LOW CARBON URBAN STRATEGIES: AN INVESTIGATION OF 124 EUROPEAN CITIES

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1 INTRODUCTION: LOCAL POLICIES FOR CLIMATE CHANGE MITIGATION

Cities are important contributors to GHG emissions, even if different quantifications of their contribution are provided in statistics. The IPCC 5th assessment report (Seto et al., 2014) presents several estimates of the global share of urban GHG emissions available in literature. According to IEA (2008), urban energy related CO_2 emissions amount to 71 per cent of global emissions (2006 data). Grubler et al. (2012) estimate urban final energy use as 56–78 per cent of global final energy use, which, converted into CO_2 emissions, amounts to 53–87 per cent of global emissions from final energy use (2005 data). Marcotullio et al. (2013) estimate GHG (CO_2, CH_4, N_2O, SF_6) emissions in urban areas in the range of 37–49 per cent of global emissions (2000 data). The evaluation of urban GHG emissions is influenced by methodological choices, like the definition of city boundaries - which could be administrative, functional or morphological - and by the choice of emission accounting methods (see paragraph 2.2). Nevertheless, all estimations agree on the increase of total urban emissions in recent years, in correspondence with fast urbanisation and the concentration in urban areas of human activities generating emissions.

Cities do not only concentrate high levels of GHG emissions, they are also considered as key places where GHG emission reduction actions can be implemented and relevant reductions can be achieved. Municipalities are increasingly recognised as having a high potential to drive sustainable energy and climate change mitigation actions thanks to their knowledge of their territories and local governments' responsibilities and powers, which can be translated into policies for GHG reduction at local level. Urban mitigation options vary by city features and development levels. The options available for rapidly developing cities include shaping their urbanisation and infrastructure development trajectories. For mature, built-up cities, mitigation options lie in urban regeneration (compact, mixed-use development that shortens journeys, promotes transit, walking and cycling, adaptive reuse of buildings) and rehabilitation/conversion to energy-efficient building designs (Seto et al., 2014). The urban scale provides unique opportunities for policy integration between infrastructure development, mobility planning and energy demand management (Bräutigam & Knack, 2004; Rodrik et al., 2004).

The GHG emission reduction potential from urban initiatives is relevant. However, the quantification of this potential is a complex task. According to Lui et al. (2020), the GHG reduction potential of 17 global cooperative initiatives (involving cities, regions, businesses, and other subnational and non-state actors) could amount to 18–21 $GtCO_2e$/year by 2030, additional to national policies. Other analyses find that emission reductions available in cities could amount to 15.5 $GtCO_2e$ by 2050, with 58% from commercial and residential buildings, 21% from transport, 16% from materials and 5% from solid waste management; almost half of such reduction would be enabled by decarbonisation of electricity (Coalition for Urban Transitions, 2019). Despite the growing recognition of cities' potential contribution to climate change mitigation, their role has not been valued yet in nationally determined contributions (NDCs), adopted by national governments in the framework of the Paris Agreement (Hsu et al., 2019; Kuramochi et al., 2020).

City governments can act on several policy levers and adopt different policy instruments to implement GHG reduction measures in their territories. Policy instruments for urban climate strategies have been categorized in literature using criteria such as the underlying policy goals, purpose (mitigation/adaptation), policy sector, governance mode (Alber and Kern, 2008; Sethi et al, 2020), complementarity with other tools (Kamal-Chaoui and Robert, 2009; Hoornweg et al, 2011; Palermo et al., 2020), and policy categories, such as command and control, economic instruments, information dissemination (Wang et al., 2015).

There is an extensive literature on local climate change mitigation policies, which has addressed different aspects. Energy related actions included in local climate plans have been analysed with reference to achieving energy savings by retrofitting residential buildings (Dall'O' et al., 2013), increasing energy efficiency of public lighting (Radulovic et al., 2011), improving the acceptance of renewable energy within rural communities (Doukas et al., 2012), increasing the adoption of low carbon and carbon-free fuels in urban transport (Berghi, 2017). Local climate plans in national samples of cities have also been considered to assess and compare policies and measures; for example, Coelho et al. (2018) analyse the sustainable energy action plans developed by 70 Portuguese municipalities, focusing on adopted measures, sectors, and policy levels included in their mitigation strategies. Fewer studies evaluate the actual results of local climate policies in terms of achieved GHG reductions from the implementation of urban mitigation actions, as assessments of reductions obtained from local plans are quite limited in literature and are usually self-conducted by cities, and they are often characterized by information gaps and biases (Seto et al., 2014).

The selection, planning, and implementation of climate policies by a city government are influenced by the city's characteristics and conditions (Fuiji et al. 2017), as well as by the national context and legislative evolution (Damso et al., 2017). In fact, national governments can contribute to promote an urban low-carbon development, through policies and measures supporting action from local governments themselves and private investment in cities (Broekhoff et al., 2018). Climate change governance is frequently defined as "multi-level" and "polycentric", since it concerns many decision-making levels and involves a series of public and private actors through a variety of actions and initiatives (Hickmann, 2016; Jordan et al., 2018).

The implementation of local climate plans and their actions can be undermined by a series of barriers and obstacles. These barriers can be institutional, economic, technological, cultural, and behavioural, including for example scarcity of funds and governance processes (Delponte e al., 2017), complex and uncertain procedures (Cajot et al., 2017) and lack of interest from citizens (Coelho et al., 2018). Local climate plans can also be characterized by a too-short term view, compared to the need for a long-term perspective required by the climate change challenge, or they can be too focused on "low-hanging fruits", lacking an overall coherent and integrated strategy for low carbon action (Damso et al., 2017). Azevedo et al. (2013) differentiate the barriers to effective local climate action into simple market failures (information failures such as lack of local information, lack of public awareness on climate change, lack of capacity in city government staff and in other actors who participate in low carbon actions; transaction costs such as high upfront costs of some measures or long payback time), institutional failures (such as the competition of climate change issue with other priorities in the city government, short-termism of local politicians, lack of regulatory capacity in certain areas that are relevant to mitigation) and multi-agent failures (coordination among the city government's departments, multi-level coordination). Delponte et al. (2017) analyse the sustainable energy action plan and monitoring report of an Italian city (Genoa) identifying different types of barriers, like procedural issues, funding and market conditions, actions' complexity, and difficulty to activate governance process, need of more time to rise awareness on the plan. There is also a vast literature on barriers to low carbon and energy efficiency policies in the building and transport sectors at different levels. Bagaini et al. (2020) categorize them in economic, institutional, and behavioural (including social, cultural, and educational) barriers, highlighting how they influence the achievement of energy efficiency goals, reduce policy effectiveness, and limit the diffusion of technologies and interventions.

Transnational municipal networks on climate change offer the opportunity to exchange best practices and experience among members, which can contribute to overcome or at least tackle some of barriers to local climate action. Cities participating in such networks have several occasions to interact and cooperate, which can produce mutual learning and diffuse policy innovations across members (Davidson, Coenen, 2019).

Over the last decades, the number of transnational municipal networks engaged in climate change issues has increased while their membership has diversified (Bulkeley & Castán Broto, 2013). The number of city initiatives that seek to address climate change appears to be rapidly proliferating. Most of these initiatives are in the form of voluntary commitments by individual cities in the framework of city networks, like ICLEI, Climate Alliance, C40 and Energy Cities at global or continental level (UNEP, 2015). However, the initiative with the highest number of participants is the Covenant of Mayors (CoM), which shows peculiar features. In fact, the CoM is a formal voluntary agreement (Croci, 2005) between individual city governments and the European Commission through which cities commit to specific emission reduction targets.

The CoM was launched in 2008 by the European Commission to endorse and support the efforts of local authorities for GHG reduction and energy efficiency, in coherence with the European targets set by the Energy and Climate package. The initiative currently involves more than 10,600 municipalities, representing more than 336 million inhabitants in May 2021. Building on the success of the CoM, in 2014, the Mayors Adapt initiative was launched. The initiative relies on the same governance model, inviting cities to make a political commitment and take action to anticipate and prepare for the unavoidable impact of climate change through adaptation. At the end of 2015, the initiatives merged under the newly integrated Covenant of Mayors for Climate and Energy, adopting the EU 2030 objectives and an integrated approach to climate change mitigation and adaptation. The new integrated Covenant of Mayors for Climate and Energy is based on three pillars: mitigation, adaptation, and secure, sustainable, and affordable energy.

This paper aims to contribute to the literature on local climate change mitigation policies by highlighting which sectors, actions and policy levers have been most frequently targeted by cities in their local strategies to reduce GHG emissions. For this purpose, the paper provides a comprehensive analysis of about 5,000 mitigation actions included by 124 European cities in their local sustainable energy action plans developed in the framework of the Covenant of Mayors (CoM), digging into data from their Baseline Emission Inventories (BEIs) and Sustainable Energy Action Plans (SEAPs). Specifically, the paper: i) identifies the most relevant sectors where cities focus their emission reduction strategies, by analysing the distribution of emission reduction commitments in the SEAPs (intended emission reductions planned by cities) by sectors and sub-sectors; ii) classifies mitigation actions included in the SEAPs according to a category of action and according to the underlying policy instrument adopted; iii) highlights the most relevant actions and policy instruments adopted by cities in their emission reduction plans, by identifying those categories of actions and policy levers with the highest recurrence and emission reduction potential.

