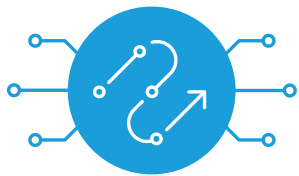




G20
Global
Smart Cities
Alliance

WORLD
ECONOMIC
FORUM



MODEL POLICY SUPPLEMENT

Adoption Playbook for Whole Life Carbon Assessment Mandates

Contents

1	About the Playbook	3
2	Why Should Governments Adopt the WLCA Policy?	4
3	Just Transition Principles	6
4	Frameworks and Tools for Adopting the Policy	8
5	Suggested Methodologies for Tracking Success	11
	Appendix	14
	A Guidance for Various Governance Structures	14
	B Communicating Value to Real Estate Investors	16
	C Example Policies	17
	D Launching a Carbon Tracking Pilot Programme	18
	Contributors	20
	Endnotes	22

Disclaimer

This document is published by the World Economic Forum as a contribution to a project, insight area or interaction. The findings, interpretations and conclusions expressed herein are a result of a collaborative process facilitated and endorsed by the World Economic Forum but whose results do not necessarily represent the views of the World Economic Forum, nor the entirety of its Members, Partners or other stakeholders.

© 2024 World Economic Forum. All rights reserved. No part of this publication may be reproduced or transmitted in any form or by any means, including photocopying and recording, or by any information storage and retrieval system.

1

About the Playbook

1.1

Purpose

This playbook supports the adoption of the G20 Global Smart Cities Alliance's [Whole Life Carbon Assessment \(WLCA\) model policy](#) by identifying the contextual nuances and providing guidance to overcome challenges and implement the policy. It also:

- Provides guidance regarding which stakeholders to involve to propagate the policy in relevant governance agencies.
- Provides guidance on the steps or mechanisms to enable easy adoption and to evaluate success after the policy is adopted:
 - Guidance resources on WLCA policy adoption
 - Relevant government levers/powers useful to implement the policy
 - Considerations cities should keep in mind for enforcement
 - Mechanisms and case studies for measuring success

1.2

Target audience

The playbook's target audience includes:

- *City officials:* The playbook is intended to help the following parties implement the WLCA policy successfully – mayors, chief resilience officers, chief sustainability officers, chief finance officers, principle environment policy officers, civic planners and engineers, building department officials.
- *National, state, provincial, or regional officials:* Depending on the governance structure, state or national officials may be involved or critical to implementing this policy.

To help assess your local governance structure to determine which parties to engage when adopting the WLCA policy, please see Appendix A: Guidance for Various Governance Structures.

The following are **NOT** the target audience of this playbook:

- *Private sector:* Real estate developers and construction engineering firms, industry participants from the value chain, banks, financiers and insurance companies. These parties are considered practitioners, for which a separate policy guidance document has been prepared, available on the [G20 Global Smart Cities Alliance site](#).
- *NGOs:* Local and international non-governmental organizations and their partners.

2

Why Should Governments Adopt the WLCA Policy?

2.1

Objectives

The objective of the playbook is to enable cities to require whole life carbon assessment (WLCA) for major developments¹ in the built environment. The data acquired through a WLCA enables precise and measurable goals, actions and trackable results. When implementing the policy, the city demonstrates a commitment to minimizing operational and embodied carbon for the ultimate goal of reaching net-zero carbon emissions. As a policy adopter, it is crucial to first assess if the goals of your city are aligned with the goal of this policy.

According to [3Keel's 2023 Retrofit Index Interim Report](#), in contrast to other G20 nations' downward trend, the United States' building-related emissions have increased by 3% from 2010 to 2020. The US is not on target to meet its own net-zero goal of 2050 unless it cuts emissions by 73%. Other European countries and the United Kingdom's greenhouse gas (GHG) reductions in buildings are also stalling, indicating that more is needed to reach net-zero goals.

All nations would benefit from the coordinating effects of a national retrofit plan, net-zero building performance standards, financial incentives and support, upskilling of the workforce and scaling up the sustainable supply chain, and promoting data transparency. In addition, federal, regional and local governments must collaborate to create stringent building standards and frameworks to encourage increased productivity, innovation and investment in the building sector, which is needed to meet national goals.

