

# NDC AMBITION HANDBOOK:

## Learning from city success to raise national ambition





# WHAT IS C40?

C40 is a network of mayors of nearly 100 world-leading cities collaborating to deliver the urgent action needed right now to confront the climate crisis. Together, we can create a future where everyone, everywhere can thrive.

C40 member cities earn their membership through action. C40's most distinguishing feature is that it operates on performance-based requirements, not membership fees. C40's [Leadership Standards](#) set the minimum requirements for all member cities and ensure the integrity of C40 as a network of climate leaders. To maintain C40 Membership, C40 cities are required to develop a [Climate Action Plan \(CAP\)](#) that has the level of ambition and action needed to play their part in meeting the objectives of the Paris Agreement and stay with 1.5°C.

Cities are leading the way in the fight against climate change. Currently, 62 C40 cities have a 1.5°C-aligned Climate Action Plan in place. As of October 2022, none of the Nationally Determined Contributions (NDC) to the UNFCCC analysed by Climate Action Tracker are 1.5°C compatible, with only 9 of the 38 NDCs analysed considered to be “almost sufficient.”<sup>1</sup> C40 Cities' Climate Action Plans can serve as a foundation for countries to accelerate their ambitions by incorporating practical, high impact actions into their NDCs. This handbook sets out the high impact climate actions that can be included in NDCs to tackle emissions from the highest emitting sectors. These actions are already being implemented in a large number of global megacities, demonstrating that they are practical, achievable and can deliver wide benefits. This handbook also sets out the strategies to avoid that, if pursued, would lead to increased greenhouse gas emissions and / or CO<sub>2</sub> lock-in for decades to come.



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<sup>1</sup> Climate Action Tracker (2022) [Countries Overview](#).



## C40 CITIES WITH 1.5°C COMPATIBLE CAPS

<b>Abidjan</b>	<b>Quezon City</b>	<b>Rotterdam</b>	<b>Los Angeles</b>
<b>Accra</b>	<b>Seoul</b>	<b>Stockholm</b>	<b>Montréal</b>
<b>Addis Ababa</b>	<b>Sydney</b>	<b>Bogotá</b>	<b>New Orleans</b>
<b>Cape Town</b>	<b>Tokyo</b>	<b>Buenos Aires</b>	<b>New York City</b>
<b>Dakar</b>	<b>Amsterdam</b>	<b>Ciudad de México</b>	<b>Philadelphia</b>
<b>Dar es Salaam</b>	<b>Athens</b>	<b>Curitiba</b>	<b>Portland</b>
<b>Durban (eThekweni)</b>	<b>Barcelona</b>	<b>Guadalajara</b>	<b>San Francisco</b>
<b>Johannesburg</b>	<b>Berlin</b>	<b>Lima</b>	<b>Seattle</b>
<b>Lagos</b>	<b>Copenhagen</b>	<b>Medellín</b>	<b>Toronto</b>
<b>Nairobi</b>	<b>Istanbul</b>	<b>Quito</b>	<b>Vancouver</b>
<b>Tshwane</b>	<b>Lisbon</b>	<b>Rio de Janeiro</b>	<b>Washington, DC</b>
<b>Auckland</b>	<b>London</b>	<b>Salvador</b>	<b>Phoenix</b>
<b>Hanoi</b>	<b>Madrid</b>	<b>São Paulo</b>	<b>Miami</b>
<b>Jakarta</b>	<b>Milan</b>	<b>Austin</b>	<b>Mumbai</b>
<b>Kuala Lumpur</b>	<b>Oslo</b>	<b>Boston</b>	
<b>Melbourne</b>	<b>Paris</b>	<b>Houston</b>	

# HOW TO USE THE HANDBOOK

To achieve the 1.5°C target, the Paris agreement called on all countries to strengthen their Nationally Determined Contributions every five years. In 2021, the Glasgow Climate Pact challenged countries to ratchet up their commitments in 2022.