The paper is structured as follows: Chapter 1 describes the paper’s scope and objectives, provides an overview of the literature on local policies for climate change mitigation and presents the Covenant of Mayors initiative; Chapter 2 describes the city sample and explains the methodology used to analyse the data provided by CoM signatories; Chapter 3 presents the main results; Chapter 4 provides a discussion of results in the context of current literature on local climate action; Chapter 5 draws the conclusions.

2 METHODOLOGY

Section 2.1. presents the cities included in the sample according to a set of variables, which regard socio-economic aspects, climate conditions and geographical peculiarities; section 2.2. describes the rules defined by the European Commission to design BEIs and SEAPs; section 2.3. defines which sectors of BEIs and SEAPs have been considered and details the methodology adopted in the paper to categorize actions and policy instruments, based on a hierarchical approach.

2.1 Definition of the sample

The analysis is based on data provided by a subset of cities participating in the Covenant of Mayors initiative. The paper analyses data from the first Covenant of Mayors initiative, through which cities committed to at least 20 per cent reduction by 2020 of their energy-related emissions, compared to the baseline. This choice was due to data availability, because when the analysis was carried out only information on plans until 2020 were available.

The cities included in the sample have been selected based on their size and on the SEAP acceptance status. The acceptance of the SEAP implies that a quality check of the BEI and of intended emission reductions, performed by the JRC, has been passed successfully. All European cities with more than 100,000 inhabitants and with an accepted SEAP by February 2014 are included in the study. The sample is composed of 124 cities (see Table 1), with populations ranging from about 108,000 to 7.67 million.

Antwerp	Verona	Vantaa
Bruxelles-Capitale	Bielsko-Biala	Rostock
Gent	Cascais	Milton Keynes
Aachen	Lisboa	Bergamo
Bremen	Porto	Espoo
Dortmund	Vila Nova de Gaia	Cádiz
Frankfurt am Main	Baia Mare	Nice
Freiburg	Braşov	Brest Métropole Océane
Hamburg	Râmnicu Vâlcea	Bilbao
Hannover	Göteborg	Tbilisi
München	Birmingham	Duisburg
Münster	Gateshead	Loures
Nürnberg	North Tyneside	Cardiff
Stuttgart	South Tyneside	Wolfsburg
Århus	Newcastle upon Tyne	Mainz
Algeciras	Nottingham	Mannheim
Badalona	Redcar and Cleveland	Matosinhos
Hospitalet de Llobregat	Sunderland	Bari
Málaga	Stockton-on-Tees	Berlin
Mataró	San Sebastián-Donostia	Comunità Montana di Valle Trompia
Murcia	Pamplona	Forlì
Santa Coloma de Gramenet	Valencia	Firenze
Tarragona	Kaunas	Seixal
Terrassa	Bristol	Gdynia
Santander	Barcelona	Cork County
Vitoria-Gasteiz	Oeiras	Funchal
Helsinki	London	Salerno
Tampere	Bologna	Heraklion
Dijon	Warsaw	Valladolid
Dunkerque Grand Littoral	Zagreb	Huelva
Grenoble	Almería	Zaragoza
Mulhouse Alsace Agglomération	Genova	Venezia
Nantes Metropole	Alcorcón	Bottrop
Paris	Bonn	Oulu
Plaine Commune	Bordeaux (La Cub)	Arad
Patras	Copenhagen	Kerry Local Authorities
Rijeka	Manchester	Helsingborg
Dublin	Córdoba	Tirgu-Mures
Modena	Napoli	Bydgoszcz
Padova	Glasgow	Marbella
Ravenna	Jönköping	Unione dei Comuni NET (Nord Est

		Torino)
Torino	Reggio Emilia	

Table 1: List of cities included in the sample

Cities have been grouped according to six variables to study the sample composition: population size (Figure 1a); heating degree days (HDD); (Figure 1b) GDP per capita (Figure 1c); population density (Figure 1d); geographical area (Figure 1e) and electricity emission factor (EEF) (Figure 1f). These features shape local energy demand and consumption levels in different urban sectors and influence the adoption of technological and non-technological solutions to satisfy urban needs. There is an extensive literature on urban GHG emission drivers, which identifies the correlation of emission levels with climate conditions, urban form, demographics, economic activities in place, state of technology, mobility and housing infrastructures, and income and lifestyle of city residents and users (Creutzig et al., 2015; Croci et al., 2011; Glaeser & Kahn, 2010; Grubler & Schulz, 2013; Kennedy et al., 2009; Makido et al., 2012; Minx et al., 2013; Peterson et al., 2009; Seto et al., 2014; UNFPA, 2009; Wiedenhofer et al., 2013). Table 2 describes the six variables used to group the cities of the sample.

Variable name	**Unit of measure**	**Variable description**	**Data source**
Population size	Number of inhabitants	Population size in the BEI year and in the year of CoM signature.	Self-declared by cities
Heating Degree Days (HDD)	Number	Heating Degree Days at NUTS 2 level were chosen as proxy of climate conditions in the city. HDD data were extracted for the BEI year or for the closest available year.	Eurostat
GDP per capita	Euro	Average GDP per capita for the BEI year was calculated using GDP at current market prices by NUTS 3 region. When the GDP in the BEI (or CoM signature) year was not available in the Urban Audit dataset, the value for the closest available year has been adjusted multiplying it by the national GDP growth at market prices (for the period between the closest available year and the year of interest). GDP growth was extracted from the World Development Indicators.	Urban Audit (Eurostat), World Development Indicators
Population density	Inhabitants/km^2	Average population density was calculated as the ratio between self-declared population and city surface. Declared data were checked and corrected if needed, based on official sources.	Self-declared by cities, official city websites
Geographical area		Five main groups of cities were defined according to geographical location: 1) Eastern European: cities from Hungary, Poland and Romania; 2) Mediterranean: cities from Greece, Italy, Portugal and Spain; 3) Northern Europe: cities from Denmark, Finland, Lithuania and Sweden; 4) Central Europe: cities from Belgium, France, and Germany. 5) UK & Ireland: cities from United Kingdom and Ireland.	
Electricity Emission Factor (EEF)	tCO_2/MWh	The local electricity emission factor is the self-declared amount of CO_2 emissions associated to a unit of electricity consumed in the city. This is a combination between national average emission factors for electricity consumed in the country and the emission factor associated to the share of electricity produced and consumed locally.	Self-declared by cities

Table 2: Variables used to study the cities sample

Considering GDP values (Figure 1c), most cities in the sample belong to the 20,000–30,000 € class (55 cities). Considering population and urban density values (Figure 1a and 1d), cities are not equally distributed among the different classes. Considering the geographical area (Figure 1e), cities are concentrated in the Mediterranean area (53 cities). Finally, considering HDD and EEF (Figure 1b and 1f), cities are concentrated in the average values.

Figure 1: Distribution of cities into the variables' classes

2.2. Guidelines for BEI definition and SEAP design

The European Commission – DG Energy - endorses and supports the efforts deployed by local authorities in the implementation of sustainable energy policies. The European Commission also established the Covenant of Mayors Office (CoMO), which is responsible for the coordination and daily management of the initiative. It provides signatories with administrative support and technical guidance, facilitates networking between Covenant stakeholders and ensures the promotion of their activities. The European Commission - Joint Research Centre (JRC) is responsible for providing technical and scientific support to the initiative and for evaluating SEAPs and monitoring reports. It works in close co-operation with the CoMO to provide signatories with clear technical guidelines and templates to assist delivery of their commitments as well as to monitor implementation and results. The European Commission also recognises CoM coordinators (supporting signatories in conducting CO_2 emission inventories as well as in preparing and implementing their SEAPs) and CoM supporters (providing tailored advice to signatories and identifying synergies with existing initiatives).

Through the SEAP, signatories commit to a minimum CO_2 emission reduction target of 20 per cent by 2020 and define the actions they intend to put in place to reach their commitment. The SEAP is a detailed set of actions, including project management information (e.g. implementation time frame, responsible bodies, costs) and estimations of impacts, per action and per sector, in terms of energy saving, renewable energy production and overall CO_2 emission reduction. The scope of the SEAP is: i) to define, to describe and to estimate quantitatively energy-related GHG reduction measures with respect to a BEI; ii) to define strategies for efficiently monitoring the effect of the implementation of measures; and iii) to define the roles of the various stakeholders in the implementation of the measures.

