

# **European Cities Leading The Fight Against Climate Change: Achievements Of The Covenant Of Mayors Initiative**

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## **ABSTRACT**

Cities play a crucial role in mitigating the effects of climate change. Urban energy consumption generates about three quarters of global carbon emissions (IPCC 2014).

Improving energy-efficiency in buildings, increasing the renewable energy share, integrating district energy systems and a gradual transformation to more efficient transportation are the most common policies for Covenant of Mayors signatories in the path towards the transition to a clean energy future. The paper provides an assessment of progress made by 122 signatories of the Covenant of Mayors initiative as of September 2015 towards their climate mitigation and energy targets. Progress towards the GHG target is substantial and more pronounced than for the renewable energy and energy efficiency. These results underline the interconnected nature of climate and energy mitigation actions adopted at local level.

One result, confirming the consistency of the “CoM data set”, is that the climate and energy progress indicators are compatible with values from international datasets at the national level (EEA), despite the differences on CoM sectors coverage and different inventory years.

Lastly, the positive effects of these policies created greater reductions than the factors generally responsible for increased emissions such as the demographic growth of 8% on absolute value.

Our analysis, using a sample of Covenant of Mayors dataset, representing all city sizes in Europe, demonstrates that strong urban energy policies and increased coordination between national and local governments is of a vital importance in the potential of urban mitigation of global climate change.

## **Introduction**

The paper provides an assessment of the progress made by local authorities which signed up to the Covenant of Mayors initiative towards their climate mitigation target, based on the monitoring reports received as of September 2015.

By joining the CoM initiative, signatories commit to reducing greenhouse gases emissions in their territories by at least 20% by 2020: they commit themselves to submitting to the European Commission the following reports: Action plan (Sustainable Energy Action Plan SEAP) which has to be submitted within one year after the adhesion to the initiative; biyearly Monitoring reports: which allow to measure progress toward the targets set in the action plan (Bertoldi et al 2010).

Both action and monitoring reports are submitted via on-line templates available on the CoM web-site signatory's restricted area. All the indicators presented in this document are elaborated based on data reported by the signatories as of September 2015. The Joint Research Centre (JRC), in charge of the scientific support of the CoM initiative has started to publish a series of yearly assessment reports on the initiative (Kona et.al. 2013).

Most of the towns are located in Southern European countries where dedicated bodies, including Covenant Territorial Coordinators (CTCs), supported cities in the process of adhesion to the CoM. The CTCs are regional authorities which voluntarily join the movement committing to promote it within their respective territory and to offer technical and/or financial support to the signatories which choose to work under their coordination.

Based on three case studies, (Melica G. et al. 2014) indicate that the multilevel governance approach adopted within the CoM has been a key determinant to get the involvement of small towns in the movement.

The CoM movement has already been investigated for specific actions, such as achieving energy savings by retrofitting residential buildings (Dall’O’, et al. 2013) increasing the energy efficiency of public lighting (Radulovic D. et al. 2011) and increasing the acceptance of renewable energy within rural communities (Doukas, et al. 2012). An in depth analysis of selected SEAPs has also been carried out (Rivas et al. 2015).

### General Statistics On Covenant Of Mayors Monitoring Phase

As of September 2015, 5951 local authorities signed the Covenant of Mayors (CoM), for a total of ca. 172 million inhabitants in the EU-28, and ca. 208 million inhabitants in the whole initiative. 4542 local authorities have submitted a Sustainable Energy Action Plan, representing ca. 166 million of inhabitants (80% of the total signatories population).

As of September 2015, 122 signatories have submitted a full monitoring report named as "CoM sample" in the paper, representing 3% of the signatories with an action plan (SEAP), for a total ca. 11 million inhabitants (7% in terms of population). Figure 1 compares the number of full monitoring reports with the number of submitted SEAPs.

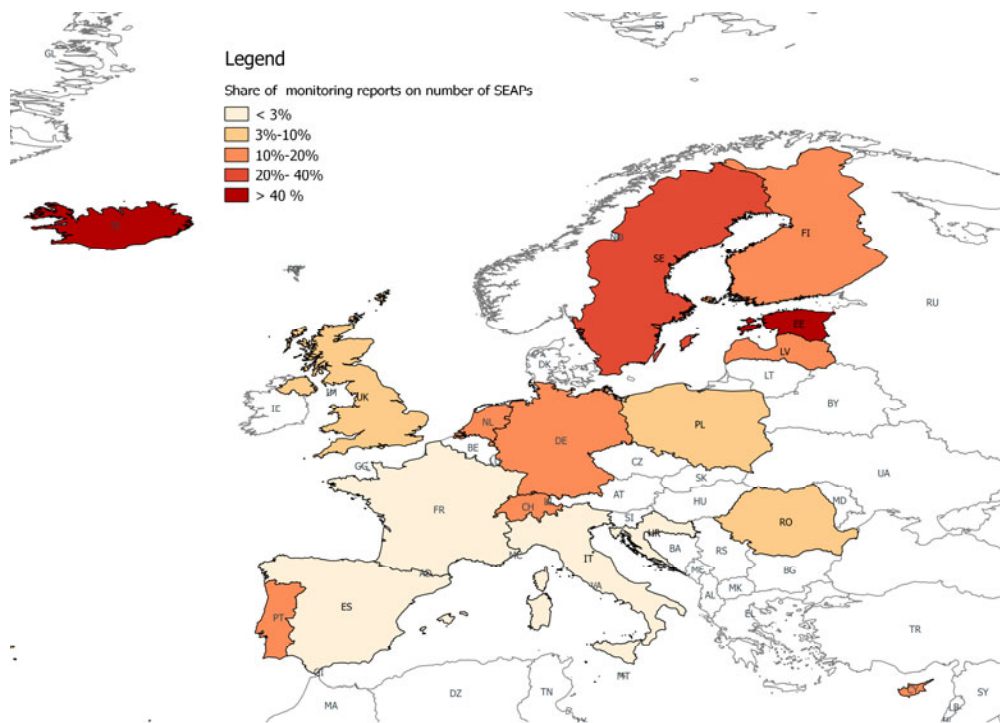


Figure 1. Covenant of Mayors: share of monitoring reports on number of SEAPs submitted  
Source: JRC 2016.

