanations: 1) many signatories do not provide vulnerabilities because they are not interested and/or 2) because they do not have assessed their vulnerabilities.

Figure 22. Percentage of signatories reporting vulnerabilities. EU28+EFTA (left) and non-EU28+EFTA (right)

Source: My Covenant Platform. *Legend*: the green area represents the percentage of signatories that have reported vulnerabilities, whereas the grey area represents the percentage of signatories that have not.

1.3.3 Impacts

Impacts are the "effects on natural and human systems. It refers to the effects on natural and human systems of extreme weather and climate events and of climate change. Impacts generally refer to effects on lives, livelihoods, health, ecosystems, economies, societies, cultures, services and infrastructure due to the interaction of climate changes or hazardous climate events occurring within a specific time period and the vulnerability of an exposed society or system. Impacts are also referred to as consequences and outcomes" (IPCC, 2014a, p. 1767).

Around 95%-98% of signatories have reported impacts on socioeconomic sectors and the environment for the present and future for both groups of countries (see Fig. 23).

Figure 23. Percentage of signatories reporting impacts on socioeconomic sectors and the environment. EU28+EFTA (left) and non-(EU28+EFTA) (right)

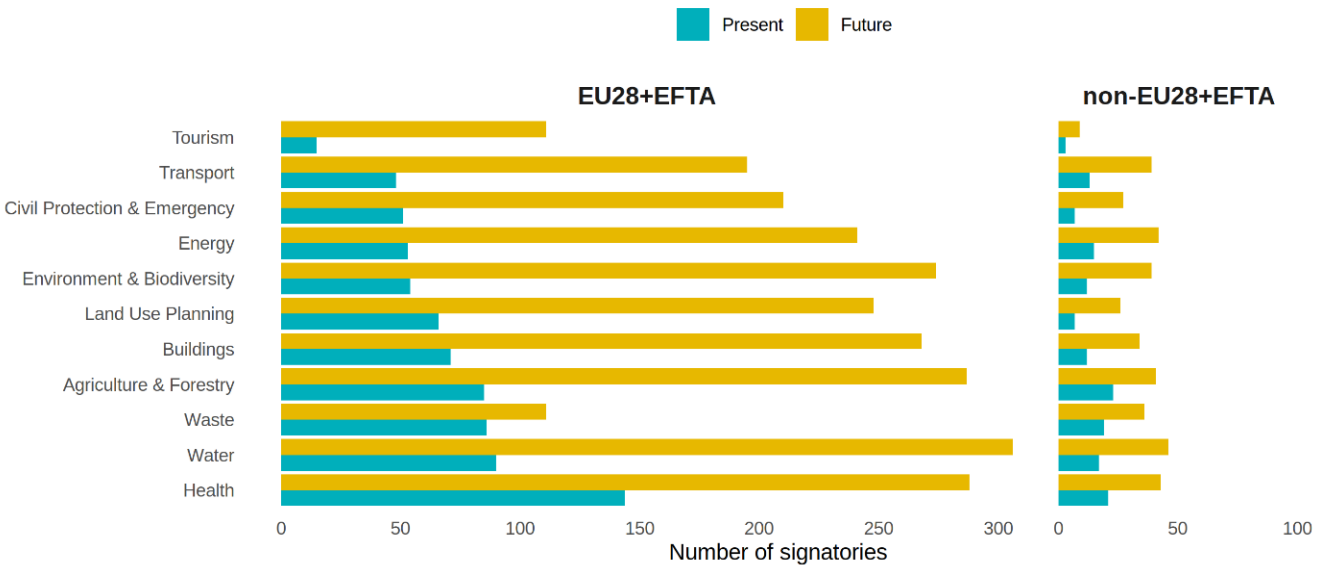
Source: My Covenant Platform. *Legend*: the green area represents the percentage of signatories that have reported impacts, whereas the grey area represents the percentage of signatories that have not.

As seen in Fig. 24, there are common patterns to both groups. First, both sectors, water and health, are reported to be the most at risk of impacts for the present and the future. Second, tourism is reported to be the sector that, in principle, will be less impacted in the present and future.

Based on Fig. 25, the percentage of increase from present to future can be calculated. Fig. 24 shows the sectors that suffer the larger increase. In the case of EU28+EFTA municipalities, although tourism was presented as the less impacted sector it seems that tourism will have the larger increase in terms of potential impact, followed by environment and biodiversity. On the opposite side, impact on waste and health are not expected to increase as much as other sectors. Non-(EU28+EFTA) municipalities foresee larger potential

