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Sun coupled innovative Heat pumps

D8.9 – SunHorizon Promotion for Municipalities towards SEAP objectives achievement

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Abbreviations

Acronym	Full name
AMB	Area Metropolitana de Barcelona
BEI	Baseline Emission Inventory
CoM	Covenant of Mayors in EU
DHW	Domestic Hot Water
EMA	European Metropolitan Areas
GHC	Green House emissions
H&C	Heating and Cooling
KPIs	Key Performance Indicators
LCA	Life-Cycle Assessment
PV-T	Hybrid Photovoltaic - Thermal technology
RES	Renewable energy sources
RREE	Renewable energies
RCM	Reliability-Centered Maintenance
SEAP	Sustainable energy action plan
SECAP	Sustainable Energy and climate action plan

TPs	Technology Packages
UE/EU	Europe Union

Executive Summary

A key for a proper dissemination of the results of the project is to reach policy makers and public bodies by spreading SunHorizon project results. Municipalities are a specific target group of the project dissemination activities in order to influence the future requirements for sun coupled heat pumps or even regulation in electric driven H&C for electricity supplier. The messages shared are related to the market potential evaluation, lessons learned and a technology-economic analysis of the SunHorizon demo buildings, generating in this way a contribution to EU policies and directives under Covenant of Mayor Action Plans in Europe's municipalities and their objectives achievement.

More than 6.000 municipalities in EU have completed and presented to Covenant of Mayors their SEAP plans with specific actions and 2030 commitments. They've calculated ambitious targets for increasing the use of renewal energy systems in municipal buildings and reducing a 55% of their CO2 emissions. Analyzing this municipalities will let us identify the most committed ones to promote public and private collaboration models for promotion of H&C energy efficiency measures.

Regional entities in Europe are the key to reach these goals because they represent hundreds of cities and towns of different sizes and countries offering services to accomplish this savings in the municipalities as:

- Networking sharing energy efficiency best practices between different municipalities
- Technical assessment to municipal workers
- One stop shops offices to refurbish existing buildings improving their RREE systems.
- Direct investment budget for RREE new technology projects in municipal buildings.

We've identified different regional entities in Europe with their best practices examples and description of their role as public entities. Final chapters are related to specific recommendations of SunHorizon technology packages for they deployment in different public buildings and a selection of best promotional SunHorizon actions fulfilling dissemination purposes in towns and cities' stakeholders.

1 Introduction

1.1 Scope

The goal of the task 8.3 is to promote Sun Horizon's 5 Technology Packages in public buildings as solution to achieve SEAP objectives.

Within this Deliverable (D8.9), besides Section 1 that constitutes the present introduction and the methodology approach, the following section are included:
Section 2 explains the role of the Covenant of Mayors in EU;
Section 3 explains the mitigation targets and actions in different municipalities ;
Section 4 presents the role of regional entities and bodies in Europe
Section 5 analyses the best implementation of SunHorizon TP in public tertiary buildings;
Section 6 tries to identify how the promotional actions done in the project help the municipalities to achieve their SEAP commitments in the EU.

1.2 Methodology

The methodology used have been focusing on ensuring the deliverable is well-written, well-structured, and meets the project objectives and requirements. It has involved research, planning, writing, editing, reviewing and revision, and has been tailored to the specific needs of the project and the target audience:

- Identification of the project goals and objectives of the deliverable. It is important to fully understand the project's objectives and expectations for the deliverable, reviewing the project proposal, work plan, results and other relevant project documents which have been described in final bibliography.

- Identification of the target audience for the deliverable as general public and stakeholders.

- Development of a clear and structured outline to organize the content of the deliverable and ensure that all required information has been included.

- Researching and gathering information in different web pages, project agreement and other related studies and documents of the project. .

- Writing and editing the content with the implementation of project activities in public buildings. Identification of potential risks and assumptions that may impact the project's success.

- Sharing the review of the deliverable for AJSC team and WP partners to ensure that it meets the D8.9 project objective and requirements and is free from errors and inconsistencies.

- Final submission of the deliverable according to the project requirement and deadline, which have been amplified until end of May 2023.

2 Covenant of Mayors Action Plans in Europe

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)[1] 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. Then, in 2017, the Covenant of Mayors for Climate and Energy and the Compact of Mayors joined forces becoming the Global CoM[2], currently de world's coalition of cities and local governments voluntarily committed to fight climate change.

2.1 Why the Covenant of Mayors?

The Covenant of Mayors, has been capitalizing on the experience gained in Europe and beyond, and is building upon the key success factors of the initiative: its bottom-up governance, its multi-level cooperation model and its context-driven framework for action.

- **The 3 pillars of signatories' commitments**
- Reducing net GHG emissions by at least 55% by 2030
- Strengthening resilience
- Alleviating energy poverty

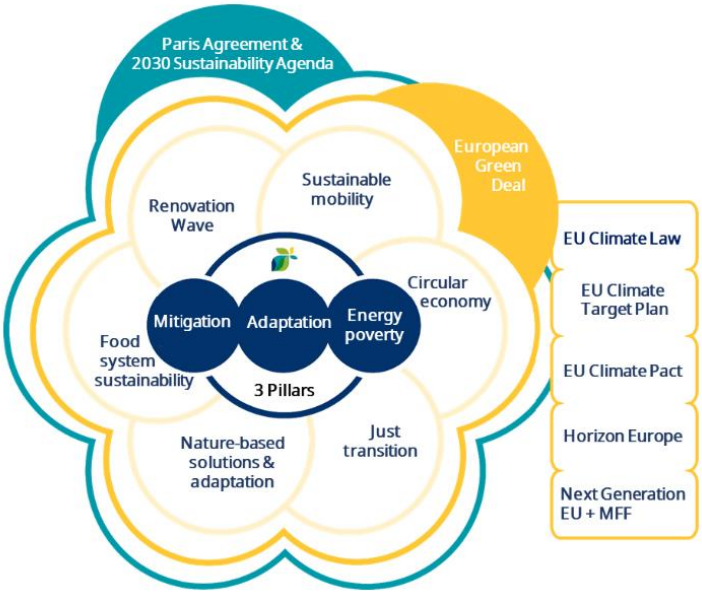

Figure 1: CoM pillar on Paris Agreement 2030 Sustainability agenda. Source: CoM web page

Paris Agreement in 2021 is a relevant EU chapter of the Global CoM initiative, announced with its renewed ambition. Participating cities were 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 access and poverty. Mitigation and alleviating energy poverty pillars include specific commitments and actions in building renovation wave where SunHorizon technologies could make a huge impact.

[1] https://eumayors.eu/about/support-the-community/office.html
[2] https://www.globalcovenantofmayors.org/about/

Since then, more than 11.600 European towns and cities stand ready to partner with national and international institutions to tackle both climate and economic crises through local initiatives, innovative financing models, and sustainable infrastructure applying 17.568 best practice actions, coordinated by supporters and coordinators that help cities to achieve their targets. These 212 coordinators are most of them representatives of European Metropolitan Authorities and other regional entities.