This C40 NDC Ambition Handbook can be utilised by countries during the NDC development phase, to identify the most impactful actions that should be implemented across sectors including energy, transport, buildings, waste, construction and urban planning. Countries can use this as inspiration when selecting, prioritising and defining actions to input into their NDC.

The playbook is structured by sector and details the importance of sectoral action inclusion within an NDC. For each sector, we include:

- High Impact Actions – those that will have the biggest impact on reducing greenhouse gas emissions
- Strategies to Avoid
- Key Adaptation Considerations

## Why Adaptation?

Adaptation is a question of climate justice. Climate impacts are expected to become more severe and frequent in the future, even if countries are able to curb greenhouse gas emissions to align with the Paris Agreement targets. Those most affected by extreme weather events are the ones who have contributed the least towards the climate crisis.

## Transformative City Adaptation Action

Over the past 30 years the deterioration of the riverine floodplain areas have resulted in escalating costs for the city, businesses and residents in **Durban (eThekweni)**. To protect the city from future climate impacts, Durban has restored sections of the Aller River, with a focus of flooding mitigation by restoring the floodplain areas, removing invasive species and introducing proper waste management.

Local communities have been employed to remove invasive alien plants and to clean litter from the streams. The project also resulted in the creation of eco-champs to build awareness and increase capacity for river stewardship, monitoring and reporting within the community.

The programme will be expanded over a 20-year period, to recover around 7,400 km of rivers at a cost of USD \$500 million. It will yield USD \$130 million of savings in damages to municipal infrastructure and up to USD \$1.6 billion in societal benefits, as well as over 9,000 permanent jobs.<sup>2</sup>

<sup>2</sup> C40 Cities Finance Facility and GIZ (2021). [Business Case for Durban's Transformative Riverine Management Programme](#).





## SECTORAL AREAS

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## BUILDINGS

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Energy use in buildings accounts for 30% of global final energy consumption and 27% of energy related CO<sub>2</sub> emissions, and is also a significant source of air pollution. By 2060, the world is projected to add 230 billion m<sup>2</sup> of buildings, or an area equal to the entire current global building stock. Meanwhile, 70% of today's buildings in the developed world are likely to still be standing in 2050.<sup>3</sup>

Energy efficient buildings improve health, are more comfortable, create jobs, reduce energy poverty, increase climate resilience, reduce pressures on energy infrastructure, and reduce greenhouse gas emissions.

### Transformative City Action

In **New York City**, buildings are responsible for nearly 70% of the city's carbon emissions, with the largest buildings responsible for approximately half of those emissions. Local Law 97,<sup>4</sup> introduced in 2019, is one of the most ambitious plans for reducing emissions from buildings. It targets most buildings over 25,000 square feet, which will be required to meet new energy efficiency and greenhouse gas emissions limits by 2024, with stricter limits coming into effect in 2030. The law cuts nearly 6 million tonnes of CO<sub>2</sub> equivalent emissions from large buildings (equal to removing 1.3 million cars from road), creates 26,700 well-paid green jobs and has resulted in the formation of an entirely new market for skilled and union labour – securing a just transition for all workers.

<sup>3</sup> C40 (2022) [Net Zero Carbon Buildings Declaration Report](#).

<sup>4</sup> City of New York (2022) [Local Law 97](#).



# BUILDINGS

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## High Impact Actions

- ✓ Government commitment to ensure all buildings that they own, occupy or develop, are net zero carbon.
- ✓ For new buildings, consider both operational and embodied emissions from the earliest stages of building design in legislation and regulations to reduce emissions over the building's lifespan. Prioritise energy demand reduction and minimising the embodied carbon in materials used.
- ✓ Implement mandatory building codes to improve building energy efficiency with energy use requirements that become progressively more stringent over time.
- ✓ Develop a net zero carbon buildings pathway for new and existing buildings (both operational and embodied emissions). Detail interim pathway milestones (e.g., existing building performance standards and updates to regulations for new buildings) and include a monitoring and evaluation system to track progress towards net zero carbon.
- ✓ Develop extensive education material, advice, in-depth support and incentives, including finance, for stakeholders to meet and exceed building decarbonisation requirements.
- ✓ Prioritise the use of existing building stock (by retrofitting and renovating) 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 or existing buildings without providing mandatory codes or a clear timeline for revising and strengthening the current building code.
- ✗ Using fossil gas as a transition fuel for heating, cooling and hot water without long-term planning for how to decarbonise the building sector. Although fossil gas produces less 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 emissions lock-in.