It can be seen that countries like Italy, France and Spain have a share of 3% of monitoring reports on number of SEAPs submitted, while Romania, Portugal and United Kingdom have a share of 10%. There are two signatories from Estonia with a SEAP submitted, and one monitoring report, therefore the share of monitoring is 50%. The only signatory from Iceland (Reykjavik) has submitted both the SEAP and the corresponding monitoring report.

## **Policy assessment in the Covenant Of Mayors Monitoring Phase**

The Covenant of Mayors concerns action at local level within the competence of the local authority. This chapter provides an overall picture of policies and measures that have been adopted by the local authority in order to reach the SEAP objectives. It concentrates on "policy" actions that will generally deliver CO<sub>2</sub>/energy saving over the longer term, e.g. via subsidies, regulations, information campaigns.

A SEAP's successful implementation requires the sufficient financial resources. It is therefore necessary to identify available financial resources, as well as the schemes and mechanisms for getting hold of these resources in order to finance the SEAP actions. The local authorities complement the financial support mechanisms existing at national or regional level, with extra financial incentives though and grants and subsidies for energy efficiency or renewable energy sources. The financial incentive mostly covers (part of) the difference between the cost of "standard construction work" and a construction/renovation that is considered as energy efficient. From the policy perspective, in figure 2, an overall picture of major policies per area of intervention used by local authorities to reach the 2020 energy and climate targets is shown. Hereafter a detailed analysis on policies is reported:

Energy management: The SEAPs can yield considerable energy savings, especially if they are implemented by energy management systems that allow the public bodies concerned to better manage their energy consumption. In the monitoring phase the energy management is the major policy instrument, contributing with 37% of the estimated GHG emission reduction in the municipal sector, with 24 % in the tertiary sector and with 75% in the public lighting.

Building standards and energy certification labelling: Covenant signatories use building code to impose more stringent energy performance requirements than those applicable at national level. In the monitoring phase the building code and energy certification labelling are the major policies instruments used by local authorities in the building sector (municipal, residential and tertiary buildings), ranging from 12- 20% of the estimated GHG emission reductions.

Public procurement: According to monitoring reports public procurement is an important policy instrument used by local authorities to reach the 2020 energy and climate targets. This policy instrument is estimated to contribute with 25% to the GHG emission reductions in the Municipal Building and Facilities and with 13% in the public lighting sector.

Grants and subsidies: In the monitoring phase the financial incentives, such as grant and subsidies, are an important policy instrument used by local authorities to promote energy efficiency and deployment of renewables in the residential buildings, i.e. 22% of GHG emission reduction contribution to the overall policies in the sector. While, in the local electricity and heat production sector, the grants and subsidies financial mechanism are used to support specific techniques or pilot projects that the local authority would consider of particular relevance for deployment of RES, considering its own context and objectives. The contribution of grants and subsidies in reducing the GHG ranges from 43% in the local electricity production to 23% in the local heat and cold production to the overall policies contributions in the respective sectors. A

detailed evaluation of policies in these sectors is reported in the under Progress on Energy Efficiency: electricity production and heating and cooling production.

Third party financing: This financial scheme perhaps the easiest way for municipalities to undertake comprehensive energy retrofits is to allow someone else to provide the capital and to take the financial risk. With these alternative methods of financing, high financing costs may be expected to reflect the fact that the debt is registered on someone else's balance-sheet. However, the interest rate is only one factor among many that should be considered in determining the suitability of a project-financing vehicle.

Energy Supplier Obligations: Among the many policy instruments introduced in the European Union to support energy efficiency, many EU member states, have introduced obligations on some categories of energy market operators (in particular electricity and gas distributors or suppliers) to deliver a certain amount of energy savings (Bertoldi et al. 2010). Energy Supplier obligations foster the uptake of standardized energy efficiency actions often targeting smaller energy users (residential sector), and in the CoM sector of local heat production this policy contributes with 17% to the GHG emission reductions and by 10% in the local electricity production sector.

Mobility planning and regulations: For the transport sector to be fully effective, a gradual transformation of the entire system is required towards greater integration between modes, innovation and deployment of alternative fuels, and improved management of traffic flows through intelligent transport systems. In the monitoring phase a pool of policies are used by local authorities, ranging from mobility planning and regulation, road pricing, awareness raising.

Awareness raising and training: During the implementation phase, it is essential to ensure both good internal communication (between different departments of the local authority, the associated public authorities and all the persons involved including global building managers, etc) as well as external communication (citizens and stakeholders). This contributes to awareness-raising, increasing the knowledge about the issues, inducing changes in behaviour, and ensuring wide support for the whole process of SEAP implementation. In CoM this instrument is widely deployed ranging from the building sector (contributing 43% to the total emission reduction in the tertiary sector), to industry (contributing 58% to the total emission reduction in the sector), and transportation (contributing 20% to the total emission reduction in the sector). Typical actions related to awareness-raising are: development of the activities of communication and awareness to the population and stakeholders with reference to energy efficiency and initiatives and tools to facilitate the participation of citizens and stakeholders in the SEAP process and the energy and climate change policies of the local authority etc.