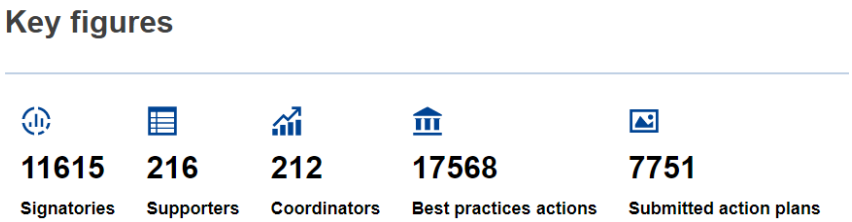

Figure 2: CoM key figures. Source: CoM web page

- **A reference for energy and climate action**

From the beginning, the Covenant of Mayors initiative has been designed to provide local governments, in highly diversified national contexts, with a framework for their local energy and climate action based on 4 principles:

1. Consistency and transparency thanks to a common reporting framework for all
2. Flexibility and adjustability of the common framework to better take specific needs and local realities into account
3. Evaluation of the data reported by the European Commission's Joint Research Centre (signatories may be suspended in case of non-compliance)
4. Promotion and exchange of experience via the website news, social media, online and offline events.

The current crises, global and local challenges have the potential to be a catalyst for transformational change. Drawing on the findings, CoM calls for cities, national governments, civil society and the **private sector to come together to accelerate bold and ambitious climate action by sharing best practices, harnessing co-benefits, increasing collaboration and funding energy retrofit.**

- **CALL TO ACTION: Cities on the frontline of the Energy crisis**

Finding the links between today's global energy crisis, the extreme weather events that have been experienced internationally throughout 2022/2023, and the urgency of action on climate change. Cities, national governments, civil society and the private sector must come together to accelerate bold and ambitious climate action. They stand behind these four calls to action.

- **Sharing best practices**

Cities can be effective testbeds for both climate change mitigation, adaptation, and energy access solutions. Whether it is low traffic neighborhoods, district heating systems, decentralized micro grids, or installing electric vehicle charging infrastructure, cities and local governments across the world are taking actions that others can learn from.

- **Harnessing co-benefits.**

Investment needs to take a joined-up approach to mitigation, resilience and energy access, recognizing the co-benefits across these pillars and building these benefits into a holistic investment case. Cities and local governments are recognizing the interactions between these objectives. Examples show how they are developing plans to deliver an integrated transition, and how they are attracting necessary investments.

- **Increasing collaboration.**

Cities and local governments can benefit from strategic partnerships, particularly with utilities from the private sectors and with other tiers of government. There are numerous opportunities for cities and local governments to work closely with others to accelerate the required energy transition. Securing greater awareness and engagement with residents will also be pivotal to reducing energy use.

- **Funding retrofit.**

The rising cost of energy over the past year has demonstrated the necessity to reduce energy use for reasons of sustainability, security and affordability. While individual energy retrofit projects are reported to be taking place, cities and local governments need support to deliver at scale. Although some cities and local governments may have budget to achieve this, others need more support from national and regional governments, international financial institutions and the private sector.

All CoM EU signatories[3] are spread around Europe (Figure 3). Italy is the signatories' leading country:

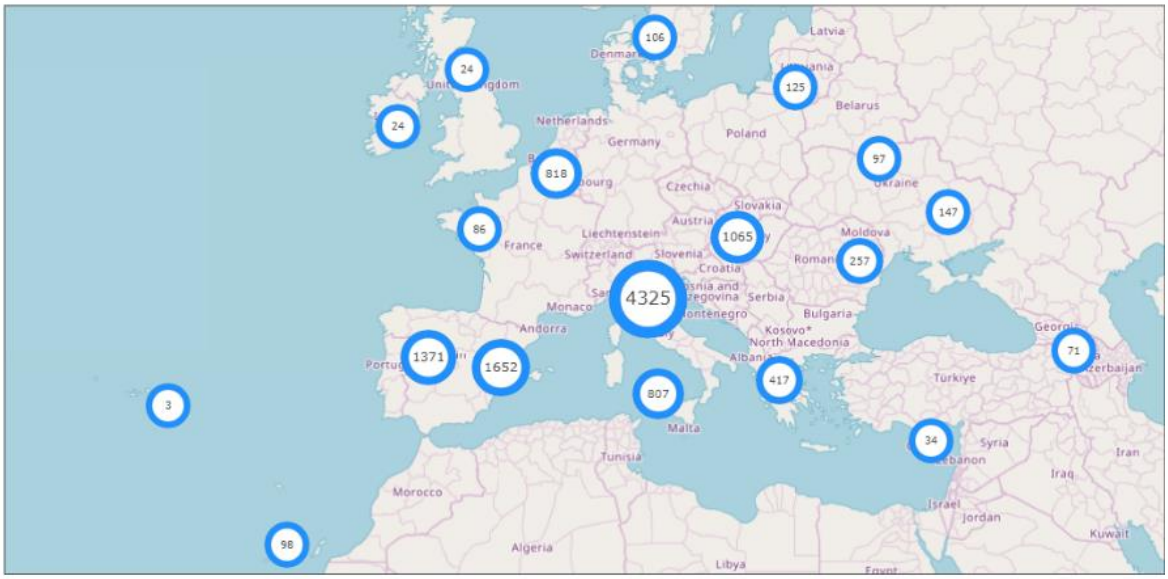

Figure 3: UE CoM signatories cities and towns. Source: CoM web page

When we focus in every country, we find large areas increasing their participation in CoM. These areas are usually specific regions (as in Spain is Catalonia, Basque Country, Valencia or Andalusian, etc...) which are coordinated by supra municipal entities which help them to share best practices and resources thanks to the physical proximity.

[3] http://com-east.eu/en/

Figure 4: Spanish CoM signatories cities and towns. Source: CoM web page

In section 4 we will further develop the important role of CoM coordinators and regional public entities.

2.1.1 SECAP: The Sustainable Energy and Climate Action Plan (SECAP)

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*)[4] as well as guidelines on how to report the SECAP, covering both mitigation and adaptation, are publicly available in the Common Reporting Framework (GCoM, 2018). Besides, the energy poverty pillar has been recently launched and is now publicly available (GCoM, 2022). Some key requirements of the initiative are briefly illustrated hereafter.

Within two years of signing up to the initiative, local authorities must 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** (BEI, A GHC emission reduction target based in 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 prioritizing 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.

[4] Guidebook 'How to develop a Sustainable Energy and Climate Action Plan (SECAP) https://publications.jrc.ec.europa.eu/repository/handle/JRC112986

As far as energy data is concerned, the “My Covenant” template requires signatories to report final energy consumption (activity data) for their baseline emission inventory and subsequent monitoring emission inventories years. These data are then multiplied by the appropriate emission factors (also reported by cities) to obtain the level of emissions in various sectors. Signatories are also requested to report energy generation data, which are not accounted for in the total emissions, but are used to calculate emission factors for grid supplied energy (i.e. electricity and district heating/cooling). Finally, cities are requested to report estimated energy savings and renewable energy production by the target year for each relevant sector/subsector and for the key mitigation actions of their action plan.

2.2 Explanation and evolution of the CoM 2020-2030

This section focuses on Joint Research Centre (JRC)[5] report complements the Covenant of Mayors 2022 Assessment report (Melica et al., 2022), describing the CoM energy activity and estimated savings, based on data declared through the “My Covenant” reporting platform. The JRC is responsible for the evaluation of submitted action plans and the provision of feedback to signatories, 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. It examines energy consumption and production and offers an overview on the progress made on energy savings and renewable energy generation. SECAP stands for Sustainable Energy and Climate Action Plan, and it is a tool developed by the European Union to help cities reduce their energy consumption and greenhouse gas emissions. Many European cities have implemented SECAPs and achieved significant 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.