## Adaptation Considerations

- **Flood and sea-level rise:** Avoid new developments in flood risk areas and relocate or protect critical infrastructure above the flood level. Ensure that the flood protection of buildings does not transfer the flood risk (rain or riverine) to other areas.
- **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.





To put the world on track to limiting the global temperature rise below 1.5°C it is essential to significantly reduce emissions from energy through phasing out unabated fossil fuels by 2050 and investing in clean, dynamic, affordable and resilient energy systems. Transitioning to clean energy with a mix of local decentralised generation will not only help in mitigating the effects of climate change, but also lead to additional benefits including: improved air quality; creation of new green jobs; improved energy security and energy access; increased resilience of the energy systems to storms, floods and other climatic hazards; reduced energy prices and improved standard of living.

#### Transformative City Action

**Seoul** is deploying domestic solar PV panels to 1 million households and making solar PV systems mandatory for public buildings, while expanding citizen participation in solar energy generation. Savings made in the public buildings were passed back to the programme to support energy efficiency measures in low-income households - up to US \$180,000 in the initial years.<sup>5</sup>

<sup>5</sup> C40 (2022) [Cities100: Seoul's Solar City powers a cleaner, greener and more equitable future.](#)



## High Impact Actions

- ✓ Develop clear commitments towards a net zero energy system, dominated by renewable energy.
- ✓ Lead by example. Deploy distributed renewable energy to government owned assets. This can help to raise awareness and confidence in these technologies, build capacity and demonstrate the business case for renewable energy solutions.
- ✓ Promote innovation for decarbonizing heating and cooling for buildings. Invest in uptake of new technologies such as heat pumps, renewable energy powered district energy systems, co-generation etc.
- ✓ Develop extensive education material, advice, in-depth support and incentives, including finance, for stakeholders (local governments, industries etc.) to meet zero carbon energy requirements.
- ✓ Promote and incentivize large scale clean energy generation.
- ✓ Promote small scale renewable energy generation and identify and implement new financing approaches to boost the market uptake.
- ✓ Introduce and implement renewable energy powered mini/micro-grids in areas where the main grid is overburdened, or hard-to-reach areas ensuring last mile connectivity.
- ✓ Take the solar opportunity. Solar photovoltaic (PV) systems can now offer the cheapest energy in history.
- ✓ Support the transition to clean cooking fuels. 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. 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, plan for electrification with a low carbon grid mix and/or contextualised renewable energy solutions in the long-term.

## Actions to Avoid

- ✗ Investing in new coal-fired power plants and other solid fossil-fuel based energy generation;
- ✗ Fossil gas as a transition fuel. Despite the fact that it produces less GHG emissions per unit of energy in comparison to coal, it still is a powerful CO<sub>2</sub> emitter. Investing in fossil gas can lock-in GHG emissions for decades; Avoid building new energy infrastructure in natural disaster-prone areas.
- ✗ 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).

## Adaptation Considerations

- **Flood and sea-level rise: Coastal flood:** Avoid new clean energy infrastructure in flood risk areas and protect clean energy infrastructure from storm surge and sea level rise.
- **Storm:** Investment in building-scale renewable energy systems contribute to reducing GHG emissions, while at the same time ensuring 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.