Other policies: In the field "Other" are grouped all policies that were not specified but a description of area of intervention were reported, such as cleaner efficient vehicles, modal shift to public transport, modal shift to cycling and bicycling, car sharing/pooling, electric vehicles and other not specified. A detailed description for policies area reported in the Progress on Energy Efficiency.

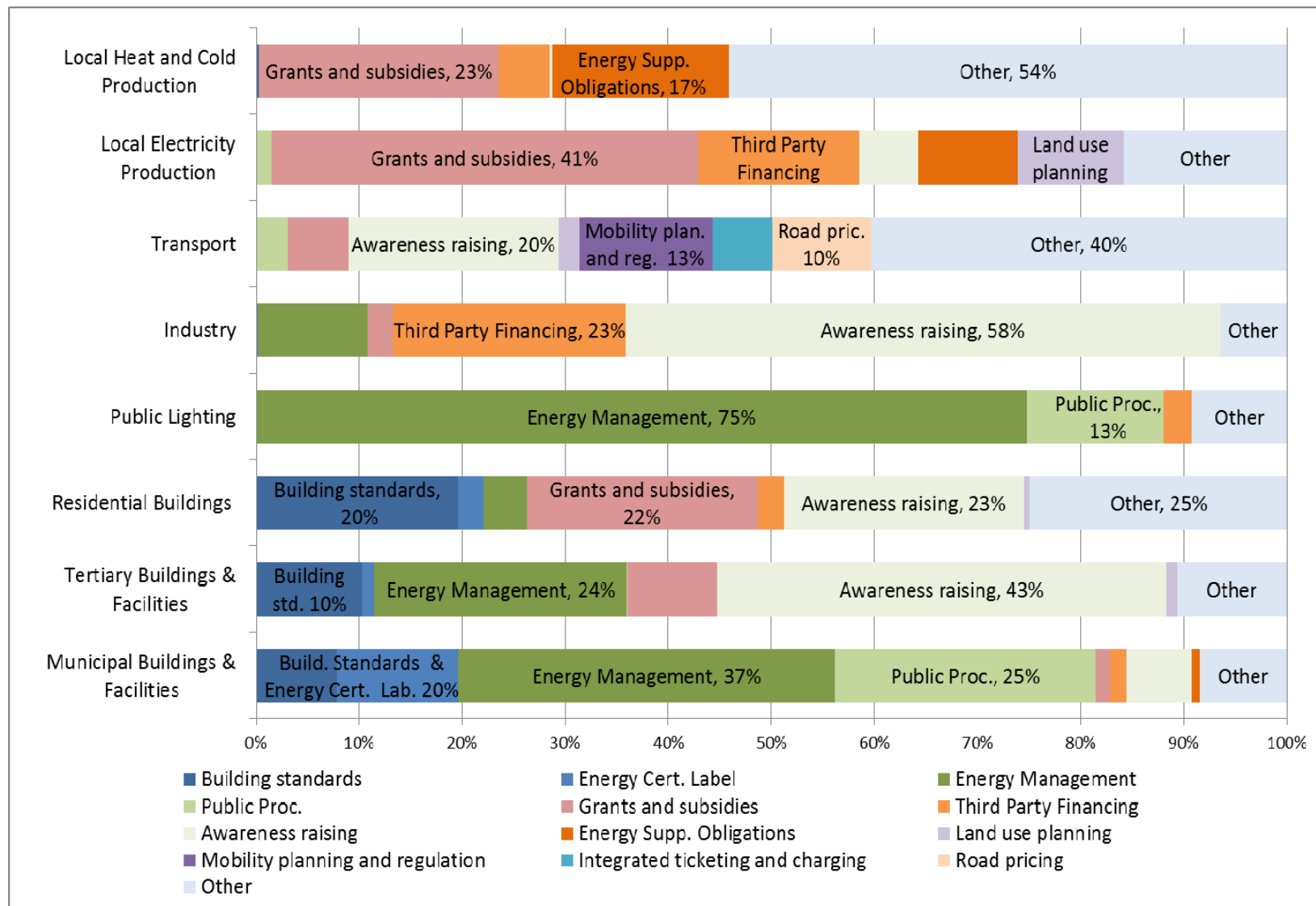


Figure 2. Shares of policies contributions in terms of estimated GHG emission reductions per sectors in the Covenant of Mayors progress reports as of September 2015. Source: JRC 2016.

## Progress Towards GHG Emission Targets

In order to achieve the Europe 2020 Climate and Energy target of 20% reduction in greenhouse gas emissions (compared to 1990) by 2020, the main instruments under the Climate and Energy Package are

1.) the EU Emissions Trading System (EU ETS<sup>1</sup>) which regulates GHG emissions from power generation and other installations with a net heat excess of 20 MW. The system works by putting a limit on overall emissions from high-emitting industry sectors. Within this limit, companies can buy and sell emission allowances as needed. This 'cap-and-trade' approach gives companies the flexibility they need to cut their emissions in the most cost-effective way. The EU ETS covers more than 11,000 power stations and manufacturing plants in the 28 EU member states as well as Iceland, Liechtenstein and Norway. Aviation operators flying within and between most of these countries are also covered. In total, around 45% of total EU emissions are limited by the EU ETS.

2.) the Effort Sharing Decision (ESD<sup>2</sup>) for sectors not included under the EU ETS system. The non-ETS sectors broadly include direct emissions from households and services, as well as emissions from transport, waste and agriculture.

Based on the report 'Trends and Projections in Europe 2015: Tracking progress towards Europe's climate and energy target' (EEA 2015) the EU is on course to meet the 2020 targets for GHG emissions. In 2014, the estimates reported by Member states indicate that GHG emissions reductions reached 23% below 1990 levels.

