NET ZERO CITIES
EU MISSION PLATFORM | CLIMATE NEUTRAL AND SMART CITIES

EU MISSIONS
CLIMATE-NEUTRAL & SMART CITIES

CCC HIGHLIGHTS

RESIDUAL EMISSIONS STRATEGIES

SUMMARY

As of May 2025, the EU Mission Label has been awarded to 92 cities, marking significant progress toward the EU's goal of achieving climate-neutral and smart cities by 2030.

- 10 cities receiving the Label in October 2023
- 23 cities in March 2024
- 20 cities in October 2024
- 39 cities in May 2025

The Mission Label is the European Commission's recognition of each city's commitment to achieving climate neutrality by 2030, as outlined in their respective Climate City Contracts (CCCs). These contracts set out the overall vision, including a commitment, and contain both an action plan and investment strategy.

This factsheet, as part of a wider series titled "CCC Highlights", explores the **residual emissions strategies** that the labelled cities presented as a critical area that cities must urgently strengthen in order to achieve climate neutrality and, in particular, as complements to the planned emissions reductions measures set out in their action plans.

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Main takeaways:

- In total, by 2030, Mission Cities will have reduced their emissions by almost 200 million tCO2eq compared to their 2018 baselines, and will need to address residual emissions of approximately 60 million tCO2eq through compensation strategies. The Transport and Built Environment sectors will be the sectors where most of the residual emissions will arise from.
- Of all submitted CCCs, 72% (66 out of 92) included a residual emissions strategy. Only two cities select all four types of strategies (Cluj Napioca and Dunkerque), 12 cities select three types of strategies, 31 cities select 2 and 25 cities select one.
- The most common type of strategy selected by cities is Carbon Farming, which makes up for almost half of the total offsetting actions. Next are Carbon Credits and Permanent Carbon Storage with 28% and 19% respectively, while Carbon Storage in Products has a marginal influence with 5%.
- Most cities' residual emissions strategies do not include calculations of direct impact in terms of GHG emissions. This is especially the case for Carbon Storage in products, whose impact is never calculated by cities, and Permanent Carbon Storage, where only five cities calculate impacts (Lathi, Aarhus, Stockholm, Trondheim, and Oslo). About ¼ of Carbon Credits impacts and almost half of Carbon Farming impacts are calculated, though methodologies for doing so differ, and are not always clearly stated.
- Cities with residual emissions strategies identify several barriers and opportunities associated with the required actions, which can be categorised as financial, administrative, regulatory, skills and capabilities, and technical. However, clear opportunities are identified in each of these areas.
- Generally, residual emissions strategies in CCCs are not very detailed, lacking clear timelines, milestones, KPIs, and investment plans, etc. Cities often mention that improved residual emissions strategies will be a priority for CCC iterations in the coming years.

1. DEFINITION OF RESIDUAL EMISSIONS FOR MISSION CITIES

As per Mission Info Kit, achieving climate neutrality will require a Mission City to reduce the GHG emissions from all sectors and sources within the city's boundary to **net zero by 2030**, including:

- **Stationary energy:** Emissions from the combustion of fossil fuels in all buildings and facilities (known as 'stationary energy'). In addition, emissions arising from the consumption of electricity and district heating/cooling used in buildings.
- **Mobility:** Emissions from the combustion of fossil fuels for all vehicles and transport. In addition, emissions arising from the consumption of electricity used in transport.
- **Waste & Wastewater:** Emissions arising from the waste generated within the city boundary, treated/managed/disposed of within or outside the city boundary.
- **AFOLU:** Emissions from changes in land use, including agriculture, forestry and other land uses.
- **IPPU:** Emissions from chemical processes in industry.

Compensation of residual emissions is possible through offsetting, with limited eligibility depending on project types. More guidance is available in [Mission Info Kit]() and [CCC iteration guidance]().

To address residual emissions and achieve net-zero, **NetZeroCities aligns with the EU Carbon Removals Certification Framework (CRCF).** The CRCF, first proposed by the European Commission in 2022, sets out to create a unified certification scheme for carbon dioxide removals. The CRCF categorises carbon removals into three key areas:

- **Carbon Farming**, such as soil carbon and afforestation/reforestation.
- **Permanent Carbon Storage/Removal** such as Biochar Carbon Removal (BCR), Direct Air Capture and Storage (DACS), Enhanced Rock Weathering (ERW), and Bioenergy with Carbon Capture and Storage (BECCS).
- **Carbon Storage in Products** such as wood-based construction materials and concrete (where the carbon is stored for 35 years).

In addition, Mission Cities can account for **Carbon Credits** from outside the city's boundary and subject to certain rules and restrictions to address residual emissions (i.e., using formal credits/certificates verified and/or validated under rigorous standards by certified third-party auditors).[1]

Certified renewable energy purchases (RES credits) are allowed for the reflection in the calculation of the local emission factor to address Scope 2 emissions.

2. QUANTIFICATION OF RESIDUAL EMISSIONS OF MISSION CITIES

In their CCCs, and specifically in their Action Plans, the Mission-labelled cities provided GHG emissions inventories for their baseline year. Then, they quantified emissions reductions from existing plans to determine the emissions gap to climate neutrality in 2030. As most cities' (but not all of them) existing plans fall short of the neutrality ambition, cities went through a collaborative process with their stakeholders to design and develop portfolios of actions to tackle the emissions gap. As a result, cities could quantify, as an estimate, the amount of residual emissions in 2030.

Data on baseline inventories, emissions reductions, and residual emissions was extracted from all submitted CCCs and visualised in the NetZeroCities Barometer. Figure 1 shows the aggregated amount of residual emissions for all Mission Cities, and the sector from which they are generated.

In total, by 2030 Mission Cities will have reduced almost 200 million tCO2eq compared to their 2018 baselines and will need to address residual emissions equal to about 60 million tCO2eq through compensation strategies.

The Transport and Built Environment sectors will be the sectors where most of the residual emissions will arise from.