## CLEAN CONSTRUCTION

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The construction sector is responsible for more than 23% of global greenhouse gas emissions and consumes more than 30% of all extracted resources. Continuing business-as-usual in this sector, which relies on carbon-intensive machinery and materials, threatens to put the world on a fast track towards a global temperature rise of 3°C or more.<sup>6</sup>

### Transformative City Action

**Vancouver** instituted an Empty Homes Tax<sup>7</sup> to help return empty and under-utilised properties to the market as long-term rental homes for people who live and work in Vancouver. The tax has reduced vacant properties in the city by 25% since 2017, helping move thousands of homes back into the rental market. The CAD \$61 million (USD \$48 million) in net revenue from the tax has been used to support affordable housing initiatives. This is one of many actions that make up the city's 10-year Housing Vancouver Strategy. On top of its inclusive impact, this action is critical to avoid emissions by repurposing existing assets instead of building new ones.

<sup>6</sup> C40 (2022) [Clean Construction Accelerator](#).

<sup>7</sup> City of Vancouver (2022) [Empty Homes Tax](#).





# CLEAN CONSTRUCTION

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## High Impact Actions

- ✓ Prioritise the better use, repurposing, and retrofit of existing building stock and infrastructure to ensure optimal use before new construction projects are considered.
- ✓ Lead by example with public procurement by requiring low carbon materials, life cycle assessments and the diversion of construction and demolition waste from disposal for all government projects. Use public purchasing power to procure or demand zero emission construction machinery in all government projects.
- ✓ Reward resource efficient and circular design, use of low carbon materials, and low to zero waste construction sites for all new projects and major retrofit.
- ✓ Demand transparency and accountability, by requiring life cycle assessments in planning permissions and embedding them into planning policies, processes and building codes. Require the public disclosure of this data to facilitate greater transparency and foster accountability to develop robust baselines, standards, certifications and policies.
- ✓ Work with businesses, industry, public institutions, citizens, workers, social partners and other organisations to establish a joint roadmap adhering to circular economy principles.

## Actions to Avoid

- ✗ Investing in infrastructure programmes fuelling business as usual processes that have high volumes of concrete that are damaging for people, communities and the planet.
- ✗ Investing in fossil fuel powered construction machinery or construction transportation that contributes to high emission and high air and noise pollution and health-related issues.
- ✗ Taxing maintenance, renovation and retrofit of existing buildings more than new buildings.

## Adaptation Considerations

- Prioritise green and blue infrastructure, especially nature-based solutions, in planning, building and infrastructure regulations.
- Assess the impact the choice of materials and construction design have on our country's overall resilience to climate impacts (i.e., increasing urban heat island, heat stress, impermeable surface increasing the risk of flooding, etc.).





# TRANSPORT

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Transport is responsible for one fifth of CO<sub>2</sub> emissions globally, with nearly three quarters of emissions in the sector coming from road-based transport. To achieve the 1.5°C target, the World Resources Institute (WRI) has indicated that the world needs to decrease the share of motor vehicle km travelled by between 4% and 14% compared to a business-as-usual scenario by 2030.<sup>8</sup>

The **Avoid - Shift - Improve Framework**<sup>9</sup> provides a basis for transport planning:

- Avoid or reduce the number and distance of transport trips through compact and connected urban planning.
- Shift private vehicle trips to public transport, cycling or walking.
- Improve the efficiency of vehicle fleets through electrification, with a particular focus on public transport and freight vehicles.
- Where possible, ensure these principles are followed for areas of transport, and provide adequate guidance, enabling regulation, and funding where responsibility is devolved to regions and cities.

## Transformative City Action

Through public transport expansion and the integration of informal transit, **Jakarta** has more than doubled its public transport coverage in the last 5 years. The city has gone from the 4th most congested city in the world in 2017, to the 46th in 2021.<sup>10</sup> The JakLingko card has reduced the cost of travel for residents from around 30% of income to 10%.<sup>10</sup> Integrating the informal sector has improved employee welfare, with drivers paid per km rather than relying solely on passenger fares, and maintenance costs being borne by the city government.

<sup>8</sup> C40 (2022) World Resources Institute (2022) [3 Ways to Reimagine Public Transport for People and the Climate](#).