Local Authorities in the CoM initiative are putting in place a bottom-up approach to contribute to the 2020 targets for GHG emissions (Raveschoot et al. 2010). The focus of the Covenant of Mayors inventories are the main non-ETS sectors under the direct influence of the local authority (such as households, transport, services). In addition to the non-ETS sectors, the CoM inventories also account for indirect emissions associated with consumption of electricity and heat/cold (as final product delivered to the final consumer). As a consequence, a certain share of emissions arising from power generation by plants included in the EU ETS scheme are computed in the inventories and addressed via the SEAPs (Iancu et al. 2013). Although the minimum commitment was to reduce the current emissions by 20% by 2020, CoM signatories who have already submitted the progress report (122 signatories), including a monitoring emission inventory already reached an overall reduction of 23% (Table 1) compared to the Baseline Emission Inventory.

Table 1. Evolution of GHG emissions from Baseline to Monitoring Emission Inventories

	Baseline Emission Inventory	Monitoring Emission Inventory
GHG emissions inventories [tCO <sub>2</sub> -eq/y]	63,331,717	48,980,985
Absolute reduction of GHG emissions from Baseline to Monitoring Emission Inventories	23%	

<sup>1</sup> Emission trading scheme: [http://ec.europa.eu/clima/policies/ets/index\\_en.htm](http://ec.europa.eu/clima/policies/ets/index_en.htm)

<sup>2</sup> Effort Sharing Decision : [http://ec.europa.eu/clima/policies/effort/index\\_en.htm](http://ec.europa.eu/clima/policies/effort/index_en.htm)

The 23% decrease in GHG Emissions between baseline and monitoring years was driven by:

- GHG emission due to electricity consumption decreased by 10% from baseline to monitoring years.
- GHG emission in buildings for heating and cooling decreased by 46% from baseline to monitoring years.
- GHG emission in in transport sector decreased by 9% from baseline to monitoring years.

The drop of GHG emissions between Baseline and Monitoring Emission Inventories resulted from the combination of several factors as energy efficiency improvement, increase of renewables, demographic growth, variation on weather conditions, economic growth etc. The relative effects of energy efficiency improvement and the progress on renewables are treated separately in the following chapters, while demographic growth is taken into account in the calculation of the per capita indicators.

## Progress On Energy Efficiency

The Energy Efficiency Directive (Energy Efficiency Directive 2012/27/EU , 2012) specifically acknowledges the Covenant of Mayors initiative and the role of local governments in achieving significant energy savings, and calls for Member States to encourage municipalities and other public bodies to adopt integrated and sustainable energy efficiency plans (preamble 18). Covenant of Mayors signatories have been reducing their final energy consumption since 1990. Compared to the baseline inventories, final energy consumption has dropped by 14% on absolute value (Table 2). The 14% decrease in final energy consumptions between baseline and monitoring years was driven by:

- final energy consumption in buildings for heating and cooling decreased by 26% from baseline to monitoring years.
- energy consumption in transport sector decreased by 9% from baseline to monitoring years.
- electricity consumption increased by 6% from baseline to monitoring years.

Table 2. Evolution of final energy consumptions from Baseline to Monitoring Emission Inventories

	Baseline Emission Inventory	Monitoring Emission Inventory
final energy consumptions in Inventories [MWh/y]	233,974,612	201,897,758
absolute reduction of final energy consumption from Baseline to Monitoring Inventories	14%	

## Electricity

The Energy Efficiency Directive asks Member States to take adequate measures for efficient district heating and cooling infrastructure to be developed and/or to *accommodate the development of high-efficiency cogeneration ...* (article 14). CoM signatories, in close collaboration with local utilities for sustainable energy systems in their territories, have been able to implement measures related to development of high-efficiency cogeneration power plans.

In comparison to baseline emission inventories the electricity consumption in the monitoring inventories increased by 6%. While local electricity production increased by 45%, from a share of 4% on final energy consumption in Baseline Inventories to 6% in Monitoring Inventories.

Form the policy perspective, in Table 3, an overall picture of major policies per area of intervention used by local authorities to reach the 2020 energy and climate targets in the local electricity production sector is shown. Grants and subsidies play a crucial rule by contributing with 41% to the overall estimated GHG emission reductions, followed by Third party financing (16%), Land use planning and energy suppliers obligations (10% each). Under “other” are grouped other policy instruments, not specified, where a general description of the area of intervention is reported. The later can be interpreted as action per areas of interventions, like photovoltaics, CHP, hydro plant and wind power where the local authorities have not implemented additional local policies to the national ones.

Table 3. Shares of policies’ contribution to GHG emission reduction in local electricity production reported by CoM signatories *Source: JRC 2016.*

Policies	Area of intervention	Contribution to the GHG emission reduction in the sector
Awareness raising		6%
Third Party Financing		16%
Energy Suppliers obligations		10%
Grants and subsidies		41%
Land use planning		10%
Other	Combined Heat and Power	6%
	Photovoltaics	8%
	Hydroelectric power	1%
	Wind power	2%
	Others	1%

## Heating and Cooling

### Heating and cooling consumption

Heating and cooling consumption has dropped in Covenant of Mayors signatories. Compared to the baseline inventories, heating and cooling consumption has dropped by 26% on



absolute value<sup>3</sup>. Also, its share on final energy consumption has dropped from 48% in Baseline Inventories to 42% in Monitoring Inventories. The 26% decrease in heating and cooling consumption between baseline and monitoring years was mainly driven by energy efficiency measures in the building sector for the four fuel/carriers (Figure 3):

- heating and cooling consumption using natural gas in buildings decreased by 24% from baseline to monitoring years;
- heating and cooling consumption using other fossil fuels (different from natural gas) in buildings decreased by 66% from baseline to monitoring years.
- Heating consumption from district heating networks increased by 8% from baseline to monitoring years;
- Heating consumption using renewable sources (solar, geothermal, biomass) increased by 108% from baseline to monitoring years.