The Covenant of Mayors methodology proposes a consolidated and flexible framework to enable local authorities to produce robust and comparable inventories of CO_2 emissions and encourages a regular reporting practice. The BEI identifies the most relevant emission sources and sectors, setting the starting point. The subsequent inventories allow monitoring progress towards the target. BEIs serve as an instrument to support local action planning on energy; therefore, they are focused on emissions mainly associated with final energy consumption (including electricity and other fuels/carriers) in sectors, which can be influenced by policies implemented by local authorities (housing, services, transport). Mayors are strongly recommended to compute emissions and design a strategy for emission reduction that includes both the transport and building sectors. They are key sectors for the CoM because they are relevant contributors to total emissions, and they fall under the regulatory control of the local administration.

For EU signatories, the recommended baseline year is 1990, or the closest subsequent year for which the most comprehensive and reliable data can be provided. The emission reduction target is set against the baseline year, and it can be set either as absolute reduction or per capita reduction. The energy-related emissions coming from other sectors might be included in the BEI, if the SEAP foresees measures for them (e.g. industry not under the ETS, highways not serving the city but crossing its territory). Some emission sources not related to energy consumption might also be included in the BEI, such as wastewater and solid waste treatment. Local energy (electricity, heat/cold) production should be accounted for in the BEI when the municipalities intend to develop and implement actions aimed at reducing the CO_2 emissions also on the supply side (e.g. development of the district heating network, wind farms, PV).

Emissions are calculated using the standard formula:

$$\text{Emissions} = \sum \text{Final Energy consumption (MWh)} \cdot \text{Emission factor } (tCO_2/MWh)$$

where all relevant emission sources and their emission factors are accounted for. The CoM allows signatories to apply emission factors in energy consumption according either to the IPCC approach or to the Life Cycle Assessment (LCA) approach, where LCA emission factors are higher than IPCC ones. The standard method for reporting GHG (IPCC approach) quantifies emissions using a national sector-based approach (Schils et al., 2005). The approach estimates emissions from the production and consumption of goods within defined national boundaries and emissions from the production of goods exported from a nation but does not consider emissions from the production of goods imported into a country (Peters, 2008).

Consequently, this method, when applied to the urban scale, includes both direct emissions (generated inside city boundaries) and indirect emissions (generated out of city boundaries, but induced by city activities, like emissions generated from electricity production plants or landfills located out of the city). LCA approaches quantify the potential environmental impacts generated throughout a product's lifecycle, from raw material acquisition through production, use, recycling, and final disposal (International Organisation for Standardisation [ISO], 2006).

Reporting of CO_2 emissions is mandatory, as it is the most important among all the GHGs associated with fuel combustion. Signatories can include emissions of methane (CH_4) and nitrous oxide (N_2O), converted into CO_2 equivalents (CO_2 eq.) according to their global warming potential (GWP). CO_2 emissions from the sustainable use of biomass/biofuels, as well as emissions from certified green electricity, are considered carbon-neutral on an annual basis.

A key difference between the BEI and the SEAP emissions accounting is related to the local production of electricity and heat/cold. In the BEI, emissions from electricity and heat/cold production are associated with the sectors of final consumption. In the SEAP, intended emission reductions associated with local electricity production and local heat/cold production are allocated to a dedicated sector and estimated as the level of emissions forgone thanks to fuel substitution. This requires first estimating the type and amount of fuel that will be substituted by local production because of the action. This is multiplied by the appropriate emission factor for the fuel (or the fuel mix) substituted. For example, the share of local production of electricity generated by renewables that is consumed by households will be accounted for in the local electricity production sector of the SEAP and it will not be included in the intended emission reduction of the residential sector, to avoid double counting.

2.3 Classification approach

SEAPs are organised according to a hierarchical categorisation of sectors and subsectors defined in the SEAP and monitoring templates developed by the JRC (Covenant of Mayors Office & Joint Research Centre of the European Commission, 2014; European Commission, 2010), which constitute the standard reporting framework for Covenant signatories. These have been used as main references to define the classification approach used in the analysis. All the SEAP sectors and subsectors defined in the original template (Building: *residential buildings and facilities, tertiary building and facilities*, *municipal buildings and facilities*; Transport: *private and commercial transport, public transport and municipal fleet;* Industry; Public lighting; Local electricity production; Local heat/cold production; Land use planning; Waste and Water; Working with citizens and stakeholders; Others) have been considered in the analysis. Further subsectors have been added in our analysis in the building and transport sectors, to highlight holistic actions. These additional sub-sectors have been named "mixed-actions". Any other sector is classified as "other".

SEAPs provide specific information and descriptions of planned actions for intended emission reductions. Actions are univocally related to a sector and a subsector. When the analysis was conducted, the SEAP database did not include information on the policy instrument used to implement the actions. For this reason, each action has been classified, based on its description, into a "category of action", including all actions characterised by the homogeneity of the area of intervention under a certain sector and subsector, and into a "policy lever" describing the instrument used by the local authority to implement the action.

Overall, 5,000 actions described in the cities' SEAP sample have been analysed. 117 categories of actions and 28 policy levers have been defined (see Appendix A). Each category of action is associated with a specific sector and subsector. Policy levers can be common to different sectors (e.g. awareness raising) or specific to a sector (e.g. building standards). For example, if the action is "thermal insulation of residential buildings", the category of action is "building envelope" and the policy instrument to implement the action could be setting new "building standards", while the subsector is "residential" and the sector is "Buildings".

Figure 2 synthesises the classification used in the paper, providing an example of classification for the building sector.

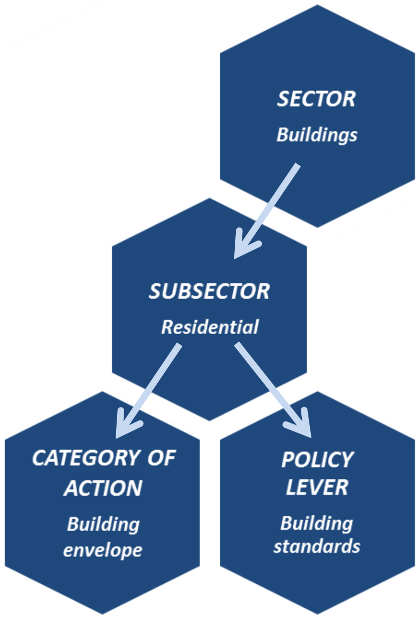

Figure 2: Classification approach applied to emission reduction actions

Disaggregated reporting is compulsory up to the sector level only. Moreover, cities are allowed to report only the most significant actions. A certain amount of intended CO_2 emission reductions has not been disaggregated into actions by Covenant signatories (see paragraph 3.1) or was not attributable to specific sectors by the authors, so residual sectors have been created. These sectors are: i) "Emissions not disaggregated into specific actions", reporting intended emission reductions that have not been disaggregated among subsectors; and ii) "Not possible to assign", reporting emissions associated to actions with unclear descriptions (e.g. alphanumeric codes attributed to an action instead of a description of it) and thus impossible to attribute to a category.

Based on the share of emissions by sector and subsector in the sample, an analysis of the intended emission reductions sectoral distribution is developed. The categories of action and the policy levers are analysed in terms of recurrence in the SEAPs and in terms of amount of intended emission reductions attributed to them by cities.

3 RESULTS

In this Chapter, section 3.1. addresses the disaggregation of data on intended emissions reductions in the city sample; section 3.2. compares the distribution of emissions and intended emission reductions by sectors and sub-sectors in BEIs and SEAPs; section 3.3. describes the distribution of intended emission reductions among categories of action and policy levers, commenting on their recurrence and reduction potential.

3.1 Disaggregation of intended emission reductions in the sample

Cities in the sample account for a total of 370 megatons of CO_2 emissions in selected baseline years and 94 megatons of intended emission reductions per year. This is mainly due to direct CO_2 emissions in sectors covered by the CoM. Most cities in the sample computed direct emissions based on IPCC emission factors, while only 12 per cent followed a LCA approach. Total emissions in the sample correspond to 10 per cent of total CO_2 emissions from the EU in all sectors in 2013 (Jos et al., 2014). The total level of emission reduction planned by cities corresponds to 25 per cent of baseline emissions in the sample, beyond the minimum target of 20 per cent required by the CoM.

The analysis of SEAPs data confirms that cities face increasing difficulties in computing intended emission reductions according to the detail (disaggregation) to be provided (sector, subsector, action, energy source, etc.); thus, the detail of analysis is sometimes limited by data availability. The distribution of intended emission reductions between sectors and subsectors is reported in Figure 3, with blue bars referring to intended emissions in the subsectors and red bars referring to aggregated emissions by sector (as a sum of blue bars on their left). There is a relevant share of cities providing only a partial disaggregation of total intended emission reductions. Overall, almost half (46.5 per cent) of emission reductions are not assigned to sectors, subsectors, and specific actions by municipalities, so they have been attributed to the sector "Emissions not disaggregated into specific actions". Moreover, an additional 10 per cent of intended emission reductions is related to actions with unclear descriptions and thus attributed to the sector "Not possible to assign". In the following analysis it has been assumed that emissions from these residual sectors show the same distribution of emissions, which have been attributed to specific sectors, subsectors, and categories of action.