1. See *Mission Info Kit* page 24 for more guidance on carbon credits projects.

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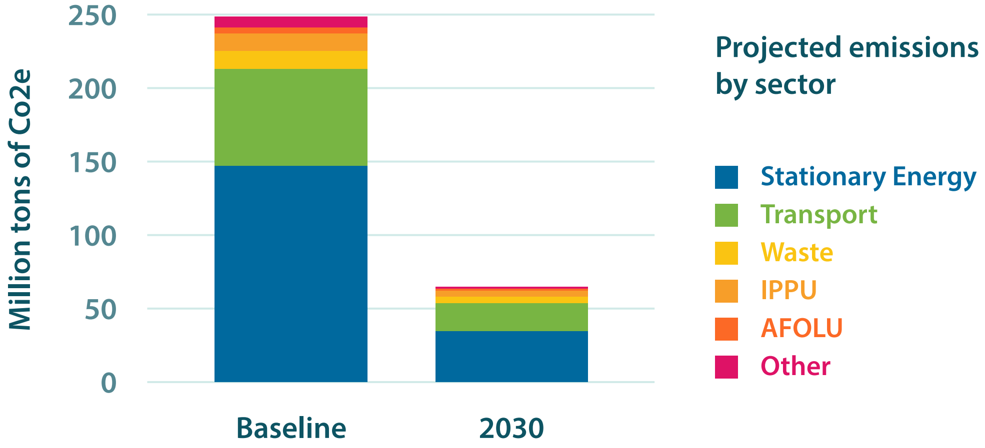


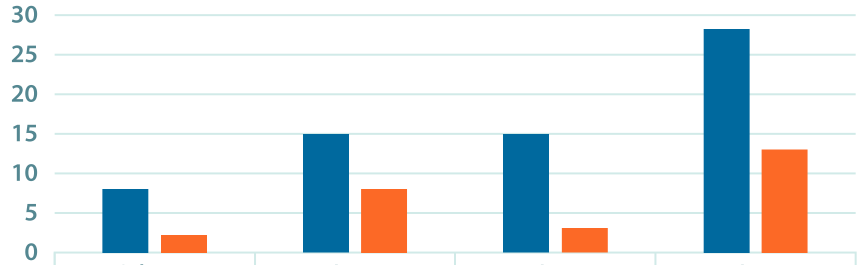
Figure 1: Quantification of estimated residual emissions

3. RESIDUAL EMISSIONS STRATEGIES IN CLIMATE ACTION PLANS

After submission, CCCs undergo a process of Completeness and Coherence Check. This process includes a checklist with questions answered by the city and validated (or not) by a reviewer.

Figure 2 below shows the distribution of cities where the reviewer validated a "yes" or "no" answer to the question **Does the CCC provide a strategy to address residual emissions in line with what is required by the Info Kit?** The results show that, of all submitted CCCs, 72% (66 out of 92) included a residual emissions strategy, with an interesting distribution across cohorts, whereby cohort 3 has the highest proportion of 'yes' to 'no' answers, and cohort 4 has the lowest.

Cities with residual emissions strategies as part of their Climate Action Plans



	Cohort 1	Cohort 12	Cohort 3	Cohort 4
Count of "yes"	8	15	15	28
Count of "no"	2	8	3	13

Figure 2: Number of Mission Cities with residual emissions strategy per cohort

Figures 3 and 4 below show the type of strategy cities are selecting and how often they are selected. Strategies were classified in 5 types: **Carbon Farming** such as soil carbon and afforestation/reforestation, **Permanent Carbon Storage/Removal** such as Biochar Carbon Removal (BCR), Direct Air Capture and Storage (DACS), Enhanced Rock Weathering (ERW), and Bioenergy with Carbon Capture and Storage (BECCS), **Carbon Storage in Products**, and **Carbon Credits** including any type of strategy implemented outside the city's boundary.

Only two cities select all 4 types of strategies, 12 cities select three types of strategies, 31 cities select 2 and 25 cities select one.

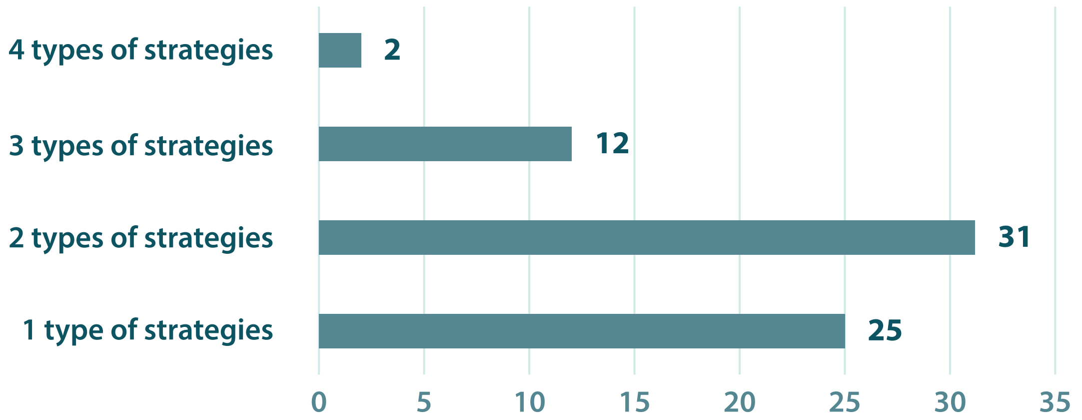


Figure 3: *Count of cities selecting 1, 2, 3 or all 4 types of strategy to address residual emissions*

The most common type of strategy selected by cities is Carbon Farming, which makes up for almost half of the total offsetting actions. Next are Carbon credits and Permanent carbon storage with 28% and 19% respectively, while carbon storage in products has a marginal influence with 5%.

Figure 4: *Share of type of action in cities residual emissions strategies*

The majority of cities' residual emissions strategies do not include calculations of direct impact in terms of GHG emissions. This is especially the case for carbon storage in products, whose impact is never calculated by cities, and permanent carbon storage, where only 5 cities calculate impacts (Lathi, Aarhus, Stockholm, Trondheim, and Oslo)|. About ¼ of carbon credits impacts and almost half of carbon farming impacts are calculated, though methodologies for doing so differ, and are not always clearly stated. This CCC includes a Part 2 / Annex / Additional Materials document presenting case studies, best practices, sample calculations, and a list of methodologies used by cities to assess residual emissions strategies.

