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Energy use and savings of cities and local governments committed to climate change mitigation and adaptation

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Abstract

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

This report complements the Covenant of Mayors 2021 Assessment report (Melica et al., 2022), describing the CoM energy activity and estimated savings, based on data declared through the MyCovenant reporting platform. It examines energy consumption and production and gives an overview on the progress made on energy savings.

Overall, fossil fuels have the greatest weight in total consumption, followed by electricity, district heating and cooling and lastly, with the minimum share, renewable fuels, suggesting that the transition to a greener energy system still requires more time and additional efforts to achieve EU targets. Meanwhile, the sector with the highest share in the reported consumption is residential buildings, followed by private and commercial transport.

Regarding local electricity production, the highest share for EU-27 signatories corresponds to photovoltaics, followed by hydroelectric power. On the contrary, for non-EU signatories, the highest shares of local electricity production are associated with combined heat and power (CHP) and hydroelectric power. Considering local heat/cold production, the highest shares for EU-27 signatories correspond to CHP and district heating (heat only), using almost entirely non-renewable energy sources and covering approximately the entire BEI heat/cold consumption. Meanwhile for non-EU signatories, the highest share corresponds to district heating (heat only), using almost entirely non-renewable energy sources.

Examining the renewable energy production, EU-27 signatories estimate 0.66 and 0.98 MWh/year per capita, respectively for 2020 and 2030 commitments. Lower estimates are declared by non-EU signatories, with 0.21 and 0.31 MWh/year per capita, respectively for 2020 and 2030 commitments.

The key findings show that the energy savings accomplished by EU-27 signatories amount to 182 TWh/year for 2020 and 39 TWh/year for 2030 commitments, which correspond to 2.02 and 2.11 MWh/year per capita, respectively. On the other hand, the energy savings accomplished by signatories in the rest of Europe (non-EU) amount to 20.6 TWh/year for 2020 and 0.82 TWh/year for 2030 commitments, which corresponds to 2.46 and 0.49 MWh/year per capita, respectively. In particular, among Covenant signatories having monitored their advances, the highest savings yearly rates correspond to the EU-27 cities of Dortmund, Munich and Budapest, saving 1.45, 1.26 and 0.85 TWh/year, respectively.

Acknowledgements

We would like to thank the European Commission's Directorate-General for Energy (DG ENER) and Directorate-General for Climate Action (DG CLIMA) for their leadership and strategic guidance in the context of the Covenant of Mayors initiative.

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

Finally, special thanks go to JRC colleagues Alejandro Ortega and Giulia Ulpiani for their helpful comments on an initial draft of this report, to Marta Giulia Baldi and Massimo Clemente for their support in the preparation of the dataset and to Georgia Tosiou for proofreading the report.

1 Introduction

In the fight for climate change mitigation, adaptation and resilience, the European Green Deal Communication[1] and the 2030 Climate Target Plan[2] announced the intention of the European Union (EU) to set more ambitious GHG emission reduction targets. The EU Climate Regulation[3] adopted in June 2021 set the legal objective for the EU to reach net-zero GHG emissions by 2050 and negative emissions thereafter, and an interim 55% emission reduction by 2030 compared to 1990 levels. The EU Climate Regulation also requires Member States to establish multilevel climate and energy dialogues involving local authorities as well as other stakeholders to engage and discuss on the achievement of the EU climate neutrality objective. Additionally, acknowledging that the impacts of climate change are already occurring today, the new EU strategy on adaptation to climate change[4] aims to make adaptation smarter, swifter and more systemic. In this regard, it intends to support the further development and implementation of adaptation strategies and plans at all levels of governance and aims to spread adaptation awareness to every single local authority, company and household[5].

It is also relevant to address the level of awareness and concern about climate change among citizens: according to the latest Eurobarometer survey by the European Commission (EC), 93% of European citizens consider climate change as a serious problem. 87% of the respondents think the EU should set ambitious targets to increase renewable energy and support energy efficiency. Six in ten respondents agree that adapting to the adverse impacts of climate change can have positive outcomes for citizens in the EU.

Therefore, cities and local authorities are becoming increasingly aware of the key role they can play to combat climate change, being the level of governance closest to citizens and having the possibility to influence and take action on several sectors. The EU Covenant of Mayors (CoM) and the Global Covenant of Mayors (GCoM) have been instrumental in spreading awareness on climate change among local governments and in providing methodologies and approaches to develop local climate and energy plans. For more than a decade now, cities and local authorities have been setting GHG emission reduction targets and adopted plans to tackle the key emitting sectors in their territories. More recently, they have started to set adaptation goals and to adopt plans addressing the climate hazards and vulnerabilities in their territories.

1.1 The Covenant of Mayors: history, commitments and reporting requirements

The Covenant of Mayors was launched by the EC in 2008, with a target for participating cities to reduce greenhouse gas (GHG) emissions in their territories by at least 20% by 2020 through the development and implementation of a Sustainable Energy Action Plan (SEAP). The initiative was very well received by cities and local governments all over the EU and beyond, with thousands of signatories of all sizes, backgrounds and levels of experience joining enthusiastically and with regional and national authorities endorsing and supporting their efforts.

In 2014, based on the experience of the Covenant of Mayors and acknowledging the vulnerability of urban areas to the unavoidable impacts of climate change, the Commission launched Mayors Adapt, a similar voluntary initiative with a focus on climate adaptation in cities. The Covenant of Mayors and Mayors Adapt then merged in 2015 resulting in the Covenant of Mayors for Climate & Energy, which set a new target in line with the EU headline target of 40% GHG emission reduction by 2030 and integrated the adaptation pillar. Then, in 2017, the Covenant of Mayors for Climate and Energy and the Compact of Mayors joined forces becoming

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1 COM(2019) 640 final

2 COM(2020) 562 final

3 Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ('European Climate Law')

4 COM(2021) 82 final

5 Among the actions from the EU Strategy of particular relevance to CoM signatories:
- increase funding opportunities to implement adaptation actions at the local scale;
- improve monitoring frameworks, develop indicators, and record data on climate-related losses (i.e. EU Risk Data Hub);
- create a "policy support facility" (CoM EU) to further support local and regional governments for a more systemic adaptation;
- further promote nature-based solutions for adaptation (biodiversity co-benefits)
- promote a socially-just transition, recognizing the higher impact of climate risks on vulnerable population groups, and avoiding reinforcing inequalities.

the GCoM, currently the world's largest coalition of cities and local governments voluntarily committed to fight climate change.

As a result of the EU's commitment to reducing its net GHG emissions by at least 55% by 2030 and becoming climate neutral by 2050, in April 2021 the EU chapter of the GCoM initiative announced its renewed ambition[6], with participating cities pledging to the goal of climate neutrality by 2050 and to tackling in an integrated manner the three pillars of the initiative, namely **climate mitigation**, **climate adaptation**, and **energy poverty**.

The Sustainable Energy and Climate Action Plan (SECAP) is the key document to translate into climate action the vision of local authorities for both mitigation and adaptation to climate change. Detailed methodological guidance on how to develop a SECAP (Bertoldi, 2018) as well as guidelines on how to report on the SECAP (Covenant of Mayors Office, 2020) covering both mitigation and adaptation, are publicly available (free of charge). The energy poverty pillar is currently under development. Some key requirements of the initiative are briefly illustrated hereafter.

Within two years of signing up to the initiative, local authorities have to approve and submit their SECAP. Such a SECAP is the key document through which the Covenant signatory presents its vision and target, together with the measures to be implemented to achieve its climate mitigation target and adaptation goals. The SECAP covers the geographical area under the jurisdiction of the local authority and includes actions by both public and private sectors. On mitigation pillar, the SECAP has to contain the results of the baseline GHG emission inventory, a GHG emission reduction target based on the country's or region's Nationally Determined Contribution (NDC) to the United Nations Framework Convention on Climate Change (UNFCCC) and a clear outline of the actions (including at least three key actions) that the local authority intends to take in order to reduce its GHG emissions. The SECAP may as well cover a longer period, in which case it is advised that the plan contains intermediate targets and goals for the year 2030. On the adaptation pillar, the SECAP includes the assessment of climate risks and vulnerabilities within the territory and a set of actions (including at least three key actions) to increase the resilience of the critical sectors and vulnerable groups.

Therefore, a local authority willing to develop a climate mitigation plan should start by developing a Baseline Emission Inventory (BEI), standing as the reference against which the achievements of the emission reductions in the target year can be measured. The BEI quantifies the level of GHG emissions in a base year according to a common methodological approach (Bertoldi, 2018), identifying the main emitting sectors and consequently prioritising areas for action. Following the SEAP/SECAP submission, cities should present, ideally every two years, a monitoring report with its corresponding monitoring emission inventory (MEI), enabling to follow the performance of their proposed actions according to their declared ambitions.

1.2 The role of the Joint Research Centre in the Covenant of Mayors

The Joint Research Centre (JRC) of the EC was entrusted since the launch of the initiative with the role of providing scientific, methodological and technical support to the EU CoM initiative, to ensure its coherence with EU climate and energy policies as well as its scientific credibility. One of the key tasks of the JRC is to assist signatories with the preparation and implementation of their action plans through the development of methodological guidebooks. With the extension of the CoM beyond the EU, the JRC has been responsible for adapting the CoM EU methodology to the environmental, economic and political conditions of other world regions. In this process, the JRC works closely with the consortium operating the EU Covenant of Mayors Office[7], with the Global Covenant of Mayors secretariat[8] as well as with other offices managing regional Covenants[9,10,11] with the goal of ensuring the feasibility of these methodologies. The JRC also contributes to the definition and regular update of the reporting framework.

6 https://eumayors.eu/index.php?option=com_attachments&task=download&id=1017
7 https://eumayors.eu/about/support-the-community/office.html
8 https://www.globalcovenantofmayors.org/about/
9 http://com-east.eu/en/
10 https://www.com-med.org/en/
11 https://comssa.org/en/

The JRC is responsible for the evaluation of submitted action plans and the provision of feedback to signatories[12], with the objectives of verifying the compliance of the plan with the Covenant commitments, principles and methodological approaches as well as of assessing the credibility of the action plan in relation to the set targets and goals. Through its feedback, the JRC may provide further guidance and suggestions to CoM signatories for the potential improvement of their plans. The JRC is also responsible for publishing open datasets and assessment reviews of submitted action plans and monitoring reports[13].

In the context of the GCoM, the JRC collaborates with partners and other research institutions for aggregation reports[14] and co-chairs the GCoM technical working group (TWG) on data. This TWG cooperates with cities and city networks to develop an efficient and robust assessment, planning, reporting and monitoring framework by ensuring that the global initiative benefits to the maximum extent from the work, knowledge and resources placed over the years. A key output of the TWG on data has been the GCoM Common Reporting Framework (CRF)[15] (GCoM, 2018), which ensures compatible and comparable reporting approaches for signatories worldwide. Specific aspects of the Covenant are also explored in dedicated studies (e.g. multi-level governance models in the Covenant (Melica et al., 2018); review of reporting platforms (Bertoldi, Kona, Rivas, & Dallemand, 2018); projections towards Paris Agreement targets (A. Kona, Bertoldi, Monforti-Ferrario, Rivas, & Dallemand, 2018); methods on indirect emission accounting (A. Kona, Bertoldi, & Kılkış, 2019); climate mitigation policies (Palermo, Bertoldi, Apostolou, Kona, & Rivas, 2020); key factors enabling higher climate ambition (Rivas, Urraca, Bertoldi, & Thiel, 2021)). Finally, given the policy relevance of the initiative, the JRC prepares scientific publications on its outcomes and its impacts on local and EU policies in order to evaluate the policies adopted by local governments and their path towards the targets. Since 2013, the JRC has published a series of assessment reports on the Covenant of Mayors status, e.g., Cerutti et al., 2013 or Melica et al., 2022, in order to track the overall progress of the initiative on the basis of action plans and monitoring reports transmitted by Covenant cities to the EC.

This report complements the Covenant of Mayors 2021 Assessment report (Melica et al., 2022), where an overall analysis was presented on the status of the initiative in relation to the mitigation and adaptation pillars. This report presents key energy figures and indicators for European signatories, based on the same dataset of action plans and monitoring reports submitted by Covenant of Mayors signatories until mid-May 2021. In that dataset, cities and local authorities report their emission inventories, energy consumption and energy supply, and their estimates on energy savings and energy production by the target year (notably 2020 and 2030) for each sector targeted by their action plan. Hence, the following report presents the energy consumption and savings for signatories from Europe EU-27 and Europe non-EU-27 (non-EU from now on), distinguishing between 2020 and 2030 commitments (see Annex 1 for the distribution of signatories by country and commitment for EU-27 and non-EU).

[12] Only to signatories from Europe, Eastern Partnership, Southern Partnership, and Sub-Saharan Africa.
[13] The first release for the GCoM - MyCovenant, 2021 dataset is available at https://publications.jrc.ec.europa.eu/repository/handle/JRC127390
[14] The latest GCoM aggregation report is available at https://www.globalcovenantofmayors.org/impact2021/
[15] https://www.globalcovenantofmayors.org/our-initiatives/data4cities/common-global-reporting-framework/

2 Energy consumption and savings in EU-27

2.1 2020 commitments – EU-27

In this section, the analysis focuses on EU-27 signatories with a commitment for the target year of 2020.

2.1.1 BEI energy consumption

Considering signatories in EU-27 with 2020 commitments, there are 5 745 action plans with a BEI, representing 147.4 million inhabitants. It can be seen that the type of fuel associated with the greatest total share of consumption corresponds to fossil fuels (68%), followed by electricity (23%), while the sector carrying the highest share of energy consumption is residential buildings (28%), followed by private and commercial transport (22%). See **Tables 1-3** for the absolute, percentage and per capita values, respectively, and **Figures 1-2** for the visualisation of the shares for the most significant sectors and fuel sources, respectively.

Examining the per capita consumption, it is informative to recognize that fossil fuels represent the maximum consumption value, with 12.8 MWh/year per capita, while renewable fuels have the lowest value, with 0.39 MWh/year per capita. Focusing on the activity sectors, residential buildings has the highest consumption value of 5.2 MWh/year per capita, followed by private and commercial transport, with 4.3 MWh/year per capita; while other sectors, such as municipal buildings, industry-ETS, municipal fleet, public transport, and agriculture, forestry and fisheries all have a minimal per capita consumption less than 1 MWh/year.

Table 1. Energy consumption reported in BEIs related to 2020 commitments – EU-27 (units TWh/year).

Sector / Sub-sector	Electricity	District heating and cooling	Fossil fuels	Renewable fuels	TOTAL	SHARE
Municipal buildings, equipment/facilities	35.4089	10.2224	23.4497	0.5822	69.6631	2.50%
Residential buildings	189.8480	83.5796	466.2139	37.4651	777.1066	27.91%
Tertiary (non-municipal) buildings, equipment/facilities	196.8843	33.2705	220.2192	2.2309	452.6049	16.26%
Industry Non-ETS	140.4695	17.3864	203.6414	4.7220	366.2194	13.15%
Industry-ETS	3.6030	0.0002	11.7445	1.1227	16.4705	0.59%
Buildings, equipment/facilities non-allocated	64.4915	45.4333	135.4317	7.8901	253.2467	9.10%
Subtotal - Stationary energy	630.7053	189.8925	1 060.700	54.0130	1 935.3111	69.51%
Municipal fleet	0.9418		4.6872	0.0581	5.6872	0.20%
Public transport	6.3593		16.3715	0.2233	22.9540	0.82%
Private and commercial transport	1.2053		624.1357	2.8480	628.1890	22.56%
Transport non-allocated	2.4514		165.5037	0.3075	168.2626	6.04%
Subtotal - Transport	10.9579		810.6981	3.4369	825.0929	29.64%
Agriculture, Forestry, Fisheries	3.7471	1.4209	17.8018	0.0185	22.9883	0.83%

Sector / Sub-sector	Electricity	District heating and cooling	Fossil fuels	Renewable fuels	TOTAL	SHARE
Other non-allocated	0.3929		0.3565		0.7494	0.03%
Subtotal - Other	4.1400	1.4209	18.1582	0.0185	23.7377	0.85%
TOTAL	645.8032	191.3134	1 889.557	57.4683	2 784.1417	
SHARE	23.20%	6.87%	67.87%	2.06%		

Source: JRC elaboration based on GCoM data

Table 2. Energy consumption reported in BEIs related to 2020 commitments – EU-27 (units %).

Sector / Sub-sector	Electricity	District heating and cooling	Fossil fuels	Renewable fuels	TOTAL
Municipal buildings, equipment/facilities	1.27%	0.37%	0.84%	0.02%	2.50%
Residential buildings	6.82%	3.00%	16.75%	1.35%	27.91%
Tertiary (non-municipal) buildings, equipment/facilities	7.07%	1.20%	7.91%	0.08%	16.26%
Industry Non-ETS	5.05%	0.62%	7.31%	0.17%	13.15%
Industry-ETS	0.13%	0.00%	0.42%	0.04%	0.59%
Buildings, equipment/facilities non-allocated	2.32%	1.63%	4.86%	0.28%	9.10%
Subtotal - Stationary energy	22.65%	6.82%	38.10%	1.94%	69.51%
Municipal fleet	0.03%		0.17%	0.00%	0.20%
Public transport	0.23%		0.59%	0.01%	0.82%
Private and commercial transport	0.04%		22.42%	0.10%	22.56%
Transport non-allocated	0.09%		5.94%	0.01%	6.04%
Subtotal - Transport	0.39%	0.00%	29.12%	0.12%	29.64%
Agriculture, Forestry, Fisheries	0.13%	0.05%	0.64%	0.00%	0.83%
Other non-allocated	0.01%		0.01%		0.03%
Subtotal - Other	0.15%	0.05%	0.65%	0.00%	0.85%
TOTAL	23.20%	6.87%	67.87%	2.06%	

Source: JRC elaboration based on GCoM data

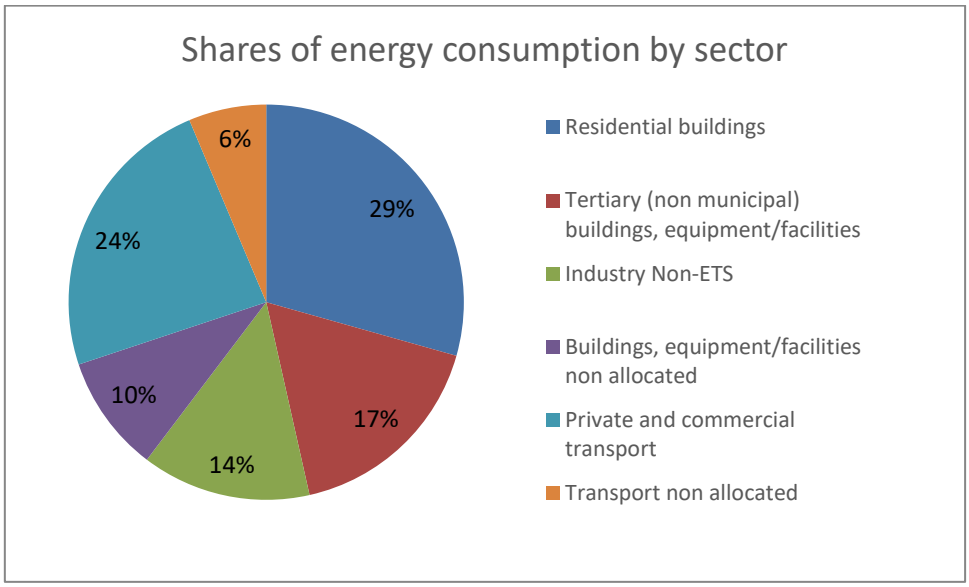
Table 3. Energy consumption reported in BEIs related to 2020 commitments – EU-27 (units MWh/year per capita).

Sector / Sub-sector	Electricity	District heating and cooling	Fossil fuels	Renewable fuels	TOTAL
Municipal buildings, equipment/facilities	0.2403	0.0694	0.1591	0.0040	0.4727
Residential buildings	1.2881	0.5671	3.1633	0.2542	5.2728
Tertiary (non-municipal)	1.3359	0.2257	1.4942	0.0151	3.0710

buildings, equipment/facilities					
Sector / Sub-sector	Electricity	District heating and cooling	Fossil fuels	Renewable fuels	TOTAL
Industry Non-ETS	0.9531	0.1180	1.3817	0.0320	2.4849
Industry-ETS	0.0244	0.0000	0.0797	0.0076	0.1118
Buildings, equipment/facilities non-allocated	0.4376	0.3083	0.9189	0.0535	1.7183
Subtotal - Stationary energy	4.2794	1.2885	7.1970	0.3665	13.1314
Municipal fleet	0.0064		0.0318	0.0004	0.0386
Public transport	0.0431		0.1111	0.0015	0.1557
Private and commercial transport	0.0082		4.2349	0.0193	4.2624
Transport non-allocated	0.0166		1.1230	0.0021	1.1417
Subtotal - Transport	0.0744	0.0000	5.5007	0.0233	5.5984
Agriculture, Forestry, Fisheries	0.0254	0.0096	0.1208	0.0001	0.1560
Other non-allocated	0.0027		0.0024		0.0051
Subtotal - Other	0.0281	0.0096	0.1232	0.0001	0.1611
TOTAL	4.3819	1.2981	12.8209	0.3899	18.8908

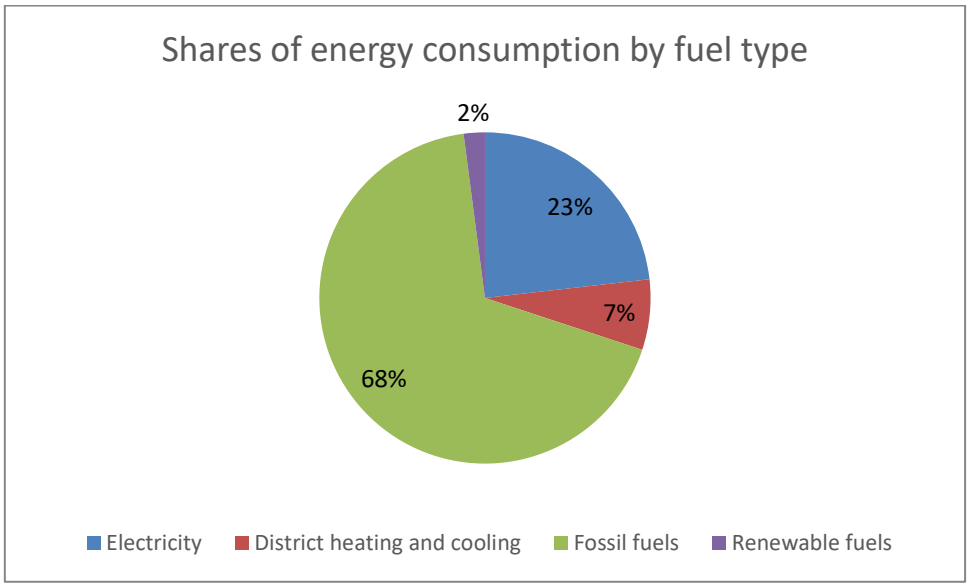
Source: JRC elaboration based on GCoM data

Figure 1. Shares of energy consumption by sector, reported in BEIs related to 2020 commitments – EU-27.