This model policy, which mandates whole life carbon assessments for buildings, will help governments take a crucial step towards measuring and mitigating GHG emissions in the building sector.

Implementing a policy that requires a WLCA enables the city to reduce the significant climate impact of the built environment sector. Construction accounts for a massive amount of emissions globally and will only continue to increase. Internationally, [60% of construction emissions](#) are associated with the production and delivery of building materials, mainly cement and steel. By 2050, the global urban population will have increased by 2.5 billion people. The world will build the equivalent of a city of more than 1.5 million people every week until 2050 to accommodate them.

Emissions reductions in the construction and renovation of buildings are critical in the fight against climate change. The first step in reducing emissions is understanding where they come from. WLCAs sum up the emissions of all building phases: from design and procurement through demolition. According to [The Embodied Carbon Review 2018](#), the number of certifications and regulations addressing embodied carbon in the construction sector has doubled in the last five years. The majority of these systems exist in Europe or North America, but are expanding throughout the world.

2.2

WLCA benefits to cities

Implementing the WLCA model policy offers numerous benefits to cities. It supports a framework to help cities achieve net-zero goals and collect data for future policy development (including Scope 2 and 3 emissions).

The WLCA model policy – in addition to a practitioners' guide and this adoption playbook – will help cities enhance health and productivity, reduce energy and CO₂ in major developments, engage the public to demonstrate socioeconomic benefits, offer international exposure and help cities meet climate commitments.

Overall, the policy supports cities in sustainable development, carbon reduction and climate goals. A WLCA also supports several Sustainable Development Goals (SDGs), principally:

- SDG 11: Sustainable cities and communities
- SDG 12: Responsible consumption and production
- SDG 13: Climate action

By mandating a WLCA for major developments in the building sector, much information and data are generated. This information can be used to identify opportunities to reduce environmental impacts upstream of the building sector by improving the sustainability of products, processes and services. However, as highlighted by the World Green Building Council, “harmonization (of WLC reporting standards) is especially important as a number of divergent WLC reporting methodologies have been developed at the national and international levels in recent years, which has the potential to cause delays and confusion among actors in the building sector.”² Therefore, standards such as the Level(s) framework, developed by the European Commission, are helpful in promoting global progress.

A WLCA can be used to assess the carbon emissions of different building materials. This information can be used to help building designers and developers choose materials that have a lower environmental impact. A WLCA can also be used to assess the environmental impacts of different transportation modes, for example. The information can be used to help transportation planners choose modes of transportation that have a lower environmental impact, in effect, lowering the overall “whole life” carbon footprint of the building.

In 2015, the world adopted the Paris Agreement, signed by 194 countries. Nationally determined contributions (NDCs) and long-term strategies (LTS) are the key tools for countries to both cut emissions and adapt. As respective short-term (five-year) and long-term (20- to 30-year) roadmaps, these are blueprints for how nations will achieve the scale, scope and speed of environmental and economic transformation required to limit global temperature rise to 1.5 degrees Celsius or below.³

The effects of focusing on whole life carbon go further than environmental sustainability. Cities that focus on reducing embodied carbon of their source products promote economic development towards low-carbon business models, frequently favour local/nearby businesses, and foster the development of local circular businesses. WLCAs in the building sector can promote circularity in several ways, including:

- *Identifying opportunities for material reuse and recycling:* A WLCA can help identify opportunities to reuse and recycle materials in buildings, which can reduce the need for virgin materials and help to close the loop on the material flow.
- *Designing for disassembly and deconstruction:* A WLCA can help design buildings for disassembly and deconstruction, which can make it easier to reuse and recycle materials at the end of the building’s life.

This adoption playbook for the whole life carbon assessment policy has been compiled by experts in various sustainability fields. The value of adopting the WLCA policy can be transformative across any city. Potential benefits:

- Establish a baseline of emissions across the built environment in your city.
- Increase information sharing and methods of collaboration between public and private sector in the built environment.

