C40 CITIES

Climate Action Planning

C40 Strategic Recommendations Guidelines

CONTENTS

INTRODUCTION

Objective of the Strategic Recommendations

The objectives of the C40 Strategic Climate Action Planning (CAP) Recommendations guidance document (SR) are to support cities identify high impact actions during the actions prioritisation process. These guidelines have been designed to support the action selection and prioritisation process and should be used alongside the ASAP tool and resources.

The SR reflect interventions that C40, through research and the work of the Global Initiatives (GI) team, has identified as having the potential for high impact in the majority of C40 cities. The SR reflect the C40 Declarations actions and targets that many C40 cities have already endorsed.

C40 Declarations are public commitments made by cities to curb emissions in sectors that are some of the greatest urban contributors to the climate crisis: buildings, transportation and waste. Signatory cities commit to developing sectoral specific actions (e.g., policies, programmes and projects) and targets (e.g., reduce food loss and waste by 50% from 2015 figures). These commitments are incorporated into each city's Climate Action Plan.

Current Declarations include: Net Zero Carbon Buildings, Green and Healthy streets, Advancing towards Zero Waste, Clean Air Cities, and Good Food Cities.

How to use the Strategic Recommendations

The SR can be utilised by the city (and City Adviser) during the Action and Plan Development phase of the CAP process, when the city is selecting, prioritising and defining actions to input into their CAP. The SR can be used alongside the C40 Climate actions ideas list, which provides a summary of approximately 200 high impact actions for cities to consider when developing their CAP.

Following the action and selection prioritisation process, City Advisers are required to document how the actions selected and prioritised by their city relate to the SR using the SR template. This is for C40 internal purposes and will help document which cities have committed to strategies included in C40 Declarations, and similarly understand the reasons where cities have not.

Guidance on the SR are detailed further in the Knowledge Hub and are referenced throughout this document.

Strategic Recommendations guidance and template

The **Strategic Recommendations guidance document** is structured by sector (directly corresponding to the C40 Climate actions database), detailing the:

- Importance of sectoral actions inclusion within a CAP.
- Guidance/narrative on GI sectoral recommendations (with reference to city declarations where appropriate):
    - Top 5 high impact strategies (e.g., recommendations for developing climate actions).
    - Strategies to avoid.
    - Key adaptation considerations for each sector.

The **Strategic Recommendations template** is structured by sector and includes:

- Sectoral recommendations.
- Examples of implementation.
- City priorities (for cities to specify how their selected and prioritised actions relate to the SR).
- Comment (for cities to explain their selection).

1. BUILDINGS & ENERGY

Buildings & Energy constitute an important percentage of cities' emissions. In order to deliver climate action in line with the goals of the Paris Agreement, cities should seek to plan and implement actions that will support the delivery of ultra-efficient, zero carbon new buildings by 2030 (and all existing buildings by 2050). In addition, they should seek to increase their low carbon electricity supply to shift toward 100% clean renewable electricity by 2030.

BUILDINGS

Energy use in buildings accounts for the majority of GHG emissions in most cities and is a significant source of air pollution. New buildings have a lifespan of 30-50 years and it is important to ensure they are built and operated in way that minimises both the emissions embodied in materials during their construction and the emissions from building operation and use.

Cities play a critical role in driving towards net zero carbon buildings, often working with national government who set and enforce national climate policies and regulations. The C40 Net Zero Carbon Buildings (NZCB) Declaration commits cities to enact regulations and/or planning policy to ensure new buildings operate at net zero carbon by 2030 (and all buildings by 2050). In order to achieve this, signatory cities have committed to establishing a roadmap for net zero (operational) carbon buildings and develop a suite of supporting incentives and programmes. In addition, the forthcoming Clean Construction Declaration will focus on reducing GHG emissions embodied in building materials. It will commit cities to enact regulations, planning policies or take other actions to meet reduction targets on embodied carbon for both buildings and infrastructure by 2030.

New buildings

It is important to consider both operational and embodied emissions from the earliest stages of building design to help reduce emissions over the building's lifespan. To avoid GHG emissions lock-in, new buildings should prioritise energy demand reduction, as well as consider water efficiency. Mandatory building codes are the most effective tool for improving building energy efficiency with energy use requirements that become progressively more stringent over time. Incentivisation schemes and capacity building also help to improve energy performance in new buildings. However, before developing new buildings, cities should always ensure that the existing stock is being maximised.

Existing buildings

Energy use in existing buildings is often one of the largest sources of GHG emissions in cities. Therefore, improving the energy efficiency of these buildings through retrofitting (e.g., implementing building codes and performance requirements, as well as providing incentives for retrofitting), is crucial for achieving a city's climate goals.

Municipal-owned buildings

To accelerate the retrofit of buildings for energy efficiency, city governments can lead by example by improving the performance of municipal-owned or managed building stock and by ensuring retrofits have low to zero embodied GHG emissions.

"Mandatory building codes are the most effective tool for improving building energy efficiency with energy use requirements that become progressively more stringent over time."