Source: JRC elaboration based on GCoM data

Figure 2. Shares of energy consumption by fuel source, reported in 2020 BEIs related to 2020 commitments – EU-27.



Source: JRC elaboration based on GCoM data

2.1.2 Energy supply

Examining the reported energy output from the 5 745 signatories having reported a BEI, there are 1 811 signatories having also reported some local heat/cold or electricity production.

2.1.2.1 Local electricity production and purchases/sales of renewable energy certificates

The highest share of local electricity production corresponds to photovoltaics, with 36.68% of the total reported local electricity production. This can be partially explained by the geographical location of the majority of this subset of signatories, whose median latitude is 45 degrees north, where solar irradiation is expected to be significant. See **Table 4** for the complete description of the total production by technology.

Furthermore, comparing non-renewable with renewable energy technologies, renewable energy has the highest share in total production, with 69.18%, representing 20.8% of the BEI electricity consumption for the cities reporting local electricity production. In per capita terms, see **Table 5**, the reported local electricity production amounts to 0.4 and 0.9 MWh/year for non-renewable and renewable technologies, respectively. **Figure 3** shows the shares of the most representative electricity production sources and technologies.

Lastly, examining purchases or sales of renewable energy certificates, there are 297 signatories reporting purchases/sales. These signatories come mainly from Belgium (52%), Italy (34%), Spain (3%) and Netherlands (3%). For all of the 297 signatories, they report a total of 3.64 TWh/year in sales/purchases, representing 5.8% of their total BEI electricity consumption. In per capita terms, it amounts to 0.33 MWh/year per capita.

Table 4. Local electricity production in BEIs related to 2020 commitments - EU-27 (units TWh/year).

Energy production technology	Non- renewable	Renewable	TOTAL	SHARE
Photovoltaics		27.2241	27.2241	36.68%
Wind		5.7174	5.7174	7.70%
Hydroelectric		18.3167	18.3167	24.68%
Geothermal		0.0107	0.0107	0.01%
Local electricity production plants - Combined Heat and Power	19.9880	0.0433	20.0313	26.99%
Local electricity production plants - Other (ETS and large-scale plants > 20 MW not recommended)	2.8826	0.0349	2.9175	3.93%
TOTAL	22.8706	51.3471	74.2176	
SHARE OF TOTAL ELECTRICITY PRODUCTION	30.82%	69.18%		
SHARE OF TOTAL ELECTRICITY CONSUMPTION*	3.54% (9.27%)	7.95% (20.8%)		

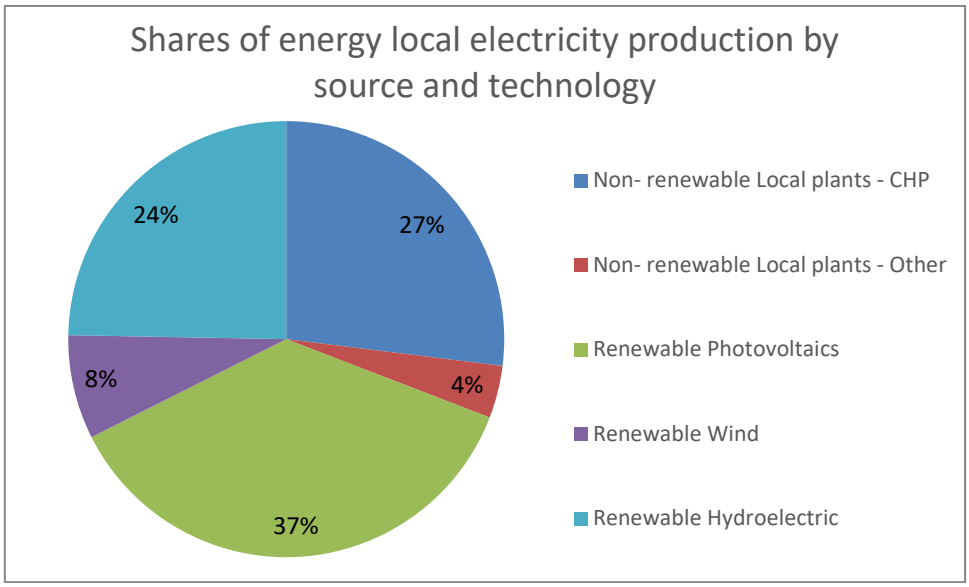
*Compared to the total electricity consumption in BEI (only for cities reporting local electricity production)
Source: JRC elaboration based on GCoM data

Table 5. Local electricity production in BEIs related to 2020 commitments - EU-27 (units MWh/year per capita).

Energy production technology	Non- renewable	Renewable	TOTAL
Photovoltaics		0.4981	0.4981
Wind		0.1046	0.1046
Hydroelectric		0.3351	0.3351
Geothermal		0.0002	0.0002
Local electricity production plants - Combined Heat and Power	0.3657	0.0008	0.3665
Local electricity production plants - Other (ETS and large-scale plants > 20 MW not recommended)	0.0527	0.0006	0.0534
TOTAL	0.4184	0.9394	1.3578

Source: JRC elaboration based on GCoM data

Figure 3. Shares of local electricity production by energy source and technology, reported in BEIs related to 2020 commitments – EU-27.



Source: JRC elaboration based on GCoM data

2.1.2.2 Local heat/cold production

Considering local heat/cold supply, the highest share of local heat/cold production corresponds to combined heat and power (CHP), with 49% of the total reported local heat/cold production, followed very closely by district heating (heat only), with 44%. See **Table 6** for the complete description of the total production by technology. Furthermore, comparing non-renewable with renewable energy technologies, non-renewable energy has the highest share, with 98%, representing the almost the totality of the BEI heat/cold consumption for the cities reporting local heat/cold production. As shown in **Table 7**, the per capita production with non-renewable fuels amounts to 3.1 MWh/year. **Figure 4** shows the shares of the most representative heat/cold production sources and technologies

Table 6. Local heat/cold production in BEIs related to 2020 commitments - EU-27 (units TWh/year).

Energy production technology	Non- renewable	Renewable	TOTAL	SHARE
Local heat/cold production plants - Combined Heat and Power	32.3629	0.7358	33.0987	48.97%
Local heat/cold production plants - District heating (heat-only)	29.5846	0.4633	30.0479	44.46%
Local heat/cold production plants – Other	4.4422	0.0003	4.4424	6.57%
TOTAL	66.3896	1.1994	67.5890	
SHARE ON TOTAL HEAT/COLD PRODUCTION	98.23%	1.77%		
SHARE ON TOTAL HEAT/COLD CONSUMPTION*	34.7% (105.3%)	0.63% (1.9%)		

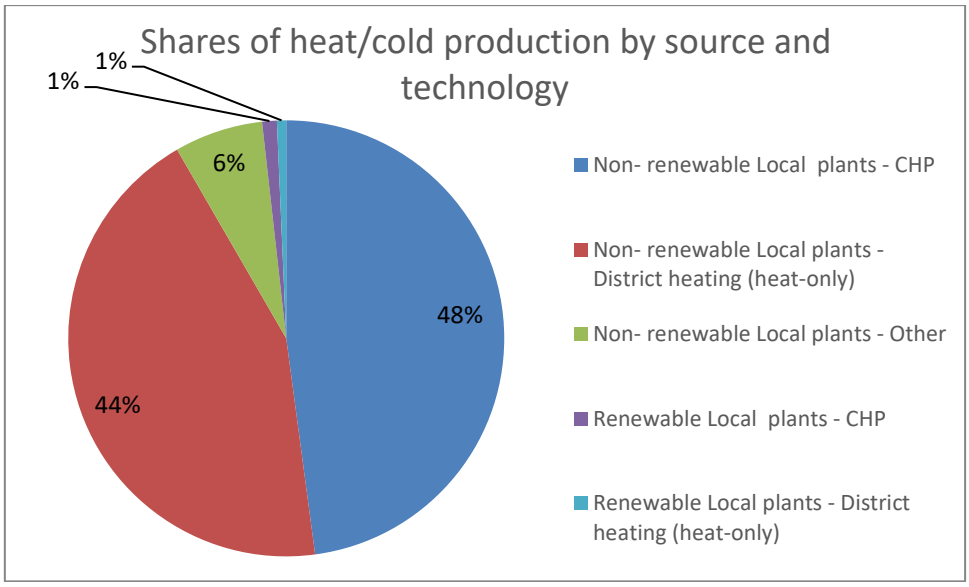
* Compared to the total heat/cold consumption in BEI (only for cities reporting local heat/cold production)
Source: JRC elaboration based on GCoM data

Table 7. Local heat/cold production in BEIs related to 2020 commitments - EU-27 (units MWh/year per capita).

Energy production technology	Non-renewable	Renewable	TOTAL
Local heat/cold production plants - Combined Heat and Power	1.5203	0.0346	1.5548
Local heat/cold production plants - District heating (heat-only)	1.3898	0.0218	1.4115
Local heat/cold production plants – Other	0.2087	0.0000	0.2087
TOTAL	3.1187	0.0563	3.1751

Source: JRC elaboration based on GCoM data

Figure 4. Shares of local heat/cold production by energy source and technology, reported in BEIs related to 2020 commitments – EU-27.



Source: JRC elaboration based on GCoM data

2.1.3 Savings and renewable energy production

Signatories are asked to report their estimates on energy savings and energy production by the target year, for each sector targeted by their action plan. Examining the reported estimated savings and renewable energy production from the signatories having reported a BEI, there are 4 240, out of the 5 745, having also reported some estimated savings or renewable energy production.

2.1.3.1 Estimated savings

The highest share of estimated savings corresponds to stationary energy, with 44% of the total estimated savings, followed by transport (35%). The details can be seen in **Table 8**. The total savings represent 10.56% of the reported consumption for these signatories (comparing the total consumption in BEI, only for cities having declared either energy savings or energy production by the target year). In total, as presented in **Table 9**, signatories estimate that they will be able to save, on average, 1.8 MWh/year per capita, by 2020. **Figure 5** shows the shares of each activity sector in the total estimated savings.

Table 8. Estimated energy savings by 2020 declared by signatories – EU-27 (units TWh/year).

Sector	Estimated energy savings	SHARE
Stationary energy (includes, Municipal buildings, Lighting, Residential buildings, Tertiary buildings, Industry)	74.5706	43.96%
Transport	58.6368	34.57%
Local electricity production	4.0449	2.38%
Local heat/cold production	6.6617	3.93%
Other	25.7164	15.16%
TOTAL	169.6304	

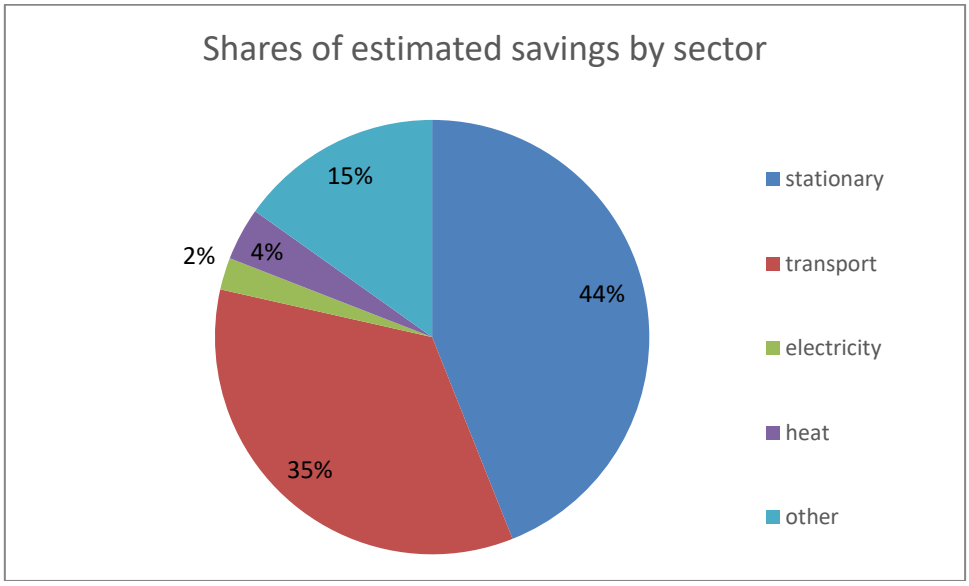
Source: JRC elaboration based on GCoM data

Table 9. Estimated energy savings by 2020 declared by signatories – EU-27 (units MWh/year per capita).

Sector	Estimated energy savings
Stationary energy (includes, Municipal buildings, Lighting, Residential buildings, Tertiary buildings, Industry)	0.8292
Transport	0.6520
Local electricity production	0.0450
Local heat/cold production	0.0741
Other	0.2859
TOTAL	1.8861

Source: JRC elaboration based on GCoM data

Figure 5. Shares of estimated savings by sector, reported in in BEIs related to 2020 commitments – EU-27.



Source: JRC elaboration based on GCoM data

2.1.3.2 Renewable energy production

The highest share of renewable energy production corresponds to the local electricity production, with 48% of the total estimated renewable energy production. The details can be seen in **Table 10**. The total renewable energy production represents 3.72% of the reported consumption for these signatories (comparing the total consumption in BEI, only for cities having declared either energy savings or energy production by the target year). In total, as presented in **Table 11**, signatories estimate that they will be able to produce, on average, 0.66 MWh/year of renewable energy per capita, by 2020. **Figure 6** shows the shares of each activity sector in the total estimated renewable energy production.

Table 10. Estimated renewable energy production by 2020 declared by signatories – EU-27 (units TWh/year).

Sector	Estimated renewable energy production	SHARE
Stationary energy (includes, Municipal buildings, Lighting, Residential buildings, Tertiary buildings, Industry)	8.1287	13.62%
Transport	1.7307	2.90%
Local electricity production	28.7470	48.15%
Local heat/cold production	13.0907	21.93%
Other	8.0000	13.40%
TOTAL	59.6970	

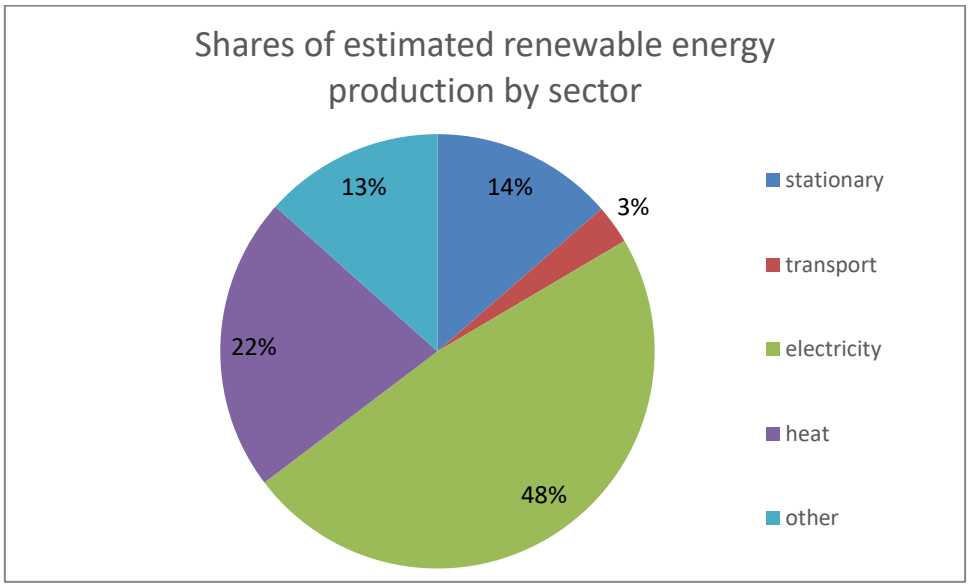
Source: JRC elaboration based on GCoM data

Table 11. Estimated renewable energy production by 2020 declared by signatories – EU-27 (units MWh/year per capita).

Sector	Estimated renewable energy production
Stationary energy (includes, Municipal buildings, Lighting, Residential buildings, Tertiary buildings, Industry)	0.0904
Transport	0.0192
Local electricity production	0.3196
Local heat/cold production	0.1456
Other	0.0890
TOTAL	0.6638

Source: JRC elaboration based on GCoM data

Figure 6. Shares of estimated renewable energy production by sector, reported in BEIs related to 2020 commitments – EU-27.



Source: JRC elaboration based on GCoM data

2.1.4 MEI energy consumption

Following the BEI, signatories should monitor the performance of their action plans in the subsequent years. Nonetheless, due to different reasons, not all of them comply with this requirement. Regarding EU-27 signatories with 2020 commitments, there are 1 825 action plans having reported a MEI, representing 93.4 million inhabitants. For monitoring reports, the type of fuel with the greatest total share of consumption is fossil fuels (62%), followed by electricity (26%). Thus, there is a slight decrease in terms of fossil fuels (-6%) and a slight increase in terms of electricity (+3%) consumption, when comparing the total MEI against the BEI. Additionally, the sector with the highest share is residential buildings (27%), followed by private and commercial transport (24%). See **Tables 12-14** for the absolute, percentage and per capita values, respectively, of the energy consumption reported in MEIs, and **Figures 7-8** for the visualisation of the shares for the most significant sectors and fuel sources, respectively.

Examining the per capita consumption, it can be highlighted that fossil fuels represent the maximum consumption value, with 10.87 MWh/year per capita, around 2 MWh/year less than the consumption declared in the BEIs. On the other hand, renewable fuels have the lowest value, with 0.57 MWh/year per capita. Meanwhile, for the activity sectors, residential buildings has the highest consumption value, with 4.7 MWh/year per capita, followed by private and commercial transport, having 4.1 MWh/year per capita, as opposite to other sectors, such as municipal buildings, industry-ETS, municipal fleet, public transport, and agriculture, forestry and fisheries, having a minimal per capita consumption less than 1 MWh/year per capita. Overall, the situation depicted in the MEIs is very much in line with what was reported in the BEIs, with respect to both the shares for types of fuel and sectors, as well as for the per capita consumption, suggesting that the transition to a greener energy future still requires additional efforts to achieve EU targets.

Table 12. Energy consumption reported in MEIs related to 2020 commitments – EU-27 (units TWh/year).

Sector / Sub-sector	Electricity	District heating and cooling	Fossil fuels	Renewable fuels	TOTAL	SHARE
Municipal buildings, equipment/facilities	18.4298	9.2733	9.4892	0.7036	37.8960	2.32%
Residential buildings	115.6184	56.2781	242.1620	23.5426	437.6012	26.84%
Tertiary (non-municipal) buildings, equipment/facilities	161.6216	27.1349	119.1628	2.2468	310.1662	19.03%
Industry Non-ETS	77.8943	15.6771	75.4063	3.9104	172.8882	10.60%
Industry-ETS	3.1441	0.1010	14.2738	4.5326	22.0515	1.35%
Buildings, equipment/facilities non-allocated	29.2493	34.4955	74.3138	7.2121	145.2708	8.91%
Subtotal - Stationary energy	405.9576	142.9600	534.8080	42.1482	1 125.874	69.06%
Municipal fleet	0.0016		2.9912	0.0810	3.0737	0.19%
Public transport	6.7646		14.8835	0.3921	22.0402	1.35%
Private and commercial transport	1.9107		374.3575	6.9410	383.2092	23.51%
Transport non-allocated	1.9699		84.7678	3.5647	90.3024	5.54%
Subtotal - Transport	10.6468		477.0000	10.9787	498.6255	30.59%
Agriculture, Forestry, Fisheries	1.0199	0.1139	3.8689	0.0447	5.0474	0.31%
Other non-allocated	0.2669	0.0007	0.4652	0.0000	0.7329	0.04%
Subtotal - Other	1.2868	0.1146	4.3342	0.0448	5.7803	0.35%
TOTAL	417.8912	143.0746	1 016.1421	53.1716	1 630.28	
SHARE	25.63%	8.78%	62.33%	3.26%		

Source: JRC elaboration based on GCoM data

Table 13. Energy consumption reported in MEIs related to 2020 commitments – EU-27 (units %).