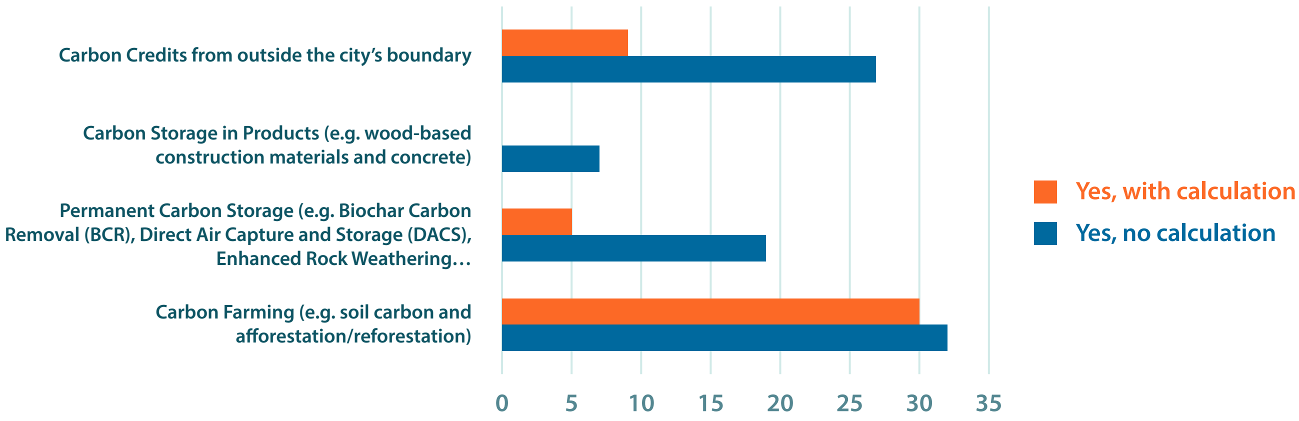


Figure 5: *Share of strategies with calculations per type*

4. BARRIERS AND OPPORTUNITIES

Cities cite several barriers linked to both the planning and implementation of their residual emissions strategies. Barriers are of financial, administrative, regulatory, skills and capabilities, and technical type. However, clear opportunities are also identified in each of these areas.

Below is a detailed list of barriers related to opportunities by lever of change:

4.1. FINANCE

Barriers	Opportunities
Cities mention that costs liked to carbon removal actions are highly uncertain, with some notable exceptions in which detailed cost plans are provided, especially in the carbon farming and carbon credits categories.	The iterative nature of CCCs offers the opportunity to update and revise plans as technologies mature and evolve.
Aside from cost planning, cities mention uncertainties in funding sources and limited municipal budgets.	Potential financing sources cities are exploring include: • Public funding from EU schemes (e.g., Horizon, Prima, LIFE), and RIF (infrastructure projects). • Corporate funding linked to social and environmental responsibility. • Compliance markets. • Voluntary (private) contributions or voluntary carbon markets. • Municipal public funding. In both compliance and voluntary carbon markets, individuals, companies, and organizations engage in the buying and selling of carbon credits to offset or compensate for their greenhouse gas emissions. In compliance markets, entities are legally obligated to meet emission reduction targets, while the voluntary market operates on a voluntary basis. Beyond carbon emissions reductions or offsetting, credits in carbon markets can and are often linked to, for example, societal co-benefits. For example, **Aachen** economically assesses the environmental values created by its renaturalisation strategy with the standard monetisation approaches of environmental science (CE Delft, Handbook of Environmental Costs, Delft 2023) and offsets these against the environmental costs that arise from greenhouse gas emissions.

Barriers	Opportunities
Several cities mention that distributed ownership and responsibility over opportunities for offsetting actions is a barrier, as the city perceived that it has little influence over decision-making.	Cities are exploring opportunities to regulate or guide more and more of these assets, thanks in part to carbon markets and other soft and 'hard' measures. As an example, Paris encourages the French government to reinforce carbon offsetting obligations for airline companies, which represents a consequential share of remaining emissions within its carbon neutrality pathway.
A methodological problem that has not yet been solved is the avoidance of "double counting". For example, Dresden notes that "there are no climate protection obligations below federal level in Germany - all measures at state or municipal level are voluntary. In order to rule out "double counting" of compensation projects below federal level with federal actions, a procedure is required for managing and weighting compensation payments below federal level. Such a procedure does not currently exist." Similar issues in reporting offsets are noted by Paris with "the identification and reporting of the Paris-based carbon footprints of companies that have offset their emissions at the national or international level. For example, the delivery happening and operated by the national Post Office in Paris is officially offset by the company (La Poste), who aims to be carbon-neutral by 2040. However, there is no data on what is compensated yet by companies or at the individual level, and what amount of Paris related emissions this offsetting is attributable to."	Stockholm is developing an approach to address the topic of bookkeeping and cancellation of carbon removal units that prevents double claiming. "The negative emissions that Stockholm Exergi creates with the BECCS project will be included in the national climate reporting (unless sold to other parties under the rulebook of the Paris Agreement). At the same time it is expected that they will be included in the climate reports prepared by companies that buy negative emissions on the created voluntary market in order to reach their climate goals. The City does not buy these negative emissions, but reports them in its climate report, where both emissions and carbon sinks within its geographical boundary are summed up. The municipal companies that act on the market cannot use the negative emissions from the City's reporting to become climate neutral."

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4.3. SKILLS AND CAPABILITIES

Barriers	Opportunities
Cities mention that there is not enough technical knowledge in the municipality to be able to create a robust offsetting strategy.	To address this it is common for cities to work together with stakeholders, for example, partnering with initiatives for skills building, or with the private sector (energy utilities, industries) on feasibility studies.
It is often the case that lack of standard methodologies for the estimation of carbon removal strategies is mentioned as a major barrier to progress in their development and inclusion in climate action plans.	Cities often ask for example calculations to follow or align with.

4.4. TECHNOLOGY

Barriers	Opportunities
While most cities see an untapped potential in greening their cities, they sometimes mention that there is not enough space for carbon sinks, or that their availability varies from year to year.	Cities quote co-benefits linked to NBS as a reason to pursue this type of action as both an offsetting activity but also for its own sake, independently from carbon accounting.
The maturity of CCSU technologies is often cited a barrier, which is linked to highly uncertain costs.	The iterative nature of CCCs offers the opportunity to update and revise plans as technologies mature and evolve.

In **Carbon Capture, Storage and Use (CCSU)**, the GHG emissions from the carbon capture can only be (up to) net zero – they do not generate credits applicable to negative emissions. However, there can be 'avoided emissions' credited to the storage and use of the captured carbon.

- As an example, trees capture carbon and store it, but they release it at end-of-life through a biogenic release process (biomass incineration, anaerobic digestion, fermentation). It is thus essential to always speak about 'net' overall emissions when assessing (biogenic) direct impacts, and to address end-of-life treatment strategies, which are essential to climate mitigation plans.
- In the case of '**Carbon Farming**' as an offsetting strategy, additional natural sinks are created and – crucially – maintained as 'permanent storage', ensuring a net surplus in the carbon captured in a specific area. The net surplus can be credited as 'avoided emissions'.

When the captured carbon is used, the net GHG emissions from replacing the process can be credited to residual emissions as an 'offset' or 'negative emissions'.

- If the tree is used to replace other construction materials, GHG emissions from the use of the other material are 'avoided' emissions (**Stored in Products**) and can be credited to 'negative emissions'.