The share of final energy consumption by sector, the highest share in the reported consumption is **residential buildings**, followed by private and commercial transport and tertiary buildings and equipment:

[5] Covenant of Mayors 2022 Energy Figures – Energy activity and savings of cities and local governments committed to climate change mitigation and adaptation. Franco, C. Melica, G. Bezerra,P: 2023 Joint Research Center

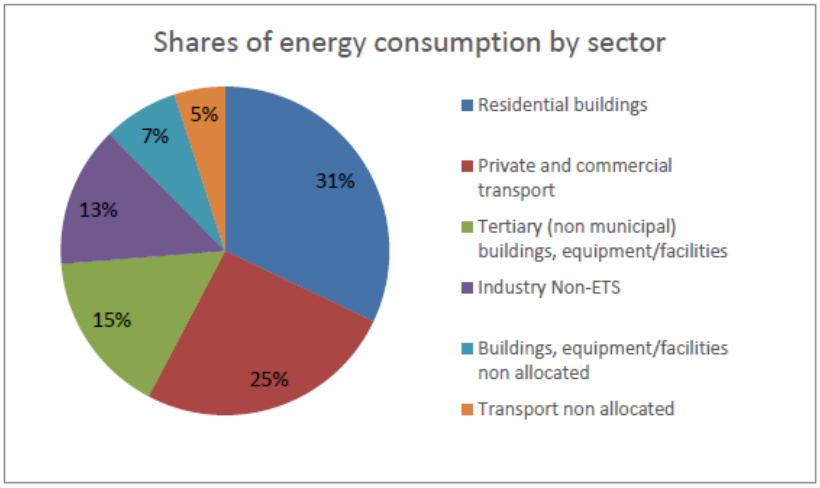

Figure 5: Shares of final energy consumption by sector. Source: JRC elaboration based in GGoM data

The reported energy output from 1.516 signatories have also reported some local/heat or electricity production. The highest share of local electricity production corresponds to photovoltaics with the 38% of the total reported local electricity production. This can be partially explained by the geographical location of most of the subset of signatories, whose median latitude is 44 degrees north, where solar irradiation is expected to be significant.

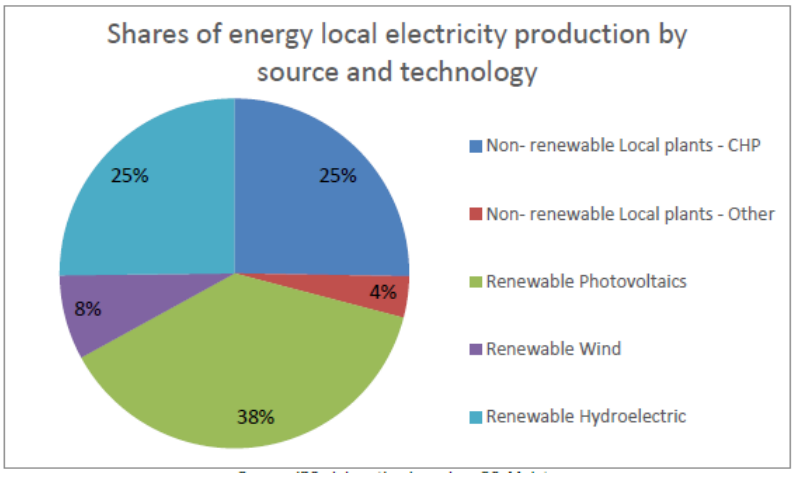

Figure 6: Shares of local electricity production by energy source and technology in CoM signatories. Source: JRC elaboration based on GCoM data

Considering local heat/cold supply in CoM signatories, the highest share of local heat/cold production corresponds to combined heat and power (CHP), with 53% of the total reported local heat/cold production, followed by district heating (heat only), with 40%. Furthermore, comparing non-renewable with renewable energy technologies, **non-renewable energy has the highest share, with 98%,** representing almost the totality of the BEI heat/cold consumption for the cities reporting local heat/cold production.

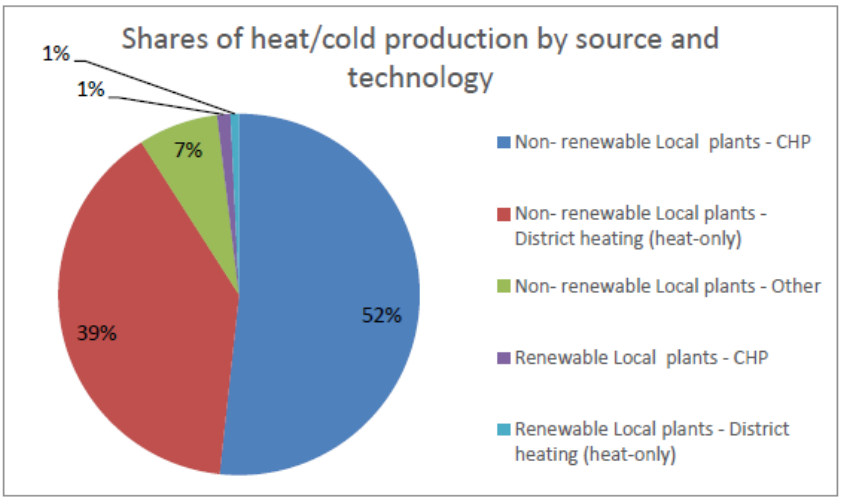

Figure 7: Shares of local heat/cold production by energy source and technology in CoM signatories. Source: JRC elaboration based on GCoM data

2.2.1 Estimated energy 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 4214, out of the 5595, having also reported some estimated savings or renewable energy production.

The highest share of estimated savings corresponds to stationary energy, with 62% of the total estimated savings, followed by transport (34%). Signatories estimate that they will be able to save, on average, 3.8 MWh/year per capita, by 2030. Figure 8 shows the shares of each activity sector in the total estimated savings.

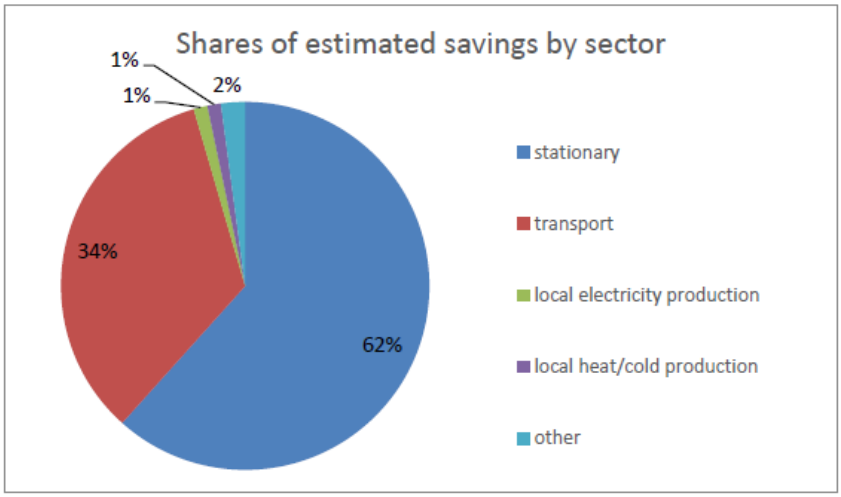

Figure 8: Shares of estimated savings by sector, reports Baseline Emission Inventories. Source: JRC elaboration based on GCoM data

The highest share of renewable energy production corresponds to the local electricity production, with 47% of the total estimated renewable energy production. The total renewable energy production represents 6% 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, **signatories estimate that by 2030, they will be able to produce, in average, 1 MWh/year per capita**. Table 1 shows the shares of each activity sector in the total estimated renewable energy production.