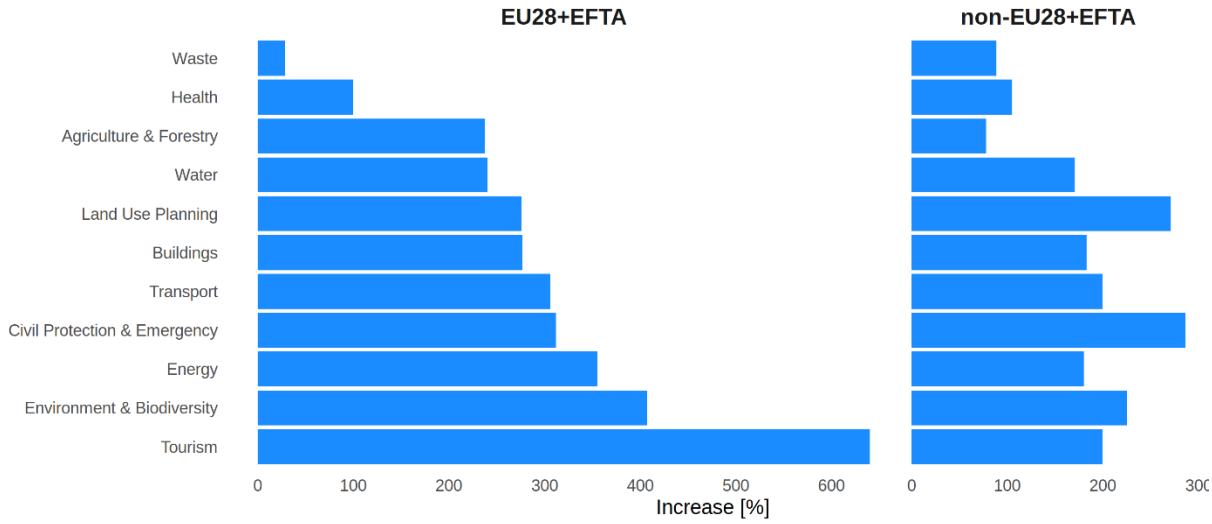
impacts on civil protection & emergency, land use planning, and environment and biodiversity, while agriculture and forestry, waste and health present the shorter increase.

Figure 24. Number of signatories reporting impacts on socioeconomic sectors and the environment (by type of sector). EU28+EFTA (left) and non-(EU28+EFTA) (right)



Source: My Covenant Platform. *Note:* land use planning and civil protection and emergency are not sectors, but actions that can be implemented to tame climate risks.

Figure 25. Increasing impacts from present to future (by type of sector). EU28+EFTA (left) and non-(EU28+EFTA) (right)



Source: My Covenant Platform. *Note:* land use planning and civil protection and emergency are not sectors, but actions that can be implemented to tame climate risks.

1.4 Actions

Adaptation actions could be divided in three different types: 1) adaptation, 2) maladaptation and 3) *adaptigation*. Adaptation is "the process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects" (IPCC, 2014a, p. 1758). On the opposite side, maladaptation refers to the "actions that may lead to increased risk of adverse

climate-related outcomes, increased vulnerability to climate change, or diminished welfare, now or in the future" (IPCC, 2014a, p. 1769). Lastly, an *adaptigation* action refers to the ability to tackle climate change integrating adaptation and mitigation, so that conflicts are avoided and synergies created (Langlais, 2009).

Around 59%-66% of signatories have reported adaptation actions (see Fig. 26). Due to the provision of actions is a mandatory field, this low rate of signatories reporting actions is explained by the fact that most of the signatories are still in the first steps of the policy cycle.

Figure 26. Percentage of signatories reporting adaptation actions. EU28+EFTA (left) and non-(EU28+EFTA) (right)

Source: My Covenant Platform. *Legend*: the green area represents the percentage of signatories that have reported adaptation actions, whereas the grey area represents the percentage of signatories that have not.

First of all, it has to be mentioned that the number of actions presented in Fig. 26 might represent actions on adaptation, maladaptation, adaptigation and even mitigation. Meaningless or vague actions that are not addressing specifically climate change adaptation can also be found. The information currently available through the *MyCovenant* platform doesn't allow to automatically retrieve statistics on this classification of actions, even though the authors are aware of their existence (some examples of these types of actions are shown in Box 11) ([16]).

Box 11. Examples of adaptation, maladaptation, adaptigation and mitigation actions uploaded by some signatories of the Covenant of Mayors

Adaptation → "Forced elevation of floodplain surface in the locations where flooding could threat buildings and other infrastructures, up to the level of planned flood-free area; conducting shore protection and erosion control works."

Maladaptation → "Ensuring the conditions for creating a comfortable temperature regime during the heat waves in places of accumulation of a significant number of people belonging to vulnerable groups of population". If fossil fuels are used for air conditioning then this can be considered as maladaptation since it increases the emission of GHG.

Adaptigation → "Green corridors to increase green areas and connectedness". Can be an adaptation measure that reduces the impact of floods and extreme temperatures, while contributing to an indirect reduction of emissions by increasing carbon sinks.