STRATEGIES

High impact

- Municipal buildings commitment to ensure all buildings owned, occupied or developed, are net-zero carbon by 2030.
- Develop a net zero carbon buildings pathway for new and existing buildings (both operational and embodied GHG emissions). Detail interim pathway milestones (e.g., existing building performance standards) while including a monitoring and evaluation system to track progress towards zero carbon.
- Develop a transparent evidence base to set mandatory ambitious energy efficiency performance requirements for all buildings.
- Develop incentives for city stakeholders to meet and exceed building energy requirements.
- Shift remaining building energy supply (including heating and cooling) to renewables (see below section "Clean Energy").
- Prioritise the use and retrofit of existing building stock to reduce the demand for new buildings.
- Require public disclosure of embodied carbon data for new buildings within the construction industry (through regulation, codes or policies).

Actions to avoid

- Voluntary standards for energy efficiency in new buildings without mandatory codes or clear timelines for stepping up the code.
- Adopting net zero carbon building code (covering both new and existing buildings) without specific requirements and quantifable performance indicators to achieve ultra-efficient buildings.
- Using natural gas as a transition fuel without long-term planning for electrifying building heating demand or increasing renewable gas in the gas grid. Although natural gas produces less GHG emissions per unit of fuel consumed in comparison to other fuels like heating oil, it is still a fossil fuel and can lead to significant GHG emissions lock-in.
- Combustion of solid fuels for household cooking or heating (including both biomass and solid fossil fuels). This combustion can result in the release of climate warming particles and gases (e.g., black carbon and methane). For households that currently must cook or heat with solid fuels (e.g., wood, coal) or kerosene, transitioning to LPG (a fossil fuel) in the short-term can dramatically reduce particulate matter pollution and protect health (reducing the number of premature deaths from exposure to air pollution). Where possible, cities should plan for electrification with a low carbon grid mix and/or contextualised renewable energy solutions in the long-term.

Climate adaptation considerations for buildings

- **Flood and sea-level rise**: Avoid new developments in flood risk areas and relocate or protect critical infrastructure above flood level. Ensure that the flood protection of buildings does not transfer the flood risk (rain or riverine) to other areas of the city.
- **Heat**: Incorporate adaptive measures when retrofitting buildings & creating new buildings codes, such as shading, passive cooling (ventilation), green and white roofs as well as standards for glazing, etc.
- **Drought**: Incorporate water efficiency measures such as rainwater harvesting, greywater recycling and reduced water consumption technologies.

ENERGY

Achieving 100% clean energy requires eradicating GHG emissions from energy use in all sectors of the economy (e.g., buildings, transport, industry) and involves fundamental changes to how we generate electricity, transport people and goods, and heat and cool our buildings. Cities cannot reach carbon neutrality without implementing actions that accelerate renewable energy generation. Decentralised renewable energy generation can also increase cities' resilience to climate change and increase energy independence in cases of extreme climate events.

It is advised that cities aim to achieve 100% clean *electricity* by 2030, in the transition to 100% clean *energy* (e.g., electricity, transport, heating and cooling) by 2050.

Shifting to 100% clean electricity through a mix of local generation and renewable grid purchases can mitigate the impact of climate change and has wider co-benefits, such as:

- Reduced air pollution related health issues at a regional scale (please see section on Air Quality).
- New local job creation in clean energy.
- Increased resilience to storms and other climatic hazards (especially in cases where the electricity supply is decentralised).
- Increase energy cost savings and return on investment (ROI) for renewable energy system owners.

STRATEGIES

High impact

- Set an ambitious commitment of 100% clean renewable electricity by 2030 and expand this to 100% renewable energy by 2050.
- Develop and incentivise building-scale renewables.
- Lead by example with municipal solar energy on all city-owned buildings.
- Incentivise large-scale clean energy generation.
- Promote clean energy sources for heating and cooling buildings.

Actions to avoid

- Investment in natural gas power plants or the development of gas grids. Natural gas is a fossil fuel and despite the fact that it produces less GHG emissions per unit of energy in comparison to coal, it still is a powerful CO_2 emitter. Investing in natural gas can lock-in GHG emissions for decades.
- Implementation of waste incineration plants does not produce clean or renewable energy (see C40 Advancing Towards Zero Waste Declaration). While energy recovery has been successfully integrated in regions with high segregation rates, high power and heat demands and extremely high land costs, developing incineration infrastructure should not be seen as a climate-friendly solution.

Climate adaptation considerations for energy:

- **Coastal flood**: Avoid new clean energy infrastructure in flood risk areas and protect the clean energy infrastructure from storm surge and sea level rise
- **Storm**: Investment in building-scale renewable energy systems contribute to GHG emissions reduction, while at the same time ensure back-up energy supply during service outages.
- **Heat**: New district-scale clean energy infrastructure, integrated with cooling systems (e.g., building-scale solar PV or solar hot water combined with white or green roofs and walls) to protect the critical infrastructure from future extreme heat events.

2. TRANSPORT AND URBAN PLANNING

Transport constitutes the fastest growing source of GHG emissions in most cities and is one of the leading sources of local air pollution. As overall demand for transport is influenced by land use within cities, it is crucial that transport and urban planning are integrated.

Adaptation measures should be integrated throughout transport and urban planning actions set out in the CAP to ensure that existing and proposed transport infrastructure is resilient to heat, flooding and other impacts of climate change.