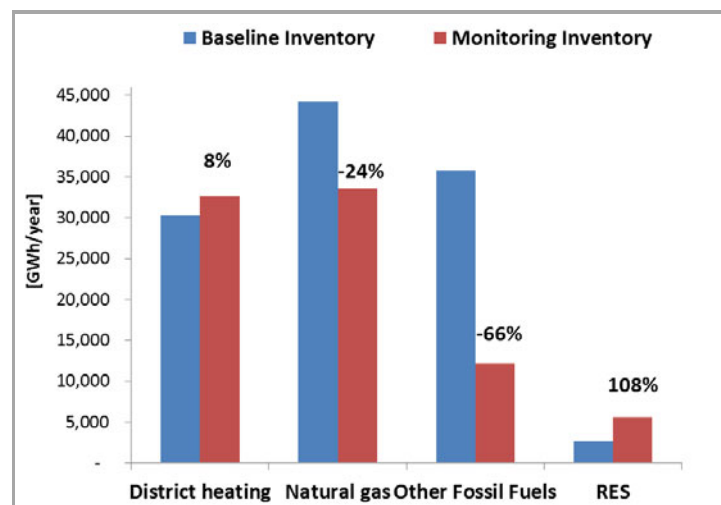


Figure 3. Heating and cooling consumption in building sector per type of fuel/carrier in Baseline and Monitoring Emission Inventories *Source: JRC 2016.*

## Heating and cooling production

In this area of intervention, local authorities can play an important role, given the possibility to establish collaboration with utilities. In comparison to Baseline Emission Inventories the local heat production from district heating, solar thermal, geothermal and biomass in CoM signatories increased by 16% on absolute value, from a share of 29% on heating and cooling consumption in Baseline Inventories to 46% in Monitoring Inventories. The 16% increase in local heating production between baseline and monitoring years was mainly driven by:

- Local district heating production increase of 8% from baseline to monitoring years;
- Local decentralized heat production from solar, geothermal and biomass almost doubled from baseline to monitoring years

<sup>3</sup> This value is not weather normalised.

In conclusion Covenant signatories, in close collaboration with local utilities for sustainable energy systems in their territories, have been able to implement measures related to efficient district heating and cooling infrastructures. The 26% decrease of heating and cooling consumption between baseline and monitoring years was mainly produced by (Figure 4)

- lower energy consumption levels and less carbon intensive fuel mix in the building sector, from a share of 48% on final energy consumption in Baseline Inventories to 42% in Monitoring Inventories;
- increase of local district heat production from a share of 13% on final energy consumption in Baseline Inventories to 16% in Monitoring Inventories;
- increase of decentralised heat production from Solar, geothermal from a share of 1% on final energy consumption in Baseline Inventories to 3% in Monitoring Inventories;

While from the policy perspective, in table 4, an overall picture of major policies per area of intervention used by local authorities to reach the 2020 energy and climate targets in the local heat and cold production sector is shown.

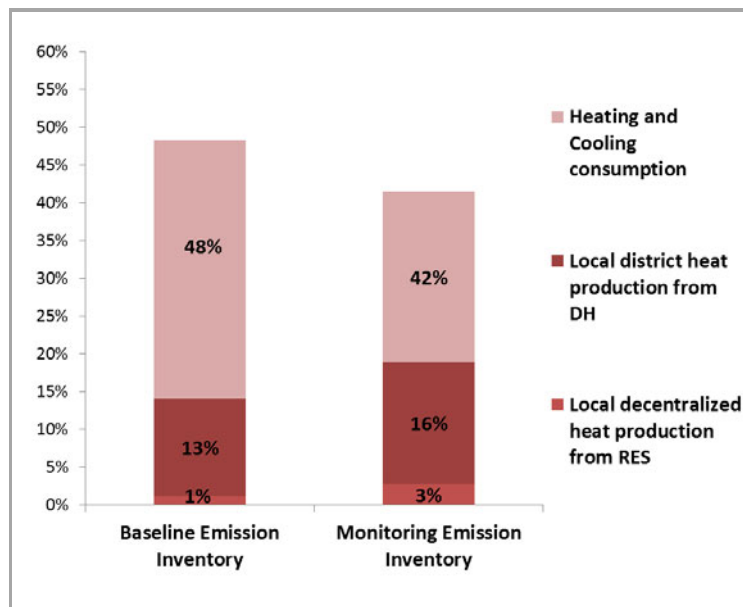


Figure 4. Shares of Heating and Cooling consumption and production on final energy consumptions in Baseline and Monitoring Emission Inventories *Source: JRC 2016.*

Grant and subsidies play a crucial role by contributing 23% to the overall estimated GHG emission reductions, followed by energy suppliers' obligations (17%) and third party financing (5%). Under "other" are grouped other policy instruments, not specified, where a general description of the area of intervention is reported. The later can be interpreted as action per areas of interventions, like district heating network expansions (contributing by 33% to the overall estimated GHG emission reductions), Combined heat and power plants (contributing by 17% to the overall estimated GHG emission reductions), where the local authorities have not implemented additional local policies.