Mitigation → "Pedestrian and bicycle transport to increase pedestrian and bicycle transport modalities".

Meaningless/vague actions → "Naming the ambition to be a climate-robust city in the following multi-annual plan (next legislature): For the purpose of accomplishing our climate adaptation goals, it would be a major signal for the new multi-annual plan to explicitly focus on climate adaptation, mentioning that our city is not only seeking to be climate neutral (mitigation), but also climate-robust (adaptation)".

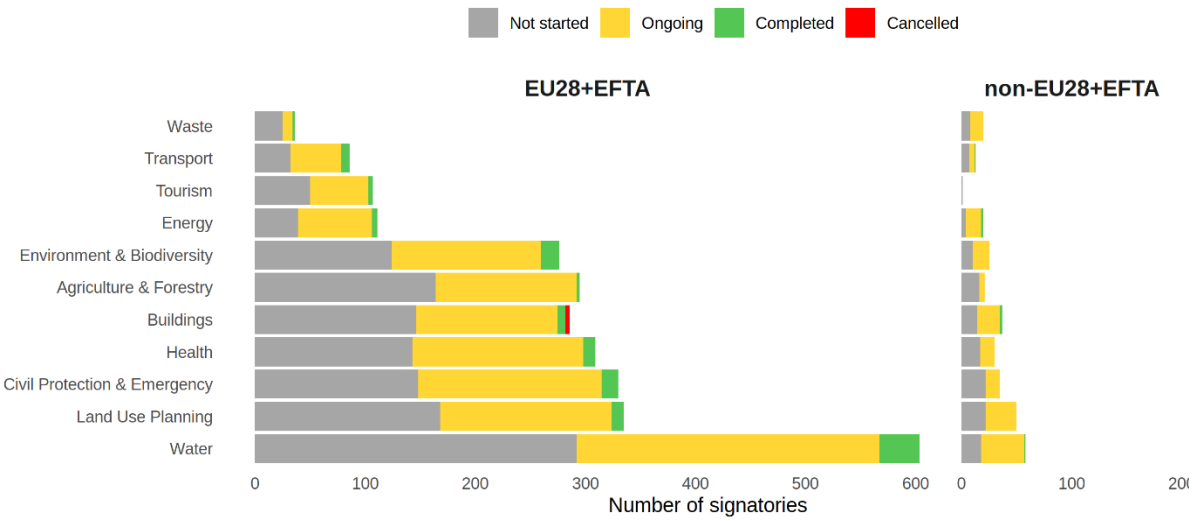
According to Fig. 27 the large majority of the actions either have not started or are ongoing, which is reasonable since there has been little time yet to develop and implement actions (adaptation actions are not expected to be proposed before four years after joining the CoM).

There are also actions that have already been completed, especially in EU28+EFTA municipalities, concretely in the water sector, environment and biodiversity, and civil protection and emergency. This can be explained by the fact that municipalities are encouraged to mainstream adaptation actions into sectoral policies.

([16]) Detailed information cannot be given due to the fact that actions description is uploaded in *MyCovenant* as free text field.

Lastly, it should be highlighted that the sectors that have received a shorter number of adaptation actions in both groups of countries are tourism, transport and waste.

Figure 27. Number of signatories reporting impacts on socioeconomic sectors and the environment (by sector). EU28+EFTA (left) and non-(EU28+EFTA) (right)



Source: My Covenant Platform.

2 Discussion

2.1 A reflection on adaptation goals

Goals are not a mandatory field in the reporting template of the *MyCovenant* platform. This fact discourage signatories reporting this data. Furthermore, usually goals (also considered targets by the literature) are treated by the signatories as objectives, i.e. they indicate the direction of the objective (such as minimise exposure to floods), but those objectives are not quantified (e.g. reduce by 25% the exposure to floods).

The position of the JRC is that goals should be a mandatory field for two main reasons: 1) goals are useful for the signatories since it helps the signatories in having a clear path and 2) the monitoring step is rather complicated to develop without having concrete goals established.

2.2 A reflection on stakeholder and citizen engagement

The crucial importance of stakeholder and citizen participation in adaptation planning (see section 3.2.2), should be better addressed in the CoM. Currently it is not possible to disaggregate stakeholder and citizen group involved per step of the policy cycle. The information of the type of stakeholder engaged is provided for the whole cycle. Furthermore, the levels of participation indicated in the MyCovenant platform - "high", "medium" and "low" - are not defined. Therefore, the use of levels can be selected by the signatories in an arbitrary way that make almost impossible to perform a robust assessment of the engagement.

An additional difficulty for the analysis is the fact that the stakeholder information is optional and provided in free text. This leads the signatories to list specific stakeholders of their municipalities, sometimes with acronyms, making difficult to compare information across municipalities.