The key to a successful strategy to reduce transport GHG emissions is the reduce/avoid, shift, improve and adapt framework. The framework aims to reduce the number and distance of trips through compact and connected urban planning, shift trips to zero and lower carbon modes (e.g., walking, cycling and public mass transit), improve the efficiency of remaining vehicle fleets through a shift to zero emission vehicles via electrification as well as ensuring transport infrastructure is resilient to the impacts of climate change. Actions to reduce transport GHG emissions should be treated as a hierarchy: reductions in the overall need for travel and a shift towards less individually polluting transport modes such as walking, cycling and public transport should be undertaken before electrification of the private vehicle fleet.

The C40 Green and Healthy Streets Declaration (also known as the Fossil Fuel Free Streets Declaration) brings these actions together. The headline commitments for signatory cities are to procure with their partners only zero-emission buses from 2025 and ensure a major area of the city is zero-emission by 2030. Whilst not all cities will have the capacity to deliver the headline commitments of the declaration within the timescales set out, the declaration provides a benchmark for all cities to work towards. The underlying actions in order to meet the commitments should form the basis of all cities' transport and urban planning actions in their climate action plan.

TRANSPORT

In order to meet net zero emissions by 2050, cities need a 100% zero emission transport system by 2050. Whilst electrification of vehicles is an important part of de-carbonisation, it should not be the first, or only, consideration. The safe and efficient movement of people and goods, as opposed to vehicles, should be the focus of transport actions within CAPs.

Ambitious targets for the modal share of walking, cycling and public transport (e.g., up to 80% by 2030 is a suggested high ambition benchmark for Global North cities) should be set with a clear strategy to achieve them. A reduction in overall vehicle miles travelled should also form part of the CAP. In many Global South cities this high-level of mode share for walking and cycling has already been achieved due to the high cost of private vehicles or lack of access to mass transit. The challenge in developing climate actions will be to maintain this level of modal share as income increases. Cities should focus on provision and upgrade of walking, cycling and mass transit infrastructure rather than developing infrastructure to provide for expanding car use. Furthermore, cities should introduce policies to encourage and enable more journeys to be taken by foot and bicycle. To achieve this, the provision of infrastructure to create safe, accessible, direct and convenient routes for pedestrians and cyclists is crucial.

The provision of a mass transit system that provides a viable and attractive alternative is equally important. The mass transit system should aim to provide significant coverage across a city, particularly in areas with high population density and should connect people to employment, services, leisure and education. A successful mass transit system should provide an attractive alternative to private vehicle usage. Factors to help encourage greater patronage include improvements to frequency and reliability, provision of real time information and an integrated ticketing system that allows travel across different modes (e.g. transfer from light rail/metro to bus) saving costs for passengers. Mass transit systems should also integrate with the walking and cycling network (e.g., through providing secure cycle parking at metro/BRT stations and safe walking and cycling routes to stations). Additionally, if there is an informal transport sector, this needs to be integrated into the system, to ensure that informal shared services complement mass transit systems by acting as feeder routes rather than competing along the same routes.

In addition to increasing the mode share for people and goods by walking, cycling and mass transit, increasing the uptake of zero emission vehicles will also be needed. Cities should seek to establish a zero-emission bus fleet. In addition to the climate benefits, this is particularly important for air quality and human health as diesel buses are often the dominant source of carcinogenic air pollutants in urban areas.

Cities should lead by example through converting municipal fleets to zero emission, establishing the necessary infrastructure and incentivising the early uptake of zero emission vehicles whilst dis-incentivising the most polluting vehicles. Where cities have specific powers over taxis and shared fleets, efforts should be focused on electrification of these vehicles through licensing restrictions and incentive packages. Powered two and three wheeled vehicles should be included within a strategy for electrification, particularly in Global South cities with high usage of these vehicle types.

Road user charging or access restrictions for vehicles can be utilised as a tool to encourage a shift to walking, cycling and public transport. Discounts for zero emission vehicles and surcharges for higher emission vehicles can also incentivise the uptake of zero emission vehicles.

Similar principles of avoid, shift, improve will apply to freight vehicles. Whilst the mode shift potential is lower, an opportunity exists to reduce overall freight mileage through shared procurement and consolidation, shifting some freight to rail, waterways and cargo bikes, and re-timing of freight deliveries to avoid the busiest periods. On an individual vehicle basis, freight vehicles tend to have high emissions of both GHGs and local air pollutants, so there is large scope for reducing emissions from this sector.

STRATEGIES

High impact

- Set an ambitious target to increase the modal share of walking, cycling and mass transit.
- Implement restrictions (e.g. charges or bans) on high polluting vehicles in a significant part of the city.
- Provide safe, equitable, convenient and accessible infrastructure for pedestrians and cyclists.
- Provide a public cycle hire/sharing scheme.
- Develop an accessible, reliable, frequent, affordable and well-integrated low emission mass transit system (e.g. bus rapid transit) with wide coverage of populated areas of the city.
- Set an ambitious target date to procure only zero emission buses in the city.
- Shift city fleets and public transport fleets to electric vehicles as soon as possible and help provide infrastructure (e.g. charge points) and appropriate incentives for wider roll out of electric vehicles.
- Incentivise the transition towards zero emission freight and reduce overall freight mileage.

Climate adaptation considerations for transport:

- **Flood**: Avoid new mass transit corridors in flood prone areas and where possible, elevate existing transport infrastructure in flood prone areas.
- **Sea-level rise**: Install back-up power for subway pumps and for charging electric fleets in case of damage. Enhance protective measures along populated coastal routes, such as sea walls and natural barriers (e.g., mangrove restoration).
- **Heat**: Consider greening of transit routes/stations, walking and cycling routes as well as installing cool pavements, drinking water fountains at stations and bicycle stations and general cooling measures for vehicles (e.g., white bus roofs, tinted windows etc.).