Sector	Estimated renewable energy production
Stationary energy (includes, Municipal buildings, Lighting, Residential buildings, Tertiary buildings, Industry)	0.2831
Transport	0.0397
Local electricity production	0.4906
Local heat/cold production	0.2247
Other	0.0106
TOTAL	1.0487

Table 1: Estimated renewable enery production by 2030 declared by signatories (units MWh/year per capita). Source: JRC elaboration baded on GCoM data

Examining *per capita* consumption, it is noted that fossil fuels represent the maximum consumption value, with 9.9 MWh/year per capita, while renewable fuels have the lowest value, with 0.45 MWh/year per capita. Focusing on the activity sectors, residential buildings have the highest consumption value, with 4.9 MWh/year per capita, followed by private and commercial transport, with 3.7 MWh/year per capita, revealing a small decrease with respect to the BEI consumption for both sectors, of around 0.7 MWh/year per capita. Table 2 shows 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, **suggesting that the transition to a greener energy future still requires additional efforts to achieve EU targets.**

Sector / Sub-sector	Electricity	District heating and cooling	Fossil fuels	Renewable fuels	TOTAL
Municipal buildings, equipment/facilities	0.1506	0.0603	0.1139	0.0057	0.3304
Residential buildings	1.2056	0.5456	2.9019	0.2732	4.9263
Tertiary (non-municipal) buildings, equipment/facilities	1.4250	0.2125	1.1064	0.0284	2.7724
Industry Non-ETS	0.8729	0.1793	1.0313	0.0284	2.1119
Industry-ETS	0.0336		0.4853		0.5189
Buildings, equipment/facilities non-allocated	0.0016	0.0015	0.0077	0.0015	0.0122
Subtotal - Stationary energy	3.6893	0.9991	5.6465	0.3371	10.6720
Municipal fleet	0.0002		0.0675	0.0017	0.0694
Public transport	0.0568		0.3505	0.0097	0.4170
Private and commercial transport	0.0040		3.6600	0.0934	3.7575
Transport non-allocated	0.0064		0.1495	0.0120	0.1679

Sector / Sub-sector	Electricity	District heating and cooling	Fossil fuels	Renewable fuels	TOTAL
Subtotal - Transport	0.0674	0.0000	4.2275	0.1168	4.4118
Agriculture, Forestry, Fisheries	0.0089	0.0090	0.0701	0.0016	0.0896
Other non-allocated	0.0028		0.0055	0.0000	0.0083
Subtotal - Other	0.0116	0.0090	0.0756	0.0016	0.0979
TOTAL	3.7683	1.0081	9.9497	0.4556	15.1817

Table 2: Energy consumption reported in Signatories Monitoring Emissions Inventor related to 2030 commitments (units MWh/year per capita). Source: JRC elaboration based on GCoM data

2.3 Focus on solar and RES mitigation action: best achievements in energy savings

The JRC report identifies the most successful EU signatories in accomplishing significant savings for 2030. Examining the accomplished absolute savings, the cities achieving the highest annual savings rates are Dublin, Ravenna and Valencia, saving 0.61, 0.36 and 0.32 TWh/year, respectively. The top-10 cities, regarding their yearly absolute and per capita savings rates, are presented in Table 3.

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	1.38
Ravenna	Italy	2007	2010	1.07	0.36	6.75	2.35
Valencia	Spain	2007	2012	1.59	0.32	2	0.39
Bruxelles/Brussel	Belgium	2008	2014	1.37	0.23	8.04	1.99
Amiens	France	2014	2016	0.34	0.17	2.58	1.29
Padova	Italy	2005	2017	2.05	0.17	9.75	0.78
Porto	Portugal	2004	2015	1.77	0.16	8.24	0.66
Genova	Italy	2005	2016	1.63	0.15	2.8	0.18
Berlin	Germany	1990	2012	2.89	0.13	0.83	0.04
Bologna	Italy	2005	2018	1.65	0.13	4.23	0.4

Table 3: Top 10 (units MWh/year per capita). Source: JRC elaboration based on GCoM data

Regarding the top 3 yearly absolute and per capita saving rates we find:

Dublin City Council (Ireland) has implemented various measures to reduce energy consumption and greenhouse gas emissions. Here are some of its best achievements in solar and RES energy savings:

- Energy-efficient buildings: Dublin City Council has retrofitted many of its buildings to improve their energy efficiency. For example, it has installed insulation, upgraded heating systems, and implemented energy-efficient lighting. This has resulted in significant energy savings.
- Renewable energy: they have invested in renewable energy sources, such as wind and solar power. The city council has installed solar panels on many of its buildings and has purchased renewable energy from external sources.
- Public engagement with the public to promote energy efficiency and reduce greenhouse gas emissions. They run campaigns to encourage people to reduce their energy

consumption, have provided advice and support to businesses and homeowners to improve their energy efficiency, and have promoted sustainable behavior change.

Ravenna City Council (Italy) has implemented several measures to reduce energy consumption and greenhouse gas emissions. Here are some of its best achievements in energy savings:

- Energy-efficient buildings: Ravenna City Council has retrofitted many of its buildings with energy-efficient technologies such as insulation, double-glazed windows, and LED lighting. This has reduced energy consumption and greenhouse gas emissions.
- Renewable energy they have installed solar panels on several public buildings and they are working on developing a local photovoltaic power plant. This has helped to increase the use of renewable energy in the city and reduce its dependence on fossil fuels.

Valencia City Council (Spain) has also implemented several measures to reduce energy consumption and greenhouse gas emissions. Here are some of its best achievements in energy savings:

- Energy-efficient buildings: they have implemented a program to retrofit its buildings with energy-efficient technologies, such as insulation, efficient lighting, and heating and cooling systems. Specific Next Generation EU subsidies for building refurbishment are implemented.
- Renewable energy: Valencia City Council has invested in renewable energy sources, such as solar power. It has installed solar panels on several public buildings, including schools and cultural centers, and has developed a local photovoltaic power plant. This has helped to increase the use of renewable energy in the city and reduce its dependence on fossil fuels.
- Public engagement with the public to promote energy efficiency and reduce greenhouse gas emissions. It has run campaigns to encourage people to reduce their energy consumption, has provided advice and support to businesses and homeowners to improve their energy efficiency, and has promoted sustainable behavior change. They run 3 energy local offices (one stop shops) to inform citizens in different energy transition areas (https://climaienergia.com/es/oficina-de-l-energia/que-es-la-oficina/)

These are just a few examples of best achievements in energy savings. The cities have made significant progress towards reducing its energy consumption and greenhouse gas emissions, and they continue to work towards a more sustainable future.

3 SECAP Targets in municipalities - some other examples

The Sustainable Energy and Climate Action Plan (SECAP) [6] is the key document to translate into climate action the vision of local authorities for both mitigation and adaptation to climate change. 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 emissions 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.

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 prioritizing 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.

