SECTION II

Local governments' climate action: innovation and progress in times of a pandemic

Introduction

During its 43rd session in Nairobi (April 2016), the Intergovernmental Panel on Climate Change (IPCC) affirmed the key role cities are to play in the fight against climate change and suggested to dedicate a special report upon climate change and cities as part of its Seventh Assessment Cycle (AR7), due to begin after the 2023 Global Stocktake. For that purpose, the IPCC held a special Cities and Climate Change Science Conference in Edmonton, Canada (5-7 March 2018), to assess the current state of academic, policy and practice-based knowledge on climate change and cities. The conference gathered more than 700 participants from all fields and involved major networks of cities and regions such as ICLEI, C40, UCLG and Cities Alliance. The synthesis of outputs from the conference led to a proposal for a Global Research and Action Agenda on Cities and Climate Change Science with the aim to cover cities of different geographies, sizes, growth patterns and contexts. Published in time for the 2019 Climate Action Summit (Sept. 2019), the *Research and Action Agenda* (**fig. 1**) is organised in three sections:

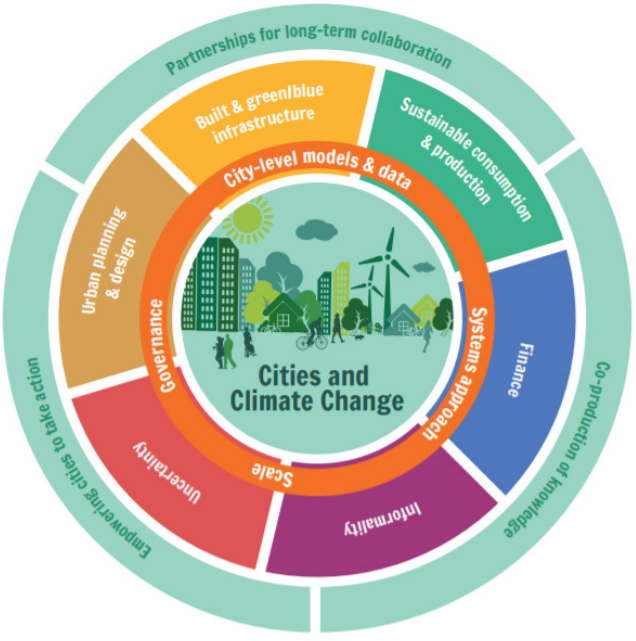
1. Crosscutting issues and knowledge gaps. The aim here is to identify the issues where cities could benefit from better uptake of existing science, such as the interaction and interdependent nature of cities within their regions and countries, capacity of local institutions in a multi-level perspective, informing integrated action at different spatial and temporal scales as well as data availability.

2. Key topical research areas where the availability of more evidence-based knowledge would support practitioners and decision-makers in addressing specific city-level challenges arising from climate change. This includes informality, urban planning and design, built and blue and green infrastructure, sustainable consumption and production, finance and uncertainty.

3. Suggested approaches to implement the *Research and Action Agenda* by strengthening the science, practice, and policy interface.

FIGURE 1

STRUCTURE OF THE GLOBAL RESEARCH AND ACTION AGENDA. THE INNER CIRCLE (ORANGE) REPRESENTS SECTION 1; THE MULTI-COLOURED INNER CIRCLE PRESENTS SECTION 2 AND THE EXTERNAL CIRCLE (GREEN) PRESENTS SECTION 3 - *Source: World Climate Research Program, 2019*



In parallel to the IPCC Conference, mayors signed the Edmonton Declaration, a political statement calling on cities to support evidence-based decision-making and action to address climate change in cities. Co-developed by the City of Edmonton and the Global Covenant of Mayors (GCoM), unanimously endorsed by ICLEI World Congress, the Federation of Canadian Municipalities and the United States Conference of Mayors, the Edmonton Declaration claims for 3,400 signatory municipalities from North America (City of Edmonton).

In the aftermath, the GCoM launched the *Innovate4Cities* initiative, a collaborative platform to gather national governments, private sectors, academia, cities and local governments in order to "*creating a shared understanding of the impacts climate change will have on cities and directly assist cities in identifying the optimal approaches to be implemented to both mitigate carbon emissions and adapt its infrastructure to a changing climate.*" *Innovate4Cities* advocates national States to dedicate 1/3 of their investments to R&D in urban issues linked to climate change within 10 years; to 10 million additional students in climate change prior to 2025; and to collaborations between cities and businesses on data sharing. Scheduled for the 11-15 October 2021, the *Innovate4Cities* virtual conference will be co-hosted by UN-Habitat and the GCoM as a follow-up to the 2018 Edmonton Conference and to provide inputs to COP26 and to the IPCC AR7's Special Report on Climate Change and Cities (UN-Habitat, 04/03/2021).

In the perspective to fuel this collaborative dynamic with concrete examples and tangibles results of locally led initiatives, the following section is providing a review of some of the key trends of action from cities over the past year. Without aiming exhaustivity, we examine current research with some literature review and showcase remarkable examples of action in different policy areas cities can address through three leverages: planning, normative power and procurement.

1.Climate action planning: from carbon accounting to net-zero targets, local governments flesh out their climate action steering

A. New carbon accounting instruments open up conceptual and technological boundaries

Calculating the greenhouse gas (GHG) emissions of a territory, whether it is a State, a region or a city, is strategic to help the authorities steer mitigation efforts in the short and long term. On the one hand, carbon accounting is useful to spot the main sources of emissions at local level, then allowing the local authority to adopt the relevant policies to mitigate them. On the other hand, in a context of international cooperation to reach Paris Agreement targets, providing quantitative measures of implemented efforts has become a cornerstone of the main transnational initiatives and networks of cities and regions (cf. **Section I**). Carbon accounting is as much a *policy tool* to drive evidence-based action as a *political instrument* for greater accountability and transparency towards citizens. There are two main approaches for this:

- **The emissions inventory** is a statistical accounting tool for direct emissions produced by activities within the administrative or geographical boundaries of a territory. It is used to identify their sources. The French Agency for Ecological Transition (Ademe), compares it to a "land register" for emissions, as it focuses on GHGs "physically" emitted in the territory (Ademe, n.d.).

- **The territorial carbon footprint** is another approach used to aggregate *direct emissions* generated by the territory's production activities and *indirect emissions* induced by its production outside its own boundaries. In some cases, a carbon footprint can also include emissions induced by consumption activities, through the accounting of emissions embodied in imports (EEI) and life-cycle assessments of products and services. Consumption-based or not, carbon footprint is a broader approach that aims to consider all the greenhouse gases that were necessary to support the territory's activities, regardless of their origin (Citepa, 2020).

Both approaches are included in **territorial carbon accounting**. Three "scopes" categorize the geographic boundaries of the emission sources (**fig. 2**). This scope framework was created by the Global Protocol for Community Scale GHG Emission Inventories (GPC)[1] and derived from the *GHG Protocol Corporate Standard*. Created by the World Resource Institute, C40 and ICLEI, the *GHG Protocol for Cities* is the most globally used methodology for city-level carbon accounting.

1 The Global Protocol for Community Scale GHG Emission Inventories (GPC), also called GHG Protocol for Cities, was created in 2014 by WRI, ICLEI and C40 to provide cities with robust emission accounting standards and methodologies.

FIGURE 2

SCOPES DEFINITION FOR CITY INVENTORIES IN THE GPC FOR CITIES - *Source: GHG Protocol, 2014; C40, 2018*

Scope	Definition
Scope 1	GHG emissions from sources located within the city boundary.
Scope 2	GHG emissions occurring as a consequence of the use of grid-supplied electricity, heat, steam and/or cooling within the city boundary.
Scope 3	All other GHG emissions that occur outside the city boundary as a result of activities taking place within the city boundary.

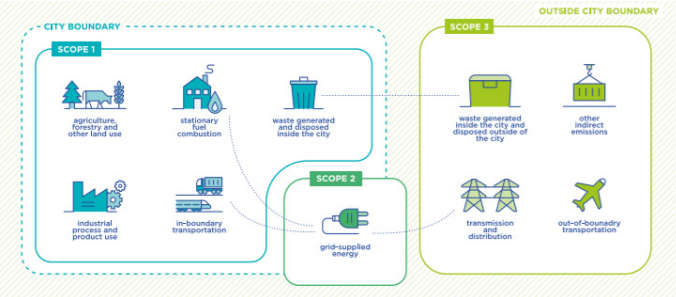


TABLE 1

CHARACTERISTICS OF THE 3 ACCOUNTING APPROACHES FOR LOCAL EMISSIONS - *Source: Association Bilan Carbone*

Approach	Territorial method	Global method	Consumption-based method
Scope	This calculation of GHG emissions emitted directly on the territory by all actors by activity sector (Scope 1) does not take account of indirect emissions caused by meeting the needs of territories, other than indirect emissions linked to the consumption of energy originating in a production unit on its territory (Scope 2). Scopes 1 and 2	Emission accounting taking account of all GHG emissions, whether direct or indirect, in other words, whether they are emitted by or for the territory. This is a more complex method because it requires a form of data collection that might prove difficult given the dispersed nature of information and a lack of statistical data at community level. A large degree of uncertainty is involved in accounting for indirect emissions. Finally, the use of scope 3, whose accounting methods are specific to each tool, renders comparisons impossible. Variable scopes 1, 2 and 3	Accounting for all goods and services required by the territory (from internal production and imports) and therefore all sectors required for the final consumption by the inhabitants of the territory (sectors present on the territory or otherwise). This approach essentially takes account of the issue of consumption-based emissions as this is an emission source. As emissions are related to the end consumer, actions will naturally focus more on citizens and consumption-based behaviours and production and service companies.
Advantages	More precise method Reductions target based on this method Robust No double counting	Comprehensive coverage of emissions Raises all problems	Easy to interpret Communications oriented towards the citizen
Disadvantages	It has a degree of bias in measuring emission reductions (e.g. outsourcing, electricity, etc.) Excludes international maritime and air transport	Not standardised Complex to interpret Double counting Integrated approach with other territories: enables identification of the degree to which the activity of a different territory can impact its emissions count and vice versa.	Difficult to calculate Calculations cannot be standardised
Uses	International standard Basis for all other methods Permits aggregation to higher levels	Design of a territorial action plan (PCET, PCTI etc.)	Citizen mobilisation
Existing tools	National inventory similar to UNFCCC or equivalent Basemis	Bilan Carbone® Territory Global Protocol for CommunityScale Greenhouse Gas Emissions Inventories (GPC) BEI/MEI US Community Protocol	PAS 2070