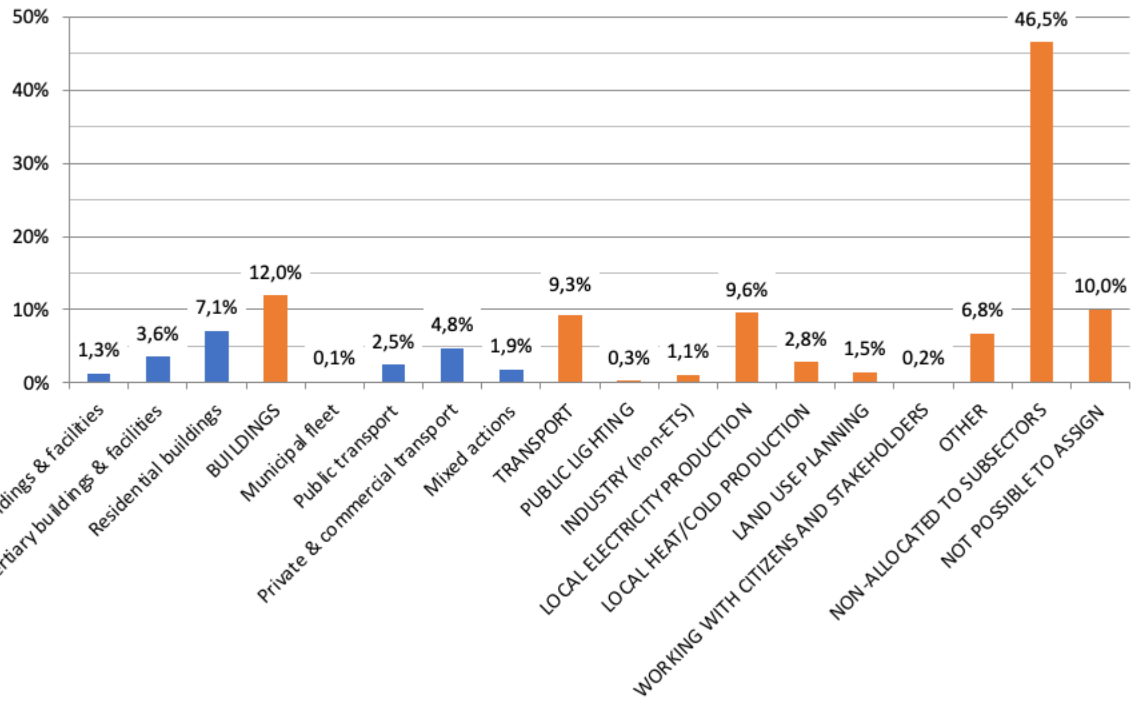

Figure 3: Distribution of intended emission reductions by subsector and sector in SEAPs

3.2 Intended emission reductions distribution by sector and subsector

A comparison of the distribution of aggregate emissions from BEIs (Figure 4A) and intended emission reductions from SEAPs (Figure 4B) in the city sample shows the prevalence of both emissions and intended emission reductions in the Building sector (respectively 49 per cent and 30.2 per cent). Emissions in the Transport sector amount to 26.3 per cent and in Industry amount to 22.1 per cent, while intended emission reductions in the Transport sector amount to 20.6 per cent and in Industry sector to 2.4 per cent. Intended emission reductions in the Local electricity production sector amount to 21.3 per cent while intended emission reductions in the Local heat/cold production sector amount to 6.3 per cent. Local electricity and Local heat/cold production sectors do not appear in the BEI sectors because their emissions are associated to final consumption sectors. The discrepancy between the relevance of emissions and intended emission reductions in the Industry sector can be explained by two main elements: i) the Industry sector is not compulsory in the SEAPs; ii) emission reductions generated by actions in the Industry sector are often accounted in the Local electricity and Local heat/cold production sectors. Overall a relevant coherence in the relative weight of considered sectors between emissions and intended emission reductions can be detected.

The amount of intended emission reductions in the Building sector is disaggregated in the following subsectors: actions in residential building are intended to yield 15.8 per cent of reductions, while tertiary buildings account for 8 per cent, municipal buildings for 2.8 per cent and mixed actions for 2.6 per cent. Looking at the Transport subsectors distribution, cities intend to reduce emissions from public transport by 5.6 per cent, from private and commercial transports by 10.6 per cent, from municipal fleet by 0.3 per cent and from mixed actions by 4.1 per cent. Land use planning (3.4 per cent) and Working with citizens and stakeholders (0.4 per cent) are sectors that do not have a correspondence in the BEI. Overall, emissions are intended to decrease by 25 per cent with respect to BEIs.

Through the analysis of the relevance of emission reductions per sector and subsector in relation to baseline emissions in the same sector and subsector, it emerges that actions in subsectors under direct control by cities' administrations (municipal buildings, public transport, municipal fleet and public lighting) are planned to deliver higher reductions with respect to the correspondent baseline emissions - though they deliver a small contribution to total intended emission reductions (9.4 per cent) - compared to actions in subsectors where private actors (households and firms) act, which are affected only indirectly by local governments' policies. In fact, based on disaggregated data, emissions from public transport, municipal fleet, municipal buildings, and public lighting show the strongest intended reductions (54 per cent, 33 per cent and 20 per cent respectively).

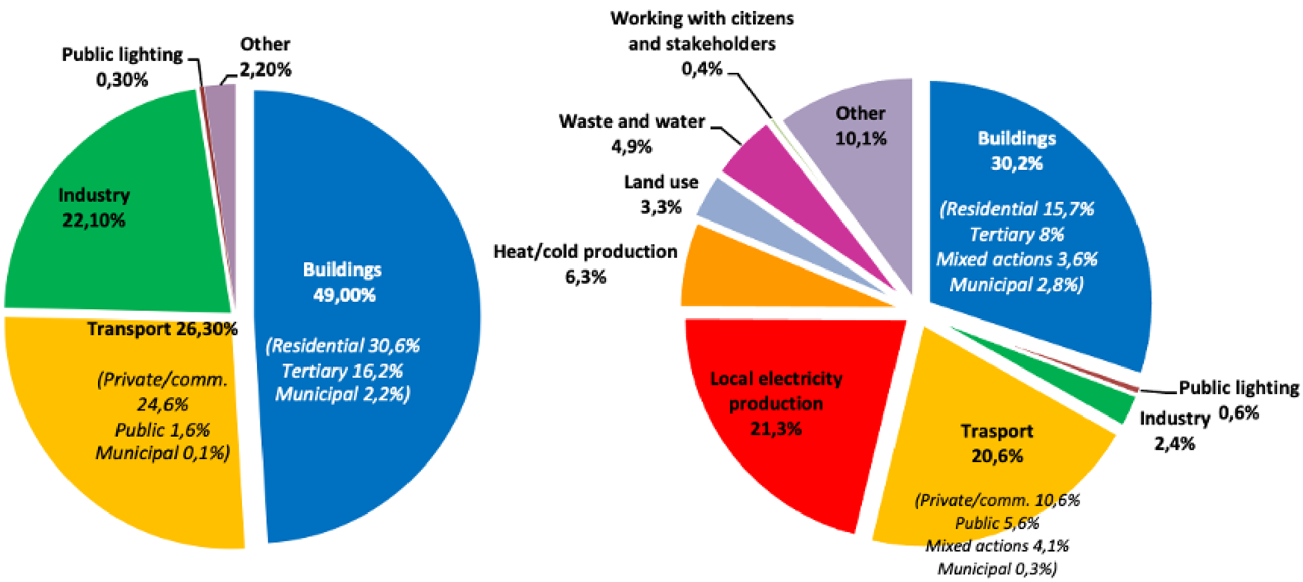

Figure 4A: Distribution of emission among sectors and subsectors; Figure 4B: Distribution of intended emission reductions among sectors and subsectors

3.3 Intended emission reductions distribution among categories of action and policy levers

Most cities included in their SEAPs actions related to the three main mitigation sectors (Buildings; Transport; Local electricity production): 68 per cent of cities plan actions in the Building sector, 66 per cent in the Transport sector and 49 per cent in the Local electricity production sector. For each sector, an analysis of the most recurrent categories of actions and policy levers, as well as of intended emission reductions associated with them, is provided below. These shares have been calculated considering as "total" the emission reductions expected from the building, transport, and local electricity sector only.

In the Building sector, the most recurrent categories of actions are: "Other" and "Integrated actions", that are also relevant in terms of intended emission reductions. These categories of action in fact represent 14.5 per cent and 14.8 per cent of the total intended CO_2 reductions respectively (Figure 5). The "building envelope" category of action is rarely present in SEAPs alone as individual measure, but it is expected to deliver a relatively high share of CO_2 emission reductions (3.5 per cent), like "energy efficiency in space heating and hot water" and "Energy efficient lighting systems".