Apart from these reflections based on the reporting platform, it is noted that the higher level of stakeholder participation takes place mainly with the local authority's staff. Therefore, the involvement of external stakeholders does not seem to be as important as local authority's staff for the signatories.

The position of the JRC is that stakeholder and citizen engagement reporting has to be improved. In order to do so, we propose the following: 1) the stakeholders engaged and the level of participation should be indicated per step of the policy cycle, 2) the meaning of the levels of participation should be clearly defined, 3) the type of stakeholders should be facilitated in a drop-down list – so that the different types of stakeholders can easily be identified– and 4) the importance of stakeholder and citizen engagement should be promoted by the CoMO through awareness raising, webinars and workshops.

2.3 A reflection on financing

The European Union seems to be a key funding institution for adaptation to climate change at local level, providing more than any other funding source.

Unfortunately, not all the municipalities report the origin of their funding, since the provision of this data is optional for the signatories. Therefore, the municipalities are somehow discouraged to provide this information.

The position of the JRC is that funding sources should be mandatory information as it is for mitigation.

2.4 A reflection on barriers to adaptation

There are two main barriers common to both group of signatories: limited financial sources and immature or high cost of technologies. These limitations are economic barriers to adaptation. However, non-EU28+EFTA have also indicated political barriers, such as possible changes in the local political priorities and lack of political support at other administration levels.

As indicated in section 3.2.3, the economic barriers might be overcome by means of 1) mainstreaming adaptation into land-use planning and infrastructure maintenance, 2) allocating personnel with expertise in climate adaptation and funding and 3) cooperating between small neighbouring municipalities to bundle together adaptation projects to make them bankable.

The position of the JRC is that the provision of barriers should be mandatory information, so that a continuous improvement could be granted.

2.5 A reflection on climate risk assessment

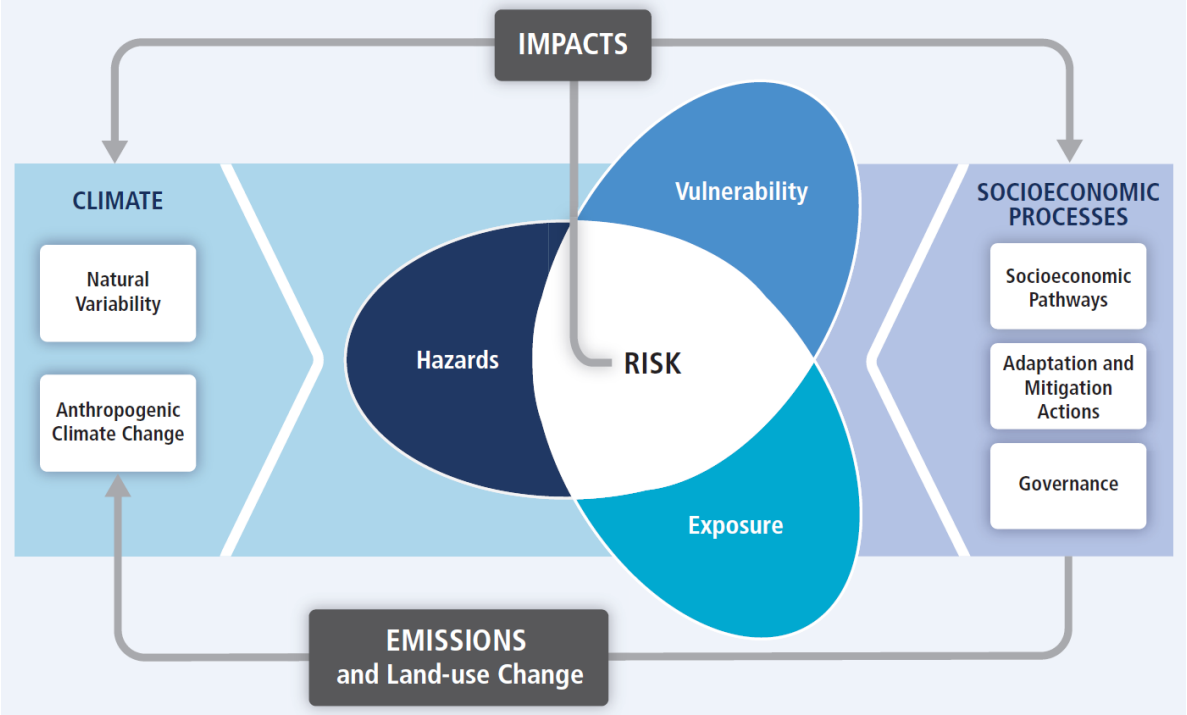
As seen in Fig. 28, risk ([17]) is a component of three elements: hazard, exposure ([18]) and vulnerability. Then, the impact refers to the "effects on lives, livelihoods, health, ecosystems, economies, societies, cultures, services and infrastructure due to the interaction of climate changes or hazardous climate events occurring within a specific time period and the vulnerability of an exposed society or system" (IPCC, 2014a, p. 1767).