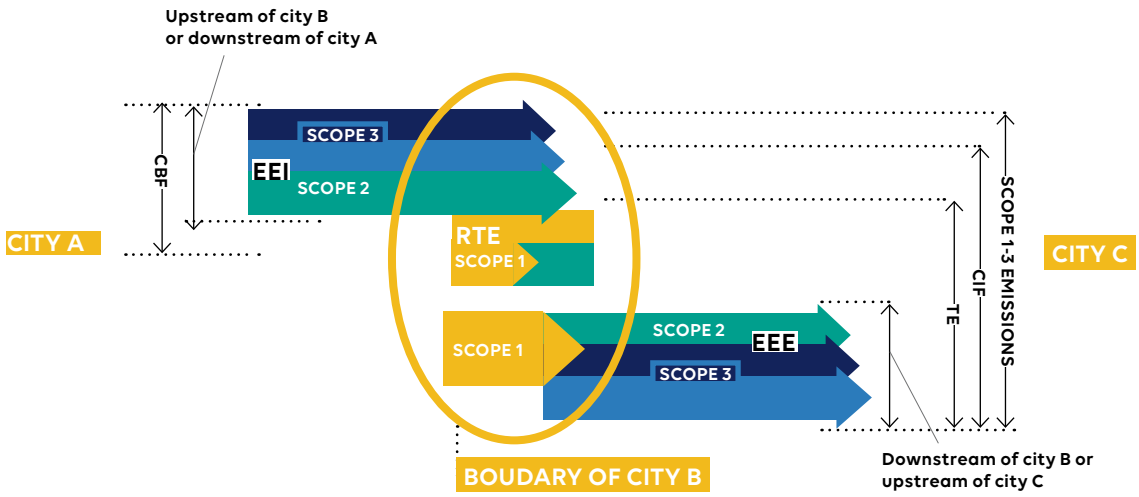
However, many different methodologies have been developed by specialized agencies and global standards, differing from one another according to their calculation perimeter, each with their advantages and disadvantages in terms of data access and aggregation, monitoring over time, transposition into concrete policies, etc. A summary of their features was drawn by the Climate Chance Observatory in the 2019 edition of the Synthesis report on local climate action (**tab. 1**).

From an empirical or political point of view, the credibility of the scenarios and public investments for low-carbon transition heavily rely on the robustness and consistency of carbon accounting. Which is why cities, academics and practitioners continuously work on new methodologies and approaches to extend the emission coverage and improve the accuracy of carbon accountings. In this edition, we choose to focus upon two of them: the boundary issue and the under-reporting issue.

• THE BOUNDARY ISSUE: FROM TERRITORIAL EMISSIONS ACCOUNTING TO CONSUMPTION-BASED ACCOUNTING? • In 2018, Consumption-based GHG emissions of C40 cities revealed that the consumption of 79 cities amounted to 3.5 $GtCO_2e$, 60% higher than the emissions from their production by local activities (2.2 $GtCO_2e$), meaning that two thirds of their emissions are imported, particularly for high-income cities (C40, 2018). *The Future of Urban Consumption in a 1.5°C World* updated these numbers and found that consumption-based emissions from nearly 94 of the world's biggest cities already represent 10% of global GHG emissions (4.5 $GtCO_2e$), whilst their total production-based emissions in 2017 are estimated at 2.9 $GtCO_2e$. These emissions are mostly hidden in territorial GHG inventories since 85% of the emissions associated with goods and services consumed in C40 cities are generated outside city boundaries (C40, 2019). This is what carbon accounting academics call the "*boundary issue*", illustrated by **figure 3**.

FIGURE 3

THE BOUNDARY ISSUE: THE RELATIONSHIP ANALYSIS FOR TERRITORIAL EMISSIONS, CONSUMPTION-BASED CARBON FOOTPRINT AND COMMUNITY-WIDE INFRASTRUCTURE FOOTPRINT - *Source: Chen et al., 2019*



SCOPE 1 & 2

- SCOPE 1
- SCOPE 2

SCOPE 3

- SCOPE 3: EMISSIONS RELATED TO KEY MATERIALS: WATER, WASTE, ENERGY, TRANSPORT, FOOD, AND CONSTRUCTION
- SCOPE 3: EMISSIONS RELATED TO OTHER GOODS AND SERVICES

NOTE: CBF = CONSUMPTION-BASED CARBON FOOTPRINT (CB METHOD); CIF = COMMUNITY-WIDE INFRASTRUCTURE FOOTPRINT (CIF METHOD); TE = TERRITORIAL EMISSIONS (PURE-GEOGRAPHIC PB METHOD); SCOPE 1-3 EMISSIONS = COMPLETE SCOPE 1-3 EMISSIONS DEFINED IN CITY PROTOCOLS; EEI = EMISSIONS EMBODIED IN IMPORTS, EEE = EMISSIONS EMBODIED IN EXPORTS; RTE = REST OF TERRITORIAL EMISSIONS.

Most of carbon accounting systems are based on a territorial approach (or *Pure-geographic production based approach*). These approaches only take account of emissions stemming from energy production located within the geographic or administrative boundaries of the territory (Scope 1) or include emissions from imported electricity necessary to in-boundary activities (Scope 2). As such, local governments can easily identify the sources of emissions, design relevant mitigation plans and target the biggest emitting sectors. Eventually, the territorial approach can also include emissions embodied in exports (EEE), namely the emissions produced outside the city boundary but induced by its in-boundary activities (Scope 3, incineration of waste for instance). In the end, the territorial approach makes it easier to allocate emissions, track the progress of each locations and aggregate data to take a wider perspective.

"*However, unlike the national accounts, cities are home to 50% of world's population but comprise only approximately 3% of land mass, which means they have to outsource a large number of emissions to outside the city boundary*", notice Chen and his colleagues. As a matter of fact stationary energy production only accounts for about 25% of global emissions (IPCC, 2014), while emissions embodied in trade are on the rise and now reach about one third of global GHG emissions (Wiedmann and Lenzen, 2018).

Territorial approaches thus fall short of reflecting emissions embodied in imported goods and services. Therefore, they do not take account of spatial, socio-economic inequalities embodied in the carbon footprint of consumption behaviours. To address this boundary issue, academic literature has paid increasing attention over the last years to **consumption-based carbon footprint (CBCF)** accounting. CBCF have a double advantage over territorial emissions: they allow to assess life-cycle and trans-boundary emissions. By projecting one policymaker's gaze beyond the "pure-geographic production based" emissions of its territory, CBCF better reflects power purchase inequalities on the one hand, and the local economic structure in relation to global markets on the other.

Heinonen et al. (2020) have identified two types of approaches to consumption-based carbon footprint (CBCF):

- **Area carbon footprint (ACF)** allocates to a location all emissions incorporated in products finally *purchased* on its territory (rather than *produced* in a territorial approach), including global production and supply chain (life-cycle assessment), regardless of whether it is purchased by local residents, tourists, visitors or commuters.

- **Personal carbon footprint (PCF)** allocates emissions to local residents of the territory, wherever happen their final purchase act, be it at the corner's drug store or during their trips at the other end of the world. Centred on people's monetary consumption, this approach excludes public sector's emissions (infrastructure expenses and governmental consumption). But it also better reflects purchasing power inequalities between territories.

The inclusion or exclusion of public sector's emission is likely to reflect geo-economic inequalities. For instance, infrastructure expenses are often higher in regions undergoing rapid development and urbanization rather than in urbanized, tertiary economies with low capital intensity. Likewise, the size of the public sector can greatly influence the calculations in the PCF approach. For example, the health sector is one of the largest sources of individual carbon footprint emissions calculated in the US as most of the costs are privatised, while they almost disappear in the Nordic countries where this sector is highly subsidized. Carbon footprint calculations can also vary whether they only take account of CO_2 or other types of greenhouse gases, that make up 25% of global annual emissions (IPCC, 2014).

To sum up, even within consumption-based carbon footprint accountings there is a broad range of approaches limiting possibilities of comparisons. These limitations necessarily push to trade-off the geographic coverage of their study and the granularity of the information used. For example, in 2018, Daniel Moran and fellow colleagues came up with a stunning statement: over 13,000 studied cities, "*100 cities account for 18% of the global carbon footprint*" (Moran et al., 2018). To find this number, the study downscaled national carbon footprints using proxy data such as population, purchasing power and other studies on subnational carbon footprint. To date, this is the only study that has intended to assess carbon footprint upon such a large range of cities at global level. Which means that, in return, the assessment is more approximate as the array of available data and their granularity is weaker.

These difficulties for calculating consumption-based carbon footprints make it very few common at city-scale, but we have underlined their complementary to territorial emission accounting. Presently, more concrete pathways are explored to enhance the accuracy of statistical inventories and fix an under-reporting issue that is drawing more and more attention in the academic field.

• THE UNDER-REPORTING ISSUE: BRIDGING THE GAP BETWEEN STATISTICAL INVENTORIES AND ATMOSPHERIC MEASUREMENTS • On average, U.S. cities underestimated their fossil fuel related CO_2 emissions by 18.3%. This is the result of a recent study that compared voluntary GHG emissions inventories from 48 of the 100 highest emitting cities in the U.S. with data produced by *Vulcan*, a tool which aggregates emissions data from national public databases between 2010 and 2015. The largest differences observed by the authors of the study and developer of *Vulcan* range from -145.5% to 63.5%. Cumulatively, these underestimated emissions represent 129 $MtCO_2$, or 25% more than the emissions of the State of California. Taken together, the 48 cities surveyed represent 13.7% of city emissions and 17.7% of the US population in 2015 (Gurney et al., 2021).

The article points out that there is no systematic, peer-reviewed methodology to assess the quality of a voluntary emissions inventory. Consequently, they are likely to present large differences in approach that can lead to significant gaps in the consideration of certain emission sources in a territory. The most common differences concern the omission of petroleum fuel use, industrial and commercial emissions on site ("*point source emissions*"), differences in the consideration of marine and aviation emissions, and methodological differences for estimating road emissions.

Such discrepancies are meaningful, as a miscalculation of emissions from a territory can distort one local government's judgement when adopting mitigation strategies. With all the more reason when it has set itself the objective of achieving carbon neutrality.