The most recurrent policy levers in the Building sector include "energy management", "awareness raising" and "infrastructure and construction", which are also the most relevant levers in terms of intended emission reductions. In particular, "Infrastructure and construction" is the third most relevant policy lever in terms of recurrence and the second most relevant one in terms of intended emission reductions (Figure 6).

Figure 5: Categories of action in the Building sector

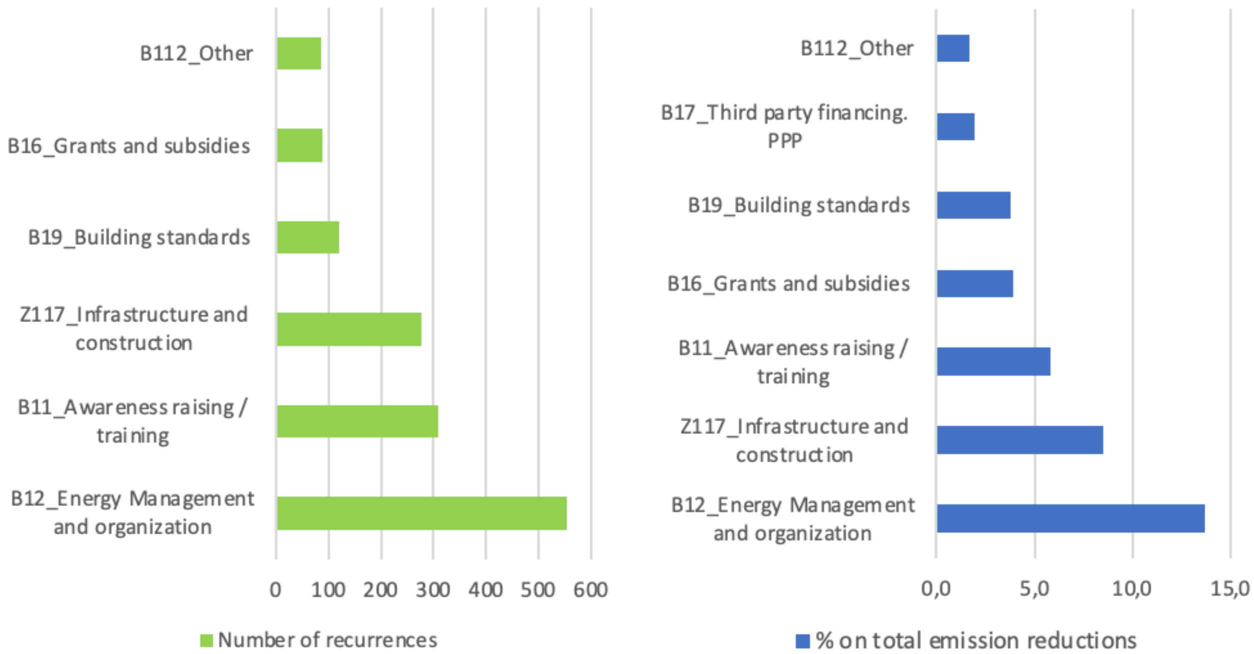

Figure 6: Policy levers in the Building sector

In the Transport sector, the most recurrent categories of action are related to “Other” and “Modal shift to public transport”. “Other” is also quite relevant in terms of intended reductions of CO_2 emissions (with 6.6 percent), whereas “Modal shift to public transport” is less relevant (with 3.1 percent). The “lower CO_2 emissions fuels refuelling stations” category of action is rarely present in SEAPs, but it is among the ones with the highest amount of intended emission reductions (4.7 per cent) (see Figure 7).

The most used policy levers in the Transport sector are related to “management and organisation”, “transport/mobility planning regulation” and “infrastructure construction”, where the first two ones are also the most relevant in terms of intended emission reductions (see Figure 8).

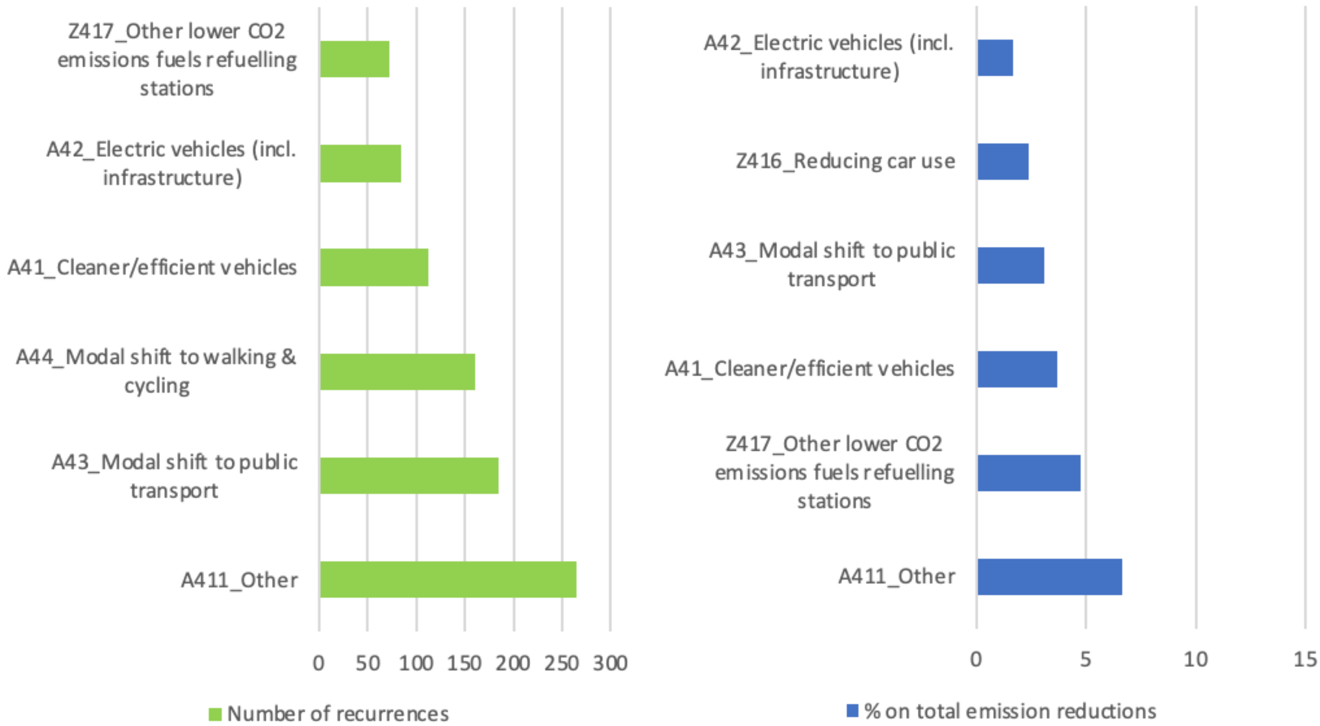

Figure 7: Categories of action in the transport sector

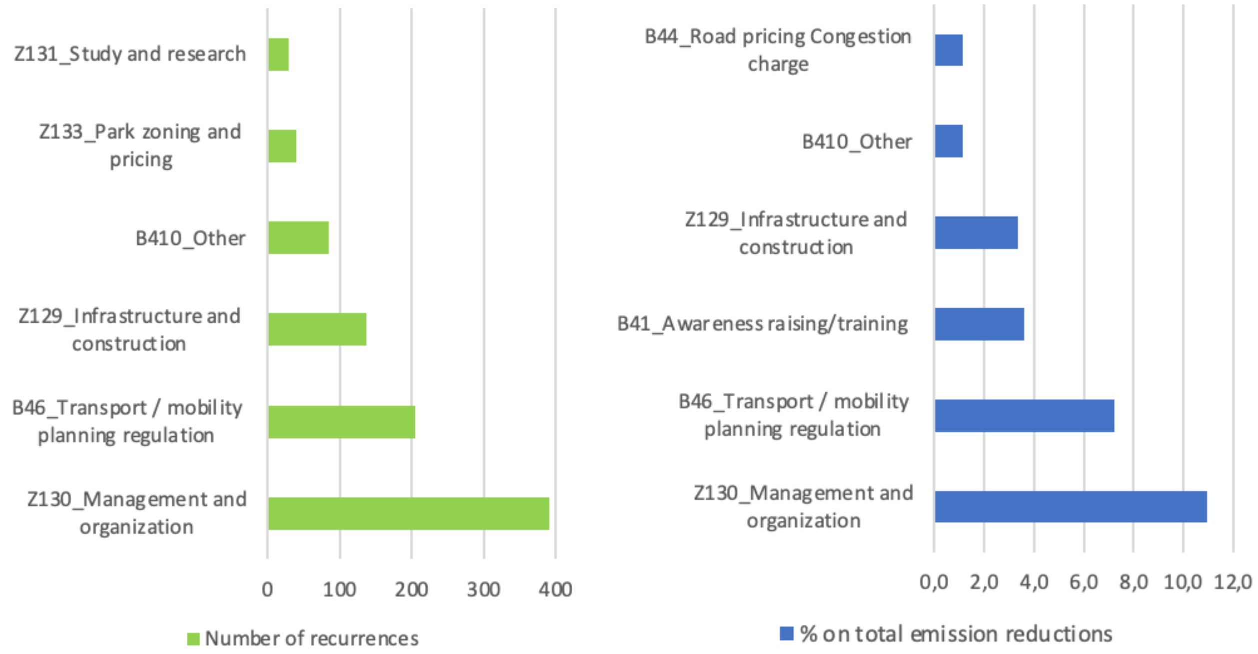

Figure 8: Policy levers in the transport sector

For Local electricity production, the most recurring category of action is photovoltaic, associated with a relatively low share of intended emissions reductions (1.7 per cent). The "combined heat and power" category of action is very relevant both in terms of frequency and in terms of emission reduction potential (10.8 per cent) (see Figure 9). Also "Wind power" and "biomass power plant" are expected to deliver relevant intended emission reductions (4.2. per cent and 2.6. respectively).