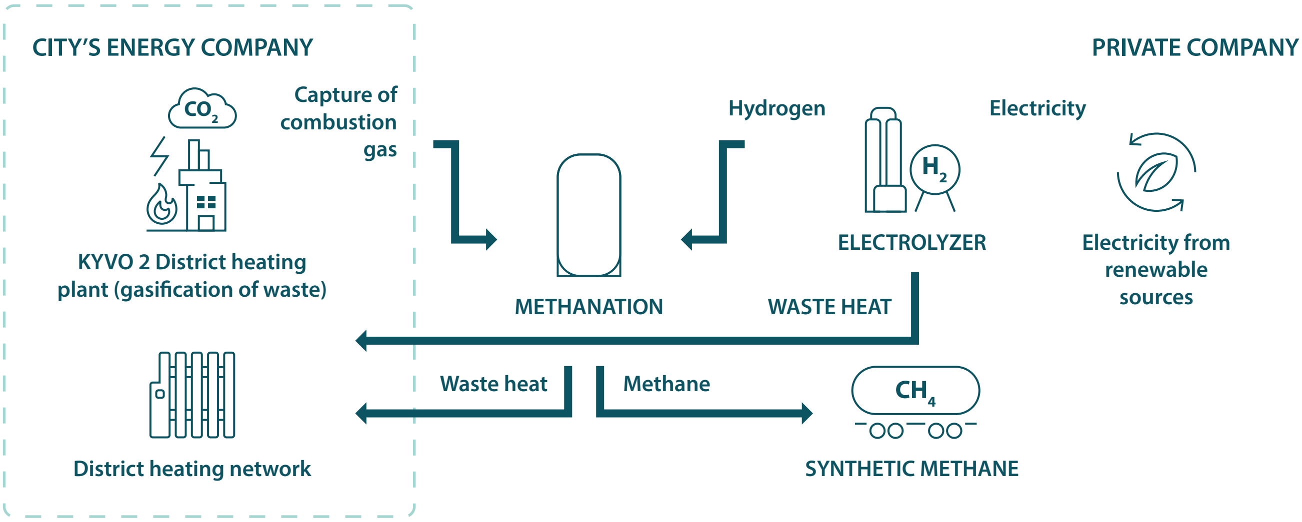
A specific and common application of CCSU is **Bioenergy with Carbon Capture and Storage (BECCS)**: If carbon emissions from biogenic processes is captured, stored, and used as fuel, the GHG emissions avoided from replacing the use of other fuels can be credited to residual emissions as an 'offset' or 'negative emissions'. Interestingly, if the biomass used in the process is sourced from a reliable Carbon Farming process, additional negative emissions are credited for the carbon sequestered by the biomass during its 'service life'. The European Strategic Energy Technology Plan (SET-Plan) identifies the technique as one of the priority actions for accelerating the energy system's transformation.

5.1. BECCS

Cities are finding it increasingly efficient to adopt BECCS or other cascading carbon capture and usage mechanisms as a strategy to both increase self-sufficiency, circularity, and lower emissions (and reap related co-benefits).

For example,

- The city-owned energy company in **Lahti** is partnering with the private company Ren-Gas and planning a major investment in synthetic methane production by combining captured carbon from district heating-powered waste incineration with hydrogen from renewable electricity sources.



- **Stockholm** reports that currently, the technology with the most potential in the city is Bio-Energy Carbon Capture and Storage, BECCS or Bio-CCS. Similarly to Lathi, a BECCS plant linked to the biofuel-fired CHP plant near the Värtan port in east-central Stockholm is expected to be operational in 2025/26, with the capacity to capture and permanently store large quantities of biogenic CO2, resulting in carbon removal from the atmosphere and the creation of so-called "negative emissions". The full-scale, world-class BECCS project is owned by Stockholm's district energy provider Stockholm Exergi (50% owned by the municipality). The project has the potential to remove around 800,000 tonnes of annual GHG emissions. In addition to producing concrete climate benefits, this project is also intended to accelerate the development of a new market for net carbon removals. The financing will likely rely on three sources: the EU, the national government, and the sales of negative emission certificates on a voluntary carbon market. The EU Innovation Fund has selected Stockholm Exergi's BECCS project as one of seven projects in the EU to receive €1.1 billion in funding.

- In addition, since 2017, **Stockholm** has operated a test site for producing bio-char; a pilot financed by Bloomberg Philanthropies as a result of the city's winning the Mayor's Challenge. Garden waste is used to produce biochar which in turn is used to improve the soil in the city´s gardens and tree plantations along the streets. Adding biochar to the soils significantly improves the growth of trees and bushes. This, in turn, leads to enhanced stormwater handling, reduced temperatures, and a more pleasant urban environment. The excess heat that is produced is distributed into the district heating system, thereby contributing to reducing the residual emissions. Biochar is a truly multifunctional solution, however, the negative emission potential is much lower than that of other solutions such as BECCS, and in addition it may not be regarded as permanent.

5.2. CARBON FARMING

Afforestation and re-greening is the residual emission strategy that is mostly mentioned or included by cities in their Climate Action Plans. Several cities mention greening or afforestation plans with a fair level of detail, including costs and impact estimates, timelines, and milestones. However, cities report a lack of skills, data, and standardised calculation methods to develop and detail robust carbon farming plans. To address these barriers, cities are partnering with existing initiatives, academia and research institutions, referring to known methodologies or guidelines, or developing their own (often collaborative) approaches.

For example,

- **Developing own guidelines and approaches:** The land use sector (Land Use, Land Use Change and Forestry, i.e. LULUCF) offers significant potential for both emission reduction and carbon sink enhancement in municipal climate action. This sector, encompassing forests, arable land, grasslands, wetlands, and built areas, is also crucial for biodiversity conservation. **Finnish municipalities** have published **Land-Use Strategies for Climate Action and Biodiversity**, a guide outlining a systematic approach to climate action in the land use sector. It introduces a progress ladder and iterative improvement methodology, identifying specific municipal actions and highlighting synergies between climate and biodiversity initiatives. The guide emphasises the importance of robust, transparent municipal climate claims and encourages collaboration with enterprises and landowners for the implementation and funding of climate actions.

- **Partnering with academia and research:** Assuming conformity with municipal procurement law, **Aachen** carries out its offsetting in cooperation with the local GREENZERO Group, and in accordance with the CEC offsetting approach formulated by the TU Berlin and Braunschweig and deposited with DIN as a DIN SPEC (see "Offsetting environmental impacts beyond climate change: the Circular Ecosystem Compensation approach", Moore et al., Berlin 2023) from the standard for environmentally neutral action - multidimensional analysis, reduction and offsetting of environmental costs (https://greenzero-group.com/ and Commitments, Appendix 2). The initiative driving the standard, "Acting together in an environmentally neutral way", led by the GREENZERO Group, pursues a holistic approach to offsetting. Ecologically degraded areas are comprehensively renaturalised with a strong focus on biodiversity gains.