Here are some examples of the best achievements in energy savings in European cities with SECAPs[7]:

Copenhagen, Denmark: Copenhagen aims to become carbon neutral by 2025, and its SECAP has played a significant role in achieving this goal. The city has implemented various energy-saving measures, such as retrofitting buildings to be more energy-efficient and promoting cycling as a means of transport. One of the city's most impressive achievements is its district heating system, which has been in operation since the 1980s.The district heating system is a network of pipes that supply heat to buildings in the city by using waste heat from electricity generation and waste incineration. By reusing this heat instead of generating it from scratch, the system is highly energy-efficient and has helped to reduce the city's carbon footprint significantly. Additionally, Copenhagen has implemented a variety of energy-efficient building standards and policies, which have helped to reduce energy consumption in buildings throughout the city. As a result, Copenhagen has reduced its CO2 emissions by 42% since 2005.

Helsinki, Finland: Helsinki has set a target of reducing its greenhouse gas emissions by 80% by 2035, and its SECAP has been instrumental in achieving this goal. The city has implemented measures such as improving energy efficiency in buildings, increasing the use of renewable energy sources, and promoting sustainable transport. Helsinki has made significant achievements in energy savings over the years, and one of the most notable examples is its commitment to district heating. Helsinki's district heating system is one of the largest and most efficient in the world, providing heat to over 90% of the city's buildings. The district heating system in Helsinki is fueled by a combination of renewable and waste heat sources, including

[6] https://eu-mayors.ec.europa.eu/en/action_plan_list

[7] The complete collection of action plans and monitoring reports from MyCovenant reporting platform is available at https://data.jrc.ec.europa.eu/collection/id-00354

biomass, geothermal energy, and heat recovery from industry. This has helped to reduce the city's reliance on fossil fuels and has significantly reduced its carbon footprint. In addition to district heating, Helsinki has also implemented a range of energy-efficient building standards and policies. For example, the city has mandated that all new buildings must meet strict energy efficiency standards, and it has launched programs to support building owners in retrofitting existing buildings to improve energy efficiency. Overall, Helsinki's commitment to district heating, energy-efficient buildings, and sustainable transportation has resulted in many significant achievements, and the city continues to be a leader in the field of sustainable energy. Helsinki has already reduced its emissions by 27% since 2005. (https://energychallenge.hel.fi/heating-helsinki-today)

Frankfurt, Germany: Frankfurt has set a target of reducing its CO2 emissions by 95% by 2050, and its SECAP has played a key role in achieving this goal. The city has implemented measures such as improving the energy efficiency of buildings, promoting renewable energy, and increasing the use of electric vehicles. One of the most notable examples is the Frankfurt Energy Efficiency Network. This initiative was launched in 2012 and has since helped numerous buildings in the city to reduce their energy consumption and greenhouse gas emissions. The Frankfurt Energy Efficiency Network is a collaboration between the city, energy companies, and building owners, with the goal of improving energy efficiency in existing buildings. The program provides support and resources to building owners, including energy audits, technical advice, and financial incentives for energy-efficient retrofits. Through this program, Frankfurt has achieved a 23% reduction in CO2 emissions from buildings participating in the initiative. Additionally, the program has helped to create jobs in the energy efficiency sector and has contributed to the city's overall sustainability goals. https://www.bmwk.de/Redaktion/EN/Artikel/Energy/energy-efficiency-networks-initiative.html

Padova, Italy: Padova has implemented a range of energy-efficient building standards and policies, including requirements for new buildings to meet strict energy efficiency standards and incentives for retrofitting existing buildings. The city has also launched initiatives to promote renewable energy, such as the installation of solar panels on public buildings and the use of geothermal energy for heating and cooling Overall, Padova’s commitment to sustainable mobility, energy-efficient buildings, and waste reduction has resulted in many significant achievements, and the city continues to work towards its goal of becoming a more sustainable and energy-efficient city.

Amiens, France: Amiens has also made significant achievements in energy savings over the years, and one of the most notable examples is its commitment to sustainable transportation. The city has implemented a range of measures to encourage the use of sustainable transportation, including bike sharing programs, pedestrianized zones, and a network of electric buses. In addition to sustainable transportation, Amiens has also focused on energy-efficient building standards and policies. For example, the city has implemented an energy retrofit program for public buildings, which has resulted in significant energy savings. Another notable achievement in energy savings in Amiens is the city's focus on renewable energy. Amiens has invested in a range of renewable energy projects, including wind and solar energy, and has set a goal to produce 100% of its electricity from renewable sources by 2050.

Latvia: The country has one of the largest district heating systems in the world, which provides heat to over 60% of the population. Latvia's district heating system is fueled by a combination of renewable and waste heat sources, including biomass, geothermal energy, and heat recovery from industry. This has helped to reduce the country's reliance on fossil fuels and has significantly reduced its carbon footprint. In addition to district heating, Latvia has implemented a range of energy-efficient building standards and policies. The country has established a national building code that requires all new buildings to meet strict energy efficiency standards,

and it has launched programs to support building owners in retrofitting existing buildings to improve energy efficiency. Latvia has also made significant investments in renewable energy, particularly in the areas of wind and solar power. The country has set a goal to produce 50% of its electricity from renewable sources by 2030.

4 The role of the supramunicipal public entities

This section is focused on finding data from regional public entities and bodies in EU, some of them acting as coordinators in implementation of SECAP in CoM.[8]

4.1 European Metropolitan Authorities (EMA)

European Metropolitan Authorities are regional governing bodies that oversee large urban areas in Europe. These authorities are typically made up of representatives from the municipalities, cities, and other local governments within the metropolitan area.

Their main role is to coordinate and manage various aspects of urban life, including transportation, housing, infrastructure, economic development, and environmental protection. This helps ensure that the region develops in a coherent and sustainable way, and that the needs and interests of all citizens are taken into account.

In essence, European Metropolitan Authorities **are like large-scale city councils that work across multiple municipalities** to ensure that the whole metropolitan area is managed efficiently and effectively.

European metropolitan authorities provide various subsidies to support sustainable energy policies and reduce greenhouse gas emissions. Some examples of subsidies include:

Energy Efficiency Subsidies: These subsidies are designed to support building owners and managers in retrofitting their buildings to improve energy efficiency. The subsidies may cover a portion of the costs associated with installing insulation, replacing windows and doors, and upgrading heating and cooling systems.

Renewable Energy Subsidies: European metropolitan authorities may also provide subsidies for the installation of renewable energy systems, such as solar panels, wind turbines, and geothermal systems. These subsidies may cover a portion of the installation costs or provide ongoing financial support for energy production.

Carbon Pricing Subsidies: Some European metropolitan authorities have implemented carbon pricing systems, which provide financial incentives for companies and individuals to reduce their greenhouse gas emissions. These subsidies may take the form of tax credits or other financial incentives for companies that reduce their emissions or invest in renewable energy projects.

The amount of subsidies provided by European Metropolitan Authorities (EMAs) varies widely depending on the specific authority, the size of the city, and the scope of the programs and policies being implemented. It's difficult to provide a precise figure for the total amount of subsidies provided by all EMAs for energy efficiency, as data is not available for all cities.
However, the European Union provides funding for energy efficiency programs and initiatives through various sources, including the European Regional Development Fund (ERDF) and the European Investment Bank (EIB). The ERDF provides funding for projects that promote economic development and social cohesion, including those focused on energy efficiency and renewable

[8] The latest GCoM aggregation report is available at https://www.globalcovenantofmayors.org/impact2021/

energy. The EIB provides loans and other financial support for energy efficiency and renewable energy projects across Europe.