<sup>9</sup> GIZ (2019) [Sustainable Urban Transport: Avoid-Shift-Improve \(A-S-I\)](#).

<sup>10</sup> TomTom (2022) [TomTom Traffic Index - Ranking 2021](#).

<sup>11</sup> C40 (2022) [C40 Green and Healthy Streets Declaration](#).



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# TRANSPORT

## High Impact Actions

- ✓ Set ambitious targets to increase the modal share of walking, cycling and mass transit and quantitative targets for reducing vehicle travel, with specific, measurable and time-bound actions for compact development, disincentives for private car use and improving environments for walking and cycling.
- ✓ Provide cities with the powers to implement restrictions (e.g. charges or bans) on high polluting vehicles in urban areas.
- ✓ Provide safe, equitable, convenient and accessible infrastructure for pedestrians and cyclists as well as funding to cities and regional governments to deliver this.
- ✓ Develop accessible, reliable, frequent, affordable and well-integrated zero emission mass transit systems (e.g. a well-connected national rail system) and ensure funding is provided for expansion, improvement and ongoing operational support at both the national and local levels.
- ✓ Set an ambitious national target date to end sales and imports of internal-combustion vehicles.
- ✓ Commit to 100% electrification of government fleets, bus fleets and rail infrastructure as soon as possible.
- ✓ Ensure specific measures to help reduce emissions from the informal transport sector, where appropriate, are included, for example: electrification of vehicles and working with sector to complement more formal public transport systems.
- ✓ Help provide infrastructure (e.g. charge points) and appropriate incentives for a wider roll out of electric vehicles.
- ✓ Incentivise the transition towards zero emission freight and reduce overall freight mileage. Reduce overall freight mileage through shared procurement and consolidation, shifting some freight to rail, waterways and cargo bikes, and retiming of freight deliveries to avoid the busiest periods.
- ✓ Incentivize production and/or importation of zero-emission vehicles.





# TRANSPORT

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## 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<sub>2</sub> issues. However, CNG and LNG are less energy efficient than diesel and have higher CO<sub>2</sub> per km emissions than diesel equivalents. Whilst CNG and LNG fuels produce fewer NO<sub>x</sub> and PM emissions than older diesel vehicles, at the latest emissions standards they now produce the same, or higher levels of NO<sub>x</sub>.
- ✗ **Biofuels:** Where possible, avoid the use of biofuels for transport. 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 decarbonise (e.g., aviation and shipping), we would not recommend further uptake as a climate action in the short-term.

## Adaptation Considerations

- **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 seawalls 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.).



# URBAN PLANNING AND DESIGN

Unregulated, or badly planned urban expansion and regeneration, can lead to greenhouse gas emissions lock-in (e.g., car-dependency, low density development), high embodied greenhouse gas emissions and/or degraded equity outcomes (e.g., slum development), as well as increase vulnerability to climate hazards (e.g., expansion in areas that are prone to flooding or suffering from the urban heat island effect).

The latest IPCC report highlights the importance of integrated urban planning to reduce emissions. The report states that achieving compact and resource-efficient urban growth through location of higher residential and job densities, mixed land use, and transit-oriented development could reduce greenhouse gas emissions between 23-26% by 2050 compared to the business-as-usual scenario.<sup>12</sup>

## Transformative City Action

**Paris** is leading the way on making the “15 minute city” model a reality to reduce emissions, and create more resilient and thriving communities by implementing a long list of actions,<sup>13</sup> including:

- Creating new green and playful public spaces by opening schoolyards and school streets to people. Paris is greening schoolyards (and opening them outside of school hours) and pedestrianising streets near schools. 168 projects have already been implemented.
- Making a cool island or walkway accessible to all residents within a 7 minute walk.
- Eliminating 50% of the city's parking spaces by 2026. This will free up to 130 hectares for new green spaces, bike lanes, café terraces and playgrounds.
- Supporting local shops in underserved neighbourhoods to help them thrive - Paris has already purchased 650 abandoned shops, and is letting them out at below-market rates to prioritise local businesses.