- **Partnering with other initiatives: Kozani** is a member of the LifeTerra project (**www.lifeterra.eu**), which aims to bring people together to plant 500 million trees within five years.

- **Referring to existing guidelines and approaches: Łódź City** uses factors from the IPCC Sixth Assessment Report to calculate an average carbon storage density of urban tree cover of 7.69 kg C / m2 (kilograms carbon per square metre) or 28.2 kg CO2 / m2 (overall stock). However, it recognises that the amount of carbon stored varies widely based on region, vegetation type, tree density, and the species composition.

- **Developing in-house capacities and capabilities:** To address this, several cities develop detailed land use models. In one of several examples, a land use (LU) analysis of the Municipality of **Prato** was performed based on available 2016 data extracted from the land use map of the Tuscany region. This database included 44 classes that were used to identify the type and extent of forest areas present within the Municipality. All the classes surveyed were aggregated into six main classes: broadleaf forests, needle forests, olive groves and herbaceous areas, the latter including meadows and annual herbaceous crops. The fifth class consisted of urban areas and the sixth of all the other classes (e.g. cemeteries, greenhouses, sports areas, etc.) An additional layer containing information on both public and private trees located in the urban area of Prato was developed by coupling a georeferenced inventory of urban trees (UTI) owned by the Municipality with the photographic interpretation of the distribution of private trees, in order to have a realistic number of urban trees within the Municipality, excluding extra-urban forest areas. Based on the study carried out by the CNR (National Council for Research), the Prato area offers the possibility of planting around 190,000 trees with an annual absorption of 33,000 tCO2 by 2030.

- **Stavanger** mapped potential emissions by land use change over a 20-year period. The characteristics of the soil impacts if these areas act as carbon sinks, or releases carbon to the atmosphere. Some areas mapped represent agricultural land on organic soil. Other areas show having stored 5–25-ton CO2-eq. per acre, 25-50 ton CO2-eq per acre, and over 50 ton CO2-eq. per acre. The map will inform the new land-use part of the municipal master plan. The goal of this system is to balance the maintenance of biodiversity and nature's contribution to people's lives, while allowing development and urbanisation to continue in stride with expected population growth.

- In **Łódź**, residents are helping to create an inventory of every single tree in the city. On the website Mapa Drzew Łódźi Mapa Drzew Łodzi - Społeczna inwentaryzacja drzew (mapadrzewlodzi.pl), https://mapadrzewlodzi.pl, they can register and fill a survey to add every tree in the city to a specially designed map.

- In **Riga**, LLC 'Rīgas meži' has prepared a detailed list of actions for the green infrastructure areas which include, among others, targeted creation of uninterrupted forest coverage, selection of sustainable planting material for forestry activity zones, assessing the risks of wind, forest fire, disease, and pest damage, as well as water impact, and making appropriate (risk-based) adjustments to the planning of new forest stands and the management of existing stands, sharing of knowledge on new forest management methods, Develop and improve the data records system and emissions calculations, Provision of information, education, awareness-raising, and engagement.

5.3. CARBON STORAGE IN PRODUCTS

Cities need to grow and land use change might be inevitable. This, however, represents a potential for the local offsetting strategies, too. Cities can raise the share of construction that stores and binds carbon, as by increasing the use of wood and other suitable materials.

For example,

- **Lathi** is considering concrete that functions as a carbon sink, which was recently developed by VTT Technical Research Centre of Finland. A pilot plant for manufacturing this carbon-negative concrete is in Hollola, a neighbouring municipality.

- **Greater Dunkirk** is considering investing in or mandating the use of innovative construction materials like carbon absorbing concrete or aggregates that incorporate captured CO_2 into their structure, locking it away permanently. 2 companies are working on it: Ecocem, making concrete from recycled materials, and ECOPAL, an intermediary and facilitator of inter-company synergies, to promote industrial and regional ecology. In addition, the city aims to explore technologies that utilise carbon-storing materials, such as hempcrete or other biomaterials, to create structures that sequester carbon over their lifespan. The company "Batilin", for example, is currently developing bio-based materials with high insulating power.

5.4. CARBON CREDITS

To address the lack of local opportunities for carbon sinks, cities are looking at regional and even international opportunities to purchase reliable and traceable carbon credits. Some of these opportunities are carbon markets, which can be mandatory or voluntary, and can also sometimes cover projects within the cities boundaries. In either case, the evaluation of co-benefits can weigh in to the decision of which credits to buy.

For example,

- In **Leuven**, the Claire platform (https://claire-co2.com/) provides the opportunity of purchasing credits locally, using reliable and conservative calculation methods.

- City of **Paris** has launched the Coopérative Carbone Paris et Métropole du Grand Paris alongside several public and private partners. This cooperative aims to accelerate the achievement of the goal of carbon neutrality by supporting and financing regional offsetting projects. It acts as an intermediary between project developers, particularly in the field of carbon sequestration, and local businesses wishing to contribute to carbon neutrality. Agroforestry projects in the Paris Basin, financed by the Coopérative Carbone and guaranteed by the national "low-carbon" label, are a unique opportunity to develop a local compensation market and to absorb a significant quantity of carbon.

- The main solution that **Porto** intends to use to offset most of its residual emissions is the national Voluntary Carbon Market established very recently by Law n.º 4/2024, of January 5th and which opens the possibility of establishing carbon offsetting projects in the Portuguese territory.

- **Aachen and Münster** purchase Carbon Farming certificates from MoorFutures. The certificates are closely aligned with the Verified Carbon Standard and the Kyoto Protocol, and follow the requirements of internationally recognised environmental standards (ISO 14064 and 14065). By offsetting through the purchase of corresponding certificates such as MoorFutures from Mecklenburg-Western Pomerania, Brandenburg and Schleswig-Holstein, it is possible to offset 1 tonne of CO2 by purchasing a certificate for 64 euros.

- **Bristol** explored the hypothetical cost to the city of using market-based mechanisms to offset its residual emissions in 2030 under a number of different price scenarios, basing its rates on [Global Carbon Market Outlook 2024 | BloombergNEF (bnef.com)](). The first scenario recognises that the voluntary carbon offset market is currently subject to widespread concerns regarding robustness, a lack of harmonised standards, and therefore valid concerns about potential greenwashing. The assumed price is $13 per tonne of carbon equivalents. The remaining scenarios assume different levels of standards harmonisation or market restriction. The assumed prices are $20, $146, and $162 per tonne of carbon equivalents by 2030.