However, cities are not to be blamed, say the authors: inventories are perfectible, and could be improved by further documenting the boundaries of the urban system. They suggest that one solution could be to combine these voluntary bottom-up reporting systems with atmospheric observation and modelling systems. This is what Mexico City, for example, is trying to do today (**case study 5**).

Mexico City – Mexico

MERCI-CO_2 an example of atmospheric accounting of emissions in Mexico City

The last time Mexico City published an inventory of GHG emissions was in 2016, with data relating to 2014. At the time, emissions amounted to 56.2 $MtCO_2$ in Mexico City metropolitan Area (MCMA), with 78% originating from transport and industries. According to its latest reporting to CDP in 2020, Mexico City's emissions amounted to nearly 47 $MtCO_2$ in 2018, up from 24 $MtCO_2$ in 2012. Yet, the magnitude of this increase is largely explained by changes in accounting methodologies and improved data accuracy. Indeed, Mexico is driving cutting-edge research to enhance its carbon accounting methodologies, testing new approaches, like atmospheric emissions measurement.

Mexico City Regional Carbon Impacts (MERCI-CO_2) is a French-Mexican research project led by the Laboratoire des Sciences du Climat et de l'Environnement (LSCE) and the Institut Pierre Simon Laplace (IPSL) on the French side, and the Grupo de Espectroscopía y Percepción Remota (EPR), the Centro de Ciencias de la Atmósfera (CCA) of the Universidad Nacional Autónoma de México (UNAM) on the Mexican side. Financed through a call for tenders launched by French National Research Agency (ANR), the project is supported by the Secretaria del Medio Ambiente (SEDEMA) of Mexico City. It started in early 2017 and now due to finish by the end of 2021.

The project aims at the deployment of a dense network of CO_2 sensors at ground-level and altitude within the Mexico City Metropolitan Area to measure CO_2 concentration gradients and their change in time. Modelling is then run with computers to compare results from the censors and the atmospheric model implied by the city's statistical inventory. Through atmospheric inversion, this comparison allows to precisely spot the locations and activities where statistical inventory have failed to match the atmospheric model, and then help to find ways to improve the statistical method. In the end, atmospheric measurement could even help verifying the effectiveness of CO_2 emission reductions taken by the city authorities. It also allows faster update of the information, whereas statistical inventory always need a few years perspective to collect data. In the case of Mexico, the city supports the project by allowing installing sensors on the local city air quality stations. Sensors were due to be set up in Spring 2020, but the pandemic delayed the deployment.

Atmospheric measurement has the advantage to provide high-precision pictures of the GHG concentrations over a territory, identify nearly real-time evolutions and spot the sources of variations. Yet, it is limited when it comes to distinguish the territorial origins of emissions in dense urban area, since gases circulate with winds. From this point of view, Mexico City geography – located in high-altitude basin at 2,000m and surrounded by mountains up to 5,000m – prevents emitted pollutants to be dispersed by winds. This is a plus to get more atmospheric signals, but in the other hand makes it harder to precisely differentiated the sources of emissions. Which is why remote sensing is not meant to replace statistical inventories, but to provide additional information to complete them. Atmospheric systems are also limited to territorial emissions, and other approaches like consumption-based accounting can bring useful perspectives to understand one city's footprint.

The atmospheric approach applied to urban CO_2 emissions is relatively recent and still in the evaluation stage and focused on big cities. Indeed, the most precise analyser stations are costly (up to €100,000), but low-cost censors are more affordable (up to €5,000). Such a project also requires high-skilled expert to run modelling software, as well as political support from the local government to be sustainable. Therefore, Mexico City is one of the only few cities testing this system in the world. Paris city council also voted the *Météo Carbone®* project in July 2020 to provide monthly measures of GHG emissions in the city, in partnership with Origin.earth, a subsidiary start-up of Suez.[2]

2 Thanks to Michel Ramonet, CNRS Researcher from the Laboratoire des Sciences du Climat et de l'Environnement (LSCE) at Institut Pierre-Simon Laplace (IPSL), coordinator of MERCI-CO_2 project, and to Thomas Lauvaux, CNRS Research scientist in atmospheric and carbon cycle sciences at the LSCE-IPSL for their inputs to this case study. May Michel Grutter from the Centre for Atmospheric Sciences of the Universidad Nacional Autónoma de México (UNAM) be thanked too.

B. The quest for global climate neutrality through local engagement

• WHAT IS CARBON NEUTRALITY? THROWBACK TO THE IPCC 1.5°C REPORT • Back to summer 2018, the IPCC released a *Special Report on Global warming of 1.5°C* to explore the impacts entailed by limiting global warming to 1.5°C above preindustrial levels, the most ambitious target set by the Paris Agreement. The report also assesses the available pathways to stay within the limits of the carbon budget induced by a 1.5°C trajectory, and concludes:

> "*Staying within a remaining carbon budget of 580 GtCO_2 implies that CO_2 emissions reach carbon neutrality in about 30 years, reduced to 20 years for a 420 GtCO_2 remaining carbon budget (high confidence).*"
>
> IPCC (2018). Special Report on Global warming of 1.5°C, p. 33

In this context, carbon neutrality consists in reducing net CO_2 emissions to zero: "*This means the amount of CO_2 entering the atmosphere must equal the amount that is removed*". As being the largest source of global GHG (~72%), this objective is sometimes limited to CO_2, or extended to other greenhouse gases with greater global warming potential (GWP) such as methane (CH_4), nitrous oxide (N_2O), sulphur hexafluoride (SF_6), etc. Whatever the pathway or the scope of gases included in the strategy, three main instruments must be considered to limit climate change:

1. Reducing, preventing, and absorbing emissions of greenhouse gas (mitigation)
2. Carbon capture and storage (CCS)
3. Offsetting emissions with the use of certified emission reduction credits

None of these approaches is neglected by any of the scenarios imagined by the IPCC. Yet, considering the existing science and knowledge, mitigating flows of greenhouse house gases sent into the atmosphere every year through **direct carbon emission reduction, prevention and absorption** is the most certain way to limit magnitude of climate change. **Carbon capture and storage** (CCS) consists in directly removing CO_2 from the atmosphere or, more frequently, from industrial facilities exhaust stacks (waste incineration plants, cement plants, steel works…), to store them into geological reservoirs. However, none of the CCS existing pilot projects have proved neither profitable nor scalable yet, and some scientists also warn against the risk that betting too much on an immature technology may only delay the adoption of measures to cut emissions (Climate Chance, 2018). As for **voluntary carbon offsetting**, it is a market instrument which consists in balancing remaining emissions through the purchase of credits certifying that some emission reduction, or negative emission (through carbon removal or investment in a carbon sink) has been implemented elsewhere.

• THE OXFORD PRINCIPLES, ONE STANDARD TO RULE THEM ALL? • Too often, carbon offsetting is understood as a substitute to reducing its own carbon emissions or suffer from a lack of high-standard certifications. In this context, several initiatives have emerged to set the standards for a common, high ambition understanding of climate neutrality for non-state actors in general, including local governments.

The **Oxford Principles for Net Zero Aligned Carbon Offsetting** are one of them. Released in September 2020, the Oxford Principles outline an approach of carbon offsetting aligned with net-zero targets. The aim is to answer some issues related to the use of carbon credits, i.e. payment to receive credit for a certified unit of emission reduction or removal carried out by another actor. These Principles are meant to provide purchasers of credits with a consistent understanding of the role of offsetting among a global mitigation strategy (University of Oxford, 2020).

- **Principle 1. Prioritise reducing own emissions, use high-quality offsets and regularly revise offsetting strategy as best practice evolves.**
This principle aims at re-establishing an order of priority of action for mitigation strategies. Before using carbon offsetting, actors shall maximise their direct emission reductions opportunities. When offsets are used, the actor should ensure they meet quality requirements (complying best standards) and maintain a high-level of transparency in their accounting, targets and types of employed offsets to track and monitor progress.

- **Principle 2. Shift from emission reduction offsetting to carbon removal offsetting.**
Most of available offsets certify *emissions reductions*, which to date are not sufficient to achieve net zero. The Principles recommend that users of offset increase demand for *carbon removal* offsets to send market signal to encourage development of carbon capture and storage (CCS) technologies. Although nearly all IPCC scenarios to reach Paris Agreement targets partly rely on deployment of CCS, only very few, unprofitable pilot projects exist today.

- **Principle 3. Shift from short-lived storage to long-lived storage.**
Long-term storage offsets should be prioritised over short-live storage to guarantee no reversal in the following decades.

- **Principle 4. Support the development of net zero aligned offsetting.**
The Principles encourage actors to actively support the development high-quality offsets through relevant levers as long-term agreements, sector-specific alliances, support to restoration and protection of ecosystems in their own rights (rather than for the mere purpose of carbon offsetting) and integrate these Principles into regulations and standard-setting approaches for offsetting and net-zero.

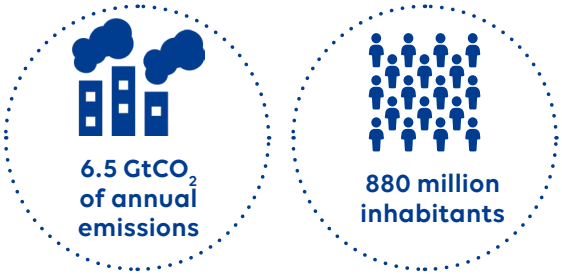
The Principles proposed by the study are intended to be applicable to all non-state actors who, on the demand side, wish to use offsetting in their carbon neutrality plans. These principles were integrated into *Race to Zero*, the UNFCCC-led, science-based umbrella campaign aggregating net zero commitments from businesses, investors, universities, cities, states and regions (UNFCCC, 2020). Among the objectives of *Race to Zero* is the promotion of common consensus-based principles for all net-zero commitments to converge towards same assumptions.