Actions to avoid

- Roadbuilding: Provision of new roads to relieve congestion is sometimes seen as a way to reduce transport emissions by encouraging greater efficiency of vehicle flow. However, greater efficiency often encourages new vehicle trips, negating any short-term efficiency gains and does not take into account the emissions associated with construction of the roads.
- Transition to Compressed Natural Gas (CNG)/Liquified Natural Gas (LNG)/Liquified Propane Gas (LPG) (or other fossil fuel derived alternative fuels): These fuels are often cited as a solution to air pollution and CO_2 issues. However, CNG and LNG are less energy efficient than diesel and have a higher CO_2 per km emissions than diesel equivalents. Whilst CNG and LNG fuels produce fewer NO_x and PM emissions than older diesel vehicles, at the latest emissions standards they now produce the same, or higher levels of NO_x.
- Biofuels: Where possible, the use of biofuels should be avoided within CAPs. Direct and indirect land use change for crop derived biofuels can lead to higher overall emissions than fossil fuels and has been linked with deforestation. Waste derived biofuels do not have the same land use emissions issues, but supply can often be limited. Whilst advanced biofuels may have a future role in sectors that are harder to de-carbonise (e.g., aviation and shipping), we would not recommend further uptake as a climate action in the short-term.

"Cities should focus on provision and upgrade of walking, cycling and mass transit infrastructure rather than developing infrastructure to provide for expanding car use. Furthermore, cities should introduce policies to encourage and enable more journeys to be taken by foot and bicycle."

URBAN PLANNING

Urban planning measures are critically important to enable cities to deliver on their GHG emissions reduction targets in transportation, construction, and other sectors, and reducing their vulnerability to the effects of climate change. Urban planning strategies and regulation(s) set a framework for urban growth, while delivery of urban growth is typically carried out by the private sector and can take place either through densification (e.g., building more on the city's existing footprint) or urban expansion.

Urban expansion, when unregulated and unplanned, can lead to GHG emissions lock-in (e.g. car-dependent, low density development), high embodied GHG emissions and/or degraded equity outcomes (e.g. slum development). Unregulated urban expansion can also increase vulnerability to climate hazards (e.g., expansion in areas that are prone to flooding or suffering from the urban heat island effect). In addition to leading to poor sustainability and resilience outcomes, unregulated urban expansion carries a higher cost for municipalities, as public services and infrastructure are more expensive to provide in low density neighbourhoods, or as part of a slum upgrading programme. Conversely, planned urban expansion can reduce per capita GHG emissions and ensure that the city is more resilient to climate hazards.

Densification strategies, such as transit-oriented development (TOD), optimise the amount of residential, commercial and recreational space within walking distance of public transport. These strategies, when coupled with public transit, can reduce car trips, improve air quality, preserve open space, and create walkable communities, all of which reduce GHG emissions and/or improve livability. Densification can also help reduce pressure on housing costs by enabling the supply of more housing units. However, densification measures in climate risk areas (e.g. that are prone to flooding or urban heat) should always include adaptation considerations.

Cities should prevent development on land vulnerable to climate hazards (e.g. rising sea levels, more extreme storms, heat, drought, and flooding). Coupled with this, cities' planning departments can apply nature-based solutions at the city-level, such as expanding the urban green canopy to reduce heat-island effect, stormwater run-off, and air pollution. The combination of urban planning policies supporting climate adaptation and mitigation is key to ensuring long-term urban sustainability.

STRATEGIES

High impact

- Set an ambitious target for the percentage of people who should have access to frequent mass transit within 500 meters.
- Set an ambitious target (and supportive policy mechanisms) for new developments near mass transit stations, provided they do not increase vulnerability to climate hazards.
- Reduce (or eliminate) single-family residential zoning to allow for appropriate multi-family development.
- Establish mixed-use zones along all major corridors and provide public amenities (e.g., schools) at the neighbourhood level, to reduce distance travelled.
- Eliminate parking minimums to disincentivise private vehicle use and increase development feasibility (e.g., integrate maximum parking standards where appropriate).
- Upgrade informal neighbourhoods that are vulnerable to climate hazards by providing public infrastructure and services (including transit).
- Reduce climate vulnerability of informal settlements where possible and locally resettle communities that are too vulnerable to climate hazards.
- Amend land use plan/zoning code to promote requalification instead of demolition/reconstruction.

Actions to avoid

- Increase transit capacity (e.g., through constructing new lines or increasing frequency of service) without corresponding land use changes to spur density around transit stations.
- Encourage development on land vulnerable to climate hazards.
- Strict single-family zoning preventing denser and/or mixed-use development.
- Informal settlement removal: In some cases, resettlement may be necessary given that the informal neighbourhood lies on land highly vulnerable to climate risks. However, removal should be avoided, and the community should be resettled as close as possible to the original location.

"Unregulated urban expansion can also increase vulnerability to climate hazards. In addition to leading to poor sustainability and resilience outcomes, unregulated urban expansion carries a higher cost for municipalities, as public services and infrastructure are more expensive to provide in low density neighbourhoods, or as part of a slum upgrading programme. Conversely, planned urban expansion can reduce per capita GHG emissions and ensure that the city is more resilient to climate hazards."