See in the following table the higher populated metropolitan areas which are boosting efficiency energy measures in region from different EU countries. **The first 15 most populated EMA regions represent nearly 80 million European citizens that live in 1613 cities and towns**:

Country	City/Metropolitan Area	Population	Area (km²)	Number of municipalities
Turkey	**Marmara Municipalities Union**	27.050.405	67000	188
France	**Greater Paris Metropolis**	7.150.000	814	131
Germany	**FrankfurtRheinMain Metropolitan Region**	5.808.518	14800	19
Germany	**Ruhr Metropolis**	5.112.050	4435	11
Italy	**Metropolitan City of Rome Capital**	4.356.403	5352	121
Spain	**Barcelona Metropolitan Area**	3.239.330	636	36
Italy	**Metropolitan City of Milan**	3.218.201	1575	134
Poland	**Warsaw Metropolitan Area**	3.053.104	6100	36
Italy	**Metropolitan City of Naples**	2.969.571	1171	92
Portugal	**Lisbon Metropolitan Area**	2.821.876	3 015.24	18
UK	**Greater Manchester**	2.782.100	1277	10
Germany	**Stuttgart Metropolitan Region**	2.700.000	3654	179
Netherlands	**Metropolitan Region Amsterdam**	2.500.000	1422	32
Germany	**Rhine-Neckar Metropolitan Region**	2.362.000	5637	290
Italy	**Metropolitan City of Turin**	2.297.917	6830	316

Table 4: Top 15 most populated areas in EMA regions. Source: based on EMA data

The main goal of EMA is to provide a space to discuss the challenges of European metropolitan governance and define the basis for collaboration between Europe's major metropolises. This joint work is reflected in studies, meetings and projects, and in an annual forum concluding with a political declaration adopted by the participants, advocating for a metropolitan dimension of European policies. EMA has also become an active platform for dialogue with high representatives of the European Commission, the European Parliament and the Committee of the Regions.

Metropolitan areas and cities are crucial for the development of efficient policies at local, regional, national and European levels. The creation of a space for political debate like EMA seeks to offer a place where European metropolises can share experience, foster joint projects, and bring common position and interests before the European Union and member states, all together with the aim of providing the necessary understanding and cooperation between European and metropolitan governance levels in reaching the intended social, economic and environmental goals.

EMA facilitates the discussion about these issues among representatives of European metropolises with similar urban realities, holding an annual forum to share experience and solutions, and join forces, all done in close collaboration with relevant European and global networks such as Metropolis, Eurocities and Metrex.

Recent challenges related to latest crises have shown the enormous power of both local and multi-stakeholder cooperation but also the potential of international exchange and support among diverse communities and societies. With new challenges related to the refugee crises around the globe and especially in Europe, EMA regions have the power of both local and international exchange and support.

It's difficult to rank European metropolitan authorities as "best" since each one has its own unique challenges, priorities, and approaches to governance. However, here are a few examples of European metropolitan authorities that are widely recognized for their leadership in promoting sustainable development and improving the quality of life in their respective regions:

Amsterdam Metropolitan Area (AMA): The AMA is a collaboration between the city of Amsterdam and 32 surrounding municipalities in the Netherlands. It has implemented several initiatives to promote sustainable mobility, improve the quality of life, and reduce carbon emissions, such as the Amsterdam Energy Arena and the Metropolitan Region Amsterdam Electric Program.

Île-de-France Region: The Île-de-France Region is the governing body of the Paris metropolitan area in France. It has implemented various measures to promote sustainable urban development and reduce greenhouse gas emissions, such as the "Plan Climate Énergie" and the "Plan Vélo".

Metropolitan City of Rome Capital: 121 metropolitan cities were given administrative powers equivalent to those of a province. This was done to improve the performance of local administration and to cut local spending by better coordinating the municipalities in providing basic services (including transport, school and social programs) and environment protection.

Metropolitan City of Barcelona (AMB): The AMB is responsible for coordinating the management of services and resources across the Barcelona metropolitan area. It has implemented various initiatives to promote sustainable mobility, improve energy efficiency, and enhance the quality of life in the region, such as the "Plan Metropolità de Mobilitat Urbana" and the "Plan de Transició Energètica".

These are just a few examples of European metropolitan authorities that are widely recognized for their sustainable development initiatives. However, there are many more metropolitan authorities throughout Europe that are working to address local challenges and promote sustainable development in their regions.

4.2 Barcelona Metropolitan Area (EMA study case)

The *Àrea Metropolitana de Barcelona* (AMB) is the metropolitan area of Barcelona, which comprises 36 municipalities in the surrounding region. It was created in 2010 to coordinate the management of services and resources across the region, including public transportation, waste management, and urban planning. The AMB covers an area of approximately 636 Km2 and has a population of over 3.2 million people. Its headquarters are located in Barcelona, and it is governed by a president and a council made up of representatives from each of the member municipalities. The budget of the Àrea Metropolitana de Barcelona (AMB) varies from year to year and depends on factors such as the economic situation and the specific projects and programs being funded. In general, the budget of the AMB is mainly financed by contributions from its member municipalities, as well as grants and subsidies from regional, national, and European institutions.

According to the AMB's most recent available financial statements for the year 2022, its total budget for that year was approximately €1.2 billion. AMB is actively involved in various European projects and initiatives that aim to promote sustainable urban development, improve public transportation, and enhance the quality of life in the Barcelona metropolitan area.

In recent years, the AMB has participated in several European programs and projects, such as the European Urban Agenda, the European Innovation Partnership on Smart Cities and Communities, the European Covenant of Mayors, and the URBACT III program, among others. These initiatives

involve collaboration with other European cities, institutions, and stakeholders to exchange knowledge and best practices, develop innovative solutions, and address common challenges related to urbanization and sustainability.

The Àrea Metropolitana de Barcelona (AMB[9]) has implemented various energy efficiency actions in recent years to reduce its carbon footprint and promote sustainable development. Here are some examples of the main objectives, figures and projects they have developed in 2022 through **the Energy Transition Office** always around the two axes: strategic aspects of the mandate the support to the Metropolitan Councils on the one hand and to the citizens on the other the other, 100% renewable municipalities in 2030:

Retrofitting buildings: energy-efficient renovations in its buildings to improve their energy performance, reduce energy consumption, and lower greenhouse gas emissions.

Renewable energy: AMB has installed solar panels in various public buildings to generate clean energy and reduce its reliance on fossil fuels.

Energy management systems: AMB has implemented energy management systems in its buildings and facilities to monitor and optimize energy consumption and reduce costs.

Public awareness campaigns: AMB has launched public awareness campaigns to educate citizens and businesses on the importance of energy efficiency and promote sustainable behaviors

In this sense, the budget for 2022 covers the development of the different strategic lines of the AMB:

- In social matters and support for the productive economy: Environmental sustainability plan, approved in 2021 to promote shared development projects between the municipalities and the AMB in order to strengthen sustainable urban mobility policies and adapt them to the new requirements arising from covid-19, as well as promote the transition ecological and energetic through, among others, investments in the management of resources - such as water and energy - and waste; and a new comprehensive action program for neighborhoods for actions aimed at combating social and income inequalities, increasing equity and serving the most vulnerable groups, which foresees an allocation of €2 million for the year 2022 and which will be multi-annual.
- Housing: launch of the metropolitan operator *Habitatge metropolis Barcelona*, which together with IMPSOL and the Metropolitan Housing Consortium will promote the promotion of affordable housing and the energy and accessibility rehabilitation of the existing park.
- In environmental matters: implementation of the Metropolitan Program for the prevention and management of municipal resources and waste (PREMET25) and the actions foreseen in the Metropolitan Agreement for zero waste, as well as investments in photovoltaic roofs and solar panels to promote renewable energies.
  The AMB's total budget is 1.176M€, where a 19’51% (230M€) is allocated in management and investment actions in the metropolitan area:

[9] Area Metropolitana de Barcelona 2022 budget and Energy Transition Office Annual Memory : https://www.amb.cat/s/web/amb/govern-metropolita/economia-i-inversions/pressupost.html

Figure 9: Picture from Collserola Natural Park in Barcelona. Source: AMB web page

4.3 Other regional entities in Europe

There are many other regional entities in Europe that have varying degrees of autonomy and responsibilities depending on their respective countries' legal and political frameworks. Here are some examples:

Autonomous communities in Spain: Spain is divided into 17 autonomous communities, each with its own government, parliament, and executive council. Examples include Catalonia, Andalusia, and the Basque Country.