• CARBON NEUTRALITY AT CITY-LEVEL: BEYOND COMMITMENTS STARTS ACTION • Since IPCC's report, and just like other nations or companies, many local and subnational governments have committed to reach carbon neutrality by 2050 or even before. **According to NewClimate Institute's and Data-Driven EnviroLab's account, 826 cities and 103 regions had taken some form of "net-zero pledges" by October 2020** (NewClimate Institute, 2020). This is up from 65 cities and regions overall recorded in 2019, among 6,000 analysed (NewClimate Institute et al., 2019). Based on data from the World Resources Institute, the report estimates that all cumulative commitments from these cities and regions cover 6.5 $GtCO_2$ in annual emissions, i.e., more than the United States' annual emissions. Globally, these commitments encompass about 880 million people, yet with huge regional gaps depending on multiple factors such as the size and population density of cities, importance of climate change in the political agenda, technical ability to set credible net-zero strategies and differentiated responsibilities in historical and present emissions. And the trend has continued since then: among the latest recorded cities having taken pledges in 2021, we can mention Philadelphia (1.5m inhab.) in the United States (WHYY, 15/01/2021) and Sunderland (174k inhab.) in the United Kingdom (Sunderland Echo, 11/01/2021).

INDICATOR

929

local governments throughout the world have a net-zero pledge



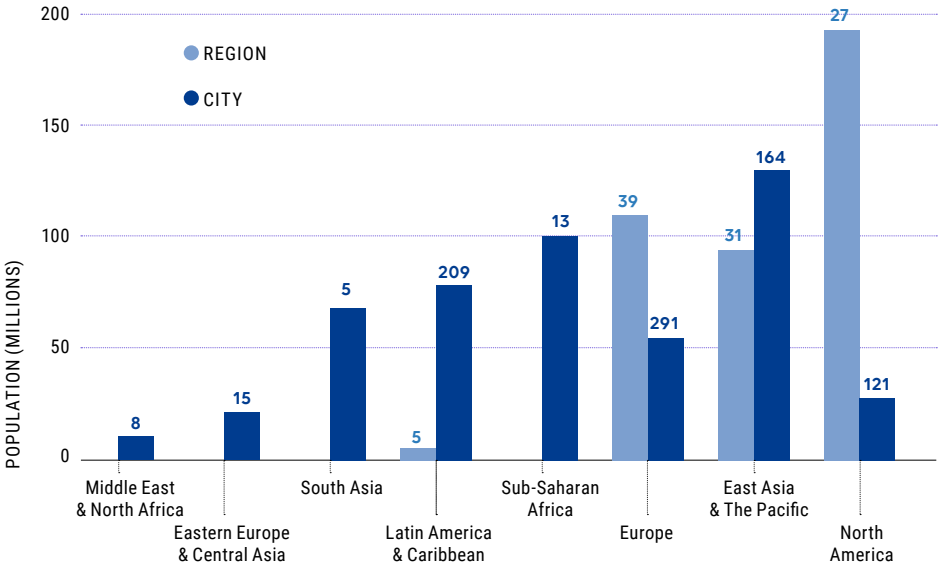
However, there is no single way to reach carbon neutrality. Cities and regions, just like private sector and other actors, use different words and concepts to talk about their commitments which tend to blur the lines between the science-based meaning of carbon neutrality, the political use it is made of it, and the technical implementation of policies to meet the objective. "Net-zero emissions", "carbon neutrality", "climate neutrality", "zero carbon"... The NewClimate Institute offers a summary of the different existing vocabulary, based on the definitions provided by the IPCC when available or existing academic literature (NewClimate Institute, 2020, p. 12-13).

In the absence of a standardized approach to carbon neutrality, it is difficult to compare local governments strategies, aggregate their contributions to global mitigation and track their progress regarding the heterogeneity of their commitments, scope of emissions covered and institutional capacities. Which is why NewClimate Institute intended to "Navigating the nuances of net-zero targets" in this report.

FIGURE 4

POPULATION OF CITIES AND REGIONS WITH NET-ZERO TARGETS, BY GEOGRAPHIC REGIONS

Source: NewClimate Institute, 2020 from Data-Driven EnviroLab

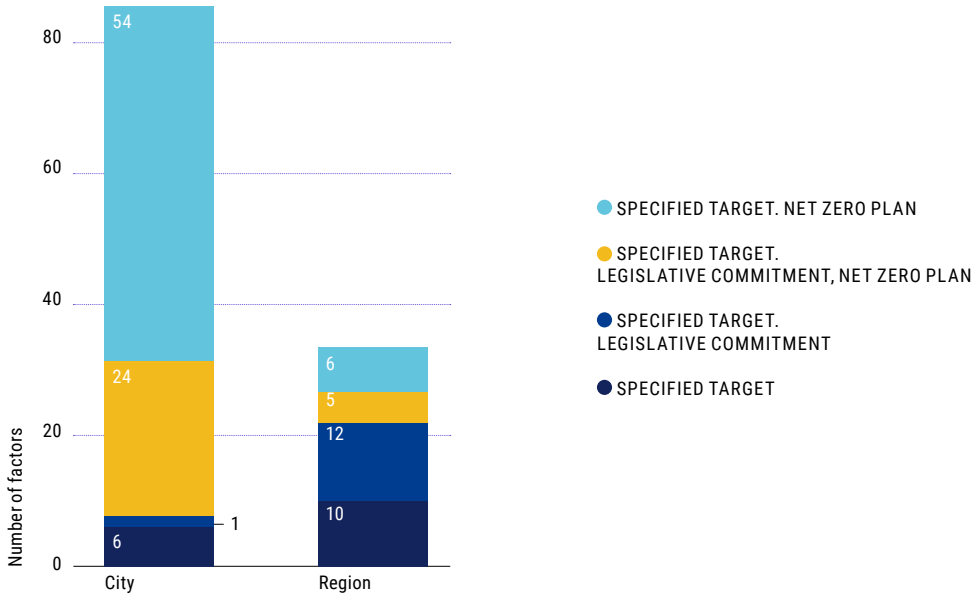


• HOW ABLE ARE LOCAL GOVERNMENTS TO DEPLOY RELEVANT POLICIES TO MEET THERE TARGETS? • Many different decarbonization pathways can be considered, varying according to the stringency of near-term CO_2 emissions phase-out policies (strict cutting of emissions) and the extent of expected contribution of carbon-dioxide removals (CDR) by the Agriculture, Forestry and Land-Use sector (AFOLU) or technological options such as Bio-energy with carbon capture and storage (BECCS) (IPCC, 2018).

Of the 929 local governments committed to net-zero emissions, only 460 have pledged a reduction by a certain percentage by a specific year (NewClimate Institute, 2020). Most of cities and regions have fixed 2050 as their deadline to reach carbon neutrality, but some have set ambitious plans to reach it before (Copenhagen by 2025, Turku by 2029...). Yet, setting a specific reduction objective is a prerequisite to give credibility to net-zero target, although not sufficient. Interim targets are much needed to allow regular tracking of progress and ensure accountability of policymakers, as well as specific sector-targeted plans to reach net zero. From this point of view, **85% of cities and regions where targets were identified by the NewClimate Institute are backed by a published plan or a legislative commitment** (**fig. 5**).

FIGURE 5

HOW WELL PLANNED ARE TARGETS FOR EMISSION REDUCTIONS? - *Source: NewClimate Institute, 2020*



Beyond climate neutrality, the CDP Cities A-List is regularly invites cities to report their climate planning practices. In 2020, 88 cities in the world were scored "A" by CDP and therefore qualified as "Leadership cities" regarding their climate mitigation and adaptation action. This means that the city "*demonstrates best practice standards across adaptation and mitigation, has set ambitious but realistic goals and made progress towards achieving those goals. Cities in the Leadership band have strategic, holistic plans in place to ensure the actions they are taking will reduce climate impacts and vulnerabilities of the citizens, businesses and organizations residing in their city.*" This year's record is down from 105 in 2019, but still twice as much as in 2015 regarding the number of cities setting targets (44) and more than three times the number of cities with adaptation plans (26). This ranking is based on voluntary reporting provided by cities when answering a questionnaire from CDP.

Among criteria, a "A" city *must*:

- Have a vulnerability assessment;
- Have an adaptation plan;
- Have an action plan;
- Have a fully reported GHG emissions reduction target.

Each of these criteria is broken down into sub-criteria, for which scoring methodology was tightened in 2020 compared to 2019 to "better align with the climate emergency" (CDP, 2020). This partially explain the fewer number of A-listed cities. Besides, when the ranking is publicised, only cities having received a A-score are highlighted; others' score remaining private. It is thus hard to identify the reasons why a city has not received the A-score.

In the following, we explore how carbon budgets can support climate plans and strengthen their credibility with robust governance instruments.

C. Budgeting climate efforts to support mitigation action planning and tracking results

• LOCAL CARBON BUDGETS TO PLAN INTERIM MITIGATION TARGETS • Carbon budgets appeared in IPCC's 2014 Synthesis Report on Climate Change, being defined as the "*cumulative amount of* CO_2 *emissions permitted over a period of time to keep within a certain temperature threshold*" (IPCC, 2014). With a carbon budget, an authority can plan the allocation of its mitigation efforts over a defined period to reach a science-based target aligned with a 2°C or 1.5°C scenario. Yet, a carbon budget is more a tracking tool setting a benchmark to assess one government's own efforts rather than a legally binding obligation, which means that missing out the targets often goes without direct consequences for the government.

As such, independent institutions and transparency are indispensable to track and monitor the progress. In the United Kingdom, the *Committee on Climate Change* established in 2008 by the Climate Change Act is the independent body in charge of setting five-year carbon budgets twelve years ahead at national level, recommend pathways to reach the targets in line with net zero objective, and monitor progress through the publication of yearly monitoring reports (Climate Chance, 2019).

To be efficient, a carbon budget must be science-based and stable over time. France for instance, one the few countries in the world with national-level carbon budget, recently received critics from non-state observatories when the government claimed it overshot its 2019 emission targets after ratcheting up the initial budget (Réseau Action Climat, 06/07/2020).

As underlined by Energy Cities in a note about carbon budgets published in April 2020, there is very few examples of cities or regions having adopted a carbon budget (Energy Cities, 2020). Yet, the note recalls, some universities and NGOs tried out to provide local governments with independent carbon budgets. This is the case in the City of Manchester (**case study 6**).

• LOCAL CLIMATE BUDGETS TO MAINSTREAM CLIMATE ACTION WITHIN DAY-TO-DAY EXPENSES • Since 2016, the city council of Oslo has adopted yearly "climate budgets", voted as part of the usual annual budget process (KlimaOslo, 2020). Climate budget is a different approach than carbon budget, rather complementary, as it does not cap ahead the long-term amount of emissions that the city must respect. Climate budget serves as a blueprint to plan yearly transformative actions aligned with the city's emission targets, within an upper limit of emissions.