<sup>12</sup> IPCC (2022) [Climate Change 2022: Mitigation of Climate Change](#).

<sup>13</sup> C40 (2022) [How to build back better with a 15-minute city](#).



## High Impact Actions

- ✓ Define a minimum of density to make infrastructure and services viable, foster active travel, as well as to reduce embodied and operational emissions from buildings.
- ✓ Reduce (or eliminate) single-family residential zoning to allow for appropriate multi-family development.
- ✓ Develop residential infill policies and projects to redensify low-density neighbourhoods. Set taxation policies to tackle buildings vacancy and under-occupation.
- ✓ Ensure a mix of uses for and allocate land use for key services, facilities and amenities within each neighbourhood. This reduces the need for travel while improving local life.
- ✓ Set protective measures and/or tax and permit incentives to promote adaptive reuse instead of demolition / reconstruction.
- ✓ Upgrade informal neighbourhoods by providing and increasing access to public infrastructure and services (including transit).
- ✓ Maximise the amount of residential, business and leisure space within walking distance of public transport. For example, set ambitious targets for the percentage of people who have access to frequent mass transit within 500 metres.
- ✓ Eliminate parking minimums to disincentivise private vehicle use and increase development feasibility (e.g., integrate maximum parking standards where appropriate).

## Actions to Avoid

- ✗ Strict single-family zoning preventing denser and/or mixed-use development pattern.
- ✗ Increasing transit capacity (for example through constructing new lines or increasing frequency of service) without corresponding land use changes to spur density and mixed-use around transit stations.
- ✗ Encouraging development on land vulnerable to climate hazards.
- ✗ 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.

## Adaptation Considerations

- **Flood:** Develop flood zones regulations and create development-free areas that will accommodate rainwater during floods. Plan and allocate land use for sustainable drainage systems incl. rain gardens, ponds, swales etc. Include limitation of construction and protective measures in vulnerable areas. Conserve the protective attributes of natural habitat, such as riparian edge of rivers or mangroves along coastal edges.
- **Sea-level rise:** Avoid incentivising densification in areas prone to sea-level rise in urban areas.
- **Heat:** Develop green cover regulation and incentives, designing street grids with wind circulation in mind, sky view factor and shading regulations. Impose % of surface (sqm) with tree canopy/natural vegetation cover for all new or renovated public spaces over a certain size. Introduce local by-laws to ensure all roofs over a certain size implement green and cool roof appropriate to the building structure.



## WASTE

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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) decay in landfills.<sup>14</sup> Methane is a short-lived greenhouse gas; however, it is 87 times more potent than CO<sub>2</sub> in the first 20 years after its release.<sup>15</sup>

Food waste and organics disposed of in landfills are the most direct source of greenhouse gas emissions from the waste sector. Due to the high moisture content of organics, they are heavy to transport, expensive to dispose of and generate the largest share of operational expenses. Additionally, the gradual decay of food waste is the main cause for leachate toxicity, structural shifting of landfills and landfill gas generation.

### Transformative City Action

**São Paulo** is using small-scale composting to avoid methane emissions. São Paulo created composting patios across the city to treat up to 10 tons of organic waste from nearby fruit and vegetable markets each day. City workers support market stands to collect their segregated organic waste in specific bags. The bags are then collected by the municipality at the end of the day and transported a short distance to the closest composting patio, rather than being transported a greater distance to landfills where the organic waste would generate methane, lose value and waste nutrients. Between January and August of 2020, a total of 7,100 tons of organic waste was collected and treated, generating 1,400 tons of compost, which was then used as fertiliser in municipal parks.<sup>16</sup>

<sup>14</sup> CC40 (2022) [Waste Management](#).

<sup>15</sup> NASA Earth Observatory (2016) [Methane Matters](#).

<sup>16</sup> Cidade de São Paul (2021) [Resíduos Orgânicos Compostagem em São Paulo](#).