Climate adaptation considerations for transport:

- **Flood**: Develop flood zones regulations and create car-free areas that will accommodate rainwater during floods.
- **Sea-level rise**: Avoid incentivising densification in areas prone to sea-level rise in the city.
- **Heat**: Develop green cover regulation and incentives, designing street grids with wind circulation in mind, sky view factor and shading regulations.

3. WASTE

Solid waste is often the third largest source of greenhouse gas emissions in cities after buildings and transport, and when poorly managed, can also be a major contributor to urban flooding, air pollution and poor public health. Urban waste generation is also growing rapidly, especially in global south cities, where it is expected to triple by 2050. Understanding the sources and impacts of GHG emissions from the waste sector is critical when developing an ambitious climate action plan for your city.

Waste disposal is responsible for roughly 5% of total greenhouse gas emissions, primarily from the methane released as food waste and other biodegradable matter (organics) decays in landfills and dumps. Methane is a short-lived GHG, 87 times more potent than CO_2 in the first 20 years after its release, which also has impacts on air quality. In cities where organics make up a higher proportion of municipal waste, waste emissions can reach between 10-15% of the overall city emissions. This is why action taken today to avoid organic waste disposal, by composting or anaerobic digestion, will produce big, near-term climate and operational benefits.

C40's Advancing Towards Zero Waste Declaration commits signatory cities to implement global best practice in terms of reducing waste generation and increasing diversion through better treatment, rather than disposing of waste in landfill or incinerators. These actions can help cities save money, protect the local environment, create jobs, build resilience, reduce emissions and support community development.

All cities can take steps towards a zero-waste future by focusing on five foundational areas of action:

"These actions can help cities save money, create jobs, build resilience, reduce emissions and support community development."

Foundational action areas:

- **Establish city-wide collection and safe disposal of all residual municipal solid waste generated in the city**: A sustainable waste management system requires that all the residual waste produced in the city is collected and safely disposed, that is, all the waste that cannot be recycled, composted or otherwise diverted for more beneficial utilization. Within GHG emission inventories, methane from landfill gas (LFG) contributes up to 97% of the emissions reported from the waste sector and uncollected waste is a significant contributor to decreased air quality and public health. The collection and disposal strategies provide the enabling foundation for a city to sustainably manage their waste.
- **Focus on reducing and treating food waste**: Food waste and organics disposed in dumpsites and landfills are the most direct source of GHG emissions from the waste sector (the other sources are scope three emissions associated with the production of the material and to a lesser extent, transportation of the waste, which is captured in transport emissions). Food and organic waste are often the main component of municipal waste, particularly in the Global South, and due to their high moisture content, are heavy to transport, expensive to dispose of and generate the largest share of operational expenses (their gradual decay is the main cause for leachate toxicity, structural shifting of landfills and LFG generation). Diverting organics at source will also keep the recyclable fraction cleaner, making it easier to process.
- **Boost recycling rates**: While the impacts of recycling may not be reflected immediately in a city's GHG inventory, a fundamental concept of improving waste management is the zero-waste hierarchy, the heart of which is the principle of minimisation and avoidance of waste. The waste hierarchy provides a framework for cities to maximise their reduction in greenhouse gas emissions from waste, recover materials from waste streams and redirect those resources recovered from landfill to the creation of new goods.

- **Be sceptical of sales pitches of solid waste incineration as a perfect solution to waste management challenges:** Often sold as a quick-fix, low carbon and sustainable way to generate revenue and produce energy while also managing waste, the reality is frequently quite different. Waste-to-energy, energy-from-waste, or the many other descriptive terms used for incineration is often much more expensive. Additionally, incineration is an inefficient energy source (particularly in high food waste cities), releases greenhouse gases and locks cities into generating and delivering high volumes of waste. To limit its environmental impacts, it requires strong environmental controls and expensive exhaust and bottom-ash management. The need for constant waste inputs dis-incentivises recycling and other waste reduction and diversion efforts.
- **Finance these activities**: Running a sustainable waste system costs money and developing waste management infrastructure is a capital-intensive process. It is vital that cities figure out ways to pay for the capital costs of building waste management infrastructure and also account for the operating expenses to successfully run it. An important enabling action that cities should take is to decouple the costs of planning and operating the waste system from the overall city budget, as this allows for a more sustainable operation and mid- and long-term planning. This is called moving towards an "enterprise" system. Cities can include user fees in existing bills (e.g., property, water or electricity bills) in order to reduce the operational challenges of generating new billing mechanisms for waste.
- **Reduce waste generation and encourage a circular economy**: In addition to fundamental waste management activities, one approach that cities can take is to take actions to reduce the generation of waste. This is a key component of the Advancing Towards Zero Waste Declaration. Consumer goods contain emissions embedded throughout their lifespan, through resource extraction, manufacturing, shipping, packaging, discarding, treatment and disposal. Thus, cities should take a strategic approach to reap even more benefits – avoiding, minimising, recovering, and treating waste, in a more integrated approach to manage material resources and advancing towards a more circular economy rather than focusing only on disposing waste in landfill or incinerators.