Sector / Sub-sector	Electricity	District heating and cooling	Fossil fuels	Renewable fuels	TOTAL
Municipal buildings, equipment/facilities	1.13%	0.57%	0.58%	0.04%	2.32%
Residential buildings	7.09%	3.45%	14.85%	1.44%	26.84%
Tertiary (non-municipal) buildings, equipment/facilities	9.91%	1.66%	7.31%	0.14%	19.03%
Industry Non-ETS	4.78%	0.96%	4.63%	0.24%	10.60%
Industry-ETS	0.19%	0.01%	0.88%	0.28%	1.35%
Buildings, equipment/facilities non-allocated	1.79%	2.12%	4.56%	0.44%	8.91%
Subtotal - Stationary energy	24.90%	8.77%	32.80%	2.59%	69.06%
Municipal fleet	0.00%		0.18%	0.00%	0.19%
Public transport	0.41%		0.91%	0.02%	1.35%
Private and commercial transport	0.12%		22.96%	0.43%	23.51%
Transport non-allocated	0.12%		5.20%	0.22%	5.54%
Subtotal - Transport	0.65%	0.00%	29.26%	0.67%	30.59%
Agriculture, Forestry, Fisheries	0.06%	0.01%	0.24%	0.00%	0.31%
Other non-allocated	0.02%	0.00%	0.03%	0.00%	0.04%
Subtotal - Other	0.08%	0.01%	0.27%	0.00%	0.35%
TOTAL	25.63%	8.78%	62.33%	3.26%	

Source: JRC elaboration based on GCoM data

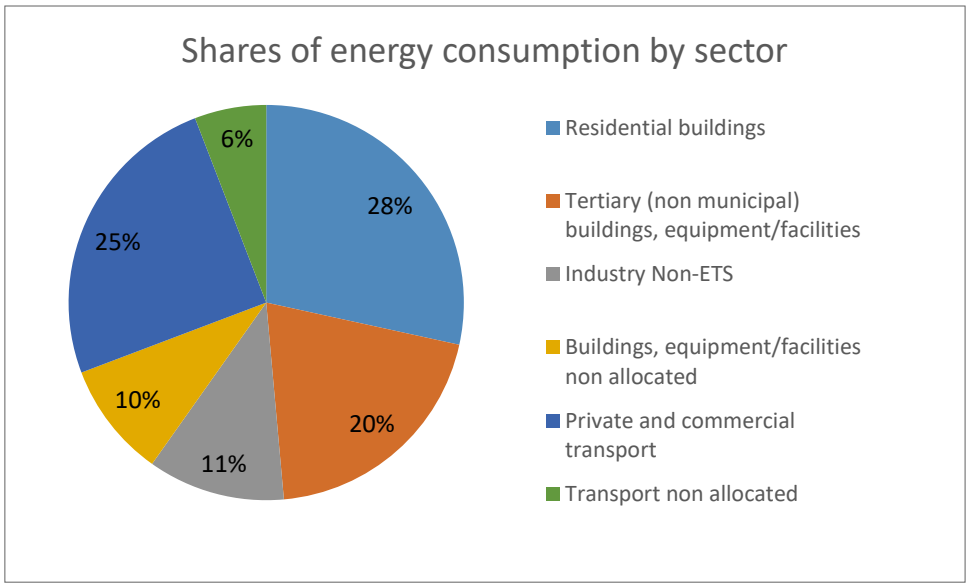
Table 14. Energy consumption reported in MEIs related to 2020 commitments – EU-27 (units MWh/year per capita).

Sector / Sub-sector	Electricity	District heating and cooling	Fossil fuels	Renewable fuels	TOTAL
Municipal buildings, equipment/facilities	0.1972	0.0992	0.1016	0.0075	0.4056
Residential buildings	1.2374	0.6023	2.5917	0.2520	4.6833
Tertiary (non-municipal) buildings, equipment/facilities	1.7297	0.2904	1.2753	0.0240	3.3195
Industry Non-ETS	0.8336	0.1678	0.8070	0.0419	1.8503
Industry-ETS	0.0336	0.0011	0.1528	0.0485	0.2360
Buildings, equipment/facilities	0.3130	0.3692	0.7953	0.0772	1.5547

non-allocated					
Sector / Sub-sector	Electricity	District heating and cooling	Fossil fuels	Renewable fuels	TOTAL
Subtotal - Stationary energy	4.3446	1.5300	5.7236	0.4511	12.0493
Municipal fleet	0.0000		0.0320	0.0009	0.0329
Public transport	0.0724		0.1593	0.0042	0.2359
Private and commercial transport	0.0204		4.0064	0.0743	4.1012
Transport non-allocated	0.0211		0.9072	0.0381	0.9664
Subtotal - Transport	0.1139	0.0000	5.1049	0.1175	5.3364
Agriculture, Forestry, Fisheries	0.0109	0.0012	0.0414	0.0005	0.0540
Other non-allocated	0.0029	0.0000	0.0050	0.0000	0.0078
Subtotal - Other	0.0138	0.0012	0.0464	0.0005	0.0619
TOTAL	4.4723	1.5312	10.8749	0.5691	17.4475

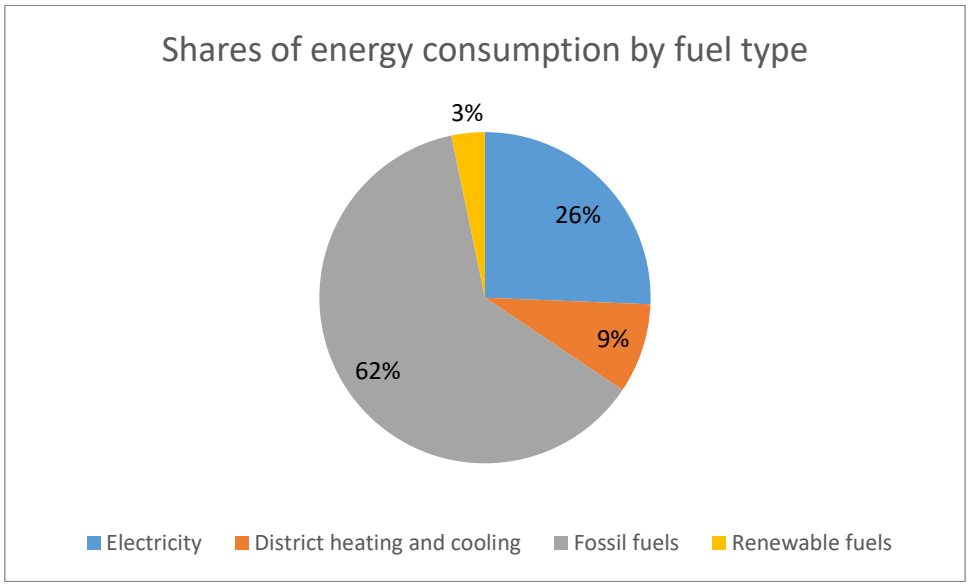
Source: JRC elaboration based on GCoM data

Figure 7. Shares of energy consumption by sector, reported in MEIs related to 2020 commitments – EU-27.



Source: JRC elaboration based on GCoM data

Figure 8. Shares of energy consumption by fuel type, reported in MEIs related to 2020 commitments – EU-27.



Source: JRC elaboration based on GCoM data

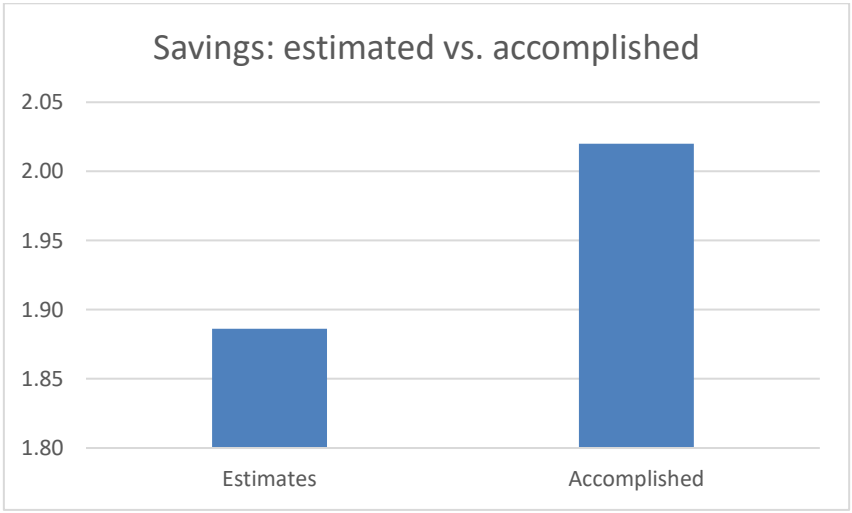
2.1.5 Achievements in energy savings

Once the reported estimated savings and the MEI consumption has been presented, it is possible to verify the actual savings for signatories holding a MEI. Below, the total estimated savings are presented, identifying the most successful signatories in accomplishing significant savings.

2.1.5.1 Accomplished savings

The total estimated savings, when computing the difference between the BEI and the MEI consumption for the signatories holding a MEI, amounts to 182 TWh/year (2.02 MWh/year per capita). Therefore, the accomplished mean per capita savings of 2.02 MWh/year exceed the declared estimated savings of 1.8 MWh/year (see **Figure 9**). Overall, the total reduced consumption is 10% of the reported BEI, and 11.2% of the MEI consumption.

Figure 9. Total energy savings, estimated vs. accomplished, related to 2020 commitments – EU-27 (units MWh/year per capita).



Source: JRC elaboration based on GCoM data

Examining the accomplished savings for every city with a coherent monitoring history (i.e., with its MEIs including at least the same sectors as the ones reported in their BEIs), the yearly savings rate is computed between the absolute consumption in the BEI and the last MEI. The highest rates correspond with Dortmund, Munich and Budapest, saving 1.45, 1.26 and 0.85 TWh/year, respectively. The top-10 cities, regarding their yearly absolute and per capita savings rates, are presented in
Table 15.

Table 15. Top-10 signatories with highest savings rates, related to 2020 commitments – EU-27 (units TWh/year).

CITY	COUNTRY	BASE YEAR	LAST MONITORING YEAR	ABSOLUTE SAVINGS	ABSOLUTE SAVINGS ANNUAL RATE	SAVINGS PER CAPITA (MWh/year)	SAVINGS PER CAPITA ANNUAL RATE (MWh/year)
Dortmund	Germany	1990	2008	26.18	1.45	44.8	2.49
München	Germany	1990	2012	27.73	1.26	19.27	0.87
Budapest	Hungary	2005	2013	6.83	0.85	3.94	0.49
Hamburg	Germany	1990	2015	20.74	0.83	11.61	0.46
Marbella	Spain	2012	2013	0.71	0.72	5.05	5.05
Padova	Italy	2005	2013	5.55	0.69	26.5	3.31
Clermont-Ferrand	France	1995	2008	8.68	0.67	62.27	4.79
Köln	Germany	1990	2007	10.58	0.62	10.39	0.61
Dublin City Council	Ireland	2006	2016	6.11	0.61	11.02	1.10
Torino	Italy	1991	2017	11.27	0.43	12.7	0.48

Source: JRC elaboration based on GCoM data

2.2 2030 Commitments – EU-27

In this section, the analysis focuses on EU-27 signatories with a commitment for the target year of 2030.

2.2.1 BEI energy consumption

Regarding signatories in EU-27 with 2030 commitments, there are 809 action plans with a BEI, with an approximate population of 32.4 million inhabitants. The type of fuel with the highest total share of consumption is associated to fossil fuels (67%), followed by electricity (23%). The sector with the highest share is residential buildings (33%), followed by private and commercial transport (25%). See **Tables 16-18** for the absolute, percentage and per capita values, respectively, and **Figures 10-11** for the visualisation of the shares for the most significant sectors and fuel sources, respectively.

Examining the per capita consumption, it can be highlighted that fossil fuels represent the maximum consumption value, with 12.5 MWh/year per capita, while renewable fuels represent the minimum consumption of 0.47 MWh/year per capita. Addressing the activity sectors, residential buildings has the highest consumption of 6.1 MWh/year per capita, followed by private and commercial transport with 4.6 MWh/year per capita, as opposite to other sectors, such as municipal buildings, industry-ETS, municipal fleet, public transport, and agriculture, forestry and fisheries, having a minimal per capita consumption of less than 1 MWh/year.

Table 16. Energy consumption reported in BEIs related to 2030 commitments – EU-27 (units TWh/year).

Sector / Sub-sector	Electricity	District heating and cooling	Fossil fuels	Renewable fuels	TOTAL	SHARE
Municipal buildings, equipment/facilities	5.5151	1.4858	4.6914	0.0286	11.7210	1.95%
Residential buildings	47.5050	22.2608	116.3623	10.1368	196.2649	32.60%
Tertiary (non-municipal) buildings, equipment/facilities	51.1688	12.9301	57.1059	2.6733	123.8780	20.58%
Industry Non-ETS	29.2098	4.1629	35.8235	1.1399	70.3362	11.68%
Industry-ETS	0.3863		0.0665	0.0040	0.4568	0.08%
Buildings, equipment/facilities non-allocated	0.9036	0.0694	4.8231	0.1443	5.9405	0.99%
Subtotal - Stationary energy	134.6886	40.9090	218.8727	14.1269	408.5973	67.87%
Municipal fleet	0.0001		1.8900	0.0572	1.9473	0.32%
Public transport	2.8340		7.7368	0.0288	10.5996	1.76%
Private and commercial transport	0.2463		146.2275	1.0525	147.5264	24.51%
Transport non-allocated	0.1914		27.7390	0.0598	27.9903	4.65%
Subtotal - Transport	3.2719		183.5934	1.1983	188.0636	31.24%
Agriculture, Forestry, Fisheries	0.8912	0.1389	3.5171	0.0487	4.5959	0.76%
Other non-allocated	0.3247	0.2209	0.1878	0.0002	0.7335	0.12%
Subtotal - Other	1.2159	0.3598	3.7049	0.0489	5.3295	0.89%
TOTAL	139.1764	41.2688	406.1709	15.3742	601.9903	
SHARE	23.12%	6.86%	67.47%	2.55%		

Source: JRC elaboration based on GCoM data

Table 17. Energy consumption reported in BEIs related to 2030 commitments – EU-27 (units %).

Sector / Sub-sector	Electricity	District heating and cooling	Fossil fuels	Renewable fuels	TOTAL
Municipal buildings, equipment/facilities	0.92%	0.25%	0.78%	0.00%	1.95%
Residential buildings	7.89%	3.70%	19.33%	1.68%	32.60%
Tertiary (non-municipal) buildings, equipment/facilities	8.50%	2.15%	9.49%	0.44%	20.58%
Industry Non-ETS	4.85%	0.69%	5.95%	0.19%	11.68%
Industry-ETS	0.06%		0.01%	0.00%	0.08%
Buildings,	0.15%	0.01%	0.80%	0.02%	0.99%

equipment/facilities non-allocated					
Sector / Sub-sector	Electricity	District heating and cooling	Fossil fuels	Renewable fuels	TOTAL
Subtotal - Stationary energy	22.37%	6.80%	36.36%	2.35%	67.87%
Municipal fleet	0.00%		0.31%	0.01%	0.32%
Public transport	0.47%		1.29%	0.00%	1.76%
Private and commercial transport	0.04%		24.29%	0.17%	24.51%
Transport non-allocated	0.03%		4.61%	0.01%	4.65%
Subtotal - Transport	0.54%	0.00%	30.50%	0.20%	31.24%
Agriculture, Forestry, Fisheries	0.15%	0.02%	0.58%	0.01%	0.76%
Other non-allocated	0.05%	0.04%	0.03%	0.00%	0.12%
Subtotal - Other	0.20%	0.06%	0.62%	0.01%	0.89%
TOTAL	23.12%	6.86%	67.47%	2.55%	

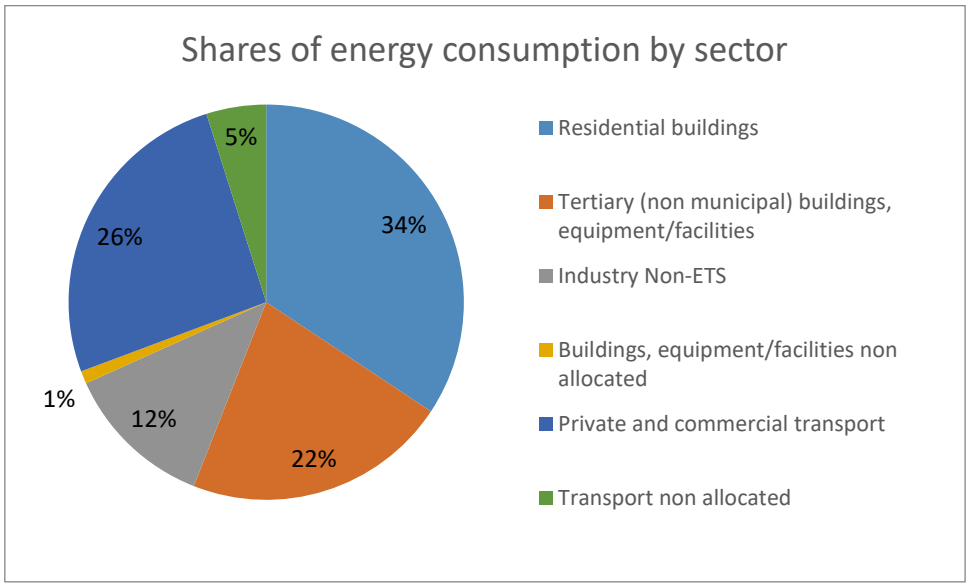
Source: JRC elaboration based on GCoM data

Table 18. Energy consumption reported in BEIs related to 2030 commitments – EU-27 (units MWh/year per capita).

Sector / Sub-sector	Electricity	District heating and cooling	Fossil fuels	Renewable fuels	TOTAL
Municipal buildings, equipment/facilities	0.1704	0.0459	0.1449	0.0009	0.3621
Residential buildings	1.4676	0.6877	3.5949	0.3132	6.0634
Tertiary (non-municipal) buildings, equipment/facilities	1.5808	0.3995	1.7642	0.0826	3.8271
Industry Non-ETS	0.9024	0.1286	1.1067	0.0352	2.1730
Industry-ETS	0.0119		0.0021	0.0001	0.0141
Buildings, equipment/facilities non-allocated	0.0279	0.0021	0.1490	0.0045	0.1835
Subtotal - Stationary energy	4.1611	1.2639	6.7619	0.4364	12.6233
Municipal fleet	0.0000		0.0584	0.0018	0.0602
Public transport	0.0876		0.2390	0.0009	0.3275
Private and commercial transport	0.0076		4.5176	0.0325	4.5577
Transport non-allocated	0.0059		0.8570	0.0018	0.8647
Subtotal - Transport	0.1011	0.0000	5.6720	0.0370	5.8101
Agriculture, Forestry, Fisheries	0.0275	0.0043	0.1087	0.0015	0.1420
Other non-allocated	0.0100	0.0068	0.0058	0.0000	0.0227
Subtotal - Other	0.0376	0.0111	0.1145	0.0015	0.1646
TOTAL	4.2997	1.2750	12.5483	0.4750	18.5980

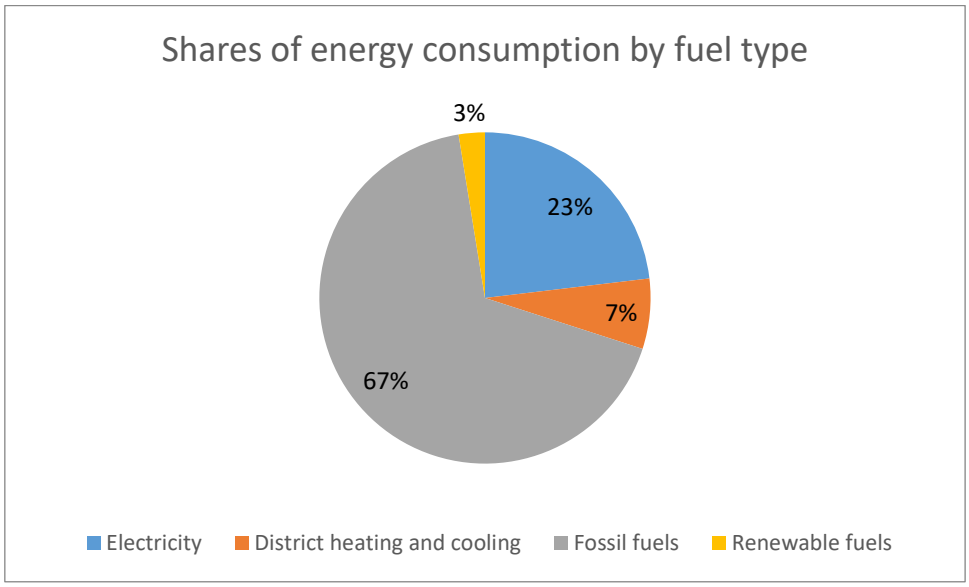
Source: JRC elaboration based on GCoM data

Figure 10. Shares of energy consumption by sector, reported in BEIs related to 2030 commitments – EU-27.



Source: JRC elaboration based on GCoM data

Figure 11. Shares of energy consumption by fuel type, reported in BEIs related to 2030 commitments – EU-27.



Source: JRC elaboration based on GCoM data

2.2.2 Energy supply

Examining the reported energy output from the signatories having reported a BEI, there are 368, out of the 809, having also reported some local heat/cold or electricity production.

2.2.2.1 Local electricity production and purchases/sales of renewable energy certificates

The highest shares of local electricity production correspond to photovoltaics (28.8%) and hydroelectric power (28%). See **Table 19** for the complete description of the total production by technology. Additionally, comparing non-renewable with renewable energy technologies, renewable energy has the highest share, with 65%, representing 11.3% of the BEI electricity consumption for the cities reporting local electricity production.