City of ManchesterUnited Kingdom

The local carbon budget of the City of Manchester

According to the city's 2020 Annual Report released in July 2020 by the Manchester Climate Change Agency (MCCA) – the body responsible for overseeing and championing climate change action at city level, Manchester's emissions have fallen by 4% in 2019. However, the city's has already spent 26% of its 2018-2100 local carbon budget in just 2 years.

The MCCA was established in 2015 by the City council and the Steering Group of the city's first climate change strategy (2010-2020) adopted in 2009 under the name "Manchester: A Certain Future". The MCCA is now responsible for overseeing and championing climate change action at city level. In 2018, the MCCA created the Manchester Climate Change Partnership (MCCP), "*a stakeholder group established to help advise the City on the actions required to reduce its emissions, mitigate the effects of climate change, and act as a focus for businesses, organisations and individuals wishing to take their own action.*" It comprises all sorts of non-state actors, including businesses, a faith group, citizen associations and public actors.

In July 2018, the Tyndall Centre for Climate Change Research, a multidisciplinary research centre, provided the MCCA with a carbon budget aligned with a 2°C scenario to support Our Manchester's Strategy 2016-2015, the city's overarching long-term vision. The carbon budget set three main goals to Manchester to stay within the 2°C carbon budget:

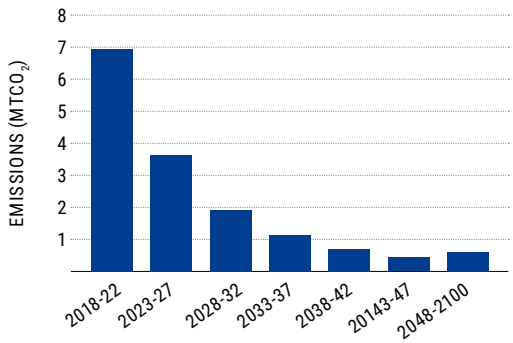
- Hold cumulative dioxide emissions from homes, workplaces, and ground transport (direct emissions) at under 15 million tonnes for 2018-2100
- Delivering an annual average of 13% cuts in emissions.
- Reducing emissions from LULUCF to zero by 2038.

Periodic 5-year, gradually decreasing carbon budgets were recommended and then formally adopted by the City Council in November 2018 (**fig. 6**), and Net Zero target was set for 2038 few months later for Greater Manchester.
A carbon budget is compelling tool as its key parameter is to settle an absolute limit to long-term emissions that requires immediate, ambitious actions from policymakers to find low-carbon pathways to drive its economy. Currently Manchester is on track to reach its 2020 targets of cutting emissions by 40% against a 2005 baseline. Yet, the 2020-2025 targets should be harder to achieve, as the city will need to halve emissions to avoid overshooting its 2023-2028 budget.

Which is why in February 2020, Manchester adopted the Climate Change Framework 2020-2025 to drive transformative action in seven areas: Buildings (existing and new), Renewable energy, Transport and flying, Food, "The things we buy and throw away", Green infrastructure and nature-based solutions; Supporting and enabling residents and organisations to act. On the advice of Tyndall Centre, the CCF also includes "*commensurate action on aviation*" CO_2 *emissions and [addresses] indirect /consumption-based carbon emissions*".

Besides, Manchester is cooperating with other European cities to share its experience as part of *Zero Carbon Cities,* a project financed by EU's URBACT program. By 2022, at the end of the 2-year long project, the cities of Frankfurt (Germany), Vilvoorde (Belgium), Zadar (Croatia), Bistrita (Romania), Modena (Italy) and Tartu (Estonia) are to set up alike local carbon budgets (Energy Cities, 09/10/2019).

LEFT: EMISSIONS PROJECTIONS CONSISTENT WITH THE 15 $MTCO_2$ BUDGET STARTING FROM COMMON YEAR (2017)
RIGHT: MANCHESTER'S 15 $MTCO_2$ BUDGET BY TIME PERIOD - *Source: MCCP, MCCA, 2020*



Time period	CO_2 budget ($MtCO_2$)
2018-22	6.93
2023-27	3.59
2028-32	1.95
2033-37	1.10
2038-42	0.64
2043-47	0.38
2048-20100	0.59
Total	15.17

The climate budget is broken down into sectoral emission targets, with specific measures and policies associated for different sectors that fall into the scope of competences of the municipality: Energy/ Buildings, Resources and Transport. It is the city's finance department that is responsible for drafting climate budgets rather than the environmental team, so that advanced emissions targets are achievable and consistent with municipal finance. Then subject to the same requirements of transparency as any other municipal policy, the success of climate policies of every municipal department can be evaluated and measured by the means allocated and the objectives that were set (Climate Chance, 2019).

When voting the first climate budget in 2016, Oslo vowed to cut GHG emissions by 95% in 2030 compared to 1990 levels, and 50% in 2020. The GHG-inventory published by the Norwegian Environment Agency in the spring of 2020 shows that Oslo will not be able to achieve its target of a 41% reduction in greenhouse gas emissions in 2020, compared with levels of 2009. The Climate Agency's estimates that the greenhouse gas emissions will be only reduced by 25% in 2020 (KlimaOslo, 05/11/2020). New 2021 budget includes the introduction of requirements on the construction industry for fossil free or zero emissions construction sites, investment in fast charging stations for heavy vehicles and coaches, parking restrictions and zero-emission zones. Following the Norwegian resolution on carbon capture and storage (CCS), Oslo is also experimenting CCS at Kemetsrud waste incineration plant.

2. Regulation and direct investment: the first arm of cities to densify services at local levels.

A. Boosting renewables at municipal levels through direct investment, regulation and community-ownership

More and more cities and regions are powered entirely by renewable electricity produced by various means. In 2020, 834 cities in 72 countries had set a renewable energy target. Among them, 617 cities had committed to the goal of 100% renewable energy supply for their municipal operations (REN21, 2021). This is up from the 671 cities IRENA recorded by 2019, including 428 with a 100% renewable energy target (IRENA, 2020). **By the end of 2019, 58 cities or regions, including 44 in Europe, reported to have achieved their 100% renewable energy targets**.

To achieve their goals, local governments have an ever-widening range of supporting strategies and policies. From the remote purchase of guarantees of origins and "green certificates" to power-purchase agreements (see **part 3.A.**), including direct investments and regulations to support local consumption and production of renewable power.

INDICATOR

59
cities or regions

have achieved 100% renewable energy targets.

INDICATOR

617
cities

have committed to supply their municipal operations with 100% renewable energies.

While photovoltaic (PV) panels have never been so cheap as now, building code regulation appears as an efficient way to progressively compel their adoption on all new buildings. As for regulations, The State of California has one of the most ambitious building codes with the obligation to install PV systems in new homes from January 2020. The State is the national leader in decentralised solar energy production with more than 1 million PV installations for a total capacity of 9,300 MW (California DG Statistics, 2020). In New Delhi the local building code was amended in 2020 with a relaxation of height standards in order to facilitate the installation of PV systems (Times of India, 14/07/20). South Delhi Municipal Corporation, one of the five municipalities in the territory of Delhi installed photovoltaic systems on 55 municipal buildings in 2018 and committed in 2019 to extending this measure to all of its buildings including municipal schools (REN21, 2019).

Community ownership of power production facilities has also attracted very much attention of the last years. Community-ownership is an innovative business model in which:

- Local stakeholders own most of the project;
- Democratic governance is applied with voting rights and control remaining community-based;
- Profits are locally distributed.

Community-ownership can deal with a large array of activities (power generation, district heating systems, energy storage, energy efficiency programs, electricity retail…), involve many sorts of actors (local governments, citizens, NGOs, energy utilities and retailers…) and be modelled upon different legal forms (co-operatives, partnerships, NGOs, community trusts, housing association…). Compared with centralized or privately-ran systems, community-ownership provides additional grid flexibility and resilience, while improving renewable energy access, increasing distributed renewable generation and eventually cutting energy cost for community through direct distribution. IRENA records about 4,000 community-owned projects providing power throughout the world, mainly in Australia, Europe and the United States (IRENA, 2020).

This movement was particularly strong in Europe, where the EU has recognised "energy communities" since the voting of the Renewable Energy Directive 2018/2001/EU as part of the "Clean Energy for all Europeans Package". Sizes of projects can vary from large-scale production, as the famous 2MW Middelgrunden offshore wind farm owned by a 8,553-citizen cooperative in Copenhagen, to smaller, off-grid village energy committees (VEC) as found in rural India.

Municipalization of electricity generation facilities as a form of community-ownership appeared as alternative to centralized and privately-ran systems. In this case, municipalities ran public utility companies through which they directly invest in local generation assets and manage the utility on behalf of their citizens. They got particularly developed in Germany where the majority of municipalizations are concentrated, with 90% of the 311 cases identified in 2017 according to the Transnational Institute (TNI, 2017). Seminal examples include Hamburg, where a referendum with binding results ended in the municipalization of electricity in 2014, gas in 2018 and long-distance heating in 2019 (EPSU, 2019); Nottingham, which created Robin Hood Energy in 2015, the first municipal energy company created by a local council in the United Kingdom in over 75 years (REN21, 2019); Barcelona, where the municipal company Barcelona Energía supplies electricity to city council buildings and facilities and to the citizens and companies of Barcelona and its metropolitan area, serving a maximum of 20,000 households (Barcelona Energía).

Yet, there has been some signals that council-owned power utilities may also represent some risk to municipal budgets. In August 2020, Nottingham had to selloff of Robin Hood Energy to British Gas, as the council-owned, not-for-profit appeared to lose about £34 million by March 2019 (BBC, 17/09/2020). Same last year, the City of Bristol had to sell Bristol Energy, debt-ridden by than £30 million (BBC, 03/06/2020).

Some cities are also going backwards for other reasons than financial meltdown. In March 2020, 44 Deutsch municipalities including Rotterdam, The Hague and Dordrecht sold all their shares of Eneco, a company involved in the development of renewables, to a Japanese consortium made up of Mitsubishi (80%) and Chubu (20%). The transaction, was valued at EUR 4.1 billion and was to the detriment of Royal Dutch Shell, which had long been positioning itself to acquire the public company as part of its renewable investment strategy (Eneco, 2020). The sale is the direct result of the unbundling of Eneco and Stedin, its network operator, in February 2017 following the liberalisation of the energy market in 2004, as the government required energy companies to get rid

of their electricity and gas networks. With very few production capacity, Eneco's 44 municipal shareholders found themselves with a retailing company for energy products and services, which they do not regard as a government task.