Table 4. Shares of policies' contribution to GHG emission reduction in Local heat and cold production reported by CoM signatories *Source: JRC 2016.*

Policies	Area of intervention	Contribution to the GHG emission reduction in the sector
Third Party Financing	Third Party Financing	5%
Energy Suppliers obligations	Energy Suppliers obligations	17%
Grants and subsidies	Grants and subsidies	23%
Other	Combined Heat and Power	17%
	District heating network	33%
	District heating plant	3%
	Others (energy management, Land use planning, etc)	2%

## Transport

For the transport sector to be fully effective, a gradual transformation of the entire system is required towards greater integration between modes, innovation and deployment of alternative fuels, and improved management of traffic flows through intelligent transport systems.

The energy consumption in the transport sector has dropped in Covenant of Mayors signatories. Compared to the baseline inventories, final energy consumption for transportation has dropped by 9% on absolute value. This was mainly driven by:

- Lower energy consumption from non-renewable sources (12% of reduction on absolute value)
- Increase of electricity consumption (49% in comparison to baseline electricity consumptions)
- Increase of renewable sources (around 13 times in comparison to baseline RES consumptions).

Major policy instruments used by local authorities (figure 5) are awareness raising campaigns that provide personally tailored information about public transport, walking and cycling alternatives have been successful in reducing car use and increasing levels of public transport use, contributing 18% to the overall emission reductions in the transportation sector

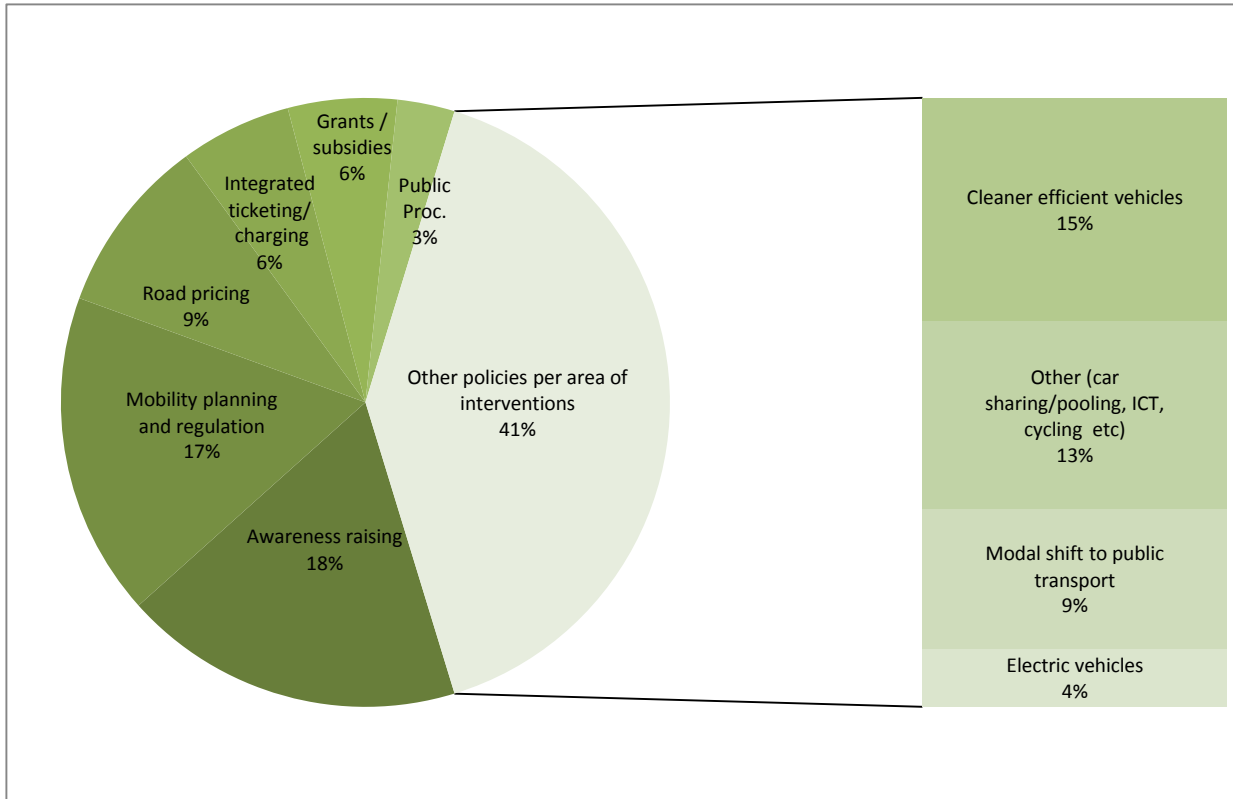


Figure 5. Shares of policies' contribution to GHG emission reduction in transportation reported by CoM signatories  
Source: JRC 2016.

Mobility planning and regulation is a direct area of intervention for local authorities, contributing with 17% to the overall emission reductions in the transportation sector. They directly influence through local mobility planning practices such as limited traffic zones, low emissions zones, designated parking spaces for low emission vehicles, free parking for cleaner efficient vehicles; access to city zones with restrictions for high GHG emitting cars, i.e. cultural city centers, environmental zones; no congestion charges to clean vehicles, etc.

Financial incentives: The local authorities complement the financial support mechanisms existing at national or regional level, with extra financial incentives through road pricing (contributing with 9% to the overall emission reduction in the sector), Integrated ticketing/charging (contributing with 6% to the overall emission reduction in the sector), grants and subsidies (contributing with 6% to the overall emission reduction in the sector) and through public procurement (contributing with 3% to the overall emission reduction in the sector).

Other policies: other policies of which the CoM signatories did not give any specification, are grouped and classified by area of intervention, contributing with 41% to the overall emission reduction in the transportation sector. Among these, the cleaner efficient vehicles are an important area of intervention, contributing by 15% to the overall emission reductions in the transportation sector, followed by modal shift to public transport (9%), electric vehicles (4%) and others comprehending promotion of car sharing/pooling, modal shift to cycling, etc.