5.5. SKILLS AND CAPACITY BUILDING, STAKEHOLDER ENGAGEMENT

Several cities feel that their capacities and knowledge of offsetting options are not enough to start planning a residual emission strategy, and report a focus on skills building. Citizen and stakeholder engagement is also noted in several residual emissions strategies, especially around planting trees and greening the city.

For example,

- **Porto** has been gaining capacity and acquiring knowledge on residual emissions through the creation of collaborations with the academia and experts. For example, the sixth session of the Porto Climate Pact Talk Series, held on June 22, 2023, focused on the topic of "Carbon Capture."

First Cohort of Mission Label Cities (Label awarded in October 2023)	Second Cohort of Mission Label Cities (Label awarded in March 2024)	Third Cohort of Mission Label Cities (Label awarded in October 2024)	Fourth Cohort of Mission Label Cities (Label awarded in May 2024)
• Sønderborg (Denmark) • Mannheim (Germany) • Madrid, Valencia, Valladolid, Vitoria-Gasteiz, Zaragoza (Spain) • Klagenfurt (Austria) • Cluj-Napoca (Romania) • Stockholm (Sweden)	• Ioannina, Kalamata, Kozani, Thessaloniki (Greece) • Heidelberg (Germany) • Leuven (Belgium) • Espoo, Lahti, Lappeenranta, Tampere, Turku (Finland) • Barcelona, Seville (Spain) • Pécs (Hungary) • Malmö (Sweden) • Guimarães, Lisbon (Portugal) • Florence, Parma (Italy) • Marseille, Lyon (France) • Limassol (Cyprus) • Izmir (Türkiye)	• Aachen, Münster (Germany) • Trikala (Greece) • Miskolc (Hungary) • Bologna, Bergamo, Milan, Prato, Turin (Italy) • Liepāja (Latvia) • The Hague (Netherlands) • Porto (Portugal) • Bucharest 2nd District, Suceava (Romania) • Ljubljana, Kranj (Slovenia) • Gothenburg, Umeå (Sweden)	• Antwerp (Belgium) • Gabrovo, Sofia (Bulgaria) • Liberec (Czechia) • Aarhus, Copenhagen (Denmark) • Dresden, Leipzig (Germany) • Cork, Dublin (Ireland) • Athens (Greece), Bordeaux Metropole, Dijon Metropole, Dunkerque, Grenoble-Alpes Metropole, Nantes Metropole, Paris (France) • Padova (Italy) • Riga (Latvia) • Taurage, Vilnius (Lithuania) • Budapest (Hungary), • Krakow, Łódź, Rzeszow, Warsaw, Wrocław (Poland) • Velenje (Slovenia) • Košice (Slovakia) • Helsinki (Finland) • Helsingborg, Lund (Sweden) • Reykjavík (Iceland) • Oslo, Trondheim, Stavanger (Norway) • Istanbul (Türkiye) • Bristol, Glasgow (United Kingdom)

LEGEND

Strategy addressed in CCC, with quantification of direct impact (green)

Strategy addressed in CCC, without quantification of direct impact (yellow)

Country	Country/ Region	City	Population	Carbon Farming	Carbon Credits	Permanent Carbon Storage	Carbon Storage in Products
W3	Germany	Aachen	252,769	green	green	yellow	
W4	Denmark	Aarhus	290,598	green		green	
W4	Netherlands	Amsterdam	921,468	yellow	yellow		
W4	France	Angers	157,175				
W4	Belgium	Antwerp	565,039				
W4	Greece	Athens	643,452				
W2	Spain	Barcelona	1,660,122	yellow		yellow	yellow
W3	Italy	Bergamo	119,534				
W3	Italy	Bologna	387,971	yellow	yellow		
W4	France	Bordeaux	261,804	green	green		
W4	Slovakia	Bratislava	475,503	yellow			
W4	England	Bristol	483,000	green	green		
W3	Belgium	Brussels	1,218,255				
W3	Romania	Bucharest	1,716,961				
W4	Hungary	Budapest	1,671,004	yellow	yellow		
W1	Romania	Cluj-Napoca	286,598	yellow	yellow	yellow	yellow
W4	Denmark	Copenhagen	644,431				
W4	Republic of Ireland	Cork	222,333	yellow	yellow		
W4	Luxembourg	Differdange	29,536	yellow	yellow		
W4	France	Dijon	159,346	green			
W4+	Germany	Dortmund	595,471				

Country	Country/ Region	City	Population	Carbon Farming	Carbon Credits	Permanent Carbon Storage	Carbon Storage in Products
W3	Germany	Dresden	563,311				
W3	Republic of Ireland	Dublin	592,713				
W4	France	Dunkirk	87,013				
W4	Israel	Eilat	53,151				
W4+	Netherlands	Eindhoven	235,691				
W2	Finland	Espoo	297,132				
W2	Italy	Florence	360,930				
W4	Bulgaria	Gabrovo	52,477				
W3	Sweden	Gävle	77,586				
W4	Scotland	Glasgow	622,820				
W3	Sweden	Gothenburg	608,462				
W4	France	Grenoble	156,389				
W4	Netherlands	Groningen	202,900				
W2	Portugal	Guimarães	158,124				
W2	Germany	Heidelberg	162,273				
W4	Finland	Helsinki	684,589				
W2	Greece	Ioannina	113,978				
W4	Turkey	Istanbul	15,462,452				
W2	Turkey	İzmir	2,948,609				
W2	Greece	Kalamata	72,906				
W1	Austria	Klagenfurt	101,403				
W4	Slovakia	Košice	229,040				
W2	Greece	Kozani	67,224				
W4	Poland	Kraków County	278,219				
W3	Slovenia	Kranj	37,944				
W4	Belgium	La Louvière	80,986				
W2	Finland	Lahti	121,383				

Country	Country/ Region	City	Population	Carbon Farming	Carbon Credits	Permanent Carbon Storage	Carbon Storage in Products
W2	Finland	Lappeenranta	73,369	green	yellow		
W4	Germany	Leipzig	625,341				
W2	Belgium	Leuven	101,032	yellow	yellow		
W4	Czech Republic	Liberec	107,982		yellow		
W3	Latvia	Liepāja	66,680				
W2	Cyprus	Limassol	235,056	green			
W2	Portugal	Lisbon	545,923				
W3	Slovenia	Ljubljana	284,293	green		green	
W4	Poland	Łódź	670,642	green	yellow		
W4	Sweden	Lund	94,393	yellow		yellow	
W2	France	Lyon	520,774				
W1	Spain	Madrid	3,332,035	green		yellow	
W2	Sweden	Malmö	11,944				
W1	Germany	Mannheim	315,554				
W2	France	Marseille	870,321	yellow			
W3	Italy	Milan	1,417,597		yellow	yellow	
W3	Hungary	Miskolc	154,521				
W4+	Germany	Munich	1,510,378				
W3	Germany	Münster	322,904	green	green		
W4	France	Nantes	325,070		green		
W4	Norway	Oslo	711,300			green	
W4	Italy	Padua	214,125	green			
W4	France	Paris	2,048,472	green	green		
W2	Italy	Parma	196,764	yellow			
W2	Hungary	Pécs	145,347				
W3	Portugal	Porto	237,591	green	yellow		
W3	Italy	Prato	194,603	green			
W4	Iceland	Reykjavík	139,875				