However, the reporting template of the CoM does not follow this framework. Concretely, the dimension of "exposure" is not explicitly considered and the dimension of vulnerability is only assumed as an optional field. This fact makes difficult to obtain a clear picture of the climate ***risk*** assessment.

The position of the JRC is that the IPCC framework should be followed by the Covenant of Mayors, making use of each dimension of the risk.

Apart from the previous comments, the hazard dimension is reasonably well developed and reported by the signatories. In fact, the most relevant climate hazards, reported by both group if signatories, are extreme heat, droughts and forest fires. All of them are somehow related to extreme temperatures. Furthermore, the sectors expected to be impacted the most are water and health, both reasonably consistent with the hazards pointed out by the signatories.

Figure 28. Illustration of the core concepts of the IPCC adaptation framework



Source: IPCC (2014b).

2.6 A reflection on adaptation actions

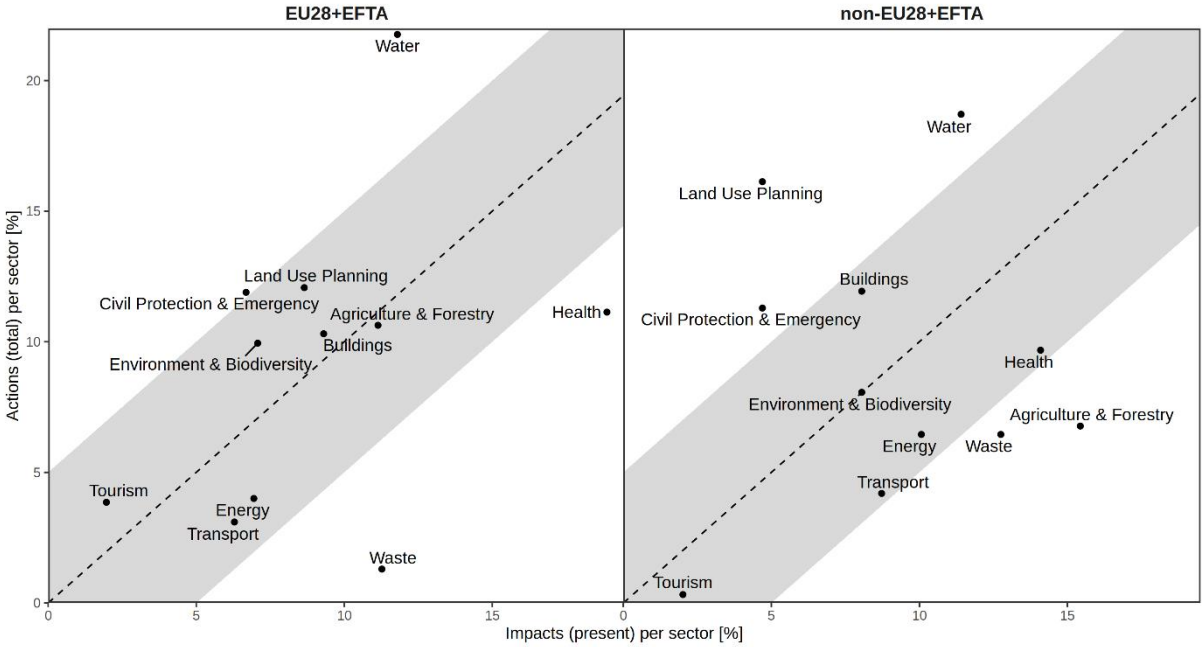
Adaptation actions are designed and implemented to tackle climate risks. This simple logic is not however easily perceived in the data provided by the municipalities. As shown in Fig. 29, impacted sectors and actions

([17]) "The potential for consequences where something of value is at stake and where the outcome is uncertain, recognizing the diversity of values. Risk is often represented as probability of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur. Risk results from the interaction of vulnerability, exposure, and hazard" (IPCC, 2014a, p. 1772).
([18]) "The presence of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected (IPCC, 2014a, p. 1765).

are confronted to correlate risks and actions. It is clear that for the sectors potentially more affected, such as water and health for EU28+EFTA (Fig. 27), there is not consistency regarding the actions developed ([19]).

Regarding non-(EU28+EFTA) signatories, the figure shows an even lower level of consistency regarding the most impacted sectors for these countries; Water, waste and Agriculture and forestry

Figure 29 Consistency between expected impacts (risks) and adaptation actions. Ranking by number of signatories reporting data. EU28+EFTA and nonEU28+EF



Source: My Covenant Platform. *Legend*: in the plot, sector located in the line indicates full consistency between the impacts defined in the climate risk assessment and the sectors tackled in the action plan. Sectors included in the grey area present light constancy, while sectors out of the grey area indicate inconsistency.