In per capita terms, **Table 20**, the reported local electricity production amounts to 0.27 and 0.5 MWh/year for non-renewable and renewable technologies, respectively. **Figure 12** shows the shares of the most representative electricity production sources and technologies. Lastly, examining purchases or sales of renewable energy certificates, there are 75 signatories reporting purchases/sales. These signatories come mainly from Belgium (70%), Italy (16%), Spain (5%) and France (4%). For all of the 75 signatories, they report a total of 0.46 TWh/year, representing 3.8% of their total BEI electricity consumption. In per capita terms, it amounts to 0.19 MWh/year per capita.

Table 19. Local electricity production in BEIs related to 2030 commitments - EU-27 (units TWh/year).

Energy production technology	Non- renewable	Renewable	TOTAL	SHARE
Photovoltaics		2.9554	2.9554	28.76%
Wind		0.6730	0.6730	6.55%
Hydroelectric		2.8771	2.8771	28.00%
Geothermal		0.0000	0.0000	0.00%
Local electricity production plants - Combined Heat and Power	3.3289	0.1762	3.5050	34.11%
Local electricity production plants - Other (ETS and large-scale plants > 20 MW not recommended)	0.2596	0.0050	0.2646	2.58%
TOTAL	3.5885	6.6866	10.2751	
SHARE ON TOTAL ELECTRICITY PRODUCTION	34.92%	65.08%		
SHARE ON TOTAL ELECTRICITY CONSUMPTION*	2.58% (6.08%)	4.80% (11.3%)		

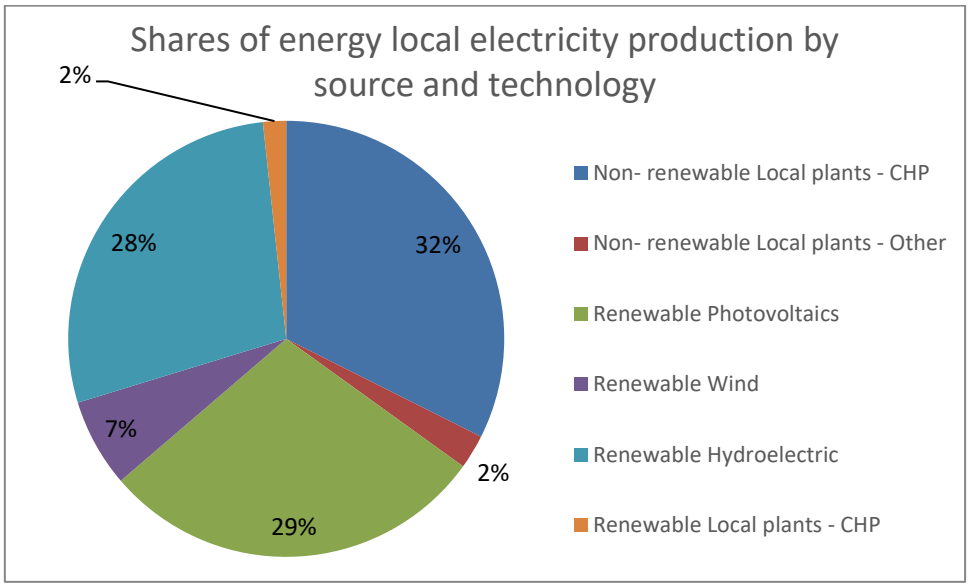
*Compared to the total electricity consumption in BEI (only for cities reporting energy supply)
Source: JRC elaboration based on GCoM data

Table 20. Local electricity production in BEIs related to 2030 commitments - EU-27 (units MWh/year per capita).

Energy production technology	Non- renewable	Renewable	TOTAL
Photovoltaics		0.2219	0.2219
Wind		0.0505	0.0505
Hydroelectric		0.2160	0.2160
Geothermal		0.0000	0.0000
Local electricity production plants - Combined Heat and Power	0.2500	0.0132	0.2632
Local electricity production plants - Other (ETS and large-scale plants > 20 MW not recommended)	0.0195	0.0004	0.0199
TOTAL	0.2695	0.5021	0.7716

Source: JRC elaboration based on GCoM data

Figure 12. Shares of local electricity production by energy source and technology, reported in BEIs related to 2030 commitments – EU-27



Source: JRC elaboration based on GCoM data

2.2.2.2 Local heat/cold production

Considering local heat/cold supply, the highest shares of local heat/cold production correspond with district heating (heat only) (53%) and CHP (47%). See **Table 21** for the complete description of the total production by technology. Furthermore, comparing non-renewable with renewable energy technologies, non-renewable energy has the highest share, with 99%, representing 97% of the BEI heat/cold consumption for the cities reporting local heat/cold production. As shown in **Table 22**, the per capita production with non-renewable fuels amounts to 2.36 MWh/year. **Figure 13** shows the shares of the most representative heat/cold production sources and technologies.

Table 21. Local heat/cold production in BEIs related to 2030 commitments - EU 27 (units TWh/year).

Energy production technology	Non- renewable	Renewable	TOTAL	SHARE
Local heat/cold production plants - Combined Heat and Power	6.6399		6.6399	47.25%
Local heat/cold production plants - District heating (heat-only)	7.2470	0.1657	7.4127	52.75%
Local heat/cold production plants – Other			0.0000	0.00%
TOTAL	13.8869	0.1657	14.0527	
SHARE ON TOTAL HEAT/COLD PRODUCTION	98.82%	1.18%		
SHARE ON TOTAL HEAT/COLD CONSUMPTION*	33.65% (97.25%)	0.40% (1.16%)		

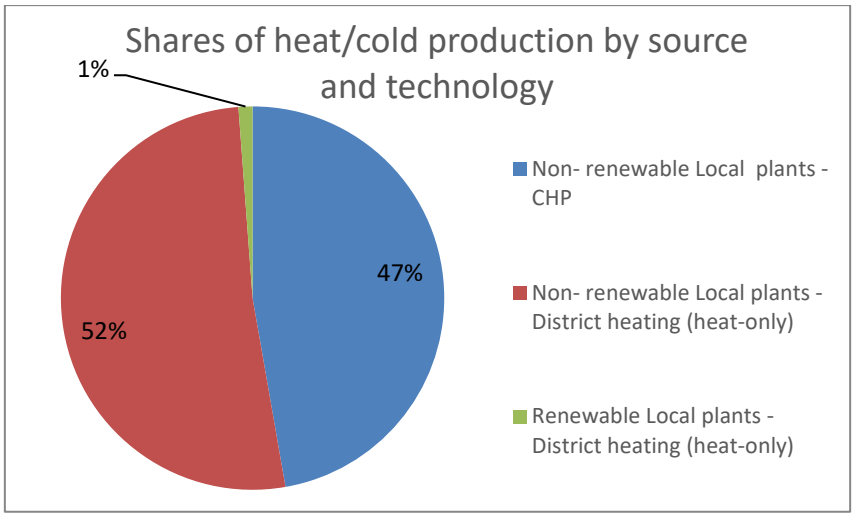
* Compared to the total heat/cold consumption in BEI (only for cities reporting local heat/cold production) *Source:* JRC elaboration based on GCoM data

Table 22. Local heat/cold production in BEIs related to 2030 commitments - EU-27 (units MWh/year per capita).

Energy production technology	Non-renewable	Renewable	TOTAL
Local heat/cold production plants - Combined Heat and Power	1.1286		1.1286
Local heat/cold production plants - District heating (heat-only)	1.2318	0.0282	1.2600
Local heat/cold production plants – Other			0.0000
TOTAL	2.3605	0.0282	2.3886

Source: JRC elaboration based on GCoM data

Figure 13. Shares of local heat/cold production by energy source and technology, reported in BEIs related to 2030 commitments – EU-27.



Source: JRC elaboration based on GCoM data

2.2.3 Savings and renewable energy production

Focusing now on the reported estimated savings and renewable energy production from the signatories having reported a BEI with 2030 commitments, there are 674, out of the 809, having also reported some estimated savings or renewable energy production.

2.2.3.1 Estimated savings

The highest share of estimated savings corresponds to stationary energy, with 64% of the total estimated savings, followed by transport (39%). The details can be seen in **Table 23**. The total savings represent 20.43% of the reported consumption for these signatories (comparing the total consumption in BEI, only for cities having declared either energy savings or energy production by the target year). In total, as presented in **Table 24**, signatories estimate that they will be able to save, on average, 3.5 MWh/year per capita, by 2030. **Figure 14** shows the shares of each activity sector in the total estimated savings.

Table 23. Estimated energy savings by 2030 declared by signatories – EU-27 (units TWh/year).

Sector	Estimated energy savings	SHARE
Stationary energy (includes, Municipal buildings, Lighting, Residential buildings, Tertiary buildings, Industry)	47.1703	64.47%
Transport	22.0178	30.09%
Local electricity production	1.6017	2.19%
Local heat/cold production	0.6513	0.89%
Other	1.7262	2.36%
TOTAL	73.1674	

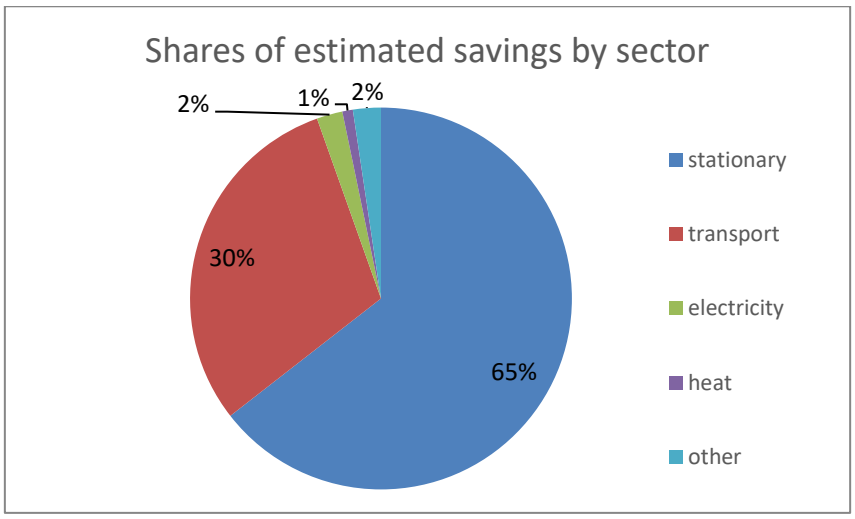
Source: JRC elaboration based on GCoM data

Table 24. Estimated energy savings by 2030 declared by signatories – EU-27 (units MWh/year per capita).

Sector	Estimated energy savings
Stationary energy (includes, Municipal buildings, Lighting, Residential buildings, Tertiary buildings, Industry)	2.2814
Transport	1.0649
Local electricity production	0.0775
Local heat/cold production	0.0315
Other	0.0835
TOTAL	3.5387

Source: JRC elaboration based on GCoM data

Figure 14. Shares of estimated savings by sector, reported in BEIs related to 2030 commitments – EU-27.



Source: JRC elaboration based on GCoM data

2.2.3.2 Renewable energy production

The highest share of renewable energy production corresponds to the local electricity production, with 52.3% of the total estimated renewable energy production. The details can be seen in **Table 25**. The total renewable

energy production represents 5.67% of the reported consumption for these signatories (comparing the total consumption in BEI, only for cities having declared either energy savings or energy production by the target year). In total, as presented in **Table 26**, signatories estimate that by 2030, they will be able to produce, in average, 0.98 MWh/year per capita. **Figure 15** shows the shares of each activity sector in the total estimated renewable energy production.

Table 25. Estimated renewable energy production by 2030 declared by signatories – EU-27 (units TWh/year).

Sector	Estimated renewable energy production	SHARE
Stationary energy (includes, Municipal buildings, Lighting, Residential buildings, Tertiary buildings, Industry)	4.9653	24.44%
Transport	0.5982	2.94%
Local electricity production	10.6245	52.29%
Local heat/cold production	4.0470	19.92%
Other	0.0819	0.40%
TOTAL	20.3169	

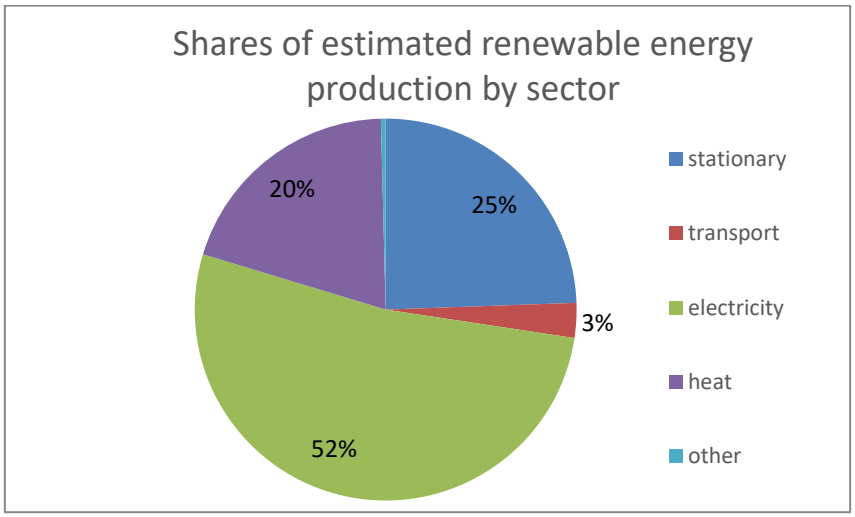
Source: JRC elaboration based on GCoM data

Table 26. Estimated renewable energy production by 2030 declared by signatories – EU-27 (units MWh/year per capita).

Sector	Estimated renewable energy production
Stationary energy (includes, Municipal buildings, Lighting, Residential buildings, Tertiary buildings, Industry)	0.2401
Transport	0.0289
Local electricity production	0.5138
Local heat/cold production	0.1957
Other	0.0040
TOTAL	0.9826

Source: JRC elaboration based on GCoM data

Figure 15. Shares of estimated renewable energy production by sector, reported in BEIs related to 2030 commitments – EU-27.



Source: JRC elaboration based on GCoM data

2.2.4 MEI energy consumption

Regarding EU-27 signatories with 2030 commitments, there are 326 action plans having reported a MEI, holding 19.1 million inhabitants. For monitoring reports, it can be seen that the type of fuel with the greatest total share of consumption is fossil fuels (65%), followed by electricity (24%). A slight decrease for fossils and a slight increase for electricity consumption, when comparing the total MEI against the BEI. The behaviour is also very similar when comparing with 2020 commitments. Additionally, the sector with the highest share is residential buildings (25%), followed by private and commercial transport (20%). See **Tables 27-29** for the absolute, percentage and per capita values, respectively, of the energy consumption reported in MEIs, and **Figures 16-17** for the visualisation of the shares for the most significant sectors and fuel sources, respectively.

Examining the per capita consumption, it is noted that fossil fuels represent the maximum consumption value, with 11.44 MWh/year per capita, while renewable fuels have the lowest value, with 0.51 MWh/year per capita. Focusing on the activity sectors, residential buildings has the highest consumption value, with 4.4 MWh/year per capita, being 1.7 lower than the declared BEI consumption, followed by private and commercial transport with 3.6 MWh/year per capita, revealing a small decrease with respect to the BEI consumption for that sector, of around 1 MWh/year per capita. Other sectors, such as municipal buildings, industry-ETS, municipal fleet, public transport, and agriculture, forestry and fisheries, have a minimal per capita consumption of less than 1 MWh/year per capita. Overall, the situation depicted in the MEIs is very much in line with what was reported in the BEIs, with respect to both the shares for types of fuel and sectors, as well as for the per capita consumption, confirming the initial insight taken from Section 2.1.4, suggesting that the transition to a greener energy future still requires additional efforts to achieve EU targets.

Table 27. Energy consumption reported in MEIs related to 2030 commitments – EU-27 (units TWh/year).

Sector / Sub-sector	Electricity	District heating and cooling	Fossil fuels	Renewable fuels	TOTAL	SHARE
Municipal buildings, equipment/facilities	3.5748	1.9358	2.9197	0.0659	8.4961	2.54%
Residential buildings	22.7362	9.5401	46.2472	5.0243	83.5478	24.96%
Tertiary (non-municipal) buildings,	25.8861	4.0820	20.7027	0.5958	51.2667	15.32%

Sector / Sub-sector	Electricity	District heating and cooling	Fossil fuels	Renewable fuels	TOTAL	SHARE
Industry Non-ETS	15.3102	4.2256	15.6158	0.7777	35.9293	10.74%
Industry-ETS	0.2082	0.0268	0.4703	0.0073	0.7125	0.21%
Buildings, equipment/facilities non-allocated	8.8521	8.0578	30.7339	0.2519	47.8956	14.31%
Subtotal - Stationary energy	76.5676	27.8681	116.6896	6.7228	227.848	68.08%
Municipal fleet	0.0027		1.5034	0.0277	1.5338	0.46%
Public transport	0.9665		7.6460	0.2122	8.8247	2.64%
Private and commercial transport	0.0638		66.6240	1.7327	68.4205	20.44%
Transport non-allocated	1.0459		23.7964	1.1065	25.9488	7.75%
Subtotal - Transport	2.0788		99.5698	3.0792	104.728	31.29%
Agriculture, Forestry, Fisheries	0.1853	0.0273	1.5434	0.0458	1.8019	0.54%
Other non-allocated	0.0836		0.2290	0.0000	0.3127	0.09%
Subtotal - Other	0.2689	0.0273	1.7725	0.0458	2.1146	0.63%
TOTAL	78.9153	27.8954	218.0318	9.8478	334.691	
SHARE	23.58%	8.33%	65.14%	2.94%		

Source: JRC elaboration based on GCoM data

Table 28. Energy consumption reported in MEIs related to 2030 commitments – EU-27 (units %).

Sector / Sub-sector	Electricity	District heating and cooling	Fossil fuels	Renewable fuels	TOTAL
Municipal buildings, equipment/facilities	1.07%	0.58%	0.87%	0.02%	2.54%
Residential buildings	6.79%	2.85%	13.82%	1.50%	24.96%
Tertiary (non-municipal) buildings, equipment/facilities	7.73%	1.22%	6.19%	0.18%	15.32%
Industry Non-ETS	4.57%	1.26%	4.67%	0.23%	10.74%
Industry-ETS	0.06%	0.01%	0.14%	0.00%	0.21%
Buildings, equipment/facilities non-allocated	2.64%	2.41%	9.18%	0.08%	14.31%
Subtotal - Stationary energy	22.88%	8.33%	34.86%	2.01%	68.08%
Municipal fleet	0.00%		0.45%	0.01%	0.46%
Public transport	0.29%		2.28%	0.06%	2.64%
Private and commercial transport	0.02%		19.91%	0.52%	20.44%

Transport non-allocated	0.31%		7.11%	0.33%	7.75%
Sector / Sub-sector	Electricity	District heating and cooling	Fossil fuels	Renewable fuels	TOTAL
Subtotal - Transport	0.62%	0.00%	29.75%	0.92%	31.29%
Agriculture, Forestry, Fisheries	0.06%	0.01%	0.46%	0.01%	0.54%
Other non-allocated	0.02%		0.07%	0.00%	0.09%
Subtotal - Other	0.08%	0.01%	0.53%	0.01%	0.63%
TOTAL	23.58%	8.33%	65.14%	2.94%	

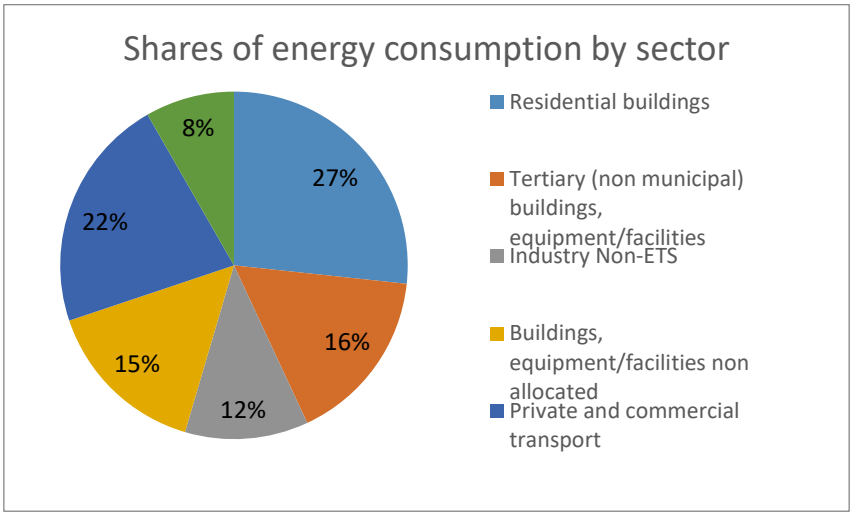
Source: JRC elaboration based on GCoM data

Table 29. Energy consumption reported in MEIs related to 2030 commitments – EU-27 (units MWh/year per capita).