STRATEGIES

High impact

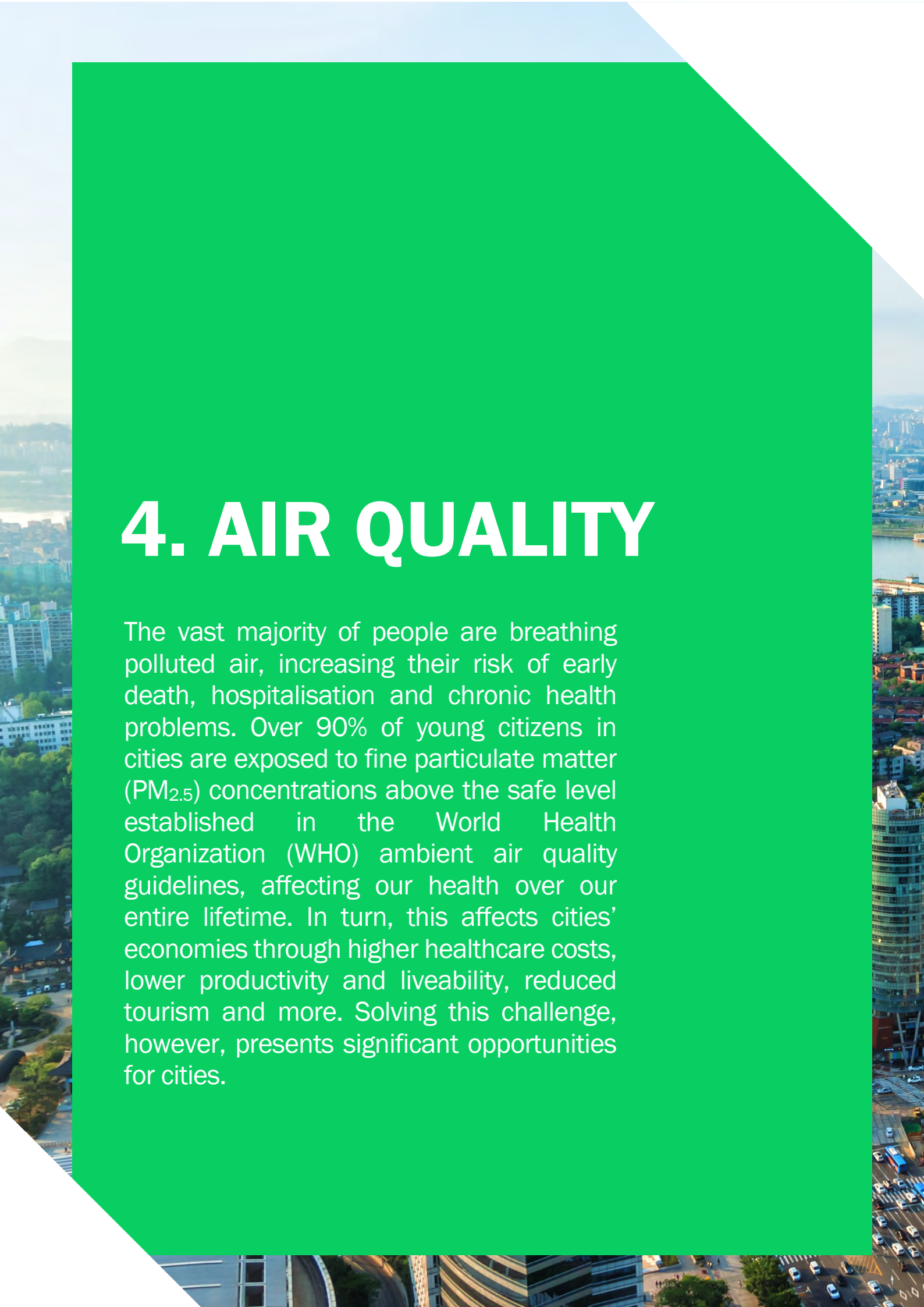
- Develop city-wide collection infrastructure, transfer systems and operational arrangements, targeting universal waste collection.
- Work in partnership with the informal sector to develop a strategy to formalise and improve working conditions for waste pickers.
- Establish requirements for source segregation (recyclables, food waste, residuals) of waste by large waste producers (e.g., markets or industrial sites).
- Ensure, at a minimum, waste is disposed in a sanitary landfill, with entrance weight bridges, an impermeable bottom layer, leachate management, periodic daily cover and gas management. Ideally, cities should utilise landfill gas to produce energy.
- Perform regular waste composition analysis to determine the amount of food waste and other streams generated in the city, in order to identify waste sources and characteristics.
- To start diverting food waste, target largest producers first and progress towards universal segregated collection.
- Use composting and/or anaerobic digestion to produce compost, bio-gas, heat, bio-fertilisers and other products.
- Make recycling services easy to use by: implementing door-to-door collection and/or drop-off schemes; using convenient, single-stream bins; and maximising the number of accepted materials.
- Restrict or ban non-recyclable materials and single-use items in the city, like single use plastic bags.
- Develop clear and targeted communications campaigns to ensure easy access to information on what can be recycled. Use positive and engaging messages that will resonate with citizens (e.g., cost savings, sustainability and job creation).
- Establish volume based collection fees (such as pay-as-you-throw waste fees) or incentives to encourage users to generate less waste.
- With fundamentals addressed, a next step is to make source segregation mandatory. Establish incentives for participation to minimise waste that is not recyclable or compostable. For example, charge less to collect organics and recyclables than residual waste, and provide smaller bins for residual waste.