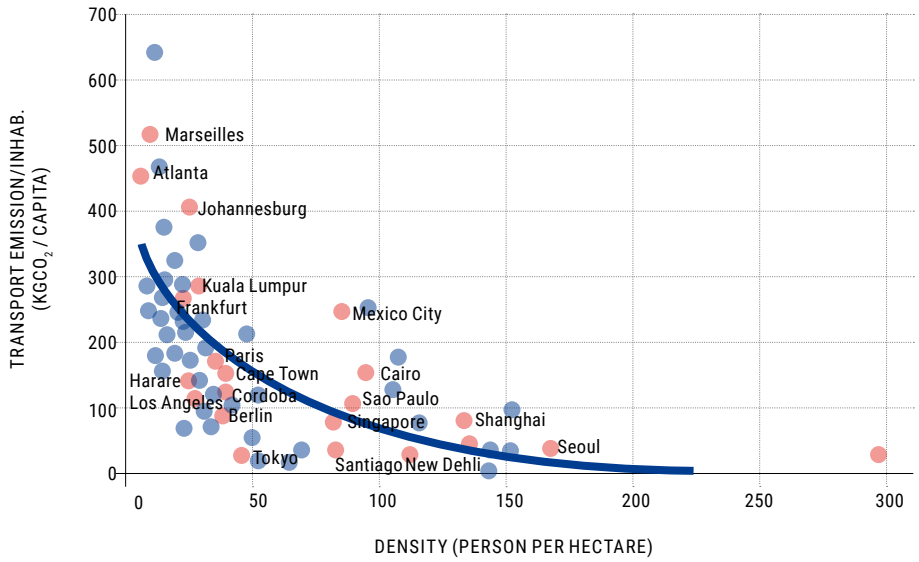
B. From "smart cities" to "15-Minute Cities" and "tactical urbanism": a new wave in strategic space management

If it were to be observed through a strict "climate prism", a prominent contribution urban planning can do to cutting GHG emissions can be boiled down to reducing fossil fuel consumption for transport of goods and persons through reduction of distances and providing proximity-based services and activities (**fig. 6**). Such a policy also contributes to reduce inequalities and reach the targets of SDG 11[3]. Indeed, medium- and low-wages households living in the outskirts or in residential areas bear the brunt of the economic and social cost of car ownership as basic urban amenities and services are located further away from their living place. Lack of spatial flexibility also impacts access to jobs[4]

Unexpectedly, Covid-19 outbreak has stressed cities' vulnerabilities and dependence upon trade and out-boundary productions to meets the basic needs of residents. In this perspective, the pandemic has given cities a necessary boost to accelerate an innovative approach shifting from increasing *mobility* to enhancing *accessibility* to densify local activities (OECD, 2020). Two approaches have raised particular attention: tactical urbanism and 15-Minute cities.

FIGURE 6

URBAN DENSITY AND TRANSPORT EMISSIONS - *Source: Liu, Z., 2012*



• TACTICAL URBANISM • In the immediate aftermath of the first lockdown, many cities throughout the world adopted emergency measures, including the building of temporary cycling lane, to ease traffic and encourage soft mobility (see p. XX). Media were rapidly keen into dubbing this movement "tactical urbanism". The word itself was coined in 2015 by Mike Lydon and Anthony Garcia, authors of *Tactical urbanism: Short-term action for Long-term Change* (Island Press, 2015), and defined as *"an approach to community-building using short-term, low-cost and scalable projects intended*

3 "Make cities and human settlements inclusive, safe, resilient and sustainable"

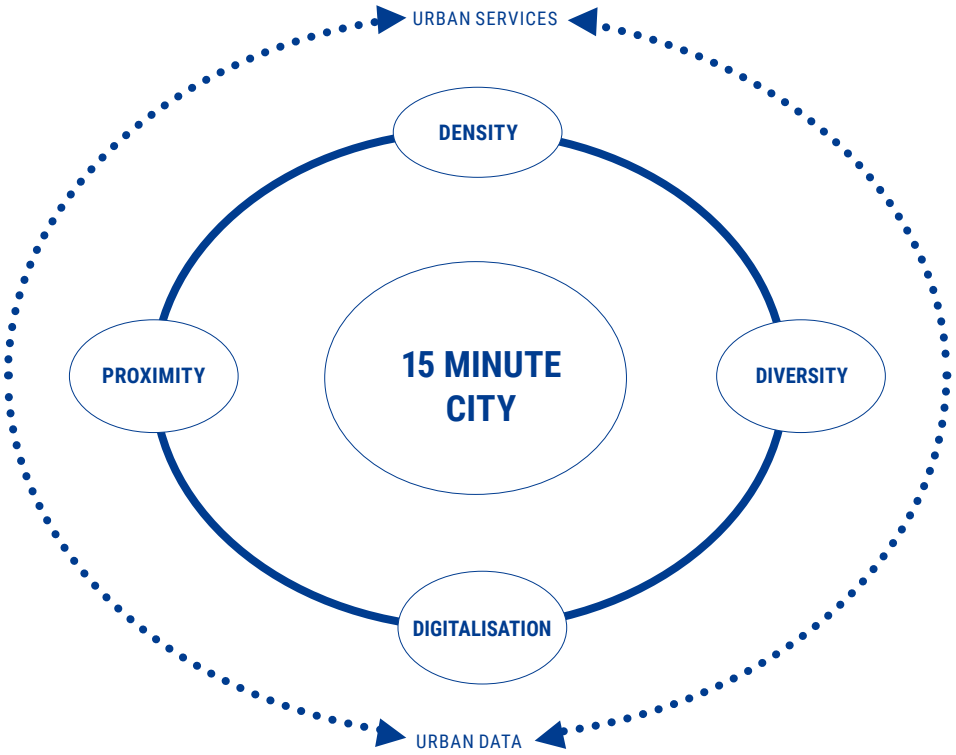
4 See Laboratoire de la mobilité inclusive (2017)

to catalyse long-term change". From demonstration projects to pilot projects and interim design, tactical urbanism can be sanctioned or unsanctioned by authorities, but is always intended to drive long-term change based on user experience rather than top-down design[5]. A successful example of bottom-up tactical urbanism movement that turned into a long-term policy is the *Park(ing) Day*, when cyclists invaded a parking lot of San Francisco in 2005 to temporarily turn it into a park, before it became a sanctioned, Mayor-supported event as soon as the next year (Herman & Rodgers, 2020).

• 15-MINUTE CITIES • Over the last years, the concept of "Smart cities" has long been dominating the discourse of urban planners in big cities, in the perspective to sustain a narrative around more liveable, resilient, sustainable cities. The idea of "Smart cities" aims at the *optimization* of urban fabric through the deployment digital technologies. The concept relies on the Internet of Things (IoT), Artificial intelligence or Big Data to address challenges currently faced by cities such as efficient resource management (energy, water…), reducing urban sprawling, cutting pollution, easing accessibility to basic services, and tackling climate change (Moreno et al., 2021).

FIGURE 7

THE 15-MINUTE CITY FRAMEWORK - *Source: Moreno et al., 2021*



It is Carlos Moreno, French-Colombian researcher in urban planning and specialist of "smart cities", who firstly coined the concept of "15-Minute City" in 2016, before it was popularised through experiments of several cities throughout the world and became a major focus of the 2020 Paris municipal election campaign. This concept is part of broader thinking about "chrono-urbanism", "*which outlines that the quality of urban life is inversely proportional to the amount of time invested in transportation, more so through the use of automobiles*" (Moreno et al., 2021).

5 See Mike Lydon presentation in Transformative Urban Mobility Initiative (03/04/2020). "Webinar on Tactical Urbanism as COVID 19 Response – April 02, 2020" [Video]. YouTube.

In a 15-Minute City, locals are able to reach within a 15-minute ride in bicycle or walk all their basic essentials and fulfil six essential urban social functions: living, working, commerce, healthcare, education and entertainment. To do so, Moreno advocates in his latest article "*the urban built environment needs to be restructured*" and the 15-Minute City to incorporate four dimensions: density, proximity, diversity, and digitalization (Moreno et al., 2021; **fig. 7**).

Some authors have then explored variations of the 15-Minute City to underline their different socio-economic benefits. For instance, Weng et al. (2019) introduced the idea of a "15-Minute Walkable Neighbourhoods" "*as a way of promoting the health dimensions of the residents especially in voiding non-communicable diseases like obesity*" in the Chinese context. Capasso Da Silva et al. (2020) argue that focusing attention to accessibility rather than transport connections during planning stages could lead to cities accessible within 20-Minute walk, cycling or transit.

In July 2020, the C40 issued a manifesto for an exit from the Covid-19 crisis, the *C40 Mayors' Agenda for a Green and Just Recovery*. The creation of 15-Minute Cities is one of the strategies put forward to strengthen cities' resilience. The document points to the need to create a legal environment that encourages inclusive zoning and mixed-use urban development (C40, 2020). Several cities have already adopted this concept in response to the Covid-19 crisis, such as the city of Milan, which is encouraging teleworking in companies, converting 35 km of roads into pedestrian and cycle zones and working with the Lombardy region to open medical centres in densely populated areas.

At neighbourhood level, it is about improving urban design to diversify usage so that people can not only live and work there, but also enjoy themselves, eat and drink and have access to education, culture, and health. In short, it is about going back to the urban design familiar to our cities before the advent of the car in the second half of the twentieth century. The city of Portland is one of the first to position the development of such neighbourhoods at the heart of its climate plan. In 2015, the city set a target of an 80% reduction in its GHG emissions by 2050, relative to 1990 levels, and one of the main strategies for achieving this is the creation of "complete neighbourhoods" for 80% of the population. The "complete neighbourhood" concept is defined as follows: "*a complete neighbourhood provides safe and convenient access to the goods and facilities needed for everyday life. It includes a variety of accommodation options, grocery stores and other shops, quality state schools, public green spaces and recreational facilities*" (Portland, 2015). Other cities will then follow this example: in 2018, Melbourne unveiled the "20-minute neighbourhood" principle, whereby people should have access to all essential services within 20 minutes; in 2019, Minneapolis made a commitment to ensure that its entire population lives in "complete neighbourhoods" by 2040 (Minneapolis) and in the same year Ottawa launched its "15-Minute neighbourhood" programme (CBC, 22/08/2019).