Sector / Sub-sector	Electricity	District heating and cooling	Fossil fuels	Renewable fuels	TOTAL
Municipal buildings, equipment/facilities	0.1876	0.1016	0.1532	0.0035	0.4459
Residential buildings	1.1932	0.5007	2.4271	0.2637	4.3846
Tertiary (non-municipal) buildings, equipment/facilities	1.3585	0.2142	1.0865	0.0313	2.6905
Industry Non-ETS	0.8035	0.2218	0.8195	0.0408	1.8856
Industry-ETS	0.0109	0.0014	0.0247	0.0004	0.0374
Buildings, equipment/facilities non-allocated	0.4646	0.4229	1.6129	0.0132	2.5136
Subtotal - Stationary energy	4.0183	1.4625	6.1239	0.3528	11.9575
Municipal fleet	0.0001		0.0789	0.0015	0.0805
Public transport	0.0507		0.4013	0.0111	0.4631
Private and commercial transport	0.0033		3.4965	0.0909	3.5907
Transport non-allocated	0.0549		1.2488	0.0581	1.3618
Subtotal - Transport	0.1091	0.0000	5.2255	0.1616	5.4962
Agriculture, Forestry, Fisheries	0.0097	0.0014	0.0810	0.0024	0.0946
Other non-allocated	0.0044		0.0120	0.0000	0.0164
Subtotal - Other	0.0141	0.0014	0.0930	0.0024	0.1110
TOTAL	4.1415	1.4640	11.4424	0.5168	17.5647

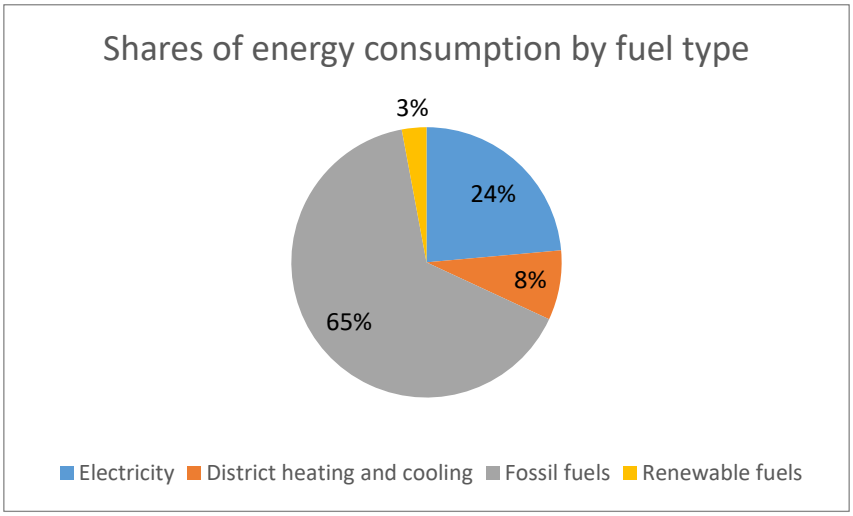
Source: JRC elaboration based on GCoM data

Figure 16. Shares of energy consumption by sector, reported in MEIs related to 2030 commitments – EU-27.



Source: JRC elaboration based on GCoM data

Figure 17. Shares of energy consumption by fuel type, reported in MEIs related to 2030 commitments – EU-27.



Source: JRC elaboration based on GCoM data

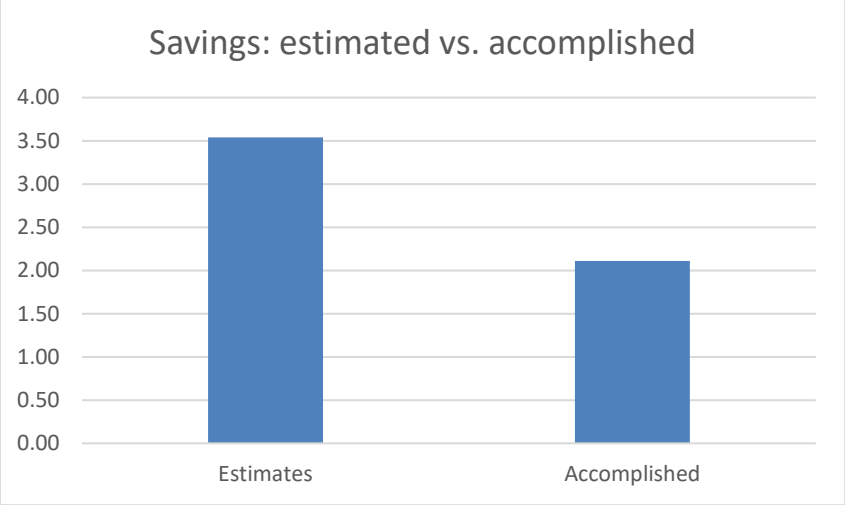
2.2.5 Achievements in energy savings

Focusing on the actual savings for signatories holding a MEI, the total estimated savings are presented next, identifying the most successful signatories in accomplishing significant savings for 2030.

2.2.5.1 Accomplished savings

The total estimated savings, when computing the difference between the BEI and the MEI consumption for the signatories holding a MEI, amounts to 39 TWh/year (2.11 MWh/year per capita). In consequence, the accomplished mean per capita savings of 2.11 MWh/year fall short to the declared estimated savings of 3.5 MWh/year (see **Figure 18**). In total, the reduced consumption amounts to 10.4% of the reported BEI, and 11.6% of the MEI consumption.

Figure 18. Total energy savings, estimated vs. accomplished, related to 2030 commitments – EU-27 (units MWh/year per capita).



Source: JRC elaboration based on GCoM data

Examining the accomplished savings for every city with a coherent sector-wise monitoring history, the annual savings rate is computed between the absolute consumption in the BEI and the last MEI. The highest rates correspond to Dublin, Wroclaw and Lisbon, saving 0.61, 0.25 and 0.25 TWh/year, respectively. The top-10 cities, regarding their yearly absolute and per capita savings rates, is presented in **Table 30**.

Table 30. Top-10 signatories with highest savings rates, related to 2030 commitments – EU-27 (units TWh/year)

CITY	COUNTRY	BASE YEAR	LAST MONITORING YEAR	ABSOLUTE SAVINGS	ABSOLUTE SAVINGS ANNUAL RATE	SAVINGS PER CAPITA (MWh/year)	SAVINGS PER CAPITA ANNUAL RATE (MWh/year)
Dublin City Council	Ireland	2006	2016	6.11	0.61	11.02	1.10
Wroclaw	Poland	1990	2015	6.29	0.25	9.89	0.39
Lisboa	Portugal	2002	2016	3.45	0.25	6.84	0.48
Sevilla	Spain	2005	2016	2.39	0.22	3.42	0.31
Murcia	Spain	2007	2015	1.47	0.18	3.33	0.41
Amiens	France	2014	2016	0.34	0.17	2.58	1.29
Santiago de Compostela	Spain	2015	2019	0.6	0.15	6.15	1.54
Genova	Italy	2005	2016	1.63	0.15	2.8	0.25
Bologna	Italy	2005	2018	1.65	0.13	4.23	0.32
Vértes - Gerecse Vidékfejlesztési Közösség	Hungary	2016	2019	0.35	0.12	8.63	2.87

Source: JRC elaboration based on GCoM data

3 Energy consumption and savings in non-EU

3.1 2020 commitments – Europe, non-EU

In this section, the analysis focuses on Europe, non-EU signatories, with a commitment for the target year of 2020.

3.1.1 BEI energy consumption

Regarding signatories in non-EU with 2020 commitments, there are 194 action plans with a BEI, holding 37.4 million inhabitants. For this subset of signatories, fossil fuels has the highest share in the total energy consumption (70%), followed by electricity (23%), while the sector with the highest share is residential buildings (40%), followed by industry non-ETS (21%). See **Tables 31-33** for the absolute, percentage and per capita values, respectively, and **Figures 19-20** for the visualisation of the shares for the most significant sectors and fuel sources, respectively.

Examining the per capita consumption, it can be highlighted that fossil fuels represent the maximum consumption value, with 11 MWh/year per capita, while renewable fuels represent the minimum consumption of 0.17 MWh/year per capita. Besides residential buildings (with a declared 6.3 MWh/year per capita), the activity sectors with greatest per capita consumption are industry non-ETS, buildings, equipment/facilities non-allocated, and private and commercial transport, with 3.3, 1.9 and 1.8 MWh/year per capita, respectively; as opposite to other sectors, such as municipal buildings, industry-ETS, municipal fleet, public transport, and agriculture, forestry and fisheries, having a minimal per capita consumption of less than 1 MWh/year.

Table 31. Energy consumption reported in BEIs related to 2020 commitments –non-EU (units TWh/year).

Sector / Sub-sector	Electricity	District heating and cooling	Fossil fuels	Renewable fuels	TOTAL	SHARE
Municipal buildings, equipment/facilities	4.3480	4.4748	6.9013	0.2034	15.9276	2.68%
Residential buildings	46.8694	30.5468	154.1713	4.7183	236.3058	39.80%
Tertiary (non-municipal) buildings, equipment/facilities	22.1132	3.7183	25.3619	0.6351	51.8285	8.73%
Industry Non-ETS	23.0199	0.6393	99.5882	0.1839	123.4314	20.79%
Industry-ETS	0.2578	0.0140	0.4193		0.6910	0.12%
Buildings, equipment/facilities non-allocated	34.9415	0.6396	34.2424	0.5636	70.3872	11.86%
Subtotal - Stationary energy	131.5497	40.0329	320.6844	6.3044	498.5714	83.97%
Municipal fleet	0.0127		0.6834	0.0125	0.7086	0.12%
Public transport	2.4449		7.7300	0.0230	10.1979	1.72%
Private and commercial transport	0.0580		66.9501	0.0308	67.0389	11.29%
Transport non-allocated			16.8608	0.0061	16.8669	2.84%
Subtotal - Transport	2.5156		92.2243	0.0725	94.8123	15.97%
Agriculture, Forestry, Fisheries	0.0847	0.0011	0.1884	0.0680	0.3422	0.06%

Sector / Sub-sector	Electricity	District heating and cooling	Fossil fuels	Renewable fuels	TOTAL	SHARE
Other non-allocated	0.0018				0.0018	0.00%
Subtotal - Other	0.0865	0.0011	0.1884	0.0680	0.3440	0.06%
TOTAL	134.1518	40.0339	413.0970	6.4449	593.7277	
SHARE	22.59%	6.74%	69.58%	1.09%		

Source: JRC elaboration based on GCoM data

Table 32. Energy consumption reported in BEIs related to 2020 commitments – non-EU (units %).

Sector / Sub-sector	Electricity	District heating and cooling	Fossil fuels	Renewable fuels	TOTAL
Municipal buildings, equipment/facilities	0.73%	0.75%	1.16%	0.03%	2.68%
Residential buildings	7.89%	5.14%	25.97%	0.79%	39.80%
Tertiary (non-municipal) buildings, equipment/facilities	3.72%	0.63%	4.27%	0.11%	8.73%
Industry Non-ETS	3.88%	0.11%	16.77%	0.03%	20.79%
Industry-ETS	0.04%	0.00%	0.07%		0.12%
Buildings, equipment/facilities non-allocated	5.89%	0.11%	5.77%	0.09%	11.86%
Subtotal - Stationary energy	22.16%	6.74%	54.01%	1.06%	83.97%
Municipal fleet	0.00%		0.12%	0.00%	0.12%
Public transport	0.41%		1.30%	0.00%	1.72%
Private and commercial transport	0.01%		11.28%	0.01%	11.29%
Transport non-allocated			2.84%	0.00%	2.84%
Subtotal - Transport	0.42%	0.00%	15.53%	0.01%	15.97%
Agriculture, Forestry, Fisheries	0.01%	0.00%	0.03%	0.01%	0.06%
Other non-allocated	0.00%				0.00%
Subtotal - Other	0.01%	0.00%	0.03%	0.01%	0.06%
TOTAL	22.59%	6.74%	69.58%	1.09%	

Source: JRC elaboration based on GCoM data

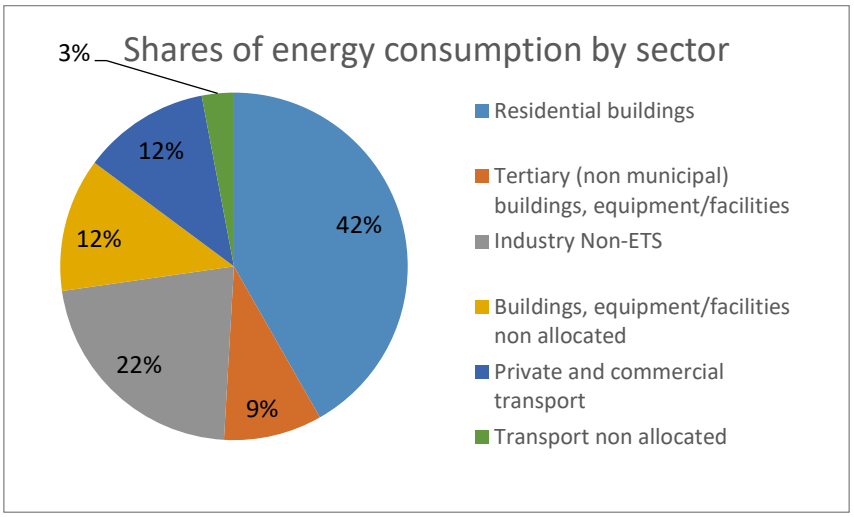
Table 33. Energy consumption reported in BEIs related to 2020 commitments – non-EU (units MWh/year per capita).

Sector / Sub-sector	Electricity	District heating and cooling	Fossil fuels	Renewable fuels	TOTAL
Municipal buildings, equipment/facilities	0.1161	0.1195	0.1842	0.0054	0.4252
Residential buildings	1.2513	0.8155	4.1160	0.1260	6.3087
Tertiary (non-municipal) buildings, equipment/facilities	0.5904	0.0993	0.6771	0.0170	1.3837

Sector / Sub-sector	Electricity	District heating and cooling	Fossil fuels	Renewable fuels	TOTAL
Industry Non-ETS	0.6146	0.0171	2.6587	0.0049	3.2953
Industry-ETS	0.0069	0.0004	0.0112		0.0184
Buildings, equipment/facilities non-allocated	0.9328	0.0171	0.9142	0.0150	1.8791
Subtotal - Stationary energy	3.5120	1.0688	8.5614	0.1683	13.3105
Municipal fleet	0.0003		0.0182	0.0003	0.0189
Public transport	0.0653		0.2064	0.0006	0.2723
Private and commercial transport	0.0015		1.7874	0.0008	1.7898
Transport non-allocated			0.4501	0.0002	0.4503
Subtotal - Transport	0.0672	0.0000	2.4621	0.0019	2.5312
Agriculture, Forestry, Fisheries	0.0023	0.0000	0.0050	0.0018	0.0091
Other non-allocated	0.0000				0.0000
Subtotal - Other	0.0023	0.0000	0.0050	0.0018	0.0092
TOTAL	3.5815	1.0688	11.0286	0.1721	15.8509

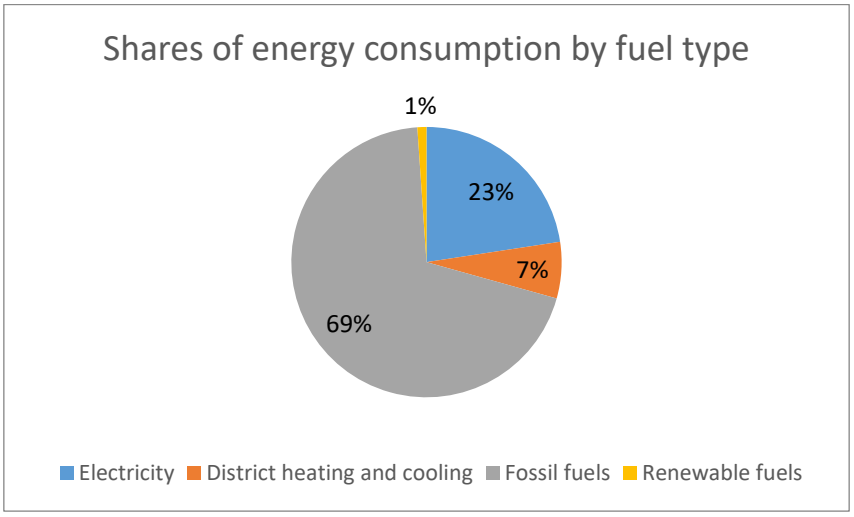
Source: JRC elaboration based on GCoM data

Figure 19. Shares of energy consumption by sector, reported in BEIs related to 2020 commitments – non-EU.



Source: JRC elaboration based on GCoM data

Figure 20. Shares of energy consumption by fuel type, reported in BEIs related to 2020 commitments – non-EU.



Source: JRC elaboration based on GCoM data

3.1.2 Energy supply

Examining the reported energy output from this subset of signatories holding a BEI, there are 49 out of the 194, having also reported some local heat/cold or electricity production.

3.1.2.1 Local electricity production and purchases/sales of renewable energy certificates

The highest share of local electricity production corresponds to CHP (49%), followed by hydroelectric (35%) and wind power (15%). See **Table 34** for the complete description of the total production by technology. Furthermore, comparing non-renewable with renewable energy technologies, they have almost the same share, with 49% and 51%, respectively. Such a volume of production, for both renewables and non-renewables (considered jointly), represents over 10% of the BEI electricity consumption for the cities reporting local electricity production.

Comparing with the local electricity production declared by EU-27 signatories, the non-EU signatories do not rely on photovoltaics, but require other technologies such as CHP, hydroelectric or wind power. This could be

explained according to their geographical location, as their median latitude is 50 degrees north, where solar irradiation is lower than the median of 45 degrees associated to EU-27 signatories.

In per capita terms, see **Table 35**, the reported local electricity production amounts to 0.17 MWh/year for both non-renewable and renewable technologies. **Figure 21** shows the shares of the most representative electricity production sources and technologies.

Examining the purchases or sales of renewable energy certificates, there are 6 action plans reporting purchases/sales (from Norway, United Kingdom, Switzerland and Iceland). Still taking these few observations as being indicative of the purchase/sales behavior of 2020 non-EU signatories, they report a total of 0.72 TWh/year, representing 7.3% of their total BEI electricity consumption. In per capita terms, it amounts to 0.75 MWh/year per capita.

Table 34. Local electricity production in BEIs related to 2020 commitments – non-EU (units TWh/year).

Energy production technology	Non- renewable	Renewable	TOTAL	SHARE
Photovoltaics		0.0007	0.0007	0.09%
Wind		0.1240	0.1240	15.21%
Hydroelectric		0.2889	0.2889	35.43%
Geothermal			0.0000	0.00%
Local electricity production plants - Combined Heat and Power	0.4017		0.4017	49.27%
Local electricity production plants - Other (ETS and large-scale plants > 20 MW not recommended)			0.0000	0.00%
TOTAL	0.4017	0.4137	0.8154	
SHARE ON TOTAL ELECTRICITY PRODUCTION	49.27%	50.73%		
SHARE ON TOTAL ELECTRICITY CONSUMPTION*	0.30% (5.24%)	0.31% (5.4%)		

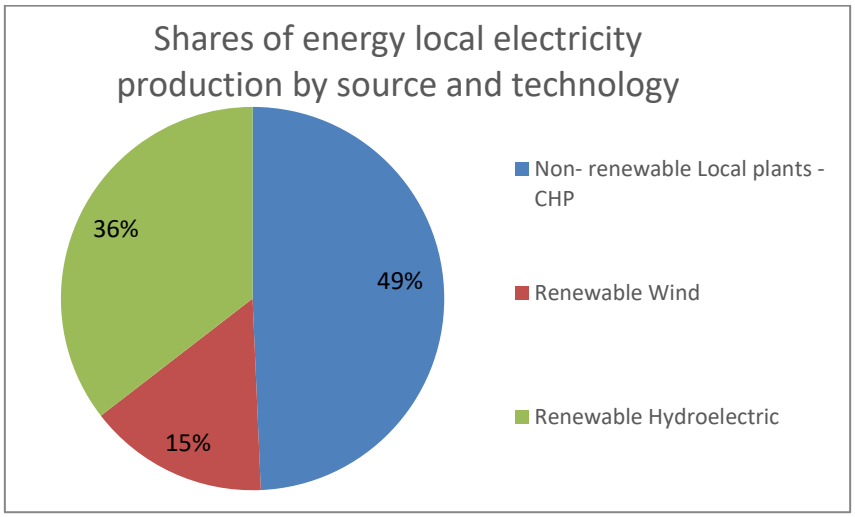
*Compared to the total electricity consumption in BEI (only for cities reporting energy supply)
Source: JRC elaboration based on GCoM data

Table 35. Local electricity production in BEIs related to 2020 commitments – non-EU (units MWh/year per capita).

Energy production technology	Non- renewable	Renewable	TOTAL
Photovoltaics		0.0003	0.0003
Wind		0.0532	0.0532
Hydroelectric		0.1239	0.1239
Geothermal			0.0000
Local electricity production plants - Combined Heat and Power	0.1722		0.1722
Local electricity production plants - Other (ETS and large-scale plants > 20 MW not recommended)			0.0000
TOTAL	0.1722	0.1773	0.3496

Source: JRC elaboration based on GCoM data

Figure 21. Shares of local electricity production by energy source and technology, reported in BEIs related to 2020 commitments – non-EU.



Source: JRC elaboration based on GCoM data

3.1.2.2 Local heat/cold production

Considering local heat/cold supply, the highest share of local heat/cold production corresponds with district heating (heat only), with 92%. See **Table 36** for the complete description of the total production by technology. Besides, for these cities, non-renewable energy sources has the highest share in the total local heat/cold production (99.7%), covering almost the totality of their BEI heat/cold consumption. **Table 37** shows the per capita production with non-renewable fuels, which amounts to 3.6 MWh/year. **Figure 22** shows the shares of the most representative heat/cold production sources and technologies.

Table 36. Local heat/cold production in BEIs related to 2020 commitments – non-EU (units TWh/year).