Actions to avoid

- Investing in incineration infrastructure as a disposal solution, including 'Waste to Energy', as it is not a sustainable or low-carbon solution. It often has high maintenance and operating costs, frequently locking-in the city in to guarantee high amounts of waste, disincentivising more sustainable solutions.
- Waste management solutions that have not considered investment costs (Capital Expenditure) and operational costs (Operating Expenditure), as well as not accounting the avoided costs (extending life of landfill, costs of finding new sites, loss of value, political costs).
- Quickly entering into long term contracts with the private sector on new waste infrastructure. Cities often look to incorporate the private sector and establish Public-Private Partnerships (PPP) to develop waste infrastructure. Too frequently, cities expect that technology providers can recover their investment through the sale of by-products, when in reality, the main revenue source for most waste facilities is the gate fees per tonne of waste treated.
- Granting concessions that rely on high amounts of waste. Where possible, avoid granting concession(s) for landfill management tied to LFG utilization (and as noted above – waste to energy inputs). Because implementing alternative solutions that divert organics from the landfill will reduce the revenue from tipping fees (also reducing the amount of LFG produced), this can lead to conflict between the concessionaire and the city.

Climate adaptation considerations for waste

- **Flood/coastal flood**: Universal waste collection – particularly of plastic bags - can help minimise flooding by preventing waste from blocking drainage systems. Cities should further ensure waste disposal sites and storage areas are not in locations prone to flooding and efforts must be taken to protect landfills from future sea level rise impact.
- **Heat**: Adjust waste collection times during heatwaves, promote home composting of organic waste to avoid odours and pests, and implement workers protection in heat events.
- **Extreme weather events**: Adjust waste collection times/routes and ensure landfill leachate collection systems have enough capacity for heavy rainfall.
- **Drought**: Implement fire-safety structures for landfills.



4. AIR QUALITY

The vast majority of people are breathing polluted air, increasing their risk of early death, hospitalisation and chronic health problems. Over 90% of young citizens in cities are exposed to fine particulate matter ($PM_{2.5}$) concentrations above the safe level established in the World Health Organization (WHO) ambient air quality guidelines, affecting our health over our entire lifetime. In turn, this affects cities' economies through higher healthcare costs, lower productivity and liveability, reduced tourism and more. Solving this challenge, however, presents significant opportunities for cities.

Many sources of CO_2 also produce health-harming air pollutants. Climate action that limits emissions from these sources can also reduce air pollution and associated health and economic impacts, even though CO_2 itself is not harmful to human health (except at very high concentrations). Common sources that produce both GHGs and air pollutants in cities are road traffic (particularly diesel vehicles), building energy use (e.g., cooking and heating with wood and coal) and industry (e.g., fossil fuel-powered heavy machinery and brick kilns).

As many of the sources of air pollution are also sources of GHG emissions, targeted action to address both challenges can bring rapid, local health benefits as well as longer-term, global climate benefits. These health benefits outweigh the cost of control. The health benefits from air pollution improvements associated with the Paris Agreement targets are estimated to be 45% to 145% higher than the costs of the interventions, demonstrating a substantial return on investment even without accounting for reduced climate-related damages.

Cities can target these pollutants by:

- Reducing emissions from vehicle traffic by enabling a shift from private vehicles to public transport, walking and cycling; by shifting remaining vehicles to electric; and by reducing allowable fuel sulphur content. In particular, cities can support increased efficiency and electrification of freight vehicles, municipal fleets, and buses, which are major sources of traffic emissions over which cities often have more control.
- Supporting a shift to cleaner cooking, in particular by replacing household cookstoves (fuelled by kerosene, coal and biomass) with more efficient models that use clean fuels – ideally electricity, if affordable and reliable electric connections are possible; otherwise LPG, ethanol and biogas, which create significantly less pollution in the home than cooking with wood or coal.
- Banning or limiting household combustion of solid fuels (e.g. wood and coal, for household heating) especially in fireplaces and older woodstoves.
- Shifting electricity production within and around the city to cleaner and more efficient sources and technologies, including increasing the use of building-scale technologies such as solar photovoltaic systems.
- Reducing emissions from municipal sewage and solid waste by collecting, safely disposing of and treating waste. This includes collecting waste to reduce open burning, treating food and organic waste (which otherwise produces methane), and treating recyclable waste. Avoid incinerating waste.
- Improving building energy efficiency to reduce energy demand, through existing building retrofits and high standards for new buildings. This helps to reduce air pollution from power plants or from fuel combustion for district heating, for example.
- Designing procurement and permitting processes to ensure that best available technologies and practices are used in construction operations.
- Procuring only zero emission construction machinery and vehicles, requiring zero emission construction sites city-wide by 2030; as transitioning to electric (renewable-powered) machinery and equipment will address both GHG emissions and air pollution associated with construction sites.
- Eliminating the use of solid fuels or high sulphur liquid fuels for home heating, by using a combination of local regulation and incentive programs to shift to electricity and cleaner fuels for home heating.
- Reducing emissions from industrial sources of pollution by setting and enforcing industrial emissions standards, to ensure best available technologies and control technologies are in place and being used.
- Investing in air quality monitoring equipment, creating air pollution emission inventories, and doing source apportionment studies; to better understand the scale of the problem, which pollutants are most problematic, and which sources can be targeted to clean the air.
- Creating city and regional air quality management plans, working with neighbouring cities and regional agencies, to reduce air pollution sources that are located outside of the city (or the city's control) but that contribute to air pollution within the city.