Apart from the unclear links between risks and actions, it has to be noted that the actions uploaded in the *MyCovenant* platform do not only tackle adaptation or *adaptigation* (as desired), but also maladaptation and mitigation actions. Not to mention the actions that are vaguely described.

The position of the JRC is that the reporting template should be improved such that the mitigation and adaptation pillars are better integrated (to reinforce *adaptigation*) and avoid maladaptation. Similarly, the signatories have to be encouraged to avoid vague and meaningless actions.

([19]) It is not here considered both land use planning and civil protection and emergency, since they are not sectors, but possible actions. This fact might be confusing the signatories when reporting the data, possibly explaining the inconsistency.

3 Conclusions

This report has highlighted that the adaptation pillar of the Covenant of Mayors for Climate and Energy is still under construction and hence it has still a high margin for improvement. The authors argued that the reporting information provided by the signatories is not sufficient and has to be improved if this initiative desires to address the issue of climate change adaptation effectively.

Since goals, budget, barriers and vulnerabilities are only optional fields to be completed by the signatories, the available information is scarce, partial and imprecise. Furthermore, the information regarding stakeholder and citizen engagement needs improving as well, even though this field is mandatory for the signatories. The type of stakeholders should be indicated and the level of engagement clearly defined for all steps of the policy cycle.

The most valuable information encountered in *MyCovenant* platform is the reported climate hazards, as well as the expected impacts (risks) per socioeconomic sector and the environment. As seen, extreme heat, droughts and forest fires seem to be the most relevant hazards threatening CoM municipalities. Furthermore, water and health seem to be the sectors potentially impacted the most by extreme climate events.

Lastly, we have also shown the information regarding the actions, highlighting the need to establish clear links in the reporting template between risks and actions. A better integration of mitigation and adaptation is needed in order to have a better understanding of the influence of maladaptation in the action plans.

The authors have provided a list of measures that could be of use for improving the reporting of climate adaptation-related information.

Annex I.

Table 11. CoM signatories with a submitted SEAP (incl. BEI) and a submitted full monitoring report (incl. MEI) in the CoM dataset, as of end of August 2019

Covenant Region	Country	No. of Signatories	Population in the adhesion phase [Million inhabitants]	No. of SEAPs in the sample	Population covered in the Baseline Emission Inventory [Million inhabitants]	Committed to 2020				Committed to 2030			
						No. of SEAPs in the sample	Population covered in the Baseline Emission Inventory [Million inhabitants]	Projected baseline emission in 2005 [$MtCO_2$-eq/year]	Projected baseline emission in 2020 [$MtCO_2$-eq/year]	No. of SECAPs in the sample	Population covered in the Baseline Emission Inventory [Million inhabitants]	Projected baseline emission in 2005 [$MtCO_2$-eq/year]	Projected baseline emission in 2030 [$MtCO_2$-eq/year]
European Union	BE	466	12.001	276	8.022	212	6.357	39.88	27.23	64	1.665	11.34	6.33
	BG	44	3.135	25	2.525	24	2.472	7.56	6.47	1	0.054	0.08	0.1
	CZ	19	2.184	8	0.491	6	0.368	1.7	1.26	2	0.123	0.61	0.36
	DK	43	3.614	35	3.076	34	3.055	20.35	15.24	1	0.021	0.12	0.02
	DE	83	19.545	57	17.061	56	16.975	192.89	121.62	1	0.085	0.6	0.37
	EE	7	0.563	5	0.522	5	0.522	3.61	3.63	-	-	-	-
	IE	17	2.550	10	1.813	8	1.642	18.15	13.53	2	0.171	1.4	0.73
	EL	221	9.189	130	5.358	112	4.395	30.16	20.4	18	0.964	6.84	3.02
	ES	2,320	35.690	1,548	26.464	1,495	23.633	114.04	81.86	53	2.831	11.73	6.67
	FR	185	18.945	78	15.926	73	15.358	70.93	52	5	0.567	2.29	1.13
	HR	83	2.099	61	1.872	60	1.845	6.24	4.85	1	0.027	0.11	0.05
	IT	4,653	49.246	3,245	38.087	3,157	36.556	176.24	126.1	88	1.532	9.65	5.33
	CY	25	0.506	22	0.487	22	0.487	3.75	2.9	-	-	-	-
	LV	23	1.242	20	1.374	19	1.360	5	2.4	1	0.015	0.01	0.01
	LT	16	1.514	13	1.411	13	1.411	5.76	4.1	-	-	-	-
	LU	11	0.124	1	0.002	1	0.002	0.02	0.01	-	-	-	-
	HU	157	5.679	46	4.351	27	2.605	14.42	10.8	19	1.746	7.53	3.63
	MT	37	0.247	21	0.105	21	0.105	0.47	0.36	-	-	-	-
	NL	36	5.705	15	3.268	14	3.070	17.79	11.76	1	0.198	1.26	0.32
	AT	29	1.968	12	1.699	11	1.688	8.57	6.3	1	0.010	0.08	0.06
	PL	74	5.399	37	3.526	36	3.402	22.94	18.52	1	0.123	0.8	0.61
	PT	163	7.579	112	5.882	108	4.822	22.92	15.12	4	1.060	6.81	3.73
	RO	162	10.653	61	4.218	54	3.742	10.2	8.64	7	0.476	0.93	0.64