## Progress On Renewable Energy

In CoM signatories renewable energy's share of final energy consumption increased from 3% in Baseline Emission Inventories to 14% in Monitoring Emission Inventories (Figure 6).

Based on the report 'Trends and Projections in Europe 2015: Tracking progress towards Europe's climate and energy target' (EEA, 2015) the share of renewable energy in the EU's gross final energy consumption in 2013 is 13%.

The steady increase of the share of renewables in the Covenant of Mayors signatories reflects the following combining trends:

- Decrease of final energy consumption by 14% on absolute value in monitoring years in comparison to baseline years;
- Electricity consumption from renewable sources increased from a share of 1% on final energy consumptions in Baseline Emission Inventories to 2% in Monitoring Emission Inventories;
- Heating and cooling using renewable sources increased from a share of 2% on final energy consumptions in Baseline Emission Inventories to 11% in Monitoring Emission Inventories;
- Renewable energy (electricity and biofuels) in transport sector increased from a share of 0.03% on final energy consumptions in Baseline Emission Inventories to 1% in Monitoring Emission Inventories.

## Conclusion

The paper provides an assessment of progress made by local authorities, signatories of Covenant of Mayors initiative as of September 2015 towards their climate mitigation and energy targets. As of September 2015, almost six thousand local authorities have signed the CoM, for a total of ca. 208 million inhabitants in the whole initiative. More than 4500 local authorities have submitted an action plan (Sustainable Energy Action Plan) for a total of ca. 166 million. Out of these, 122 signatories, representing 3% of the signatories with an action plan, have submitted a monitoring report including a monitoring emission inventory for a total ca. 11 million inhabitants

Monitoring inventories enable to track the evolution of GHG emissions in local authorities' territories as well as changes in energy consumption patterns, and to compare estimated impacts of the actions against actual results. Main statistical indicators based on data provided by Covenant of Mayors signatories in the monitoring reports submitted as of September 2015 are reported in the following:

*GHG emissions:* although the minimum commitment was to reduce the current emissions by 20% by 2020, CoM signatories who have already submitted the progress report including a monitoring inventory reached an overall reduction of 23% between Baseline and Monitoring Emission Inventories. Progress towards the GHG target is substantial and more pronounced than for the renewable energy and energy efficiency driven by lower energy consumption levels and less carbon intensive fuel mix in the building sector; a more efficient and less carbon intensive of local energy production and transportation.

*Energy efficiency:* The Covenant of Mayors signatories have been reducing their final energy consumption. Compared to the baseline inventories, final energy consumption has dropped by 14% on absolute value.

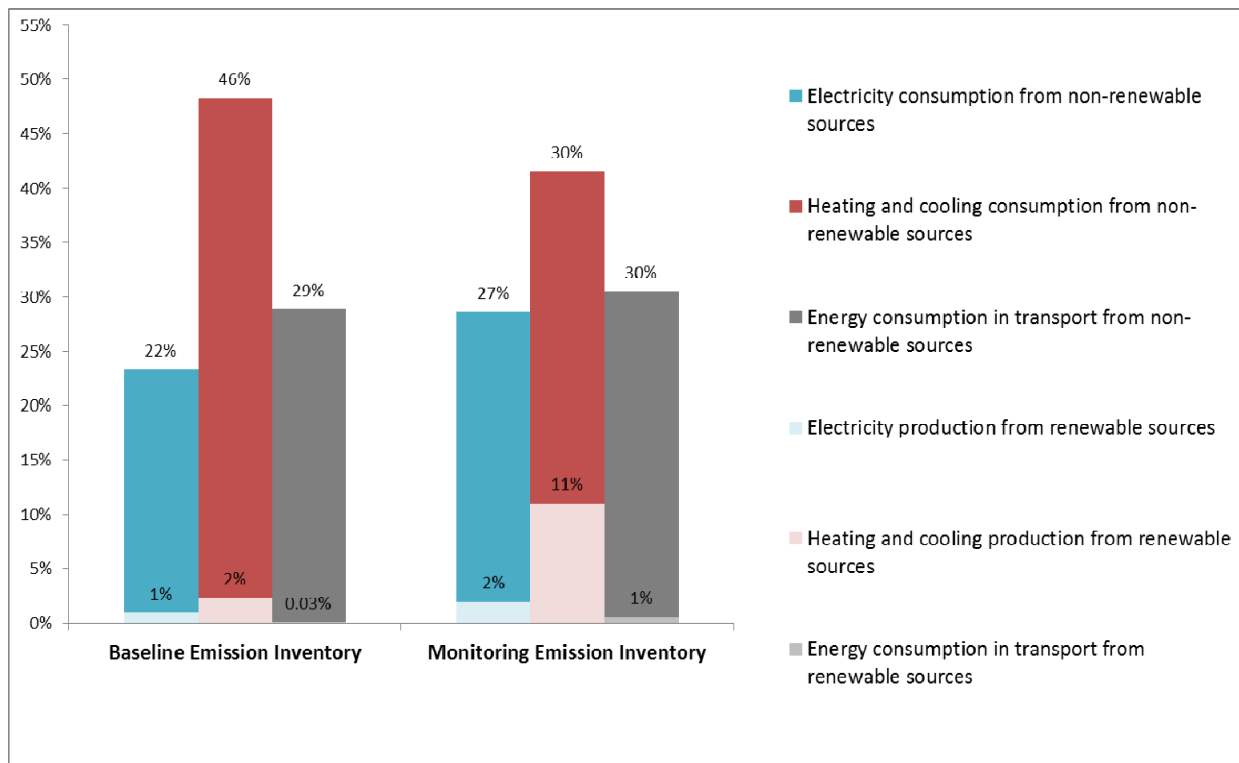


Figure 6. . Shares on final energy consumption of renewable and non-renewable energy sources per sector in Baseline and Monitoring Emission Inventories Source: JRC 2016.