In Sweden, ArkDes, the national architecture and design museum, started to experiment in 2020 the *Street Move* national program, with the support of the national government and financed by Vinnova, the state innovation agency. The project consists in interactive kits designed in a similar style to Lego pieces or Ikea furnitures, to be built by local residents to transform their streets into more liveable places. Sitting places, soft-mobility hubs, playgrounds, plantings… the aim is to find new functions to parking places to densify hyperlocal activities and progressively turn those cities into a "One-Minute Cities". Firstly, tested in Stockholm and now Gothenburg, other units are to be set in Helsingborg (The Guardian, 08/02/2021; ArkDes, 2020).

C. Transport and mobility: aligning city-scale Covid-19 resiliency with climate change mitigation

As described in Climate Chance's 2020 Synthesis report on climate action by sector, Covid-19 has put municipal public transport financial schemes in dire straits. Pressure on public transports has been tighter in cities where the sector receives few public subsidies and mostly relies on user fares to fund the system. More than elsewhere, reduced demand for transport in these regions has had violent repercussions, cutting incomes while operating costs remained. In Brazil, operators in Salvador and São Paulo have already gone bankrupt, and half of the bus transport companies are threatening to file for bankruptcy by the end of 2021 according to the president of the NTU, the national association of urban transport companies (Folha de S. Paulo, 09/07/20).

However, some public transport systems proved much more resilient despite heavy reliance on user fares. For instance, Seoul financial model is highly dependent on users (between 70 and 75% of the operating budgets of the bus network, the same for the metro), but it resisted Covid-19 very well, limiting the drop in ridership to -30% at its peak in March 2020 compared to 2019 and recovered 84% of pre-pandemic levels in November.

In a comparative investigation, the online magazine City Monitor tried to figure out what policy choices made a difference in Seoul, compared to another city that suffered much more, San Francisco (SF). San Francisco recorded a drop of around -90% in April 2020 without having recovered normal levels since. The financial losses of the BART, the San Francisco Bay express train, are estimated at USD 975 million over the next three years (San Francisco Chronicle, 14/07/2020). While containment measures were much stricter in San Francisco than in Seoul, the latter recorded 23 times fewer cases than its American counterpart. The article proposes several explanatory factors: greater health discipline on the part of Koreans (and consent to privacy control) and transport operators (systematic disinfection of buses after each journey), a more widespread and accepted practice of teleworking in San Francisco, with lower rates of public transport use in the U.S. than in Asia (and already declining since 2014 in SF), and a more systematic reliance on cars in the U.S. than in Korea, whereas public transport is central for workers transit in Seoul. Finally, the fragmentation of transport services in the SF urban area and poor coordination between operators complicates the rebound in usage (City Monitor, 28/12/2020).

INDICATOR

2,570 km

of cycle paths have been announced by cities in Europe since the beginning of the pandemic, with half of them already completed.

In this context, direct investment in cycle lanes infrastructure not only appeared as a low-cost, efficient emergency measure to encourage soft mobility, but also as a long-term policy to mitigate transport emissions. As of February 2021, the European Cyclists' Federation has recorded the allocation of budgets totalling over €1.1 billion to promote bicycles since the beginning of the pandemic and exactly 2,571.84 km of cycle paths have been announced, more than half of which have actually been completed to date. 76.9% of these measures relate to the creation of bicycle lanes, 18.3% to calming and reducing traffic and 4% to opening pedestrian areas (ECF, 2020). In some European cities, these infrastructure investments have also been combined with subsidy programmes to purchase electric bikes, such as in Paris, Vienna, Guernsey, Lisbon or Madrid.

Rufisque - Senegal

A localized food system to encourage local demand of local products

While agriculture is the first emitting sector in Senegal (49%; UNFCCC, 2016), it is only a small share of Dakar's territorial emissions (1.6%), much less than food consumption resulting from imports (7.8%; ARENE, 2013). As any other urbanized city, this reveals the high dependence of the capital to suburban and farming lands of the countryside to sustain the food system.

Yet, at the country level, the primary sector (including agriculture, breeding, sylviculture and fishing) only accounted for 15% of the GDP in 2019, although it occupies 50% of jobs (ANSD, 2020). peanuts (5.9% of exports), canned and fresh fish (9.8%) as the main primary products sent to exports. Because of this gap, Senegal heavily relies on international imports to meet demand for food. Overall food products accounted for 29% of the country's total imports of goods, while they amount to 40.6% of the country's exports. Rice alone, which weighs 70% of a Dakari's alimentation (ARENE, 2013), amounts to 4.9% of national imports and is among the most imported products in the country, behind refined petroleum and machineries (ANSD, 2019).

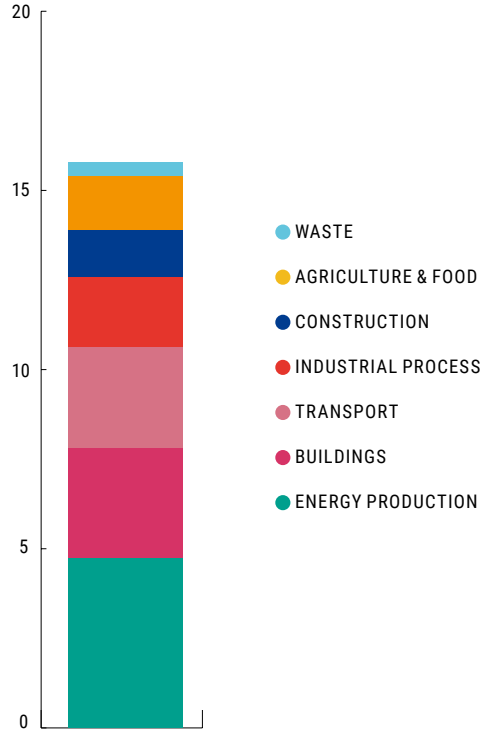
Rufisque is a 500,000-inhabitant department covering 2/3 of Dakar region's area and most of its agricultural lands. In 2017, a food system diagnosis revealed Rufisque's farming lands are threatened by the combined rapid urbanization of the cities Dakar, Thiès and Mbour. There, family farming rub shoulders with big, capitalistic crops, and women play a central role in food transformation and catering. While household dedicate most of their income to buying food, their purchase power and nutrition are subject to international speculation over raw food products. In the meantime, processed food products are more and more popular (GRDR, 2017). At national level, rainfall variability and climate change have been identified as major risks for key farming activities, as peanut culture (Plan Sénégal Émergent, 2014). Born out of the 2013 Decentralisation Act, the Departmental Council of Rufisque (DCR) has the relevant competences to protect farming lands and develop local economic fabric.

The DCR experiments an approach focused on encouraging local demand to support regional production called "*territorialized food system*." (TFS). TFS is an emerging approach relying on a food governance based on multi-actor participation, agroecology, reduction of food waste and fair share of added value at local scale (Alimenterre, 2019).

Implementing a TFS approach is the purpose of the AMOPAR program, which aims at delivering a Local Food Plan in Rufisque based on the diagnosis. Funded by AFD, and co-piloted by Senegalese association CICODEV, French-NGO GRDR and the DCR, the project is part of the broader programme SADMAD to strengthen resiliency of the populations in food insecurity in the suburbs of Dakar. Concretely, the Local Food Plan will seek to improve quality of meals in canteens, raise pupil's awareness about nutrition, provide consumers with relevant information about quality food, raise incomes of women in the supply chain, and develop a participatory-based governance of the Plan. The diagnosis also underlined the potential benefits for mitigating the food system's emissions of bringing consumers and producers closer through the supply chain. The project is due to end by February 2022 (GRDR, n.d.; AFD, 10/03/2021).

EX-REGION OF DAKAR EMISSIONS 2008 ($MTCO_2E$)

Source: ARENE, 2013



D. Food systems: the case for renewing city-region relationship in a context of pandemic

In the same vein, with the purpose to densify local economic activities and to tighten links between cities and their regions, Covid-19 has triggered a lot of thinking about food systems vulnerabilities. Panic-buy behaviours and empty shelves in the first days of lockdowns also put pressure on large retailers. Romania for example, although one of the EU's largest cereal exporter, decided to ban exports of wheat, corn, rice, sunflower and other food basics such as sugar and vegetable oils during Covid-19 state of emergency (Euractiv, 10/04/2020). Some political leaders at national levels and supranational levels then started to call for building "food sovereignty", such as French President Macron during a public speech in June 2020, or the European Union though the "Farm to fork" strategy introduced as part of the European Green Deal.

At local level, 31 cities from all over the world signed the Glasgow Food and Climate Declaration on 14th December 2020. Supported by several transnational local government networks as C40, Under2 Coalition and ICLEI, it was also endorsed by local initiatives such as the Spanish Red de Ciudades por la Agroecología[6] as well as the Milan Urban Food Policy Pact, an international agreement on urban food policies signed by over 200 cities in 2015. The Glasgow Declaration is a 16-point document advocating the integration of food policies into Nationally Determined Contributions (NDCs) that are due to be revised in the lead up to COP26 in Glasgow. The Declaration also insists on horizontal (between different sectors) and vertical (between different levels of governance) integration of food policies and advocate the building of food systems able aligned with the Paris Agreement and the Sustainable Development Goals. Indeed, food sovereignty is not only a matter of adaptation to climate change, since food systems today account for 21-37% of total GHGs (IPCC, 2019). Considering that "*the majority of food system innovation and change are occurring at local and regional levels*", the Declaration highlights the need to empower local governments to scaling and extending action.

In December 2020, the EuroChoice journal dedicated a special issue upon "Covid-19 pandemic impacts on agri-food systems" (vol. 19, issue 3). To one of the authors, building a resilient food system is a matter of trade-off between globalised, high-emitting food chains dependent on international transport networks (threatened by lockdowns in the pandemic context) and local chains dependent on few producers and purchasers (which is also a risk for food security as vulnerabilities are not shared) (Matthews, A., 2021).

Several initiatives sprang up. In Spring 2020, the French NGO Les Greniers d'Abondance edited a free guidebook for local policymakers entitled *Towards Food Resiliency. Face global threats at local level*, which provides diagnosis of the French food systems vulnerabilities and practical pathways to enhance resiliency at each stage of the food system. Les Greniers d'Abondance also developed CRATer, an online application that automatically calculates some indicators characterising the level of food resilience of a given territory: relation need/production; farming practices; farming population; and land-use policy.