	SI	37	0.888	29	0.719	29	0.719	5.37	4.37	-	-	-	-
	SK	37	0.844	4	0.527	4	0.527	2.7	2.15	-	-	-	-
	FI	13	2.213	9	1.435	8	1.342	9.08	6.72	1	0.093	0.64	0.33
	SE	74	6.531	49	3.673	44	3.483	20.85	11.89	5	0.191	0.9	0.32
	UK	50	23.774	30	15.786	30	15.786	118.75	76.67	-	-	-	-
	Tot	**9,085**	**233.62**	**5,959**	**169.68**	**5,68**	**157.73**	**950.3**	**656.9**	**276**	**11.953**	**63.74**	**33.77**
Europe – non EU	AL	5	1.051	1	0.620	1	0.620	0.5	0.53	-	-	-	-
	BA	21	1.785	19	1.659	19	1.659	4.23	4.3	-	-	-	-
	CH	11	0.902	7	0.767	7	0.767	3.7	2.79	-	-	-	-
	IS	1	0.122	1	0.117	1	0.117	2.09	1.67	-	-	-	-
	ME	5	0.323	3	0.173	3	0.173	0.31	0.24	-	-	-	-
	MK	5	0.878	1	0.600	1	0.600	1.44	0.97	-	-	-	-
	NO	9	1.490	6	0.992	6	0.992	5.32	3.7	-	-	-	-
	RS	14	2.517	1	0.258	1	0.258	1.08	0.82	-	-	-	-
	TR	20	18.091	12	14.140	10	9.421	14.22	16.85	2	4.719	8.81	7.98
	XK	2	0.181	-	-	-	0.000	-	-	-	-	-	-
	Tot	**93**	**27.4**	**51**	**19.326**	**49**	**14.606**	**32.88**	**31.88**	**2**	**4.719**	**8.81**	**7.98**
Eastern Partnership	AM	25	1.755	10	1.441	10	1.441	0.4	0.92	-	-	-	-
	AZ	2	0.107	1	0.004	1	0.004	0.01	0.01	-	-	-	-
	BY	51	3.639	16	1.302	10	0.765	1.11	1.53	6	0.538	0.28	1.4
	MD	44	1.747	16	0.366	13	0.327	0.57	0.45	3	0.039	0.04	0.02
	GE	22	2.245	10	1.912	10	1.912	2.51	2.65	-	-	-	-
	KG	5	0.318	-	0.000	-	0.000	-	-	-	-	-	-
	KZ	9	2.986	1	0.350	1	0.350	0.6	0.84	-	-	-	-
	TJ	1	0.030	1	0.020	1	0.020	0.03	0.02	-	-	-	-
	UA	272	21.398	112	12.231	81	10.442	38.79	25.94	31	1.789	7.73	3.4
	Tot	**431**	**34.24**	**167**	**17.627**	**127**	**15.260**	**44.02**	**32.36**	**40**	**2.366**	**8.05**	**4.82**
South Mediterranean	DZ	3	0.693	3	0.736	3	0.736	1.65	1.6	-	-	-	-
	IL	7	0.462	4	0.221	4	0.221	1.86	1.42	-	-	-	-
	JO	7	1.825	3	0.392	1	0.160	0.08	0	2	0.232	0.71	0.36
	LB	27	0.188	3	0.068	3	0.068	0.06	0.06	-	-	-	-

	MA	13	3.178	5	2.003	5	2.003	2.18	2.03	-	-	-	-
	PS	16	1.403	4	0.520	4	0.520	1.11	0.88	-	-	-	-
	TN	4	0.635	1	0.292	1	0.292	0.66	0.61	-	-	-	-
	Tot	**77**	**8.383**	**23**	**4.232**	**21**	**4.000**	**7.6**	**6.6**	**2**	**0.232**	**0.71**	**0.36**
OTHER	**Tot**	7	8.979	-	0.000	-	0.000	-	-	-	-	-	-
TOTAL		**9,693**	**312.6**	**6,200**	**210.87**	**5,880**	**191.6**	**1,035**	**727.7**	**320**	**19.271**	**81.3**	**46.94**

Table 12. CoM signatories with a submitted SEAP (incl. BEI) and a submitted full monitoring report (incl. MEI) in the CoM dataset, as of end of August 2019