The C40 Clean Air Cities Declaration recognises clean air as a human right and commits signatory cities to work together towards meeting the WHO air quality guidelines. These cities will establish baseline air quality levels and set ambitious reduction targets within two years of endorsing the declaration, begin implementing new policies and programmes to address their top sources of air pollution by 2025, and ensure the robust foundations of effective air quality management exist within their cities.

STRATEGIES

High impact

- Expand air quality management tools to support effective policymaking (e.g., monitoring systems, inventories, modelling, public health tools).
- Create a low emission zone (LEZ), ultra-low emission zone (ULEZ), or zero emission area in the city centre.
- Develop and enforce stricter vehicle emissions standards.
- Amend vehicle fuel standards in order to reduce sulphur content.
- Provide or enable affordable, reliable access to clean cooking fuels (such as electricity, ethanol, and LPG).
- Reduce (or where possible, ban) the use of solid fuels for household heating and cooking.
- Provide or enable access to electricity / solar lighting, to discourage use of kerosene for lighting.
- Ensure that all waste is collected and safely disposed of, to reduce open burning and open dumping.
- Reduce (or where possible, ban) open burning of solid fuel and/or solid waste.
- Invest in expanding public transit / cleaner public transit.
- Increase bicycle or pedestrian-protecting infrastructure within the city.
- Switch boilers, including industrial boilers, to electricity instead of liquid fuels and coal.
- Use facility permitting authority to limit air pollutant emissions from industrial facilities.
- Design permitting and procurement processes to limit air pollutant emissions from industry, construction, and other relevant sectors.

Actions to avoid

- Avoid increasing the use of diesel generators ("gen sets") as these have high emission factors for air pollutants (including $PM_{2.5}$) and are often located close to people so have a high intake fraction (as opposed to power stations, which may be further away).
- Avoid increasing demand for coal-fired electricity generation, as this can result in increased emissions of pollutants such as $PM_{2.5}$, if they are not controlled at the source.
- Avoid increasing combustion of biomass (including wood) or other solid fuels - this includes avoiding combustion of biomass for space heating.
- Avoid combustion of biomass (e.g., wood or pellets) for electricity generation. Given that biomass has a lower energy content than other fuels, there are significant transportation emissions associated with transfer of the fuel to power stations. Often, biomass used for power generation is not sustainably harvested, which can lead to a loss of soil carbon and have negative consequences for biodiversity. In addition, there is a lag between the time when biomass is harvested and the time by which planted trees will have grown enough to sequester the equivalent amount of carbon.

Climate adaptation consideration for air quality:

- Consider integrating the collection of climatic metrics (e.g., temperature/heat, precipitation) into air quality monitoring stations.

5. ADAPTATION

The consequences of climate change are already posing an existential threat worldwide with over 98% of C40 cities reporting that they have faced severe climate threats that have jeopardised their economic and social prosperity. This includes longer and intense heat waves, exacerbated inland flooding from heavy downpours, water shortage due to drought and extended coastal flooding due to sea-level rise and storms such as hurricanes and monsoons.

Many C40 cities have declared climate emergencies as their citizens sound the alarm on climate impacts felt much in advance of what was anticipated. Given the trajectory to date, climate impacts are expected to become increasingly more severe in the future, and even if cities are able to curb greenhouse gas emissions to Paris Agreement targets, they will have already transitioned to a new climate norm that requires significant adaptation across the board. Cities must lead the way to a climate-prepared future, building in systems change thinking which marries adaptation with mitigation to allow for inclusion, climate justice and climate forward economies.

Adaptation is a climate justice issue. Those most affected by extreme weather events (in both Global North and South cities), did not necessarily contribute towards the climate crisis. The solutions will vary across cities and will challenge city governments, their residents and local stakeholders to be innovative. Adaptation decision-making within cities must consider processes beyond the city boundaries (e.g., resource scarcity, economic flows and potential disease vectors) as these are inter-linked with city processes and also have a direct impact on the city.

STRATEGIES

High impact

- Protect citizens and infrastructure from key climate hazards faced within each city.
- Establish forecasting, monitoring and early warning systems for climate hazards.
- Develop a crisis and disaster management system.
- Conduct flood & heat (vulnerability) mapping to target adaptation actions for the most vulnerable areas and population within the city.
- Design and construct hazard resistant infrastructure (e.g., heat, flood, landslide, drought and wildfire resistant).
- Implement Nature-Based solutions to address multiple climate hazards and leverage co-benefits.
- Upgrade informal settlements to reduce vulnerability.
- Collaborate between municipal departments (e.g., Water, Health, Greening, Public Works, etc.) for the implementation of adaptation actions.

Actions to avoid

- Investing in infrastructure and real estate that is located in flood prone areas (e.g., coastal or inland) may result in economic losses and lives at risk in extreme climate events.
- Extensive sealing of soil which prevents water from natural infiltration.
- Increasing dark surfaces on roads and buildings which absorb heat and exacerbate the Urban Heat Island Effect.
- Implementing adaptation actions (e.g. green infrastructure) only in central and/or affluent neighbourhoods.
- Wasting water through pipe leakages or excessive consumption in drought-prone areas/seasons.
- Removing urban green areas, that act as natural water drainage and have a cooling effect, for other land use pressures.