Regions in France: France is divided into 18 regions, each with its own council and president. Examples include Île-de-France, Provence-Alpes-Côte d'Azur, and Occitanie.

Länder in Germany: Germany is divided into 16 Länder (states), each with its own parliament and government. Examples include Bavaria, Berlin, and North Rhine-Westphalia.

Provinces in Italy: Italy is divided into 20 regions, each with its own government and administrative council. Examples include Lombardy, Tuscany, and Sicily.

Cantons in Switzerland: Switzerland is divided into 26 cantons, each with its own government and parliament. Examples include Zurich, Geneva, and Bern.

Each country has its own unique system of regional governance, and the specific responsibilities and powers of regional entities vary widely. They are coordinated by supramunicipal entities which help them to share best practices and resources thanks to the physical proximity.

5 SunHorizon technologies deployment in public buildings

SunHorizon project aims at promoting the integration of advanced heat pumps and solar thermal systems in buildings. The project has developed several technology packages that can be deployed in buildings to improve their energy efficiency and reduce their carbon footprint. Here are a few examples of technology packages that have been deployed in buildings:

Hybrid solar-assisted heat pump system: This package combines a heat pump system with solar thermal collectors to provide space heating, domestic hot water, and cooling. The heat pump system is used to provide the majority of the heating and cooling needs, while the solar thermal collectors are used to provide supplementary heating and domestic hot water. This package has been deployed in a residential building in Austria, where it has been shown to reduce energy consumption by up to 40%.

Solar-assisted district heating system: This package combines a solar thermal system with a district heating network to provide heating and domestic hot water to multiple buildings. The solar thermal system collects solar energy, which is then transferred to a central heat exchanger and distributed through the district heating network. This package has been deployed in a residential district in Denmark, where it has been shown to reduce carbon emissions by up to 25%.

Solar-assisted heat pump for industrial processes: This package combines a heat pump system with solar thermal collectors to provide heat for industrial processes. The solar thermal collectors provide the majority of the heating needs, while the heat pump system is used to boost the temperature as required. This package has been deployed in a dairy plant in Italy, where it has been shown to reduce energy consumption by up to 35%.

Each package is designed to meet specific energy needs and can be customized to fit different types of buildings and applications.

5.1 Main Barriers

There are several barriers to improving energy efficiency in public buildings. Here are some of the main ones:

- **Lack of awareness**: Many building managers and administrators may not be aware of the benefits of energy efficiency improvements or may not have the necessary knowledge to implement them effectively.
- **Limited budgets:** Public buildings are often subject to strict budget constraints, which can make it difficult to allocate funds for energy efficiency improvements.
- **Complex decision-making processes:** In many cases, energy efficiency improvements require approval from multiple decision-makers, such as building owners, facility managers, and government officials. This can make it challenging to implement changes quickly.
- **Building age and condition**: Many public buildings are old and may require significant upgrades to improve their energy efficiency. This can be costly and time-consuming.
- **Regulatory barriers:** Some regulations or policies may actually hinder energy efficiency improvements in public buildings. For example, restrictions on the use of certain building materials or technologies may prevent building managers from implementing energy-efficient solutions.
- **Tenant behaviour:** In multi-tenant public buildings, tenant behaviour can play a significant role in energy consumption. Even if building managers implement energy-efficient technologies, tenants may still waste energy by leaving lights on or using appliances inefficiently.

- **Access to BEMS**. The municipal buildings are protected so that they do not suffer computer attacks. These protections make access to energy monitoring management complicated. The involvement of municipal technology services is necessary.
- **Economic and management planning:** Governments have a limited vision (at most 4 years). This makes it difficult to implement programs and/or remodeling plans for facilities that have been planned for more than 4 years. It must be a strategy of all political parties.
- **Bureaucratic processing**. In order to ensure the good use of public money, the legal tendering procedures it is very long.

Overcoming these barriers often requires a combination of policy changes, funding support, and education and awareness-raising efforts.

5.2 Opportunities

There are several opportunities for improving energy efficiency in public buildings:

- **Energy cost savings:** By implementing energy-efficient measures, public buildings can reduce their energy consumption and save money on utility bills. This can free up funds for other building maintenance and operational needs.
- **Environmental benefits:** Energy-efficient measures can also reduce greenhouse gas emissions and improve the building's environmental footprint. This is particularly important for public buildings that have a large energy consumption and are expected to be leaders in environmental stewardship.
- **Improved occupant comfort:** Energy-efficient measures such as improved insulation, HVAC upgrades, and smart lighting systems can also improve the comfort of building occupants. This can lead to improved productivity and satisfaction among employees and tenants.
- **Positive public perception**: Public buildings that prioritize energy efficiency and environmental sustainability can generate positive perceptions among the public, helping to build trust and support for government initiatives.
- **Funding opportunities:** Governments may offer funding opportunities to support energy efficiency improvements in public buildings. This can include grants, rebates, and low-interest loans.
- **Innovative technologies:** Advancements in energy-efficient technologies are constantly emerging, providing new opportunities for public buildings to improve their energy efficiency. Technologies such as smart building automation systems, energy storage, and renewable energy sources can offer significant energy savings and environmental benefits.
- **Results:** If the pilot test gives demonstrably satisfactory results, it can be replicated in other facilities and even promoted in other municipalities.

These are just a few of the main opportunities for improving energy efficiency in public buildings. By leveraging these opportunities, public buildings can not only reduce their energy consumption and costs, but also improve their environmental impact and public perception.

5.3 Best public buildings for replication purposes of SunHorizon technologies

When it comes to retrofitting public buildings, there are several factors to consider. Here are some of the types of public buildings that may be good candidates for energy-efficient retrofits:

- Large buildings: Public buildings with a large floor area tend to have high energy consumption and are good candidates for retrofits. Examples include government buildings, hospitals, schools, and universities.

- Older buildings: Older buildings often have outdated systems and may not meet modern energy efficiency standards. Retrofitting these buildings can result in significant energy savings.

- Buildings with high occupancy: Buildings that are frequently occupied, such as schools or community centers, can benefit from energy-efficient retrofits as they tend to have higher energy consumption than buildings with lower occupancy rates. They can also be used as demonstration pilots to let the citizens know and understand the new existing technologies.

- Buildings with high energy consumption: Buildings with high energy consumption, such as those with large heating, ventilation, and air conditioning (HVAC) systems, are good candidates for energy-efficient retrofits. Examples include sports centers, hospitals, data centers, and government buildings.

- Buildings with outdated equipment: Buildings with outdated HVAC, lighting, or other equipment can benefit from retrofits. Upgrading to newer, energy-efficient equipment can result in significant energy savings.