Energy production technology	Non- renewable	Renewable	TOTAL	SHARE
Local heat/cold production plants - Combined Heat and Power	1.2993		1.2993	6.97%
Local heat/cold production plants - District heating (heat-only)	17.0962	0.0589	17.1551	92.03%
Local heat/cold production plants – Other	0.1857		0.1857	1.00%
TOTAL	18.5812	0.0589	18.6401	
SHARE ON TOTAL HEAT/COLD PRODUCTION	99.68%	0.32%		
SHARE ON TOTAL HEAT/COLD CONSUMPTION*	46.41% (119.8%)	0.15% (0.38%)		

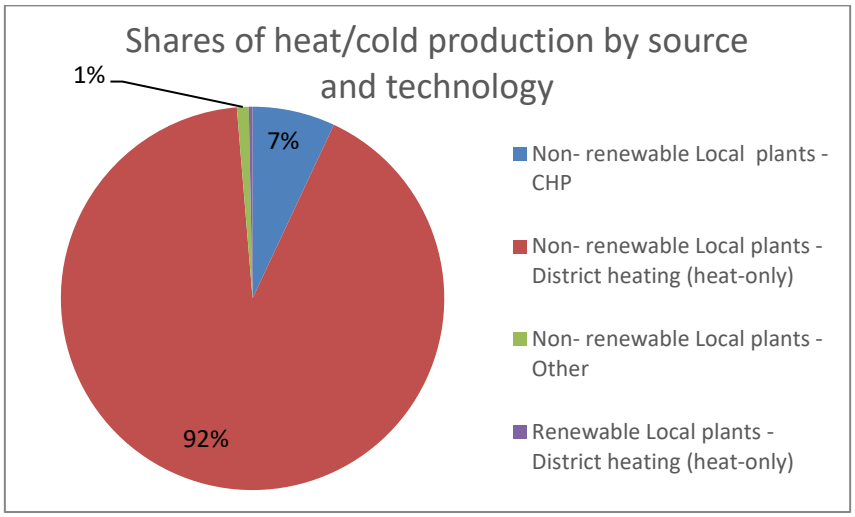
* Compared to the total heat/cold consumption in BEI (only for cities reporting local heat/cold production)
Source: JRC elaboration based on GCoM data

Table 37. Local heat/cold production in BEIs related to 2020 commitments – non-EU (units MWh/year per capita).

Energy production technology	Non-renewable	Renewable	TOTAL
Local heat/cold production plants - Combined Heat and Power	0.2521		0.2521
Local heat/cold production plants - District heating (heat-only)	3.3169	0.0114	3.3284
Local heat/cold production plants – Other	0.0360		0.0360
TOTAL	3.6050	0.0114	3.6165

Source: JRC elaboration based on GCoM data

Figure 22. Shares of local heat/cold production by energy source and technology, reported in BEIs related to 2020 commitments – non-EU.



Source: JRC elaboration based on GCoM data

3.1.3 Savings and renewable energy production

Looking at the reported estimated savings and renewable energy production from the signatories having reported a BEI, there are 121, out of the 194, having also reported some estimated savings or renewable energy production.

3.1.3.1 Estimated savings

The highest share of estimated savings corresponds to stationary energy, with 55% of the total estimated savings, followed by local heat/cold production (15%) and transport (14%). The details can be seen in **Table 38**. The total savings represent 13% of the reported consumption for these signatories (comparing the total consumption in BEI, only for cities having declared either energy savings or energy production by the target year). In total, as presented in **Table 39**, signatories estimate that they will be able to save, on average, 2.16 MWh/year per capita, by 2020. **Figure 23** shows the shares of each activity sector in the total estimated savings.

Table 38. Estimated energy savings by 2020 declared by signatories – non-EU (units TWh/year).

Sector	Estimated energy savings	SHARE
Stationary energy (includes, Municipal buildings, Lighting, Residential buildings, Tertiary buildings, Industry)	19.1137	55.08%
Transport	4.8415	13.95%
Local electricity production	1.3703	3.95%
Local heat/cold production	5.3373	15.38%
Other	4.0396	11.64%
TOTAL	34.7023	

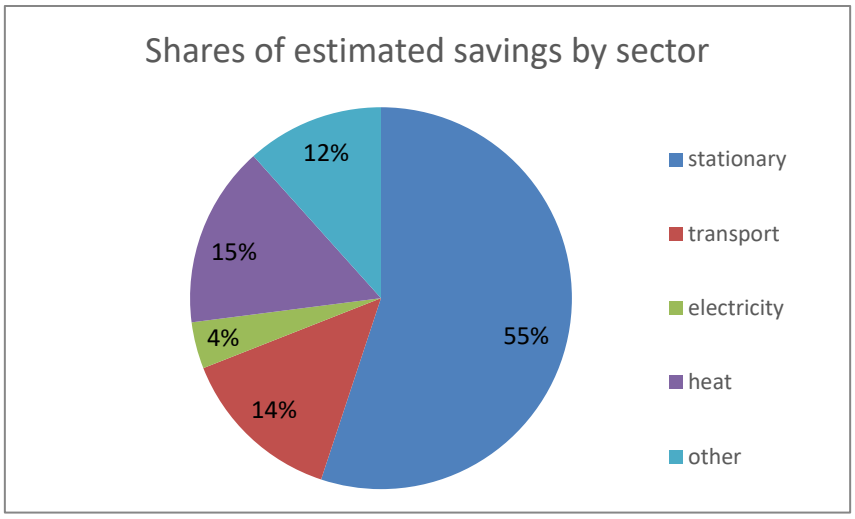
Source: JRC elaboration based on GCoM data

Table 39. Estimated energy savings by 2020 declared by signatories – non-EU (units MWh/year per capita).

Sector	Estimated energy savings
Stationary energy (includes, Municipal buildings, Lighting, Residential buildings, Tertiary buildings, Industry)	1.1903
Transport	0.3015
Local electricity production	0.0853
Local heat/cold production	0.3324
Other	0.2516
TOTAL	2.1610

Source: JRC elaboration based on GCoM data

Figure 23. Shares of estimated savings by sector, reported in BEIs related to 2020 commitments – non-EU.



Source: JRC elaboration based on GCoM data

3.1.3.2 Renewable energy production

The highest share of renewable energy production corresponds to the local heat/cold production, with 32% of the total estimated renewable energy production. The details can be seen in **Table 40**. The total renewable energy production represents 1.28% of the reported consumption for these signatories (comparing the total

consumption in BEI, only for cities having declared either energy savings or energy production by the target year). In total, as presented in **Table 41**, signatories estimate that they will be able to produce, in average, 0.21 MWh/year per capita, by 2020. **Figure 24** shows the shares of each activity sector in the total estimated renewable energy production.

Table 40. Estimated renewable energy production by 2020 declared by signatories – non-EU (units TWh/year).

Sector	Estimated renewable energy production	SHARE
Stationary energy (includes, Municipal buildings, Lighting, Residential buildings, Tertiary buildings, Industry)	0.9221	27.19%
Transport	0.3176	9.36%
Local electricity production	0.8945	26.38%
Local heat/cold production	1.0906	32.16%
Other	0.1664	4.91%
TOTAL	3.3912	

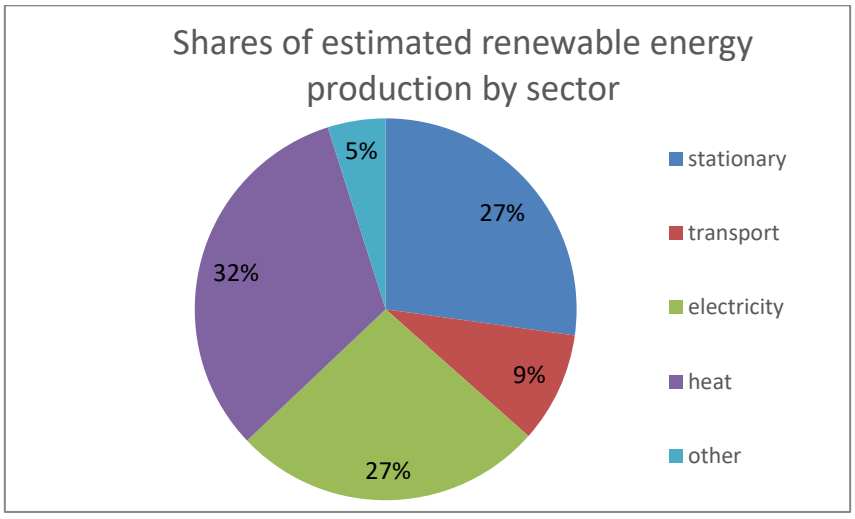
Source: JRC elaboration based on GCoM data

Table 41. Estimated renewable energy production by 2020 declared by signatories – non-EU (units MWh/year per capita).

Sector	Estimated renewable energy production
Stationary energy (includes, Municipal buildings, Lighting, Residential buildings, Tertiary buildings, Industry)	0.0574
Transport	0.0198
Local electricity production	0.0557
Local heat/cold production	0.0679
Other	0.0104
TOTAL	0.2112

Source: JRC elaboration based on GCoM data

Figure 24. Shares of estimated renewable energy production by sector, reported in BEIs related to 2020 commitments – non-EU.



Source: JRC elaboration based on GCoM data

3.1.4 MEI energy consumption

Considering non-EU signatories with 2020 commitments, there are 53 action plans having reported a MEI, representing 8.6 million inhabitants. For monitoring reports, it can be seen that the type of fuel with the greatest total share of consumption is fossil fuels (70%), followed by electricity (24%). Additionally, the sector with the highest share is residential buildings (38%), followed by private and commercial transport (20%). It is noticed here that industry non-ETS diminishes its share from 21% in BEIs, to 8%. See **Tables 42-44** for the absolute, percentage and per capita values, respectively, of the energy consumption reported in MEIs, and **Figures 25-26** for the visualisation of the shares for the most significant sectors and fuel sources, respectively.

Examining the per capita consumption, it can be pointed out that fossil fuels represent the maximum consumption value, with 9 MWh/year per capita, decreasing in 2 MWh/year per capita with respect to the BEI consumption, while renewable fuels have the lowest value, with 0.13 MWh/year per capita. Focusing on the activity sectors, residential buildings has the highest consumption value, with 4.9 MWh/year per capita, followed by private and commercial transport with 2.6 MWh/year per capita. Other sectors, such as municipal buildings, industry-ETS, municipal fleet, public transport, and agriculture, forestry and fisheries, have a minimal per capita consumption of less than 1 MWh/year per capita. Overall, it is interesting to see that the consumption in the (non-ETS) industry and non-allocated buildings, equipment/facilities sectors dropped with respect to the declared BEI consumption, from 3.3 to 1 and from 1.8 to 1 MWh/year per capita, respectively, while the consumption in private and commercial transport increased from 1.8 to 2.6 MWh/year per capita.

Table 42. Energy consumption reported in MEIs related to 2020 commitments – non-EU (units TWh/year).

Sector / Sub-sector	Electricity	District heating and cooling	Fossil fuels	Renewable fuels	TOTAL	SHARE
Municipal buildings, equipment/facilities	0.8540	1.0233	0.9820	0.1120	2.9713	2.64%
Residential buildings	8.7670	4.2667	28.9341	0.7557	42.7235	37.99%
Tertiary (non-municipal) buildings, equipment/facilities	9.1107	0.5197	7.3862	0.1163	17.1330	15.24%
Industry Non-ETS	4.0505	0.2278	5.0235	0.0648	9.3666	8.33%

Sector / Sub-sector	Electricity	District heating and cooling	Fossil fuels	Renewable fuels	TOTAL	SHARE
Industry-ETS	0.3102	0.0095	0.3680		0.6876	0.61%
Buildings, equipment/facilities non-allocated	3.2530		5.7045	0.0287	8.9861	7.99%
Subtotal - Stationary energy	26.3453	6.0470	48.3983	1.0774	81.8681	72.80%
Municipal fleet	0.0058		0.2027	0.0010	0.2095	0.19%
Public transport	0.3094		3.8524	0.0010	4.1628	3.70%
Private and commercial transport	0.0404		22.4151	0.0158	22.4713	19.98%
Transport non-allocated			3.4167		3.4167	3.04%
Subtotal - Transport	0.3555		29.8869	0.0179	30.2604	26.91%
Agriculture, Forestry, Fisheries	0.2146	0.0041	0.0510	0.0596	0.3294	0.29%
Other non-allocated	0.0000	0.0001			0.0001	0.00%
Subtotal - Other	0.2146	0.0042	0.0510	0.0596	0.3295	0.29%
TOTAL	26.9155	6.0512	78.3362	1.1549	112.4579	
SHARE	23.93%	5.38%	69.66%	1.03%		

Source: JRC elaboration based on GCoM data

Table 43. Energy consumption reported in MEIs related to 2020 commitments – non-EU (units %).

Sector / Sub-sector	Electricity	District heating and cooling	Fossil fuels	Renewable fuels	TOTAL
Municipal buildings, equipment/facilities	0.76%	0.91%	0.87%	0.10%	2.64%
Residential buildings	7.80%	3.79%	25.73%	0.67%	37.99%
Tertiary (non-municipal) buildings, equipment/facilities	8.10%	0.46%	6.57%	0.10%	15.24%
Industry Non-ETS	3.60%	0.20%	4.47%	0.06%	8.33%
Industry-ETS	0.28%	0.01%	0.33%		0.61%
Buildings, equipment/facilities non-allocated	2.89%		5.07%	0.03%	7.99%
Subtotal - Stationary energy	23.43%	5.38%	43.04%	0.96%	72.80%
Municipal fleet	0.01%		0.18%	0.00%	0.19%
Public transport	0.28%		3.43%	0.00%	3.70%
Private and commercial transport	0.04%		19.93%	0.01%	19.98%
Transport non-allocated			3.04%		3.04%

Subtotal - Transport	0.32%	0.00%	26.58%	0.02%	26.91%
Sector / Sub-sector	Electricity	District heating and cooling	Fossil fuels	Renewable fuels	TOTAL
Agriculture, Forestry, Fisheries	0.19%	0.00%	0.05%	0.05%	0.29%
Other non-allocated	0.00%	0.00%			0.00%
Subtotal - Other	0.19%	0.00%	0.05%	0.05%	0.29%
TOTAL	23.93%	5.38%	69.66%	1.03%	

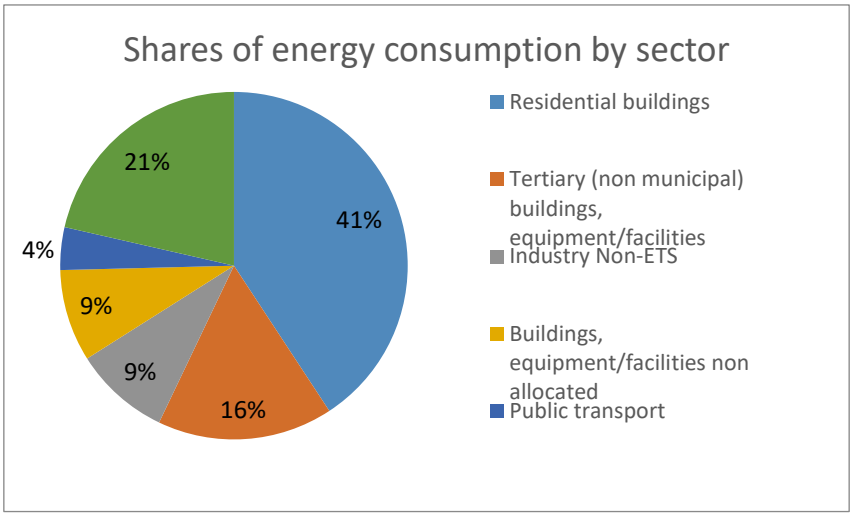
Source: JRC elaboration based on GCoM data

Table 44. Energy consumption reported in MEIs related to 2020 commitments – non-EU (units MWh/year per capita).

Sector / Sub-sector	Electricity	District heating and cooling	Fossil fuels	Renewable fuels	TOTAL
Municipal buildings, equipment/facilities	0.0987	0.1182	0.1135	0.0129	0.3433
Residential buildings	1.0130	0.4930	3.3434	0.0873	4.9368
Tertiary (non-municipal) buildings, equipment/facilities	1.0528	0.0601	0.8535	0.0134	1.9797
Industry Non-ETS	0.4680	0.0263	0.5805	0.0075	1.0823
Industry-ETS	0.0358	0.0011	0.0425		0.0795
Buildings, equipment/facilities non-allocated	0.3759		0.6592	0.0033	1.0384
Subtotal - Stationary energy	3.0442	0.6987	5.5925	0.1245	9.4600
Municipal fleet	0.0007		0.0234	0.0001	0.0242
Public transport	0.0357		0.4452	0.0001	0.4810
Private and commercial transport	0.0047		2.5901	0.0018	2.5966
Transport non-allocated			0.3948		0.3948
Subtotal - Transport	0.0411	0.0000	3.4535	0.0021	3.4966
Agriculture, Forestry, Fisheries	0.0248	0.0005	0.0059	0.0069	0.0381
Other non-allocated	0.0000	0.0000			0.0000
Subtotal - Other	0.0248	0.0005	0.0059	0.0069	0.0381
TOTAL	3.1101	0.6992	9.0519	0.1334	12.9947

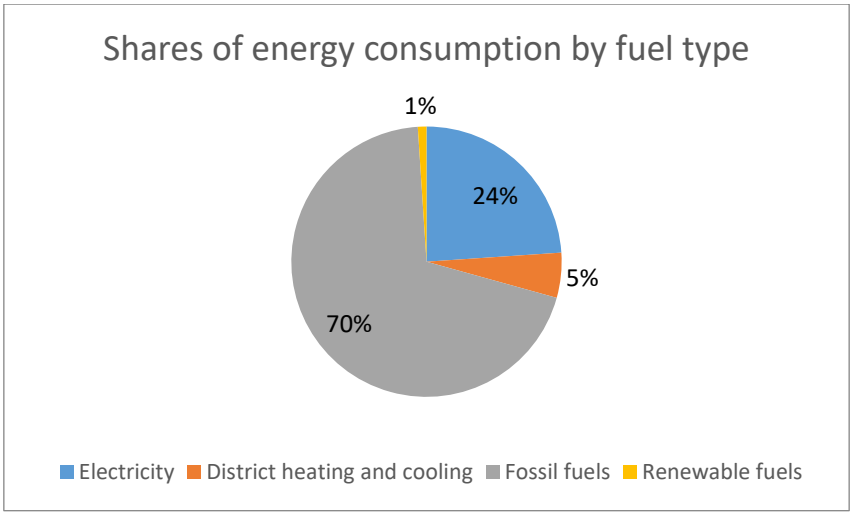
Source: JRC elaboration based on GCoM data

Figure 25. Shares of energy consumption by sector, reported in MEIs related to 2020 commitments – non-EU.



Source: JRC elaboration based on GCoM data

Figure 26. Shares of energy consumption by fuel type, reported in MEIs related to 2020 commitments – non-EU.



Source: JRC elaboration based on GCoM data

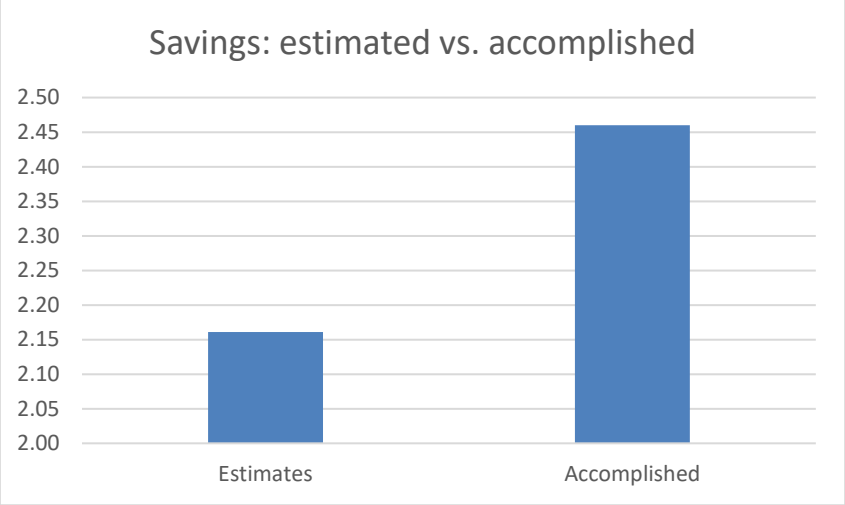
3.1.5 Achievements in energy savings

Now, in order to verify the actual savings for signatories holding a MEI, the total estimated savings are examined below, identifying the most successful signatories in accomplishing significant savings.

3.1.5.1 Accomplished savings

After computing the difference between the BEI and the MEI consumption for the 2020 non-EU signatories holding a MEI, the total estimated savings amount to 20.6 TWh/year (2.46 MWh/year per capita). Therefore, the accomplished mean per capita savings of 2.46 MWh/year exceed the declared estimated savings of 2.16 MWh/year (see **Figure 27**). The total reduced consumption is 15.5% of the reported BEI, and 18.3% of the MEI consumption.

Figure 27. Total energy savings, estimated vs. accomplished, related to 2020 commitments – non-EU (units MWh/year per capita).



Source: JRC elaboration based on GCoM data

Examining the accomplished savings for every city with a coherent sector-wise monitoring history, the annual savings rate is computed between the absolute consumption in the BEI and the last MEI. The highest yearly savings rates correspond with Sunderland, Cardiff and Leicester, saving 0.28, 0.27 and 0.22 TWh/year, respectively. The top-10 cities, regarding their yearly absolute and per capita savings rates, are presented in **Table 45**.

Table 45. Top-10 signatories with highest savings rates, related to 2020 commitments – non-EU (units TWh/year)

CITY	COUNTRY	BASE YEAR	LAST MONITORING YEAR	ABSOLUTE SAVINGS	ABSOLUTE SAVINGS ANNUAL RATE	SAVINGS PER CAPITA (MWh/year)	SAVINGS PER CAPITA ANNUAL RATE (MWh/year)
Sunderland	United Kingdom	2005	2007	0.56	0.28	1.98	1.0
Cardiff	United Kingdom	2005	2015	2.68	0.27	7.51	0.75
Leicester	United Kingdom	1990	2013	4.98	0.22	14.93	0.65
Milton Keynes	United Kingdom	2005	2014	1.83	0.2	7.06	0.78
Aberdeen	United Kingdom	2005	2012	1.31	0.19	5.71	0.81
Bristol	United Kingdom	2005	2013	1.45	0.18	3.3	0.41
Cherkasy	Ukraine	2009	2017	1.07	0.13	3.84	0.48
Gateshead	United Kingdom	2005	2008	0.35	0.12	1.82	0.60
Zürich	Switzerland	2005	2012	0.69	0.1	1.74	0.25
Truskavets	Ukraine	2012	2018	0.5	0.08	17.43	0.30

Source: JRC elaboration based on GCoM data

3.2 2030 Commitments – non-EU

In this section, the analysis focuses on non-EU signatories with a commitment for the target year of 2030.