The decrease in final energy consumption between baseline and monitoring years was driven by energy efficiency improvement in buildings for heating and cooling (26% of decrease). Furthermore a more efficient transportation can also be highlighted: energy consumption in transport sector decreased by 9% from baseline to monitoring years.

*Renewable energy:* the final energy consumption using renewable sources has increased by around 2.5 times from baseline to monitoring inventories, while the share of renewables on final energy consumption increased from 3% to 14%. The steady increase of the share of renewables in the Covenant of Mayors signatories reflects the following combining trends of increase of electricity production from renewables, of increase of renewable sources in district heating and cooling (around five times); a doubling of local decentralized heat production from renewables (solar, geothermal, biomass); the increase of biomass in transport sector and lower final energy consumptions (by 14% in monitoring years in comparison to inventory years).

One result, confirming the consistency of the “CoM sample” is that the climate and energy progress indicators are compatible with values from international datasets at national level (EEA), despite the differences on CoM sectors coverage and different inventory years (Kona et al. 2015).

These results underline the interconnected nature of climate and energy mitigation actions adopted at local level. The CoM signatories adopted a range of policies and measures in improving energy efficiency through building regulations, increasing of renewable energy share, and a gradual transformation to more efficient transportation. The positive effects of these policies outweighed factors generally responsible for emissions such as the demographic growth of 8% on absolute value between baseline and monitoring years.

Our analysis, using a sample of Covenant of Mayors dataset, representing all city sizes in Europe, demonstrates that strong urban energy policies and increased coordination between national and local governments is of a vital importance in the potential of urban mitigation of global climate change.

## References

- Bertoldi, P. et al., 2010. Energy supplier obligations and white certificate schemes: Comparative analysis of experiences in the European Union. *Energy Policy*, 38(3), pp.1455–1469. Available at: <http://dx.doi.org/10.1016/j.enpol.2009.11.027>.
- Bertoldi P., Bornás Cayuela D., Monni S., Raveschoot Piers R. de., JRC Science and Policy Report . Guidebook: How to develop a sustainable energy action plan (SEAP). <http://iet.jrc.ec.europa.eu/energyefficiency/publication/guidebook-how-develop-sustainable-energy-action-plan>, 2010.
- Dall’O’ G., Norese M.F., Galante A., Novello C. “A Multi-Criteria Methodology to Support Public Administration Decision Making Concerning Sustainable Energy Action Plans.” (*Energies*) 6:4308-4330 (2013).
- Doukas H., Papadopoulou A., Savvakis N., Tsoutsos T., Psarras J. “Assessing energy sustainability of rural communities using Principal Component Analysis.” (*Renewable and Sustainable Energy Reviews*) 16, no. 4 (2012): 1949–1957.
- EEA 2015: Trends and Projections in Europe 2015: Tracking progress towards Europe's climate and energy target
- Iancu A., Cerutti A., Janssens Maenhout G., Gabrielaitiene I., Paina F., Melica G., Zancanella P., Bertoldi P., How to develop a sustainable energy action plan (SEAP) in the eastern partnership and central asian cities - Guidebook: PART II - Baseline emission inventories. Scientific and Technical Reports, EUR 25804 EN, Publications Office of the European Union, 2013.
- IPCC 2014 . Climate Change 2014: mitigation of Climate change: Contribution of Working group III to the Fifth Assessment Report of the Intergovernmental Panel on climate change.
- Kona A., Melica G., Rivas Calvete S., Zancanella P., Iancu A., Gabrielaitiene I., Saheb Y., Janssens-Manhout G., Bertoldi P. Covenant of Mayors in Figures and Performance Indicators – 6-year Assessment. JRC Science and Policy Report. EUR 27110 EN, Publications Office of the European Union, 2014.
- Kona A, Melica G, Bertoldi P, Zancanella P, Rivas Calvete S, Iancu A, Janssens-Maenhout G. The Covenant of Mayors Initiative: transition to an energy efficient low carbon future. eceee 2015 Summer Study - First fuel now; ECEEE (Organiser). ECEEE; 2015. JRC95863
- Melica G., Bertoldi P., Kona A., Rivas Calvete S., Zancanella P., Janssens-Maenhout G., Cerutti AK., Iancu A., Ganisheva K. “The Covenant of Mayor Initiative: An Assessment and Evaluation.” ACEEE Summer Study on Energy Efficiency in Buildings. ACEEE, 2014.
- Melica G., Zancanella P., Kona A., Rivas Calvete S., Gabrielaitiene I., Iancu A., Bertoldi P. “The role of regions and provinces to support the participation of small local authorities in the Covenant of Mayors.” 13th IAEE European Conference. Rome, Italy, 2014.

- Raveschoot R. Piers de, Bornás Cayuela D., Bertoldi P., Monni S. “Review of Methodologies for the Development of Sustainable Energy Action Plans in the Frame of the Covenant of Mayors.” ACEEE Summer study on Energy Efficiency of Buildings. ACEEE, 2010.
- Rivas S., Melica G., Kona A., Zancanella P., Serrenho T., Iancu A., Koffi B., Gabrielaitiene I., Janssens-Maenhout G., Bertoldi P. The Covenant of Mayors: In-depth Analysis of Sustainable Energy Action Plans . EUR 27526. Luxembourg (Luxembourg): Publications Office of the European Union; 2015. JRC95656