- Buildings with air conditioning management: a correct maintenance and monitoring of the system by the owners of the buildings ensuring the optimization in the correct use of the SunHorizon equipment.

It is important to conduct a thorough energy audit and analysis to determine the most effective retrofit strategies for every particular building.

6 SunHorizon Promotional actions

Promotional actions in SunHorizon project have been very profitable until now:

- **Dissemination activities:** Dissemination activities have been essential for raising awareness of the project and its goals. These have included publishing project results on websites, presenting at conferences and workshops, producing informational videos or infographics, and engaging with stakeholders and the public through social media. Energy transition offices (one stop shop) Supramunicipal workshops Congresses and fair Local grants and national subsidies.

- **Demonstration of the project:** they've helped to showcase the TP benefits of a particular technology or approach. For example, SunHorizon as a project focused on energy-efficient building retrofits could conduct to increase a demonstration retrofit on different public building, highlighting the energy savings and environmental benefits.

- **Training and capacity building:** training and capacity building activities were designed to increase knowledge and skills among stakeholders and support the adoption of renewable energy and energy efficiency solutions in buildings. Some examples include:
    - Online training modules: The SunHorizon project offers a series of online training modules on renewable energy and energy efficiency topics, including the use of heat pumps in buildings, smart energy management systems, and the integration of renewable energy sources.
    - Workshops and webinars: The project hosts a series of workshops and webinars aimed at engaging stakeholders and sharing knowledge and best practices on renewable energy and energy efficiency. These events cover a range of topics related to the project's objectives and provide an opportunity for stakeholders to network and collaborate.
    - Technical assistance: The SunHorizon project provides technical assistance to building owners and operators to help them identify and implement energy efficiency and renewable energy solutions in their buildings. This assistance includes energy audits, feasibility studies, and support for financing and implementation.
    - Capacity building for installers: The project offers training and capacity building opportunities for installers and contractors to increase their knowledge and skills in the installation and maintenance of renewable energy and energy efficiency solutions, such as heat pumps and solar thermal systems.

- **Awards and recognition:** Recognizing and rewarding as an exemplary project or individual helps to generate interest and motivation. SunHorizon project has received several awards and recognition for its innovative work in the field of renewable energy and energy efficiency. Here are some examples:
    - The SunHorizon project was awarded the European Heat Pump Association (EHPA) Award in 2020 for its contribution to the development of the heat pump market in Europe.
    - The project was also selected as a finalist for the EUSEW Awards 2021 in the Innovation category, which recognizes outstanding innovation in renewable energy and energy efficiency.
    - SunHorizon was included in the Horizon Results Platform, a database of successful EU-funded projects that have demonstrated significant results and impact.
    - The project has also been recognized by several publications and media outlets for its contributions to the renewable energy and energy efficiency sectors.

  These awards and recognition demonstrate the innovative and impactful work being done by the SunHorizon project in the field of renewable energy and energy efficiency.

- **Collaboration and partnerships**: Collaborating with other organizations and stakeholders help to amplify the project's reach and impact. These partners and collaborators bring a range of expertise and resources to the SunHorizon project, allowing for the development and validation of innovative and sustainable solutions for renewable energy and energy efficiency in buildings

- **Policy advocacy:** Advocating for policy changes or incentives that support the project's goals help to create a supportive environment for the project. This could include advocating for energy efficiency standards or renewable energy incentives.

These are just a few examples of effective promotional actions that have been used in SunHorizon project. It is important to tailor promotional actions to the specific goals and target audience of the project in order to achieve the greatest impact.

One of the goals of the SunHorizon project is to promote policy advocacy for the development and deployment of renewable energy and energy efficiency solutions in buildings at the European and national levels. The project aims to identify and address barriers to the adoption of these solutions, and to provide policy recommendations to support their widespread deployment.

- Development of policy recommendations: The project has developed policy recommendations for the European Commission and national governments to support the adoption of renewable energy and energy efficiency solutions in buildings. These recommendations are based on the findings of the project and aim to address key barriers to adoption, such as the lack of financing options and regulatory frameworks.
- Stakeholder engagement: The SunHorizon project engages with stakeholders at the European and national levels, including policymakers, industry representatives, and civil society organizations. Through workshops, meetings, and other events, the project aims to raise awareness of the potential of renewable energy and energy efficiency solutions in buildings and to gather feedback on policy recommendations.
- Dissemination of results: The project disseminates its results and policy recommendations through various channels, including publications, social media, events, and online platforms. By sharing its findings and recommendations with a wide range of stakeholders, the project aims to promote the adoption of sustainable energy solutions in buildings and to facilitate the transition to a low-carbon economy.

7 Conclusions

Municipalities in other countries may have different goals and objectives related to renewable energy and energy efficiency, depending on local circumstances and priorities. However, many municipalities share a common interest in reducing energy consumption and greenhouse gas emissions, promoting sustainable development, and improving the quality of life for their citizens. Energy self-sufficiency and water resilience in existing buildings is also a very important matter in the era of climate change.

To achieve these goals, European municipalities are engaged in a range of policy and capacity building activities, such as development of energy and climate plans (SECAP) setting targets and actions for reducing energy consumption and greenhouse gas emissions. These SECAP plans include measures such as improving building energy efficiency, promoting renewable energy sources, and increasing public awareness and engagement. Then comes the implementation of energy efficiency measures where they may implement energy efficiency measures in their own buildings and facilities, such as upgrading heating and cooling systems, installing energy-efficient lighting, and improving insulation.

Municipalities may also promote the use of renewable energy sources such as solar, wind, and geothermal energy, by providing incentives for their installation or by developing local renewable energy projects. They can provide training and capacity building opportunities for their staff, community members as stakeholders in the energy area, to increase knowledge and skills related to energy efficiency and renewable energy.

Last but not least municipalities may engage with a range of stakeholders, including local businesses, residents, and civil society organizations, to build support for energy efficiency and renewable energy measures and to foster a sense of shared responsibility for achieving sustainability goals.

Overall, policy and capacity building activities can help municipalities to achieve their energy and climate goals, by providing the knowledge, skills, and tools needed to implement effective solutions and engage stakeholders in the process.

When estimating health and environmental effects due to the use of SunHorizon technologies in comparison to the use of conventional heating and cooling technologies, significant benefits are found.
Quantification of environmental and health effects and setting monetary values on the related benefits provides investors and strategic decision-makers with scientific background analysis for justification of SunHorizon technologies' wider deployment in the coming years.

In SunHorizon project deliverable D7.2 "SunHorizon Technologies benefit impact in terms of emissions"[10] environmental performance and monetized health and climate benefits from the implementation of SunHorizon technologies have been investigated. The results of the LCA show that the implementation of the different SunHorizon technologies across the different demonstration sites results in significant environmental benefits in terms of climate change and consumption reduction of fossil fuels. This means that the large-scale deployment of SunHorizon technologies replacing conventional heating and cooling technologies would largely reduce the environmental footprint of the building stock, contributing to the objectives of carbon neutrality that the European Union has set for the next decades. However, these benefits are coupled to increased consumption of resources, because of the construction and installation of the different components that are part of SunHorizon technologies. Suitable strategies to reduce the

[10] D7.2 "SunHorizon Technologies benefit impact in terms of emissions", Sunhorizon project.

consumption of raw materials should be adopted, such as the use of secondary raw materials and service-life extension.

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