3.2.1 BEI energy consumption

Considering signatories in non-EU with 2030 commitments, there are 133 action plans with a BEI, with an approximate population of 7.6 million inhabitants. It can be seen that the type of fuel with the greatest total share of consumption is fossil fuels (56%), followed by district heating and cooling (26%), and by electricity (14%). On the contrary to 2020 non-EU signatories, the share of district heating and cooling is almost 20% higher, while the one for electricity is almost 9% lower. Furthermore, the sector with the highest share is residential buildings (58%), followed by private and commercial transport (15%). See **Tables 46-48** for the absolute, percentage and per capita values, respectively, and **Figures 28-29** for the visualisation of the shares for the most significant sectors and fuel sources, respectively.

Examining the per capita consumption, it can be pointed out that the fossil fuels represent the maximum consumption value, with 4.7 MWh/year per capita, which decreased with respect to 2020 signatories, from 11 to 4.7 MWh/year per capita, followed by district heating and cooling, which doubled with respect to 2020 signatories, from 1.1 to 2.2 MWh/year per capita. Meanwhile, renewable fuels represent the minimum consumption, with 0.37 MWh/year per capita. The sectors with highest consumption are residential buildings (4.8 MWh/year per capita) and private and commercial transport (1.2 MWh/year per capita), while all the other sectors have a per capita consumption of less than 1 MWh/year.

Table 46. Energy consumption reported in BEIs related to 2030 commitments – non-EU (units TWh/year).

Sector / Sub-sector	Electricity	District heating and cooling	Fossil fuels	Renewable fuels	TOTAL	SHARE
Municipal buildings, equipment/facilities	0.9570	3.5836	1.6049	0.3057	6.4512	10.15%
Residential buildings	5.1062	11.4276	18.6024	1.6065	36.7426	57.80%
Tertiary (non-municipal) buildings, equipment/facilities	1.8903	1.0490	2.9238	0.0681	5.9312	9.33%
Industry Non-ETS	0.4392	0.3067	1.5504	0.0520	2.3484	3.69%
Industry-ETS	0.2140		0.3128		0.5268	0.83%
Buildings, equipment/facilities non-allocated	0.0016			0.2340	0.2356	0.37%
Subtotal - Stationary energy	8.6082	16.3669	24.9943	2.2663	52.2357	82.18%
Municipal fleet	0.0000		0.2581	0.0087	0.2669	0.42%
Public transport	0.1919		0.8289	0.0013	1.0221	1.61%
Private and commercial transport			9.1222	0.1256	9.2478	14.55%
Transport non-allocated			0.0011		0.0011	0.00%
Subtotal - Transport	0.1919		10.2104	0.1356	10.5379	16.58%
Agriculture, Forestry, Fisheries	0.0815	0.0650	0.1980	0.4433	0.7878	1.24%
Other non-allocated	0.0018				0.0018	0.00%

Sector / Sub-sector	Electricity	District heating and cooling	Fossil fuels	Renewable fuels	TOTAL	SHARE
Subtotal - Other	0.0833	0.0650	0.1980	0.4433	0.7896	1.24%
TOTAL	8.8835	16.4319	35.4027	2.8452	63.5633	
SHARE	13.98%	25.85%	55.70%	4.48%		

Source: JRC elaboration based on GCoM data

Table 47. Energy consumption reported in BEIs related to 2030 commitments – non-EU (units %).

Sector / Sub-sector	Electricity	District heating and cooling	Fossil fuels	Renewable fuels	TOTAL
Municipal buildings, equipment/facilities	1.51%	5.64%	2.52%	0.48%	10.15%
Residential buildings	8.03%	17.98%	29.27%	2.53%	57.80%
Tertiary (non-municipal) buildings, equipment/facilities	2.97%	1.65%	4.60%	0.11%	9.33%
Industry Non-ETS	0.69%	0.48%	2.44%	0.08%	3.69%
Industry-ETS	0.34%		0.49%		0.83%
Buildings, equipment/facilities non-allocated	0.00%			0.37%	0.37%
Subtotal - Stationary energy	13.54%	25.75%	39.32%	3.57%	82.18%
Municipal fleet	0.00%		0.41%	0.01%	0.42%
Public transport	0.30%		1.30%	0.00%	1.61%
Private and commercial transport			14.35%	0.20%	14.55%
Transport non-allocated			0.00%		0.00%
Subtotal - Transport	0.30%	0.00%	16.06%	0.21%	16.58%
Agriculture, Forestry, Fisheries	0.13%	0.10%	0.31%	0.70%	1.24%
Other non-allocated	0.00%				0.00%
Subtotal - Other	0.13%	0.10%	0.31%	0.70%	1.24%
TOTAL	13.98%	25.85%	55.70%	4.48%	

Source: JRC elaboration based on GCoM data

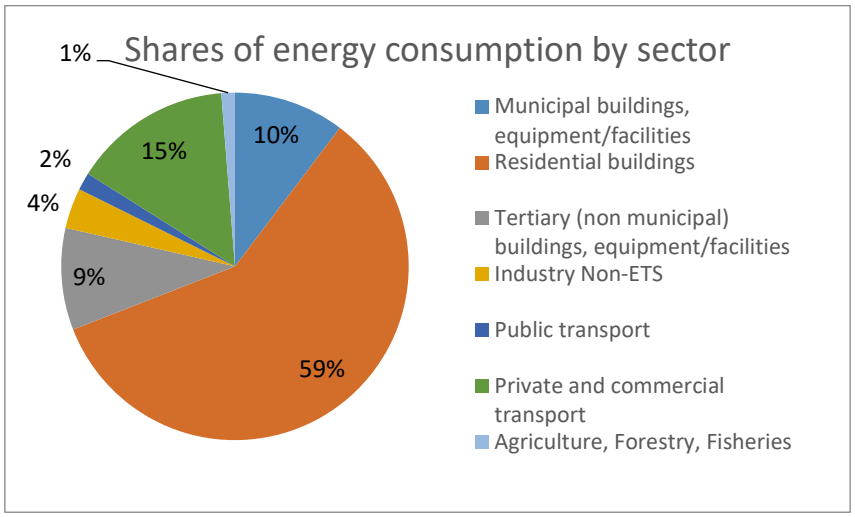
Table 48. Energy consumption reported in BEIs related to 2030 commitments – non-EU (units MWh/year per capita).

Sector / Sub-sector	Electricity	District heating and cooling	Fossil fuels	Renewable fuels	TOTAL
Municipal buildings, equipment/facilities	0.1260	0.4718	0.2113	0.0402	0.8493
Residential buildings	0.6722	1.5045	2.4491	0.2115	4.8373
Tertiary (non-municipal) buildings, equipment/facilities	0.2489	0.1381	0.3849	0.0090	0.7809
Industry Non-ETS	0.0578	0.0404	0.2041	0.0068	0.3092

Sector / Sub-sector	Electricity	District heating and cooling	Fossil fuels	Renewable fuels	TOTAL
Industry-ETS	0.0282		0.0412		0.0694
Buildings, equipment/facilities non-allocated	0.0002			0.0308	0.0310
Subtotal - Stationary energy	1.1333	2.1547	3.2906	0.2984	6.8770
Municipal fleet	0.0000		0.0340	0.0011	0.0351
Public transport	0.0253		0.1091	0.0002	0.1346
Private and commercial transport			1.2010	0.0165	1.2175
Transport non-allocated			0.0001		0.0001
Subtotal - Transport	0.0253	0.0000	1.3442	0.0179	1.3873
Agriculture, Forestry, Fisheries	0.0107	0.0086	0.0261	0.0584	0.1037
Other non-allocated	0.0002				0.0002
Subtotal - Other	0.0110	0.0086	0.0261	0.0584	0.1040
TOTAL	1.1695	2.1633	4.6609	0.3746	8.3683

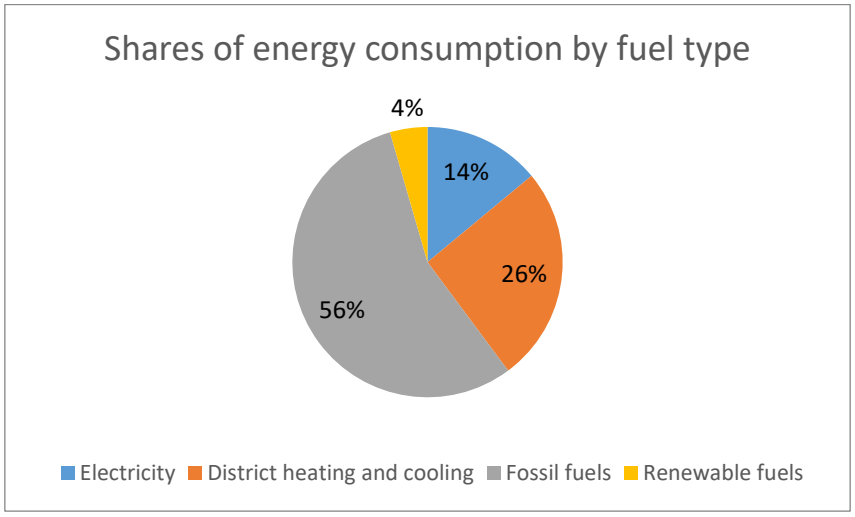
Source: JRC elaboration based on GCoM data

Figure 28. Shares of energy consumption by sector, reported in BEIs related to 2030 commitments – non-EU.



Source: JRC elaboration based on GCoM data

Figure 29. Shares of energy consumption by fuel type, reported in BEIs related to 2030 commitments – non-EU.



Source: JRC elaboration based on GCoM data

3.2.2 Energy supply

Looking at the reported energy output from the signatories having reported a BEI, there are 21, out of the 133, having also reported some local heat/cold or electricity production.

3.2.2.1 Local electricity production and purchases/sales of renewable energy certificates

The only shares of local electricity production reported by cities correspond with renewable hydroelectric power (61%) and non-renewable CHP (39%). See **Table 49** for the complete description of the total production by technology. In this way, renewable energy has the highest share, with 61%, representing 72% of the BEI electricity consumption for the cities reporting local electricity production. As presented in **Table 50**, the per capita production for hydroelectric and CHP amount to 1 and 0.64 MWh/year per capita, respectively. **Figure 30** shows the shares of the most representative electricity production sources and technologies. On the other hand, it should be pointed out that no valid declared purchases of renewable energy certificates are available for this subset of signatories.

Table 49. Local electricity production in BEIs related to 2030 commitments – non-EU (units TWh/year).

Energy production technology	Non- renewable	Renewable	TOTAL	SHARE
Photovoltaics			0.0000	0.00%
Wind			0.0000	0.00%
Hydroelectric		0.7003	0.7003	61.11%
Geothermal			0.0000	0.00%
Local electricity production plants - Combined Heat and Power	0.4456		0.4456	38.89%
Local electricity production plants - Other (ETS and large-scale plants > 20 MW not recommended)			0.0000	0.00%
TOTAL	0.4456	0.7003	1.1459	
SHARE ON TOTAL ELECTRICITY PRODUCTION	38.89%	61.11%		
SHARE ON TOTAL ELECTRICITY CONSUMPTION*	5.02% (45.9%)	7.88% (72.1%)		

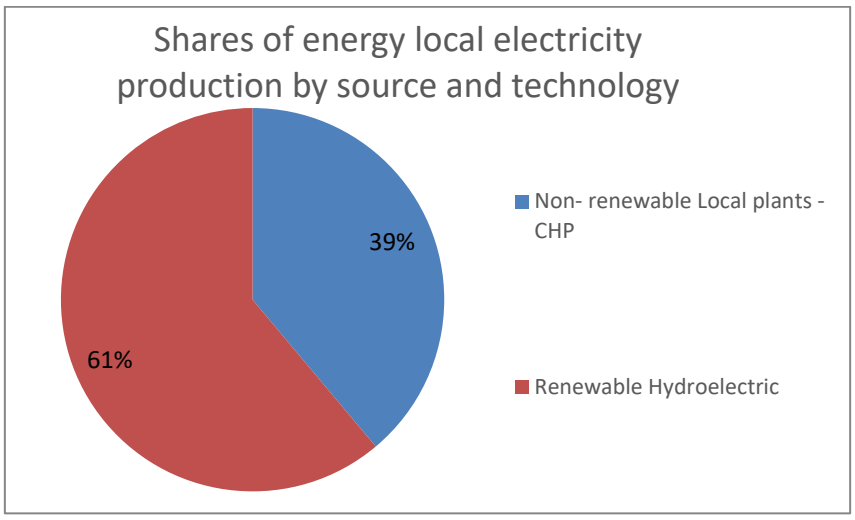
*Compared to the total electricity consumption in BEI (only for cities reporting energy supply)
Source: JRC elaboration based on GCoM data

Table 50. Local electricity production in BEIs related to 2030 commitments – non-EU (units MWh/year per capita).

Energy production technology	Non- renewable	Renewable	TOTAL
Photovoltaics			0.0000
Wind			0.0000
Hydroelectric		1.0005	1.0005
Geothermal			0.0000
Local electricity production plants - Combined Heat and Power	0.6366		0.6366
Local electricity production plants - Other (ETS and large-scale plants > 20 MW not recommended)			0.0000
TOTAL	0.6366	1.0005	1.6371

Source: JRC elaboration based on GCoM data

Figure 30. Shares of local electricity production by energy source and technology, reported in BEIs related to 2030 commitments – non-EU.



Source: JRC elaboration based on GCoM data

3.2.2.2 Local heat/cold production

Considering local heat/cold supply, the highest share of local heat/cold production corresponds with district heating (heat only), with 92%. See **Table 51** for the complete description of the total production by technology. Additionally, comparing non-renewable with renewable energy technologies, non-renewable energy has the highest share of the total local heat/cold production, with 99.9%, representing 87% of the BEI heat/cold consumption for the cities reporting local heat/cold production. As shown in **Table 52**, the per capita production with non-renewable fuels amounts to 4 MWh/year. **Figure 31** shows the shares of the most representative heat/cold production sources and technologies.

Table 51. Local heat/cold production in BEIs related to 2030 commitments – non-EU (units TWh/year).

Energy production technology	Non- renewable	Renewable	TOTAL	SHARE
Local heat/cold production plants - Combined Heat and Power	0.6624		0.6624	7.76%
Local heat/cold production plants - District heating (heat-only)	7.8590	0.0128	7.8718	92.24%
Local heat/cold production plants – Other			0.0000	0.00%
TOTAL	8.5214	0.0128	8.5341	
SHARE ON TOTAL HEAT/COLD PRODUCTION	99.85%	0.15%		
SHARE ON TOTAL HEAT/COLD CONSUMPTION*	51.86% (87.18%)	0.08% (0.13%)		

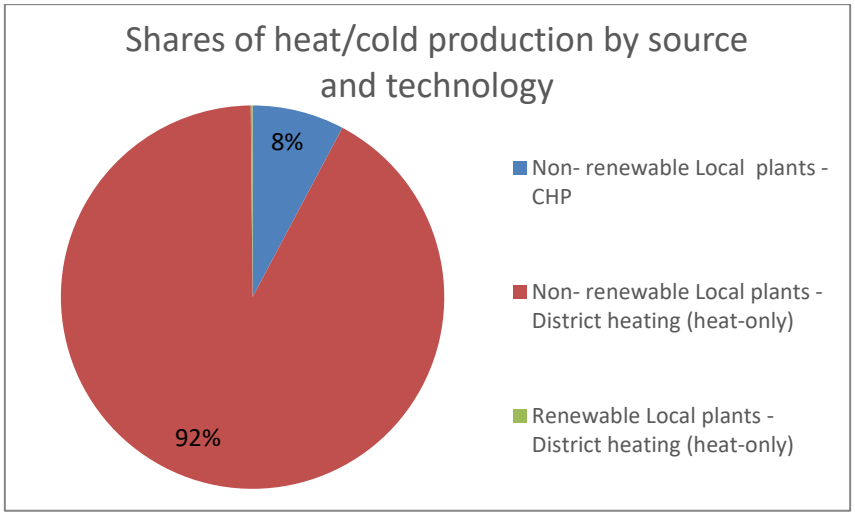
* Compared to the total heat/cold consumption in BEI (only for cities reporting local heat/cold production)
Source: JRC elaboration based on GCoM data

Table 52. Local heat/cold production in BEIs related to 2030 commitments – non-EU (units MWh/year per capita).

Energy production technology	Non-renewable	Renewable	TOTAL
Local heat/cold production plants - Combined Heat and Power	0.3106		0.3106
Local heat/cold production plants - District heating (heat-only)	3.6857	0.0060	3.6917
Local heat/cold production plants – Other			0.0000
TOTAL	3.9964	0.0060	4.0023

Source: JRC elaboration based on GCoM data

Figure 31. Shares of local heat/cold production by energy source and technology, reported in BEIs related to 2030 commitments – non-EU.



Source: JRC elaboration based on GCoM data

3.2.3 Savings and renewable energy production

Now, examining the reported estimated savings and renewable energy production from the 2030 non-EU signatories having reported a BEI, there are 112, out of the 133, having also reported some estimated savings or renewable energy production.

3.2.3.1 Estimated savings

The highest share of estimated savings corresponds with stationary energy, with 77% of the total estimated savings. The details can be seen in **Table 53**. The total savings represent 27% of the reported consumption for these signatories (comparing the total consumption in BEI, only for cities having declared either energy savings or energy production by the target year). In total, as presented in **Table 54**, signatories estimate that they will be able to save, on average, 2.5 MWh/year per capita, by 2030. See **Figure 32** for the shares of each activity sector in the total estimated savings.

Table 53. Estimated energy savings by 2030 declared by signatories – non-EU (units TWh/year).

Sector	Estimated energy savings	SHARE
Stationary energy (includes, Municipal buildings, Lighting, Residential buildings, Tertiary buildings, Industry)	11.0875	77.01%
Transport	1.5153	10.52%
Local electricity production	0.1227	0.85%
Local heat/cold production	1.0621	7.38%
Other	0.6104	4.24%
TOTAL	14.3980	

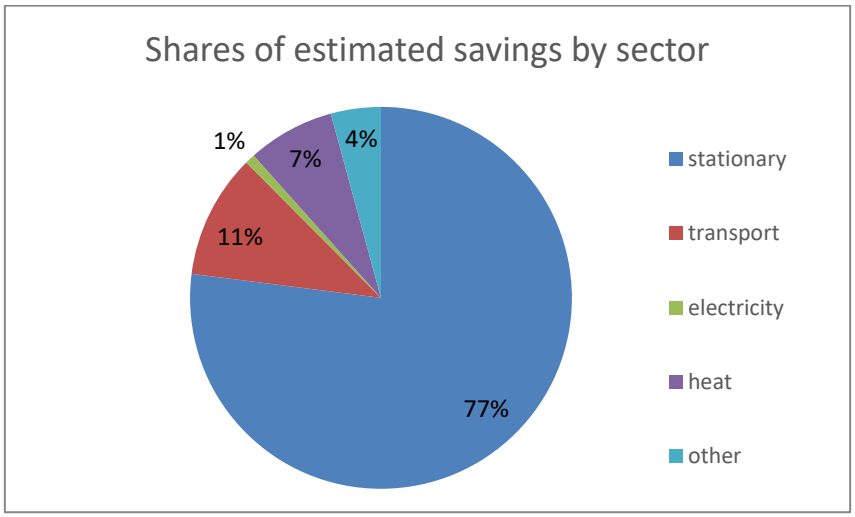
Source: JRC elaboration based on GCoM data

Table 54. Estimated energy savings by 2030 declared by signatories – non-EU (units MWh/year per capita).

Sector	Estimated energy savings
Stationary energy (includes, Municipal buildings, Lighting, Residential buildings, Tertiary buildings, Industry)	1.9268
Transport	0.2633
Local electricity production	0.0213
Local heat/cold production	0.1846
Other	0.1061
TOTAL	2.5021

Source: JRC elaboration based on GCoM data

Figure 32. Shares of estimated savings by sector, reported in BEIs related to 2030 commitments – non-EU.



Source: JRC elaboration based on GCoM data

3.2.3.2 Renewable energy production

The highest share of renewable energy production corresponds to stationary energy (going from the 27% of 2020 commitments to 44%), followed by local heat/cold production (going from the 32% of 2020 commitments to 38%). Although the share for local heat/cold production actually increased with respect to the renewable energy production declared by non-EU 2020 commitments, the reported production for stationary energy increased much more. The details can be seen in **Table 55**. The total renewable energy production represents 3.4% of the reported consumption for these signatories (comparing the total consumption in BEI, only for cities having declared either energy savings or energy production by the target year). In total, as presented in **Table 56**, signatories estimate that by 2020, they will be able to produce, in average, 0.31 MWh/year per capita. **Figure 33** shows the shares of each activity sector in the total estimated renewable energy production.

Table 55. Estimated renewable energy production by 2030 declared by signatories – non-EU (units TWh/year).