Country	Country/ Region	City	Population	Carbon Farming	Carbon Credits	Permanent Carbon Storage	Carbon Storage in Products
W4	Latvia	Riga	605,802	🟩			
W4+	Italy	Rome	2,872,800				
W4	Poland	Rzeszów	195,871	🟨			
W2	Spain	Seville	684,234	🟩	🟨		
W4	Bulgaria	Sofia	1,276,956	🟨	🟨		
W1	Denmark	Sønderborg	27,595		🟨		
W4	Norway	Stavanger	146,011	🟩	🟨		
W1	Sweden	Stockholm	978,770	🟩		🟩	
W3	Romania	Suceava	84,308	🟨			
W2	Finland	Tampere	260,358	🟨		🟨	🟨
W4	Lithuania	Taurage	21,203	🟨	🟩		
W3	Netherlands	The Hague	549,163	🟨		🟨	
W2	Greece	Thessaloniki	315,196	🟩	🟨	🟩	
W3	Greece	Trikala	62,064	🟩	🟩		
W4	Norway	Trondheim	212,660	🟨		🟩	
W3	Italy	Turin	851,199	🟨			
W2	Finland	Turki	189,669				
W3	Sweden	Umeå	130,224				
W1	Spain	Valencia	825,948	🟨	🟨	🟨	
W1	Spain	Valladolid	297,459	🟨			
W4	Slovenia	Velenje	24,327				
W4	Lithuania	Vilnius	607,404	🟩			
W1	Spain	Vitoria-Gasteiz	255,886	🟨	🟨		
W4	Poland	Warsaw	1,860,281				
W4	Poland	Wroclaw	672,929	🟨			
W4	Croatia	Zagreb	767,131				
W1	Spain	Zaragoza	675,301				

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Country	Country/ Region	City	Quantification	Methodology
W3	Germany	Aachen	Baseline (2019): 39.725 t CO2e across different utilisation types 2030 Target: limited or no expansion	Statistical Yearbook 2020/21 of the City of Aachen, statistisches_ jahrbuch_2020-2021.pdf
W4	Denmark	Aarhus	2030 Target: 45000tCO2	n/a
W4	France	Bordeaux	76 ktCO2e by 2030 as a summary from different categories (hardwood forests, mixed forests, coniferous forests, poplar forests, wetlands, meadows, agricultural land, impermeabilized soils, artificial soil with grass, vineyards, orchards) and split in biomass, litter, and soil	n/a
W4	England	Bristol	Less than 50,000 tonnes CO2/year	n/a
W4	France	Dijon	Baseline (2018): 13,400tCO2 2030 Target: 27,800tCO2 from all land uses combined	n/a
W4	Germany	Dresden	Baseline: 21,000tCO2/year	n/a
W4	France	Grenoble	Baseline (2018): The [territory's] forest (its soil, living trees and dead trees) stores around 140 kteqCO2. […] the carbon sequestration of metropolitan forests and natural lands at around 4,000 tCO2e/year	ENERDATA/Solagro assessment; "metropolitan GHG Assessment"
W2	Portugal	Guimarães	Baseline: 120,548tCO2/year from biomass in LULUCF sector in Guimaraes	https://comum.rcaap.pt/entities/publication/8cd1c0ae-e2f1-492e-8d4d-8bd89c5b91c0
W4	Finland	Helsinki	About 70kt co2e	n/a
W2	Greece	Kozani	Baseline: 3205 trees x 20-40kgCO2/tree = 64-128tCO2/year 2025 Target: 250,000 trees = 5,000 -10,000 tCO2/year	"International literature"
W2	Finland	Lappeenranta	2030 Target: 25 800 tons of CO2e	n/a
W2	Cyprus	Limassol	Baseline: 278 to 1020 tCO2/ha/year carbon sequestration in seagrasses; 6.2ha parks x 45tCO2/ha of canopy cover = 1020tCO2e/year 2030 Target: 141.2 ha seagrass meadow; 300,000 new trees	n/a

Country	Country/ Region	City	Quantification	Methodology
W3	Slovenia	Ljubljana	Baseline (2018): 49,100tCO2 (with splits per biogenic carbon sink type) 2030 Target: 65,700tCO2, 143,447m Eur	n/a
W4	Poland	Łódź		
W1	Spain	Madrid	2030 Target: 500tCO2/year in green infrastructure	n/a
W3	Germany	Münster	12.5kgCO2 per year, per tree	Münster Climate Neutrality 2030 concept study
W4	Italy	Padua	2030 Target: 1,505tCO2 through 'green assets'	Green Spaces Plan
W4	France	Paris	Baseline (2018): 361 tCO2 / year from desilting and planting, 2.52mtCO2 carbon stock in Paris soil	ADEME's ALDO tool
W3	Portugal	Porto	Baseline: 1 355 ton CO2/year (65 000 trees mapped in the city sequester an average of 50 kg/CO2/year) 2030 Target: 3kt CO2/year	Graça, M., et al., Assessing how green space types affect ecosystem services delivery in Porto, Portugal, Landscape and Urban Planning, Volume 170, 2018, pp. 195-208, https://doi.org/10.1016/j.landurbplan.2017.10.007.
W3	Italy	Prato	2030 Target: 33,000tCO2 from 190,000 trees	Study carried out by the CNR (National Council for Research)
W4	Latvia	Riga	Baseline (2019): 324ktCO2 2030 target: ~300ktCO2/ year from forests + 16ktCO2e/year from peat bog areas	LLC 'Rīgas meži' estimates
W2	Spain	Seville	Baseline: 526tCO2eq carbon sinks 2030 Targets: 1800tCO2eq in Green Belt	n/a
W4	Norway	Stavanger	Baseline: soils beyween 5 and 50 tCO2eq/ha; heather 15-20kgCO2/m2	NiN- methodology (Nature in Norway), Norwegian Environment Agency regarding emission/uptake inventory for Forestry and other land use
W2	Sweden	Stockholm	n/a	City and national accounting and corporate accounting of emissions
W2	Greece	Thessaloniki	2030 Target: 4,000tCO2/year in trees	n/a
W3	Greece	Trikala	2030 Target: 3,42 kt of CO2e	n/a
W4	Lithuania	Vilnius	Baseline: 542.53ktCO2eq / year absorption	n/a "preliminary estimates"