The policy levers addressing local electricity production that are expected to attain the highest intended emission reductions are: "management and organisation" (16.8 per cent), "infrastructure construction" (5.2 per cent) and "awareness raising" (4.2 per cent) (see Figure 10). The first two levers are also the most frequently adopted ones.

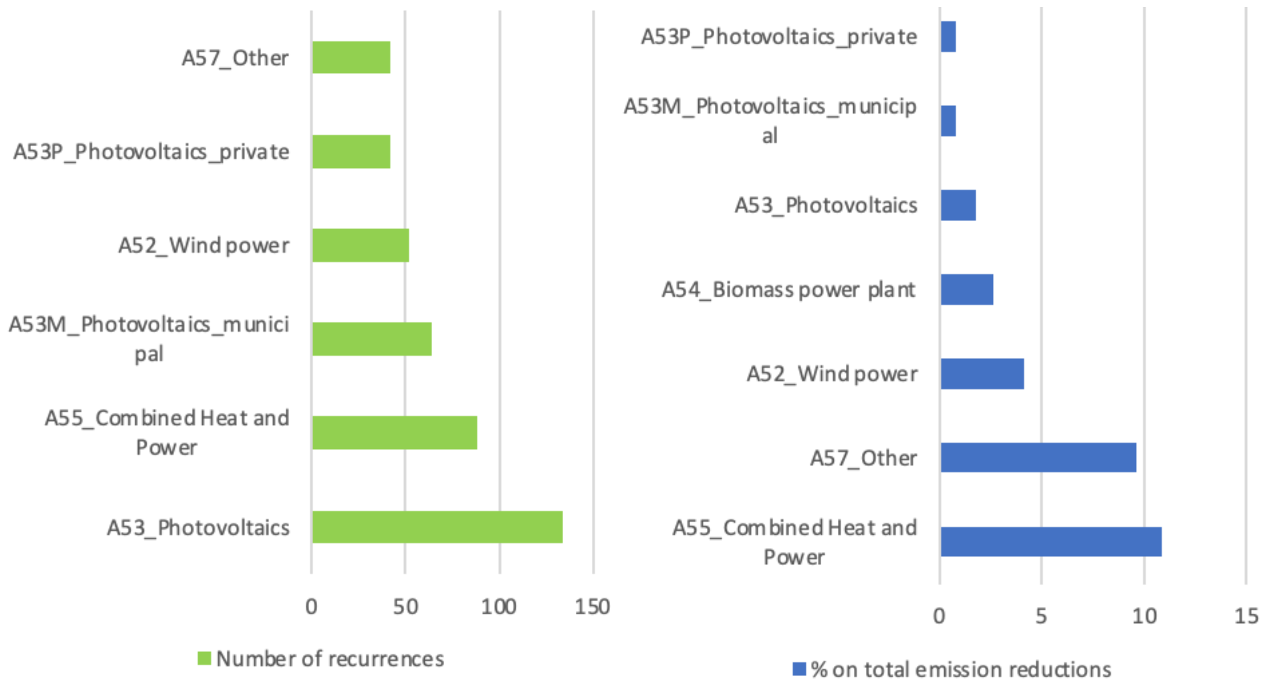

Figure 9: Categories of action in the Local Electricity Production sector

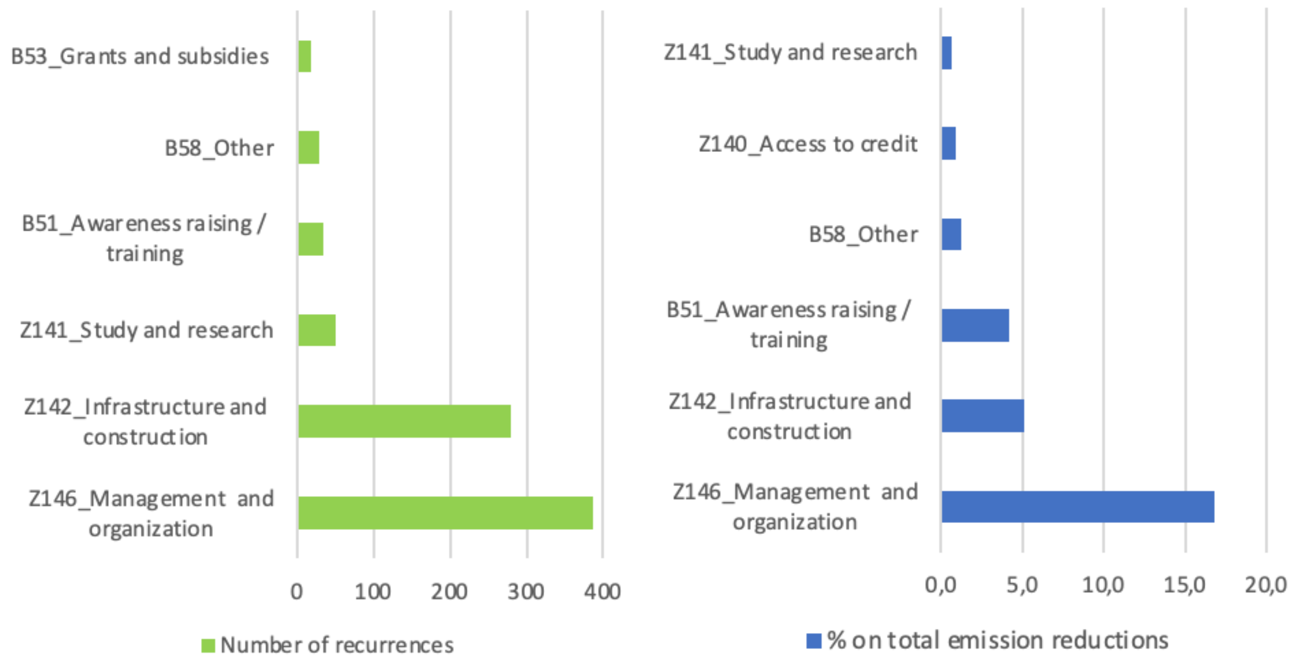

Figure 10: Policy levers in the Local Electricity Production sector

4. DISCUSSION

From our analysis of BEIs, buildings and transport stand out as the sectors with the highest contribution to emissions. Furthermore, from the analysis of SEAPs, cities intend to deliver the major emission reductions in these two sectors. This is in line with the overall figures of the CoM, as reported in the 8-year assessment of the initiative (Kona et al., 2017), where buildings and transport are the two most important sectors both in BEIs (representing 67% and 26% of total emissions) and in SEAPs (representing 49% and 23% of total expected emission reductions by 2020, respectively). In terms of building sub-sectors, residential is the most important one both considering emissions and intended emission reductions, followed by tertiary and municipal ones. A similar result appears in the transport sector, where private sub-sector is the most relevant one followed by public and municipal ones. The private sectors are therefore expected to deliver the major reductions, considering the overall amount of intended reductions declared in the SEAPs. This may be explained by the fact that in the European Union, most of the built stock is formed by residential buildings (Pohoryles et al., 2020). The residential share of total floor area varies according to the country from 60% to more than 85% (EU Building Stock Observatory, 2013). Large part of the residential stock in Europe has low energy performances, therefore there is a great potential to adopt energy efficiency measures and achieve emission reductions in this sector. Similarly, private traffic usually represents a large share of a city's overall mobility, and therefore it shows greater opportunities for optimization and efficiency increases.

Considering the share of emission reductions in relation to emissions in base year for each sub-sector, the public sector shows higher expected reductions, even if its weight is relatively low compared to sectors where private actors have responsibility to implement actions and delivers results. City governments seem to be able to plan and foresee more relevant emission reductions in sectors that they can directly control and target (i.e. municipal buildings, municipal vehicles, public transport). However, some cities might prefer to focus their strategies mainly on interventions in the private sector, because of the difficulty of financing public investments, as Berghi et al. (2017) find in the SEAPs of major Italian cities like Milan and Rome.