- Set and achieve emission goals through transparent measurement practices.
- Benefit from social opportunities (i.e. job creation, healthier communities) that may come from a more aligned public and private sector, and the resulting reduced emissions and localized particulate matter.
- Help set up or strengthen policy infrastructure/opportunities.
- Ensure closer connections and collaboration with influential NGOs such as the World Economic Forum, C40 Cities and others.
- Leverage information and experiences directly from experts.
- By adopting a WCLA assessment, cities could be featured as best practices in international materials, such as the Clean Construction Policy Explorer or C40 Cities Knowledge Hub, where reports such as the [C40 Cities Whole Life Carbon Policy Playbook](#) is hosted.

3 Just Transition Principles

3.1 Defining a just transition

With the creation of this model policy, policy-makers are encouraged to follow the principles of a “just transition” towards a net-zero economy, which not only safeguards livelihoods and maximizes job creation, but accelerates the aforementioned SDGs and climate action. Cities have an important responsibility in guiding this transition through the use of local economic development and urban regeneration policies.

Perception of the green economy varies greatly between countries and regions. The model policy suggests that policy-makers who commit to a life cycle assessment (LCA) reporting process could encounter significant resistance from practitioners. However, the policy writers aim to help cities and other relevant stakeholders avoid making practitioners feel marginalized, disenfranchised, or disadvantaged by new policy implementation.

3.2 Stakeholder inclusion and decent jobs

The International Labour Organization (ILO) defines the just transition as greening the economy in a way that is as fair and inclusive as possible to everyone concerned, creating decent work opportunities and leaving no one behind.⁴ Decency of work is a core objective of a global just transition towards climate sustainability. In the face of the green transition of the built environment, construction worker unions around the world have called for decent work in the form of protection from harassment or discrimination, gender equality, health and safety protections. Union representatives (especially those in extreme heat-prone areas) have highlighted that the reduction of greenhouse gases, and its positive effect on climate change, inevitably supports the reduction of heat-stroke risk on the worksite.⁵

Cities play a critical role in ensuring that just transition principles are embedded into climate action. For example, as part of the multi-city pledge, [Cities and Unions Call to Action: A Climate Decade for Good Quality Jobs](#), BWI (Building and Wood Worker’s International Global Union) and C40 Cities (a climate leadership group of nearly 100 mayors of the world’s leading cities) have made joint efforts to transition towards clean construction without creating a dilemma for decent job creation. The pledge states that a just transition is one that:

- Relies on social dialogue between governments, employers and workers' organizations to overcome barriers, realize opportunities, release potential and deliver innovation.
- Delivers retraining, green skills development and employment support programmes equitably for workers.
- Guarantees access to social protection as a human right.
- Includes macroeconomic, industrial and sectoral policies to support sustainable and innovative enterprises and create green jobs.
- Promotes social justice and value while striving for poverty eradication and social inclusion.

3.3

Equity and inclusivity

The World Health Organization (WHO) defines equity as the “absence of unfair, avoidable or remediable differences among groups of people”. Inclusivity, meanwhile, is the practice of including relevant stakeholders – particularly marginalized groups and, in this context, those impacted by climate change and/or climate policy – into policy-making and urban governance, to ensure a fair process with equitable outcomes.⁶ Therefore, when considering a just transition to net zero, cities must include and collaborate with a wide variety of stakeholders, such as residents (especially those impacted by unequal effects of climate change), civil society groups, for-profit and non-profit companies, business groups, universities and other levels of government.

To accurately assess the impacts of climate change and climate action policy on stakeholders, cities are recommended to follow the guidelines inside C40 Cities Knowledge's [Achieving the just transition: A toolkit for city leaders across the globe](#). The toolkit presents seven pillars of recommended action. Each pillar contains key concepts, advice on implementation and a self-assessment checklist to guide stakeholders along the way. Case studies from cities already taking innovative action within each pillar are also provided.⁷

Another is by addressing affordability concerns. In a just economy that strives to meet SDG 11 (sustainable cities and communities), “by 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums.”⁸

3.4

Market economic impact

Following principles of a just transition can help policy-makers build political support for climate action and maximize employment benefits of climate actions. One way is through the creation of municipal procurement and infrastructure projects, automating unsafe or highly repetitive tasks, and by upskilling and reskilling workers.