Sector	Estimated renewable energy production	SHARE
Stationary energy (includes, Municipal buildings, Lighting, Residential buildings, Tertiary buildings, Industry)	0.7912	43.79%
Transport	0.0324	1.79%
Local electricity production	0.1601	8.86%
Local heat/cold production	0.6908	38.23%
Other	0.1324	7.33%
TOTAL	1.8069	

Source: JRC elaboration based on GCoM data

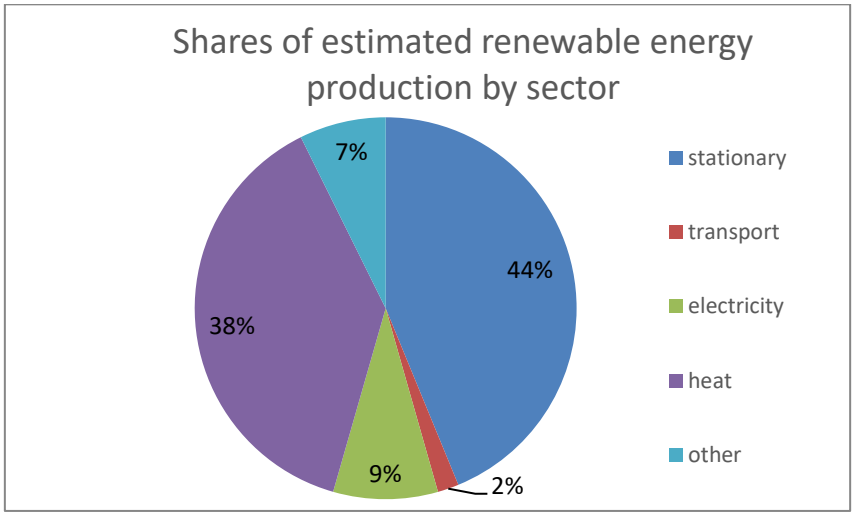
Table 56. Estimated renewable energy production by 2030 declared by signatories – non-EU (units MWh/year per capita).

Sector	Estimated renewable energy

	production
Stationary energy (includes, Municipal buildings, Lighting, Residential buildings, Tertiary buildings, Industry)	0.1375
Transport	0.0056
Local electricity production	0.0278
Local heat/cold production	0.1201
Other	0.0230
TOTAL	0.3140

Source: JRC elaboration based on GCoM data

Figure 33. Shares of estimated renewable energy production by sector, reported in BEIs related to 2030 commitments – non-EU.



Source: JRC elaboration based on GCoM data

3.2.4 MEI energy consumption

Regarding non-EU signatories with 2030 commitments, there are 14 action plans having reported a MEI, holding 1.5 million inhabitants. For these signatories, the type of fuel with the greatest total share of consumption is fossil fuels (75.7%), followed by electricity (11%). Comparing with the reported BEI consumption, the share of fossil fuels increased in 20%, but at the same time the district heating and cooling decreased in almost 20%, while the share on renewables increased 2.5% (from 4.5% in 2020 to 7% in 2030 commitments).

Additionally, the consumption is mainly allocated by residential buildings (45%), with a declared 1.4 MWh/year per capita, 3.4 lower than the consumption declared in the BEI, private and commercial transport (38%) and industry ETS (11%). See **Tables 57-59** for the absolute, percentage and per capita values, respectively, of the energy consumption reported in MEIs, and **Figures 34-35** for the visualisation of the shares for the most significant sectors and fuel sources, respectively. Examining the per capita consumption, it is relevant to point out the decrease with respect to the consumption reported in the BEI for all types of fuels, mainly for district heating and cooling, passing from 2.1 to 0.2 MWh/year per capita.

Table 57. Energy consumption reported in MEIs related to 2030 commitments – non-EU (units TWh/year).

Sector / Sub-sector	Electricity	District heating and cooling	Fossil fuels	Renewable fuels	TOTAL	SHARE

Municipal buildings, equipment/facilities	0.0357	0.0215	0.0255	0.0035	0.0862	1.77%
Residential buildings	0.2776	0.2764	1.3409	0.3027	2.1976	45.25%
Tertiary (non-municipal) buildings, equipment/facilities	0.0028	0.0213	0.0463	0.0034	0.0738	1.52%
Industry Non-ETS					0.0000	0.00%
Industry-ETS	0.2140		0.3128		0.5268	10.85%
Buildings, equipment/facilities non-allocated				0.0234	0.0234	0.48%
Subtotal - Stationary energy	0.5300	0.3192	1.7255	0.3330	2.9078	59.87%
Municipal fleet			0.0073		0.0073	0.15%
Public transport			0.1169		0.1169	2.41%
Private and commercial transport			1.8246		1.8246	37.57%
Transport non-allocated					0.0000	0.00%
Subtotal - Transport	0.0000		1.9488	0.0000	1.9488	40.13%
Agriculture, Forestry, Fisheries					0.0000	0.00%
Other non-allocated					0.0000	0.00%
Subtotal - Other	0.0000	0.0000	0.0000	0.0000	0.0000	0.00%
TOTAL	0.5300	0.3192	3.6743	0.3330	4.8566	
SHARE	10.91%	6.57%	75.66%	6.86%		

Source: JRC elaboration based on GCoM data

Table 58. Energy consumption reported in MEIs related to 2030 commitments – non-EU (units %).

Sector / Sub-sector	Electricity	District heating and cooling	Fossil fuels	Renewable fuels	TOTAL
Municipal buildings, equipment/facilities	0.73%	0.44%	0.53%	0.07%	1.77%
Residential buildings	5.72%	5.69%	27.61%	6.23%	45.25%
Tertiary (non-municipal) buildings, equipment/facilities	0.06%	0.44%	0.95%	0.07%	1.52%
Industry Non-ETS					0.00%
Industry-ETS	4.41%		6.44%		10.85%
Buildings, equipment/facilities non-allocated				0.48%	0.48%
Subtotal - Stationary energy	10.91%	6.57%	35.53%	6.86%	59.87%
Municipal fleet			0.15%		0.15%
Sector / Sub-sector	Electricity	District heating and cooling	Fossil fuels	Renewable fuels	TOTAL
Public transport			2.41%		2.41%

Private and commercial transport			37.57%		37.57%
Transport non-allocated					0.00%
Subtotal - Transport	0.00%	0.00%	40.13%	0.00%	40.13%
Agriculture, Forestry, Fisheries					0.00%
Other non-allocated					0.00%
Subtotal - Other	0.00%	0.00%	0.00%	0.00%	0.00%
TOTAL	10.91%	6.57%	75.66%	6.86%	

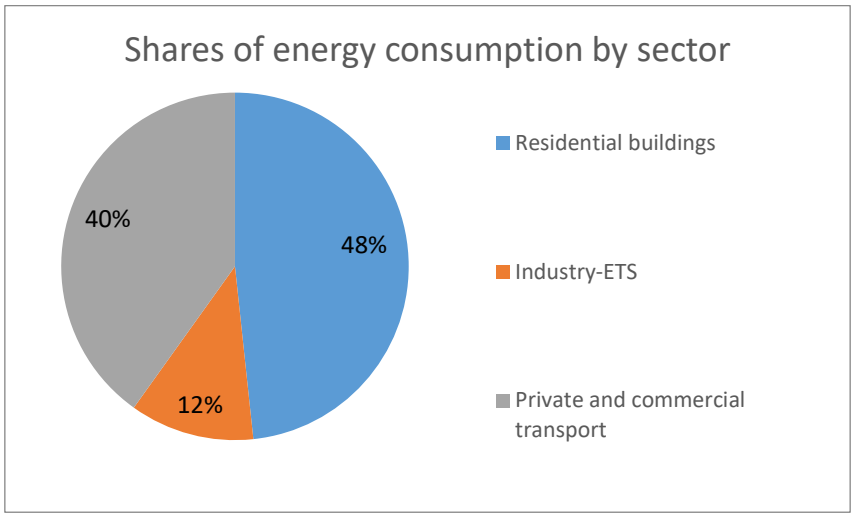
Source: JRC elaboration based on GCoM data

Table 59. Energy consumption reported in MEIs related to 2030 commitments – non-EU (units MWh/year per capita).

Sector / Sub-sector	Electricity	District heating and cooling	Fossil fuels	Renewable fuels	TOTAL
Municipal buildings, equipment/facilities	0.0228	0.0137	0.0163	0.0023	0.0551
Residential buildings	0.1776	0.1768	0.8576	0.1936	1.4056
Tertiary (non-municipal) buildings, equipment/facilities	0.0018	0.0136	0.0296	0.0022	0.0472
Industry Non-ETS					0.0000
Industry-ETS	0.1369		0.2001		0.3369
Buildings, equipment/facilities non-allocated				0.0150	0.0150
Subtotal - Stationary energy	0.3390	0.2042	1.1036	0.2130	1.8599
Municipal fleet			0.0047		0.0047
Public transport			0.0748		0.0748
Private and commercial transport			1.1670		1.1670
Transport non-allocated					0.0000
Subtotal - Transport	0.0000	0.0000	1.2465	0.0000	1.2465
Agriculture, Forestry, Fisheries					0.0000
Other non-allocated					0.0000
Subtotal - Other	0.0000	0.0000	0.0000	0.0000	0.0000
TOTAL	0.3390	0.2042	2.3501	0.2130	3.1063

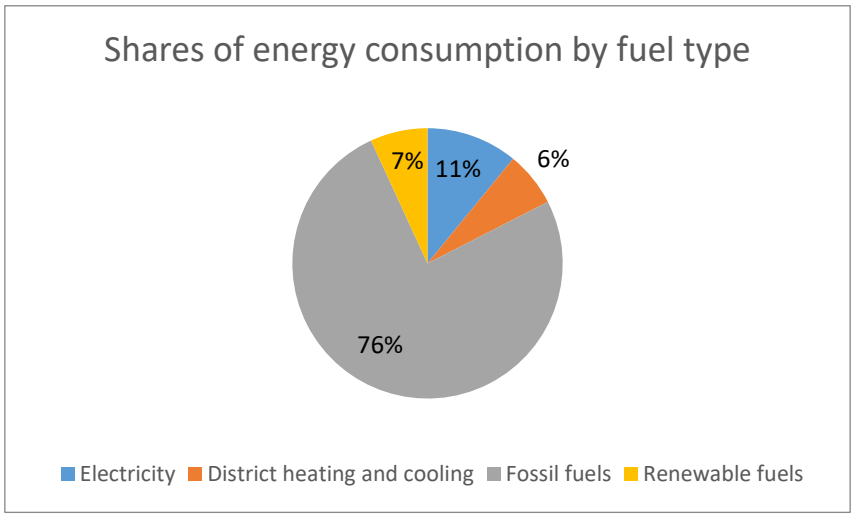
Source: JRC elaboration based on GCoM data

Figure 34. Shares of energy consumption by sector, reported in MEIs related to 2030 commitments – non-EU.



Source: JRC elaboration based on GCoM data

Figure 35. Shares of energy consumption by fuel type, reported in MEIs related to 2030 commitments – non-EU.



Source: JRC elaboration based on GCoM data

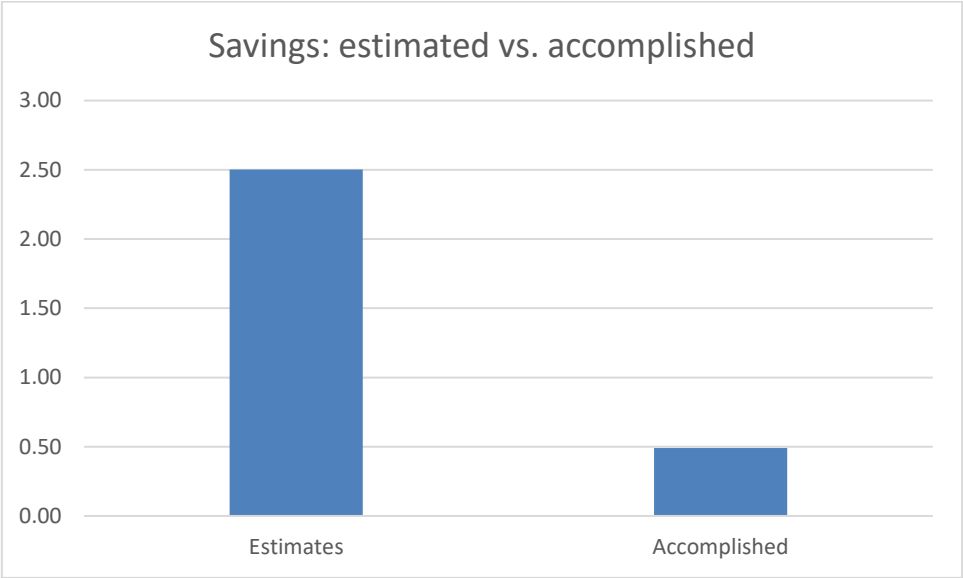
3.2.5 Achievements in energy savings

Focusing on the actual savings for signatories holding a MEI, the total estimated savings are presented next, identifying the most successful signatories in accomplishing significant savings for 2030.

3.2.5.1 Accomplished savings

The total estimated savings, looking at the difference between the BEI and the MEI consumption for the signatories holding a MEI, amounts to 0.82 TWh/year (0.49 MWh/year per capita). The accomplished mean per capita savings of 0.49 MWh/year fall short to the declared estimated savings of 2.5 MWh/year (see **Figure 36**). The total reduced consumption is 14.5% of the reported BEI, and 17% of the MEI consumption.

Figure 36. Total energy savings, estimated vs. accomplished, related to 2030 commitments – non-EU (units MWh/year per capita).



Source: JRC elaboration based on GCoM data

Examining the accomplished savings for every city with a coherent sector-wise monitoring history, the annual savings rate is computed between the absolute consumption in the BEI and the last MEI. The highest yearly savings rates correspond with Birmingham, Tuzla and Lukavac, saving 0.014, 0.01 and 0.0095 TWh/year, respectively. The top-10 cities, regarding their yearly absolute and per capita savings rates, is given in **Table 60**.

Table 60. Complete ranking (top-10) of signatories with highest savings rates, related to 2030 commitments – non-EU (units TWh/year)

CITY	COUNTRY	BASE YEAR	LAST MONITORING YEAR	ABSOLUTE SAVINGS	ABSOLUTE SAVINGS ANNUAL RATE	SAVINGS PER CAPITA (MWh/year)	SAVINGS PER CAPITA ANNUAL RATE (MWh/year)
Birmingham	United Kingdom	1990	2005	0.21	0.0141	0.21	0.01
Tuzla	Bosnia and Herzegovina	2002	2020	0.18	0.0101	1.65	0.09
Lukavac	Bosnia and Herzegovina	2010	2020	0.09	0.0095	2.2	0.22
Bijeljina	Bosnia and Herzegovina	2004	2020	0.11	0.007	1.1	0.06
Doboj	Bosnia and Herzegovina	2013	2020	0.05	0.0067	0.78	0.11
Bihac	Bosnia and Herzegovina	2010	2020	0.05	0.0048	0.86	0.08
Sanski Most	Bosnia and Herzegovina	2011	2020	0.03	0.0037	0.85	0.09
Zvornik	Bosnia and Herzegovina	2009	2020	0.03	0.0031	0.65	0.05
Odžak	Bosnia and Herzegovina	2011	2020	0.02	0.0023	1.17	0.13
Doboj Istok	Bosnia and Herzegovina	2010	2020	0.01	0.0014	1.37	0.13

Source: JRC elaboration based on GCoM data

4 Conclusions

The evidence collected in this report suggests that, on average, fossil fuels hold the greatest share in the total energy consumption (around 65%), followed by electricity (around 20%), district heating and cooling (around 10%) and in the last place, renewable energies (ranging from 1-6%), suggesting that the transition to a greener energy system still requires more time and additional efforts to achieve EU targets. Meanwhile, the sector with the highest share in the reported consumption is residential buildings (around 30% in EU-27, and 45% in non-EU), followed by private and commercial transport (around 20%).

Furthermore, for **EU-27 signatories**, considering their 2020 and 2030 commitments, it has been established that the achieved savings amount to 2.02 and 2.11 MWh/year per capita, respectively. For **2020 commitments** (1 825 signatories), the accomplished mean per capita savings of 2.02 MWh/year exceed the declared estimated savings of 1.8 MWh/year. The highest savings yearly rates correspond to the cities of *Dortmund*, *Munich* and *Budapest*, with 1.45, 1.26 and 0.85 TWh/year, respectively. On the contrary, for **2030 commitments** (326 signatories), the accomplished mean per capita savings of 2.11 MWh/year fall short of the declared estimated savings of 3.5 MWh/year, where the highest savings yearly rates correspond to *Dublin*, *Wroclaw* and *Lisbon*, saving 0.61, 0.25 and 0.25 TWh/year, respectively.

Considering **non-EU signatories**, the achieved savings for 2020 and 2030 commitments amount to 2.46 and 0.49 MWh/year per capita, respectively. For **2020 commitments** (53 signatories), the accomplished mean per capita savings of 2.46 MWh/year exceed the declared estimated savings of 2.16 MWh/year. The highest savings yearly rates correspond to the cities of *Sunderland*, *Cardiff* and *Leicester*, with 0.28, 0.27 and 0.22 TWh/year, respectively. On the contrary, for **2030 commitments** (14 signatories), the accomplished mean per capita savings of 0.49 MWh/year fall short of the declared estimated savings of 2.5 MWh/year, where the highest savings yearly rates correspond to *Birmingham*, *Tuzla* and *Lukavac*, saving 0.014, 0.01 and 0.0095 TWh/year, respectively. Although the 2030 sample of non-EU signatories is rather small, the results are presented for the sake of completeness, but no general conclusions can be drawn from them.

Regarding **EU-27 signatories**, taking the sample of action plans reporting energy production, the highest share of local electricity production corresponds to photovoltaics (around 32%), followed by hydroelectric power (around 26%). Here, it should be pointed out that in 2030 commitments, the share for photovoltaics seems to drop, against an increase in hydroelectric power, sharing both of them 28% of the total production. Renewable energy has the highest share in the total local electricity production reported for 2020 (and 2030), reaching 69.18% (65%), which represents 20.8% (11%) of the BEI electricity consumption. Purchases/sales of renewable energy certificates represent a small share of the total BEI electricity consumption (6% and 4% for 2020 and 2030 commitments, respectively). On the other hand, considering local heat/cold production, the highest shares correspond to combined heat and power (CHP) and district heating (heat only), using almost entirely non-renewable energy sources and covering approximately the entire BEI heat/cold consumption. Lastly, the estimated renewable energy production for signatories with 2020 and 2030 commitments, amounts to 0.66 and 0.98 MWh/year per capita, respectively.

Focusing on **non-EU signatories**, taking the sample of action plans reporting energy outputs, the highest share of local electricity production corresponds to CHP and hydroelectric power (each one, sharing around 45% of the total production). Wind power is also significant (only for 2020 commitments). For 2020 commitments, non-renewable and renewable energy have similar shares in the total local electricity production, each one representing around 5% of the BEI electricity consumption. For 2030 commitments, renewable sources have the highest share, reaching 61%, which represents 72% of the BEI electricity consumption). Purchases/sales of renewable energy certificates represent a small share of the total BEI electricity consumption (7% for 2020 commitments). Considering local heat/cold production, the highest shares correspond to district heating (heat only), using almost entirely non-renewable energy sources and covering approximately the entire BEI heat/cold consumption (for 2030 commitments it represents 87% of the respective BEI consumption). Finally, the estimated renewable energy production for signatories with 2020 and 2030 commitments, amounts to 0.21 and 0.31 MWh/year per capita, respectively.

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List of abbreviations and definitions

BEI	Baseline Emission Inventory
CoM	Covenant of Mayors
CHP	Combined Heat and Power
CRF	Common Reporting Framework
EC	European Commission
EU	European Union
GCoM	Global Covenant of Mayors
GHG	Greenhouse Gas
JRC	Joint Research Centre
MEI	Monitoring Emission Inventory
NDC	Nationally Determined Contribution
SEAP	Sustainable Energy Action Plan
SECAP	Sustainable Energy and Climate Action Plan
TWG	Technical Working Group
UNFCCC	United Nations Framework Convention on Climate Change

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Annexes

Annex 1. Proportion of signatories by commitment and country.

Table A1. Proportion of signatories with a BEI by country and commitment – EU-27 (units %)

Country	2020 commitment (%)	2030 commitment (%)
Italy	55.60	20.52
Spain	26.25	44.47
Belgium	3.82	17.69
Greece	2.08	3.44
Portugal	1.94	0.86
France	1.30	1.23
Croatia	1.08	0.98
Romania	1.06	1.11
Germany	1.01	0.61
Sweden	0.83	0.61
Poland	0.66	0.37
Denmark	0.61	0.00
Hungary	0.50	4.67
Slovenia	0.50	0.12
Cyprus	0.42	0.25
Bulgaria	0.40	0.12
Latvia	0.33	0.37
Malta	0.33	0.00
Netherlands	0.26	0.12
Austria	0.23	0.12
Lithuania	0.21	0.00
Finland	0.17	0.98
Ireland	0.14	0.74
Czech Republic	0.10	0.49
Estonia	0.09	0.00
Slovakia	0.07	0.12
Luxembourg	0.02	0.00

Source: JRC elaboration based on GCoM data

Table A2. Proportion of signatories with a BEI by country and commitment – non-EU (units %)

Country	2020 commitment (%)	2030 commitment (%)
Ukraine	40.51	62.41
United Kingdom	16.41	1.50
Bosnia and Herzegovina	9.74	14.29
Moldova	6.67	10.53
Armenia	5.13	0.75
Georgia	5.13	0.00
Belarus	5.13	9.77
Switzerland	4.10	0.00
Norway	3.08	0.00
Montenegro	1.54	0.00
North Macedonia	0.51	0.00
Iceland	0.51	0.00
Serbia	0.51	0.00
Azerbaijan	0.51	0.75
Albania	0.51	0.00

Source: JRC elaboration based on GCoM data

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