Covenant Region	Country	Number of signatories having submitted a full monitoring report	Population covered in the Monitoring Emission Inventory	Share of MEIs over SEAPs	Share of population in MEI over population SEAPs	Projected baseline emission in 2005 [$MtCO_2$-eq/year]	Projected monitoring emission in 2017 [$MtCO_2$-eq/year]	Projected emission in 2020 based on the target declared [$MtCO_2$-eq/year]
European Union	BE	145	4.375	53%	55%	27.258	19.923	19.120
	BG	7	1.768	28%	70%	6.227	6.167	5.406
	CZ	4	0.466	50%	95%	2.155	1.656	1.594
	DK	20	1.815	57%	59%	11.837	7.278	8.513
	DE	34	14.750	60%	86%	170.014	119.402	107.078
	EE	2	0.416	40%	80%	3.206	3.954	3.152
	IE	4	1.194	40%	66%	13.764	8.520	10.125
	EL	19	1.396	15%	26%	9.125	7.228	6.322
	ES	689	17.568	45%	66%	80.701	59.554	59.897
	FR	19	6.782	24%	43%	36.241	28.722	25.941
	HR	15	1.260	25%	67%	4.117	4.363	3.276
	IT	646	14.973	20%	39%	84.050	65.036	62.997
	CY	6	0.197	27%	40%	1.587	1.386	1.224
	LV	9	0.269	45%	20%	0.443	0.365	0.364
	LT	2	0.956	15%	68%	4.538	3.217	3.192
	LU	1	0.002	100%	100%	0.020	0.006	0.014
	HU	10	2.163	22%	50%	12.331	10.850	9.517
	MT	-	-	0%	0%	-	-	-
	NL	7	1.600	47%	49%	9.367	8.276	5.913
	AT	6	1.561	50%	92%	7.190	6.830	5.529
	PL	23	3.284	62%	93%	23.140	22.448	18.681

	PT	68	3.968	61%	67%	20.276	14.455	13.814
	RO	13	1.015	21%	24%	2.986	2.493	2.487
	SI	3	0.074	10%	10%	0.287	0.226	0.224
	SK	1	0.086	25%	16%	0.242	0.233	0.191
	FI	8	1.352	89%	94%	9.124	7.567	6.654
	SE	30	2.596	61%	71%	15.889	11.686	8.723
	UK	11	2.963	37%	19%	22.085	13.227	15.383
	Tot	**1,802**	**88.848**	**30%**	**52%**	**578.201**	**435.068**	**405.331**
Europe – non EU	AL	-	-			-	-	-
	BA	6	0.467	32%	28%	1.408	1.721	1.212
	CH	5	0.718	71%	94%	3.391	2.079	2.563
	IS	1	0.117	100%	100%	2.090	0.308	1.670
	ME	-	-	-	-	-	-	-
	MK	-	-	-	-	-	-	-
	NO	1	0.099	17%	10%	1.631	0.210	1.297
	RS	-	-	-	-	-	-	-
	TR	5	4.152	42%	29%	8.054	12.700	9.377
	XK	-	-	-	-	-	-	-
	Tot	**18**	**5.552**	**35%**	**29%**	**16.573**	**17.018**	**16.119**
Eastern Partnership	AM	-	-	-	-	-	-	-
	AZ	-	-	-	-	-	-	-
	BY	4	0.168	25%	13%	0.406	0.397	0.582
	MD	3	0.167	19%	46%	0.340	0.278	0.284
	GE	1	1.137	10%	59%	2.165	2.908	1.881
	KG	-	-	-	-	-	-	-
	KZ	-	-	-	-	-	-	-
	TJ	-	-	-	-	-	-	-
	UA	17	1.685	15%	14%	7.261	3.195	4.719
	Tot	25	3.157	15%	18%	10.172	6.779	7.466
TOTAL		**1,845**	**97.557**	**30%**	**46%**	**604.946**	**458.865**	**428.916**

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List of abbreviations and definitions

BEI	Baseline Emission Inventory
CH4	Methane
CO	Carbon monoxide
CO_2	Carbon dioxide
CO_2–eq	CO_2 equivalent
CoM	Covenant of Mayors
COP	Conference of the Parties
CTC	Covenant Territorial Coordinators
EC	European Commission
EDGAR	Emission Database for Global Atmospheric Research
EEA	European Environment Agency
ETS	Emission Trading System
ESD	Effort Sharing Directive
EU	European Union
GHG	Greenhouse gases
GWP	Global Warming Potential
JRC	Joint Research Centre
ICLEI	Local Governments for Sustainability
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
LCA	Life Cycle Assessment
MEI	Monitoring Emission Inventory
MS	Member States
N_2O	Nitrous oxide
RES	Renewable Energy Source
RVA	Risk and Vulnerability Assessment
SEAP	Sustainable Energy Action Plan
UNFCCC	United Nations Framework Convention on Climate Change
UNDP	United Nations Development Programme

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