In terms of mitigation actions analysed in our sample, some categories of actions stand out as being relevant both in terms of recurrence and contribution to GHG emission reductions (e.g. integrated actions in the building sector), whereas some are less frequently adopted but are expected to deliver relevant reductions (e.g. purchase of green energy in the building sector). In the building sector, cities often rely on adopting "integrated actions" rather than individual measures, and expect from them relevant emission reductions. In the transport sector, cities often include actions related to modal shift to public transport in their SEAPs, however they estimate relatively modest emission reductions from this type of actions. In the local electricity production sector, actions targeting photovoltaics are quite diffused in the SEAPs, even if they deliver relatively low emission reductions. This could be explained by the size and fragmentarity of PV systems that in cities may be implemented in a diffused way. Instead, combined heat and power stands out in local mitigation strategies for its wide adoption and relevant emission reduction potential

In terms of policy instruments, management and organization emerge as the most relevant levers both in terms of recurrence and reduction potential in the building and transport sectors. Further relevant levers are awareness raising (in building and transport) and construction of infrastructure (in the building sector and in local electricity).

Cities' choices on which actions and policy instruments to include in the SEAPs and to deliver intended emission reductions depend on the political will of the city government and on other main factors: i) abatement costs, ii) technical feasibility and iii) social acceptability (Croci et al., 2017). The 5th IPCC report (IPCC, 2014) shows that in recent years, energy consumption in buildings has fallen in several European countries where strong policies have been implemented, also at the local level. Policy makers have focused on the building sector mainly through regulatory instruments, including building codes and standards (see, among others, Boza-Kiss et al., 2013; Koeppel & Urge-Vorsatz, 2007) and information to citizens and consumers, including energy labels, building labels and certificates (Boza- Kiss et al., 2013; Kelly, 2012). The relevance of the transport sector in recent policy making is also confirmed. Different policy mixes to reduce the use of private transport at city level have been used; cities have usually focused on land use patterns, public transport options, pricing, and other strategies (Barth and Boriboonsomsin, 2008). More recent innovations include bicycle and car sharing (Sperling and Nichols, 2012; Olaru et al., 2011).

The paper results highlight the need to develop integrated local mitigation strategies, that consider the emission reduction potential of each sector and rely on the most effective policy mix according to the local and national context. Local governments' mitigation strategies should exploit the relevant emission reduction potential of private sectors and strive to include actions that foster actions from private stakeholders in their mitigation plans. Public authorities can stimulate private actors in the implementation of sustainable energy measures through a range of norms, incentives and awareness raising actions (Alber and Kern, 2008). Furthermore, urban policies can influence each other in a relevant way, therefore potential synergies or trade-offs should be considered when designing the policy mix of a local mitigation plan (Deetjen et al., 2018).

It should be recalled that emission reductions included in the SEAPs are potential, and they need to be achieved through the actual implementation of actions. The effectiveness of mitigation actions included in SEAPs should be investigated by comparing data on intended emission reductions and achieved emission reductions, as reported in the Monitoring Reports. Several signatories of the CoM have already presented a Monitoring Report to show their progress on implemented actions and achieved reductions (2,800 as of May 2021), referred to different monitoring years. Data for 2020 are not yet available and it is not possible to compare intended emission reductions with actual results for all cities in the sample. Based on Kona et al. (2017), the 315 CoM signatories having presented a full monitoring report up to September 2016 reduced overall GHG by 23 %, compared to a mean reduction target of 30 % by 2020. Such result is due to a 36% GHG reduction in the building sector, 7% in the transport sector and 17% from improvements in electricity consumption. As reported by Bertoldi (2020), the number of signatories with a full report increased substantially in the following years, reaching 1845 full reports delivered up to August 2019. Based on their monitoring reports, this wider group of cities reached a 21% emission reduction compared to a 28% reduction target by 2020, with a 22% reduction in the building sector and 16% in the transport sector. Even if the authors of both studies specify that these results cannot be considered as representative of the overall CoM signatories, because the group of reporting cities presents some specificities in terms of city size and experience, we can comment that these data show a GHG reduction trend in participating cities, even if not enough to reach the targets.

As described in the introduction, the implementation of local climate plans and their actions can be undermined by a series of barriers and obstacles. It is not possible to identify which barriers could impact on the achievement of intended emission reductions in the city sample considered in this paper, because this would require a dedicated analysis and the implementation of a survey to policy makers and other actors in these cities. However, the possible presence of barriers should be considered when reading the emission reduction potential expressed by cities in their plans.

5 CONCLUSIONS

More than 10,600 cities had signed the CoM by May 2021, committing to climate action targets to be reached by 2020 or 2030. More than 7,500 cities have developed an action plan at this purpose and almost 2,800 have presented a monitoring report on their progress.

The analysis, based on a sample of 124 European cities with more than 100,000 inhabitants, outlines: i) the intended emission reductions in the sample for each sector (and subsector); and ii) the actions and the policy levers most used by cities in the design of their SEAPs. Overall, 5,000 actions have been analysed and then attributed to 117 categories of actions and 28 policy levers.

Main results show that cities in the sample are committed to achieve a reduction of 25% of baseline emissions by 2020. Buildings and Transport stand out as the sectors where cities intend to deliver the major emission reductions. The share of emission reductions compared to emissions in base year is higher in the public sector, even if its weight is relatively low compared to sectors where private actors have responsibility to implement actions and delivers results. In terms of mitigation actions, some categories of actions stand out as relevant both in terms of recurrence and contribution to GHG emission reductions (e.g. integrated actions in the building sector), whereas some are less frequently adopted but are expected to deliver relevant reductions (e.g. purchase of green energy in the building sector). In terms of policy instruments, management and organization emerge as the most relevant levers both in terms of recurrence and reduction potential in the building and transport sectors. Further relevant levers are awareness raising (in building and transport) and infrastructure construction (in the building sector and in local electricity).

The analysis has some limitations. The first one is due to the limited level of detail provided by some cities. Nonetheless, the uniform approach to emission accounting ensures the comparability of cities and the consistency of results regarding available data. Secondly, data analysed in the paper refer to intended emission reductions and not to actual reductions. This is due to data availability when the analysis was performed, since at that time no monitoring reports were available yet. Currently, data for 2020 are not yet published and may not be available for all cities included in the sample. For this reason, the analysis has been integrated in the discussion chapter with an overview of the most updated results achieved up to now by CoM signatories. Another limitation is due to how GHG intended reductions are calculated by signatories, which may lead to underestimate the emission reduction potential. Reductions are estimated compared to a fixed base year, rather than to a BAU scenario which accounts for the evolution of emissions under certain conditions. Several factors can influence emission trends in cities, like population trends, climate, economy, urban form development, as well as unforeseen circumstances - like the Covid-19 pandemic. Lockdown measures implemented across the world have generated a fall in global daily CO_2 emissions by 17% as 7 April 2020, compared to the previous year (Le Querè et al., 2020).

This paper does not analyse the factors underlying cities' mitigation choices because data on implementation costs, technical feasibility and social acceptability are not provided in the CoM process. The paper also does not consider the potential co-benefits of mitigation actions and distributional effects. These elements should be investigated in further research. Despite this, the paper provides a detailed overview and analysis of the actions and policy instruments that cities participating in the Covenant of Mayors initiative have adopted in their local mitigation strategies to achieve their CO_2 reduction targets.

The results of the analysis can be useful to urban policy makers (especially in medium and large size cities) to shape their mitigation strategies and learn from the experience of cities in the sample. The paper results highlight the need to develop integrated and mixed local mitigation strategies, considering the emission reduction potential of each sector, the main features of the city and the national context and the potential synergies and trade-offs between policies.

For some of the signatories, the Covenant of Mayors initiative is a structured way of implementing national regulations, for others it is an opportunity to go beyond them and lead a transformation process. Initiatives to address climate change do not exclusively originate from national governments but are co-produced by different types of sub-national actors (Dellas, Pattberg and Bestill 2011). By contrast, in absence of strong national policies, signatories have the possibility to design their own measures. In fact, local authorities do not act in isolation. Each local authority is placed in a specific context, where national, regional, and local competences, legislation and policies on energy and climate-related sectors interact. Numerous studies have pointed to the increased role played by non-state, and sub-national, actors, in mitigating climate change (Hewson and Sinclair 1999; Kahler and Lake 2003; Avant, Finnemor and Sell 2010). These studies contend that different types of sub-national actors perform several functions that previously rested solely with national governments. Sub-national actors play a crucial role in the field of global environmental policies. The most prominent examples are, indeed, the climate change related involvement of local governments (Bulkeley, 2010). The Covenant of Mayors initiative is a factual demonstration of such involvement of cities and of the potential relevance of their contribution.