Country	Country/ Region	City	Quantification	Methodology
W3	Germany	Aachen	Purchasing certificates from MoorFutures: 1t CO2 for 64 eur for 273,000 tonnes of CO2 per year = 23m Eur/year Federal Environment Agency: € 180 per tonne of CO2eq = € 49 million per year	"Offsetting environmental impacts beyond climate change: the Circular Ecosystem Compensation approach", Moore et al., Berlin 2023) from the standard for environmentally neutral action - multidimensional analysis, reduction and offsetting of environmental costs (https:// greenzero-group.com/ and Commitments, Appendix 2 Monetisation approach: CE Delft, Handbook of Environmental Costs, Delft 2023
W4	France	Bordeaux	Up to 80,000 ktCO2 outside its territory	Carbon cooperative of La Rochelle certified by a Label bas carbon controlled by the French ministry of ecological transition
W4	England	Bristol	Assumed price of $13 per tonne = £2,510,421 Assumed price of $20 per tonne = £3,862,186 Assumed price of $146 per tonne by 2030 = £28,193,955 Assumed price of $162 per tonne = £31,283,703	https://about.bnef.com/blog/global-carbon-market-outlook-2024/
W3	Germany	Münster	Rewetting moorlands: 218,000 to 436,000 hectares for 90,000 tonnes of CO2 per year; 2,180,000,000 to 4,360,000,000 euros purchasing corresponding certificates from MoorFutures: 1t CO2 for 64 eur for 90,000 tonnes of CO2 per year; 5,760,000 Eur/year	ISO 14064 and 14065 (MoorFutures)
W4	France	Paris	Baseline (2018): 5,292 tCO2e/year carbon stock of which 93% in wood	ADEME's ALDO tool
W3	Greece	Trikala	71.905,5€ for 82,65 kt CO2e	"Voluntary market"
W4	Lithuania	Tauragė	8kt CO2e across different afforestation actions in the Taurage region	n/a
W4	Israel	Eilat	n/a	n/a (see Annex)
W4	France	Nantes	Baseline (2021): LULUCF sector in metropole region absorbs 32ktCO2eq. Potential in 2030 340ktCO2eq	n/a

Country	Country/ Region	City	Quantification	Methodology
W2	Greece	Thessaloniki	Baseline: 140,000tCO2/year from BECCS	"According to a representative of the contractor"
W4	Denmark	Aarhus	2030 Target: 335000tCO2	n/a
W3	Slovenia	Ljubljana	2030 Target: 394,616tCO2/year; over 51m Eur	n/a
W1	Sweden	Stockholm	Target: 800,000t CO2e from BECCS	City and national accounting and corporate accounting of emissions
W4	Norway	Trondheim	2030 target: 130000tCO2	https://www.regjeringen.no/en/topics/energy/landingssider/ny-side/sporsmal-og-svar-om-langskip-prosjektet/id2863902/
W4	Norway	Oslo	2030 Target: 170000tCO2 in BECCS	n/a

7. CONCLUSION

Generally, residual emissions strategies in CCCs are not very detailed, lacking timelines, milestones, KPIs, investment plans, etc. Cities mention that this is also due to the uncertainty in the amount of emissions that will be reduced by portfolios of actions and thus how much will be left to compensate for in 2030. Uncertainties in estimating emissions reductions potentials and thus the final residual emissions are reportedly due to:

- Actions from the private sector not being mapped thoroughly.
- Impact from enabling, ‘soft’ actions relying on uncertain factors (e.g. behavioral change, the impact of digitalisation, etc).
- Uncertainties on future technological development (e.g. improvements in efficiency and performance).
- Influence of external factors such as changes in regulatory or political context beyond the city (e.g. simplified authorization processes, strengthening incentives for renewable sources).
- The achievable emission reduction effect in cities, especially in the 2030 perspective, depends significantly on changes in the power supply system of the national power system, which will determine the future EF reduction of the electricity mix.

Cities often mention that improved residual emissions strategies will be a priority for CCC iterations in coming years. More robust estimates of emissions reductions in climate action plans and progress implementation tracking will support better quantification of residual emissions, while stronger partnerships with key network stakeholders will lead to more detailed plans. For example, several cities are partnering with academic and research institutes or entering dedicated initiatives to better quantify, cost, implement, and certify their residual emissions strategies.

Many aspects of negative emissions remain grey areas, and carbon removal technologies are still in development, so it is recognised that the conversation around offsets and compensation is still evolving. However, the Cities Mission and thus residual emissions strategies in upcoming CCC iterations shall follow a set of fixed principles:

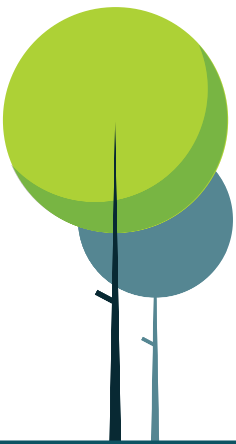
- **Transparency:** Cities should rigorously report positive and negative emissions. In addition, if credits are used, these should always be traceable, which means that cities should keep track of all offsets and carbon credit programs purchased, funded, the verification date and verifier, selection of emission factors, natural disturbances, and other key datapoints. Cities should also document how double-counting is averted or minimised.

- **Environmental safety, ethics:** Both credits and sinks should consider ecological impacts, disruption of food, albedo effects, etc. Key attributes of credits and largely sinks too are that these should be additional, permanent, measurable, independently audited, transparent, and address leakage (i.e. do no harm in other sectors).

- **Co-benefits:** When selecting among different options, cities should consider co-benefits in the local territory or beyond, with those that align with SDGs prioritised when possible.

- **Diversification:** We encourage cities to diversify their strategy to protect their overall planning from risks. Natural and technological sinks, credits etc. But within each category as well, eg. When addressing natural sinks, do not rely only on the forest but also on the soil, etc.

- **Cost and time effectiveness:** Concerning costs, when defining the role the city should take in the context of carbon credit projects, the capital costs applicable to the project developer and the credit buyer should be compared. Concerning timing, a late or early compensation of residual emissions may unlock different potential advantages and disadvantages, whose likelihood and impact may vary from city to city. For sure, in the case of Mission Cities, a too-late approach may not be viable.



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