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### High Impact Actions

- ✓ Adopt an integrated approach to minimise, recover and treat waste to reduce emissions and develop a circular economy. Minimise and avoid waste through the zero-waste hierarchy: prevent, reduce, reuse, recycle, recover, and finally, dispose.
- ✓ Develop 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, utilise landfill gas to produce energy.
- ✓ 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.
- ✓ 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 low-carbon solution. It often has high maintenance and operating costs, frequently 'locking-in' the city as it guarantees high amounts of waste, disincentivising alternative sustainable solutions.
- ❌ Waste management solutions that have not considered investment costs (e.g., capital expenditure) and operational costs (e.g., operating expenditure), as well as not accounting the avoided costs (e.g., extending life of landfill, costs of finding new sites, loss of value or political costs).

### Adaptation Considerations

- **Flood/coastal flood:** Universal waste collection - particularly of plastic bags - can help minimise flooding by preventing waste from blocking drainage systems. 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.





## AIR QUALITY

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Many sources of CO<sub>2</sub> 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<sub>2</sub> itself is not harmful to human health (except at very high concentrations). Common sources that produce both greenhouse gas emissions and air pollutants 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).

### Transformative City Action

Four million **Londoners** living within the expanded Ultra-Low Emissions Zone (ULEZ) are now breathing cleaner air. Just 6 months after implementation of the ULEZ in 2022, NO<sub>2</sub> concentrations in inner London are estimated to be 20 per cent lower than they would have been without the ULEZ and its expansion. In central London, NO<sub>2</sub> concentrations are now estimated to be 44% lower, while the number of older, more polluting vehicles has fallen by 47,000 (a 37% reduction).

Significant health improvements have been delivered - a 94% reduction in the number of Londoners living with illegal levels of air pollution and a 97% reduction in the number of schools located in such areas.<sup>17</sup>

<sup>14</sup> CGreater London Authority (2022) [Millions of Londoners breathing cleaner air thanks to ULEZ expansion](#).

## High Impact Actions

- ✓ Expand air quality management tools to support effective policy making (e.g., monitoring systems, inventories, modelling, public health tools). This could include funding for hyperlocal monitoring programs, funding to identify pollution hotspots, and funding for programs to address air pollution exposure inequities.
- ✓ Set and strictly enforce health-based national ambient air quality standards, reflecting the 2022 World Health Organisation air quality guidelines.
- ✓ Create a national regulatory framework to encourage or mandate low emission zones, ultra-low emission zones and zero emission, especially in densely populated areas.
- ✓ Develop and enforce strict vehicle emissions standards.
- ✓ Update vehicle fuel standards to reduce sulphur content.
- ✓ Provide or enable access to electricity / solar lighting, to discourage use of kerosene for lighting.
- ✓ Reduce (or where possible, ban) open burning of solid fuel and / or solid waste.
- ✓ Invest in expanding public transit and increase bicycle or pedestrian-protecting infrastructure by investing in infrastructure projects that make active transit the mode of choice in cities.
- ✓ Incentivize zero emission transport, for example by providing financial incentives and rebates for purchasing electric bicycles and electric vehicles.
- ✓ 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.
- ✓ Incentivize purchase and installation of efficient, healthy, lower-emission appliances, such as heat pumps and induction stoves through national legislation that provides funding and programmatic assistance to local governments for implementation.

## Actions to Avoid

- ✗ Increasing the use of diesel generators as these have high emission factors for air pollutants (including PM<sub>2.5</sub>) and are often located close to people and therefore have a high intake fraction (as opposed to power stations, which may be further away).
- ✗ Increasing demand for coal-fired electricity generation, as this can result in increased emissions of pollutants such as PM<sub>2.5</sub> if they are not controlled at the source.
- ✗ Use of dirty liquid fuels, such as bunker fuel, for electricity generation.
- ✗ Combustion of biomass (e.g., wood or pellets) for electricity generation and space heating. 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.