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Appendix A: Categorization of actions and policy instruments in each sector and sub-sector

SECTORS	SUBSECTORS	CATEGORIES OF ACTIONS	POLICY LEVERS
A1_Buildings	**A1_Municipal**	A11M_Building envelope	B11_Awareness raising / training
		A12M_Renewable energy for space heating and hot water	B12_Energy Management and organization
		A13M_Energy efficiency in space heating and hot water	B13_Energy certification / labelling
		A14M_Energy efficient lighting systems	B14_Energy suppliers obligations
		A15M_Energy efficient electrical appliances	B15_Energy / carbon taxes
		A16M_Integrated action (all above)	B16_Grants and subsidies
		A17M_Information and Communication Tecnologies	B17_Third party financing. PPP
		A18M_Behavioural changes	B18_Public procurement
		A19M_Other	B19_Building standards
		Z100M_Purchase of green energy without production	B20_Existing buildings standard
		Z101M_Green/ecological/recycled goods	B21_New buildings standard
		Z102M_Energy audit/ Monitoring	B110_Land use planning regulation
			B111_Not applicable
	A1_Residential	A11R_Building envelope	B112_Other
		A12R_Renewable energy for space heating and hot water	Z113_Access to credit
		A13R_Energy efficiency in space heating and hot water	Z114_Public Investment
		A14R_Energy efficient lighting systems	Z115_Study and research
		A15R_Energy efficient electrical appliances	Z116_BAU
		A16R_Integrated action (all above)	Z117_Infrastructure and construction
		A17R_Information and Communication Tecnologies	
		A18R_Behavioural changes	
		A19R_Other	
		Z100R_Purchase of green energy without production	
		Z101R_Green/ecological/recycled goods	
		Z102R_Energy audit/ Monitoring	
	A1_Tertiary	A11T_Building envelope	
		A12T_Renewable energy for space heating and hot water	

		A13T_Energy efficiency in space heating and hot water	
		A14T_Energy efficient lighting systems	
		A15T_Energy efficient electrical appliances	
		A16T_Integrated action (all above)	
		A17T_Information and Communication Tecnologies	
		A18T_Behavioural changes	
		A19T_Other	
		Z100T_Purchase of green energy without production	
		Z101T_Green/ecological/recycled goods	
		Z102T_Energy audit/ Monitoring	
	A1_Not specified	A11_Building envelope	
		A12_Renewable energy for space heating and hot water	
		A13_Energy efficiency in space heating and hot water	
		A14_Energy efficient lighting systems	
		A15_Energy efficient electrical appliances	
		A16_Integrated action (all above)	
		A17_Information and Communication Tecnologies	
		A18_Behavioural changes	
		A19_Other	
		Z100_Purchase of green energy without production	
		Z101_Green/ecological/recycled goods	
		Z102_Energy audit/ Monitoring	

A2 Public lighting		A21_Energy efficiency	B21_Energy Management and organization
		A23_Integrated renewable power	B22_Energy suppliers obligations
		A24_Information and Communication Tecnologies	B23_Third party financing PPP
		A25_Other	B24_Public procurement
			B25_Not applicable
			B26_Other
			Z117_Public Investment

			Z118_Access to credit
			Z119_BAU
			Z120_Study and research

A3 Industry		A31_Energy efficiency in industrial processes	B31_Awareness raising / training
		A32_Energy efficiency in industrial buildings	B32_Energy Management and organization
		A33_Renewable energy	B33_Energy certification / labelling
		A34_Information and Communication Tecnologies	B34_Energy performance standards
		A35_Other	B35_Energy / carbon taxes
		Z36_Integrated action (all above)	B36_Grants and subsidies
		Z37_Behavioural changes	B37_Third party financing. PPP
			B38_Not applicable
			B39_Other
			Z122_Public Investment
			Z123_Access to credit
			Z124_BAU
			Z125_Study and research

A4 Transport	**Municipal, Public, Private and commercial transport**	A41_Cleaner/efficient vehicles	B41_Awareness raising/training
		A42_Electric vehicles (incl. infrastructure)	B42_Integrated ticketing and charging
		A43_Modal shift to public transport	B43_Grants and subsidies
		A44_Modal shift to walking & cycling	B44_Road pricing Congestion charge
		A45_Car sharing/pooling	B45_Land use planning regulation
		A46_Improvement of logistics and urban freight transport	B46_Transport / mobility planning regulation
		A47_Road network optimisation	B47_Public procurement
		A48_Mixed use development and sprawl containment	B48_Voluntary agreements with stakeholders
		A49_Information and Communication Tecnologies	B49_Not applicable
		A410_Eco-driving	B410_Other
		A411_Other	Z126_Access to credit

		Z412_Mobility management for private companies	Z127_Offer of services
		Z413_Mobility management for municipal employees	Z128_BAU
		Z414_Provision of alternative transport modes (e.g. car sharing, bike sharing) for travels of municipal employees	Z129_Infrastructure and construction
		Z415_Traffic lights optimization	Z130_Management and organization
		Z416_Reducing car use	Z131_Study and research
		Z417_Other lower CO_2 emissions fuels refuelling stations	Z132_Public Investment
			Z133_Park zoning and pricing

A5 Local electricity production		A51_Hydroelectric power	B51_Awareness raising / training
		A51M_Hydroelectric power_municipal	B52_Energy suppliers obligations
		A51P_PHydroelectric power_private	B53_Grants and subsidies
		A52_Wind power	B54_Third party financing. PPP
		A52M_Wind power_municipal	B55_Building standards
		A52P_Wind power_private	B56_Land use planning
		A53_Photovoltaics	B57_Not applicable
		A53M_Photovoltaics_municipal	B58_Other
		A53P_Photovoltaics_private	Z140_Access to credit
		A54_Biomass power plant	Z141_Study and research
		A54M_Biomass power plant_municipal	Z142_Infrastructure and construction
		A54P_Biomass power plant_private	Z143_Offer of services
		A55_Combined Heat and Power	Z144_BAU
		A55M_Combined Heat and Power_municipal	Z145_Tariff schemes
		A55P_Combined Heat and Power_private	Z146_Management and organization
		A56_Smart grids	
		A56M_Smart grids_municipal	
		A56P_Smart grids__private	
		A57_Other	

A6 Local heat/cold production		A61_Combined Heat and Power	B61_Awareness raising / training
		A62_District heating/cooling plant	B62_Energy suppliers obligations

		A63_District heating/cooling network	B63_Grants and subsidies
		A64_Other	B64_Third party financing. PPP
			B65_Building standards
			B66_Land use planning regulation
			B67_Not applicable
			B68_Other
			Z150_Study and research
			Z151_BAU
			Z152_Offer of services
			Z153_Access to credit
			Z154_Tariff schemes
			Z155_Management and organization
			Z156_Public Procurement
			Z157_Public Investment

Z8 Land use planning		Z81_Other	Z151_Awareness raising / training
		Z82_Urban regeneration	Z160_Energy suppliers obligations
		Z83_Urban/ Land use sustainable development oriented	Z161_Grants and subsidies
		Z84_Tree planting in urban areas	Z162_Third party financing. PPP
		Z85_Agriculture and forestry related	Z163_Building standards
		Z86_Climate change adaptation oriented	Z164_Land use planning regulation
		Z87_Integration of urban planning and energy planning	Z165_Not applicable
		Z88_CO_2 evaluation of major works	Z166_Other
			Z167_Study and research
			Z168_BAU
			Z169_Offer of services
			Z170_Access to credit
			Z171_Tariff schemes
			Z172_Management and organization
			Z173_Infrastructure and construction
			Z174_Public Procurement
			Z175_Public Investment

Z9 Waste & water		Z91_Waste prevention, recycling, and reuse	Z180_Awareness raising / training
		Z92_‘Waste to energy’ facilities	Z181_Energy suppliers obligations
		Z93_Methane combustion from landfill sites	Z182_Grants and subsidies
		Z94_Other	Z183_Third party financing. PPP
		Z95_Landfill sites	Z184_Building standards
		Z96_Water savings/ Behavioural changes	Z185_Land use planning regulation
		Z97_Efficiency of the systems	Z186_Not applicable
		Z98_ Recovery of heat	Z187_Other
			Z188_Study and research
			Z189_BAU
			Z190_Offer of services
			Z191_Access to credit
			Z192_Tariff schemes
			Z193_Management and organization
			Z194_Infrastructure and construction
			Z195_Public Procurement
			Z196_Public Investment

Z10_Working with citizens and stakeholders		Z200_Set up of local energy alliances/groups/forums involving several stakeholders (i.e. citizens, companies, associations…)	

A7 Other		A75_Other	B71_Awareness raising / training
			B72_Land use planning
			B73_Not applicable
			B74_Other
			Z201_Study and research
			Z202_BAU
			Z203_Energy suppliers obligations
			Z204_Grants and subsidies
			Z205_Third party financing. PPP
			Z206_Building standards
			Z207_Land use planning regulation

			Z208_Offer of services
			Z209_Access to credit
			Z210_Tariff schemes
			Z211_Management and organization
			Z212_Infrastructure and construction
			Z213_Public Procurement
			Z214_Public Investment