In Scotland, the usually export-oriented fishing industry suffered from the overall falling of exports in the United Kingdom during the first six months of 2020 (-23.3% by value), combined with declining demand from restaurants during lockdown and issues raised by Brexit. In response, the Edinburgh Fish City project was launched in 2020 by the marine conservation charity Open Seas and Edible

6 "City Network for Agroecology"

Edinburgh, the city-wide, city council-led multi-actor partnership to build a sustainable food system in Edinburgh. The campaign aims to build relationships between traceable suppliers of sustainable fish and their local community. First, signatory businesses pledge to a charter including stating location and fishing gear used; stop selling seafood "red rated" by the Marine Conservation Society's Good Fish Guide; and procure certified or "green rated" seafood by the Good Fish Guide, promote small scale fishing and providing transparent information to consumers. Pledgers are then listed to an online directory of sustainable seafood businesses from which people can find details of the nearest supplier to directly buy from them (Nourish Scotland, 15/01/2021).

3. Sourcing renewable energy and EV fleets through public procurements

Green Public Procurements (GPP) have been well documented in the past years as for any act of purchase from a public authority to "*procure goods, services and works with a reduced environmental impact throughout their life cycle when compared to goods, services and works with the same primary function that would otherwise be procured*" (European Commission, n.d.). World Bank estimates that 12% of the global Gross Domestic Product is spent following some form procurement regulation, at a nearly identical level in low-income and high-income countries (Bosio, Djankov, 05/02/2020).

In Europe, these GPP are legally defined in two directives related to procurements (2004/18/EC and 2004/17/EC). In the European legal context, Ecolabels provide proofs of compliance with the environmental criteria the public authority is looking to meet. From printing equipment to data centres or textile products (to quote those products whose criteria were revised by the Commission in 2020), GPP norms cover a large range of products and services. The famous EU Energy Label rating the energy efficiency of appliances from D (red) to A+++ (dark green), or the Energy Performance Certificate for buildings, are some of them. Directive 2004/17/EC specifically rules the water, transport and energy sectors.

In a climate perspective, procurements and purchase power of local governments can be voluntarily oriented towards specific products and services to abate emissions through low-carbon goods and services. Public procurement from local authorities also constitutes a good indicator to identify how relationship between local governments and private sector is evolving. In the following we examine the case of two sectors where specific trends have emerged: energy with power-purchase agreements, and transport and with the rise of e-buses.

A. The trend of Power-Purchase Agreements reaches cities in Europe, Australia and United States

Power Purchase Agreements (PPA) are privately negotiated long-term contracts between renewable electricity producers and consumers ("offtaker"), without going through an electricity supplier. PPAs make it possible to secure a fixed price per KWh over time, reducing the risks associated with market prices for both sides. As renewable energy prices are dropping, PPAs appear as a good way to secure investments for facility developers. As municipalities are major consumers of electricity whether for public buildings, schools or urban lighting, municipal PPAs can also help cities reaching their renewable consumption targets without investing in local power facilities. However, apart from big cities, municipal PPAs remain an emerging practice, compared to those signed by the private sector[7].

For instance, in November 2020, the City of London signed a £40 million (€46 million) PPA with the French renewable power producer Voltalia to buy all the electricity produced by a new-build 95,000-panel solar farm in the county of Dorset, South of England, for 15 years. The solar farm is not built yet, which is the aim of a PPA: the contract helps the company to leverage cash to finance the project, while the city saves money (about £3 million here) in energy costs (City of London, 18/11/2020). Regarding the cases of Nottingham and Bristol, PPA also seem a less risky option than council-owned companies (see **part 2.A.**).

7 See Energy chapter in Climate Chance Observatory (2020). Global Synthesis report on climate action by sector. *Climate Chance*

Yet, to be profitable, a PPA must deal upon a large amount of energy to allow economies of scale – which can be excluding to smaller cities with smaller budgets, and other local actors. So, cities can facilitate group purchasing for other players in their region by forming new entities known as Community Choice Aggregations (CCA). Cities or groups of cities purchase wholesale electricity to meet the combined loads of residents and businesses in their region, benefiting competitive rates by aggregating demand (IRENA, 2019). The latter then have the choice of remaining in the programme or reverting to their former supplier. This makes it possible to negotiate competitive prices with suppliers and to choose your electricity mix. This is mainly the case in the United States, where eight States have CCA legislation allowing local government to consolidate the electricity loads of residents, businesses and municipal facilities, but there are also programmes in several municipalities in the prefectures of Yamagata and Gunma in Japan (IRENA, 2019). Melbourne's two successive PPA over the last three years is also providing a good example of how local government can lead their biggest energy-consuming facilities to turn towards low-carbon power (**case study 8**).

B. Deploying low-carbon vehicles through public tenders

Electric-vehicles are getting increasingly popular in Europe, Japan and China, and the market proved remarkably resilient to the pandemic (+40% in 2020 globally, while global car sales were plummeting by 14%), although still limited to small share of the global car markets (0,8% in 2019) (IEA, 2021). In this context, cities are playing their part. Since Shenzhen reportedly became the first city in the world with 100% electric bus fleet in 2017 (Climate Chance, 2018), many cities have made use of public procurement to shift their public transport fleet into e-vehicles.

Latin America in general, and Colombian cities in particular, have been leading the way to introducing electric buses (e-buses) into their public transport fleets (Climate Chance, forthcoming). Cali's *MIO* system was the first to implement electric buses with the first of a total of 136 electric vehicles starting operations in 2019. In Bogotá, where the pollution caused by the *TransMilenio* – the Bus Rapid Transit (BRT) system of the city – has been a highly salient political issue, a major step was taken towards electrification with the arrival of 379 e-buses in 2020, forming the largest such fleet on the continent. These vehicles are expected to cut emissions by 21,900 tons of CO_2 (Sustainable Bus, 2019). Across Colombia and the continent, most of tenders have been won by Chinese automakers like BYD, which has made a massive entrance into the South American electric vehicle market since 2019 (Diálogo Chino, 20/06/2020). As of March 2021, the E-Bus Radar recorded a total of 2,306 e-buses in Latin America (2.28% of the bus fleets of the cities on the platform), up by 170% since 2017. It estimates that it allows saving 234.71 $ktCO_2$ per year (E-Bus Radar, 2020).

INDICATOR

+170%

the growth of e-buses in Latin American cities since 2017

BYD, which only lost last year the number one seat of global EV producers to Tesla (Clean Technica, 10/12/2019), is also entering the European market, as evidenced by the 259 BYD e-buses operated by Keolis that entered service in several middle-cities and small towns of the Netherlands, recorded as Europe's largest e-bus order yet (Automotive World, 14/12/2020).

CASE STUDY 8

Australia - Melbourne

Melbourne, a 100% renewable-powered city at the vanguard of Power Purchase Agreements

Home to more than 5 million people, Melbourne reported emissions amounted to 4,9 $MtCO_2$ in 2019, down by 14% from 5,8 $MtCO_2$ in 20148. Changes of methodologies apart, City of Melbourne identifies the surge of renewable energies over the last years as the main driver of this success (CDP, 2020). Indeed, in early 2019, Melbourne claimed it became the first Australian Council to cover 100% of its infrastructures power consumption (universities, lighting, corporations, cultural institutions…) with renewable energies (City of Melbourne, 17/01/2019). An achievement consistent with the city's pledge to reach zero net emissions for all the Council's public operations by 2020 (City of Melbourne, 2014). From 2011-2012 to 2018-2019, the municipality of Melbourne alone (i.e. the Council representing 159,992 inhab.) reduced emissions from its operations by 54% (Scope 1, 2, 3), including a 65% drop in Scope 2 emissions, which includes energy purchase (City of Melbourne, 2019).

At the heart of this success is the use of Power Purchase Agreements (PPA) to supply the city with electricity from renewable sources. In 2017, a first PPA signed under the aegis of Melbourne supported the construction of the new 39-turbine Crowlands Wind Farm, operated by Pacific Hydro firm in Western Victoria, some 200 km away from Melbourne. The new farm opened in early 2019 with a capacity of 80 MW and proposed yearly generation of 264 GWh, of which 88 GWh were purchased by thirteen of Melbourne's biggest energy consumers. Gathered in a city-led consortium called Melbourne Renewable Energy Project (MREP), none of these actors had to make any direct capital investment into the project, as the agreement alone provides guarantee of financial returns on investment to Pacific Hydro. 40% will be purchased at a fixed price, while 60% will be a market-based price renegotiated every two years. In total, the PPA avoids the emissions of 96,800 tCO_2e a year in Melbourne and equates to the annual power consumption of 17,600 households or taking 22,500 cars off the road every year. The project now supplies energy to power town halls, bank branches, universities and street lights.

In June 2020, Melbourne facilitated the signing of a second collective PPA with seven local players including universities and businesses. The Melbourne Renewable Energy Project (MREP 2) will supply 110 GWh of renewable electricity per year to the purchasing group over 10 years, i.e. 22 GWh more than the first PPA. This electricity will supply fourteen shopping centres, nine office buildings, seven university campuses and four factories, equivalent to the consumption of 22,000 Australian households a year (City of Melbourne). This time, MREP2 sources power supply directly from existing Yaloak South Wind Farm, and the remaining from other wind farm projects in Victoria State. MREP 2 is expected to reduce the equivalent of 2.7% of the city's emissions every year, i.e. 1 $MtCO_2$ over the 10-year lifetime of the project. The two PPA combined lead to 5% equivalent reduction in City of Melbourne community emissions.

Melbourne's approach is close the Community Choice Agreements (CCA) that exist in the United States. As a local government of a big city, taking the lead of a consortium strengthens the application of smaller actors of the city, but also outside the city boundaries: the deal made in the first MREP only covered one third of the annual amount of power generated of Crowlands Wind Farm, but secures enough outlet for the farm to supply power to other places not part to the deal.

The City of Melbourne also edited a guide to advise corporate organisations of its territory on the different ways to purchase off-site renewable energy through PPAs but also renewable energy certificates and "contracts for difference".

8 Although these emissions are reported by "City of Melbourne" in CDP database, we reckon these figures cover all Greater Melbourne Area regarding their proportion. In this case study, the MREP is driven by the municip