Requiring LCA reporting may add cost and time constraints to major projects and affect project economics. LCA mandates could lead to a reduction in major projects and suppress supply of housing, commercial and industrial spaces, thereby driving prices up. Therefore, governing bodies must work with industry groups to address these concerns, streamline planning and approval processes, and improve access to funding to ensure inclusion and opportunity for buyers and builders of assets in the green transition.

Cities should recognize that they have the power to create positive incentives to build sustainable, equitable and affordable housing. From the entitlement process to inspections and everything in between, cities should reexamine their existing policies and practices in light of the climate emergency. Cities need to

make significant changes to encourage the development of just and liveable built environments. Generally, this means that cities should seek out, support, fast track and even subsidize affordable net-zero projects, as well as encourage adherence and the creation of standards for innovation building solutions.

For further information, see Appendix B: Communicating Value to Real Estate Investors.

3.5

Additional just transition implementation resources

The model policy is intended for use by city policy-makers, but the writers acknowledge that policy-making powers vary by governance structure and geography. As such, it is important to highlight the growing trend of national governments embracing just transition principles.

According to a recent United Nations Development Programme (UNDP) report, just transition principles are now reflected in 38% of NDCs and 56% of LTS, as well as a growing number of high-profile global initiatives.⁹ To help policy-makers who are in the process of designing long-term strategies, UNDP and the World Resources Institute partnered to publish the [Quality Assurance Checklist for Long-Term Low Greenhouse Gas Emission Development Strategies](#). This resource can be used to help policy-makers evaluate their inclusion of just transition principles and overall strategies.

Before adopting the WCLA model policy, practitioners should consult tools and resources on this topic, such as [Achieving the Just Transition: A toolkit for city leaders across the globe](#) and Good, Green Jobs - C40 Cities by [C40 Cities](#), and the [Just Transition Planning Toolbox](#) by Climate Transition Fund, as well as consult resources by the UNDP's Climate Promise [Just Transition Report](#). Within these resources, you will find guidance and case studies for a transformative approach to a just transition.

4

Frameworks and Tools for Adopting the Policy

4.1

Considerations for policy implementation and local contextualization

There are many ways by which a government can implement a policy. This paper aims to guide governing agencies on implementation strategies for the model policy in question. Sample implementation approaches and tools are outlined below; however, it is important to acknowledge that implementation guidance is not a one-size-fits-all approach. Some cities may feel reluctant to quickly mandate WLCAs, and therefore might take a more gradual approach, such as incentivizing voluntary measures and incrementally implementing mandates.

With this in mind, you should evaluate the WLCA policy and guidance document within your local context, including evaluating structural implementation barriers within your own system of governance. Various frameworks are provided to help policy adopters understand their most useful relationships between the government, the private sector and nonprofits locally.¹⁰ You are also encouraged to review Appendix A: Guidance for Various Governance Structures.

4.2

Checklist of adoption levers

To improve the likelihood of a successful WLCA policy implementation, a city should have at its disposal the following “levers” or tools:

- An established net-zero carbon target and climate action plan with a basic understanding of the city’s key emissions areas. If not, the city may adopt a carbon reduction target or plan set by the national government in a nationally determined contribution or long-term strategy and adapted by the city to contribute to the NDC.
- The city should have an understanding of the “baseline data” of what the built environment is contributing towards emissions within their jurisdiction. If not, the city should begin to plan how to collect this data to establish a baseline/business-as-usual case of emissions. While there is no standard global framework or methodology, the city should familiarize itself with the European Commission’s established Level(s) framework, “which aims to provide the building sector with a harmonized and EU-approved methodology for assessing the environmental impact of buildings, including WLC.”¹¹ To learn more about the Level(s) framework, and to access learning resources and calculator tools, please see [Let’s meet Level\(s\)](#). In addition to Level(s), you are encouraged to consult the 2023 IEA EBC (International Energy Agency’s Energy in Buildings and Communities Programme) Publications on LCA, which can be found [here](#). These publications provide useful data for a broad international audience.
- Staffing with experience in WLCAs or capacity to train/educate staff to support compliance monitoring. If the city does not have staff with experience in this field, it is suggested to develop a capacity-building plan and/or hire consultants with significant experience in this field.
- Capacity inside the agency to implement the policy and follow up on enforcement, for example, control over planning policies and processes, building codes writing and/or enforcement powers. Collaboration and partnerships with the private sector may be crucial to building a “carbon baseline” against which progress can be measured. Governing agencies are encouraged to identify private sector or nonprofit actors to help.
- Zoning regulations that organize how land is allowed to be used within a city, including the shape and density of development, can be used to specify the minimum requirements for whole life carbon tracking for new buildings. For example, a city could require that all new buildings be designed to achieve a certain level of whole life carbon emissions reduction within specific areas of the city.
- Building codes, which are currently focused on operational emissions, can also be used to specify the materials and construction methods that must be used to achieve certain whole life carbon emission reduction targets. For example, a city could require that all new buildings be constructed using materials that have a low embodied carbon footprint. Codes can focus on environmental product declarations (EPDs), material-specific regulations, or whole-building requirements.
- Climate action plans set targets on tracking and reducing embodied and whole life carbon. Embodied carbon can be considered in various activities of a city’s climate action plan, such as waste management and historic preservation.
- Procurement policies, such as buy-clean and material-specific policies. The Carbon Leadership Forum (CLF) offers helpful resources and toolkits to enable governments to reduce embodied carbon in construction. Its policy primer series (toolkit) contains an introduction to procurement policies, also known as Buy Clean, here: [Embodied Carbon Policy Toolkit - Carbon Leadership Forum](#).
- Financial incentives, such as tax breaks or rebates, can be used to encourage building developers to track whole life carbon. For example, a city

could offer a tax break to building developers who achieve a certain level of whole life carbon emissions reduction.

- Public awareness campaigns can be used to educate the public about the importance of whole life carbon tracking and to encourage building developers to take steps to reduce the carbon emissions of their buildings. Campaigns can also increase awareness of resources available to the building sector to implement a WLCA policy, including educational resources, other capacity-building support and incentives.

4.3

Voluntary adoption levers

City governments can work with building developers and other stakeholders to develop voluntary whole life carbon tracking programmes. These programmes can provide building developers with the resources and support they need to track whole life carbon and make informed decisions about how to reduce the carbon emissions of their buildings.

City governments can work with building developers and other stakeholders to develop voluntary whole life carbon tracking programmes in several ways, including:

- *Providing technical assistance:* City governments can provide technical assistance to building developers and other stakeholders to help them understand the whole life carbon concept and to develop the tools and resources they need to track whole life carbon. Focus on supporting compliance rather than punishing non-compliance.
- *Sharing best practices with the private sector:* City governments can share best practices with building designers, developers and other stakeholders to help them learn from the experiences of others and to identify the most effective ways to reduce the carbon emissions of their buildings.
- *Sharing best practices with NGOs and the public sector:* Sharing best practices, case studies and more with NGOs such as the World Economic Forum, C40 Cities, Carbon Neutral Cities Alliance, International Living Future Institute (ILF), National Research Council, Carbon Leadership Forum (CLF), Zero Emissions Buildings Exchange (ZEBx) and others. For example, the City of Vancouver in Canada partnered with the US cities of Seattle and Portland in a group facilitated by ILFI to collaborate and solve challenges to create embodied carbon policy.
- *Creating incentives:* City governments can create incentives, such as tax breaks or rebates, to encourage building developers to participate in voluntary whole life carbon tracking programmes.
- *Building capacity:* City governments can build the capacity of building developers and other stakeholders to track whole life carbon by providing training and education opportunities.
- *Advocating for change:* City governments can advocate for changes to zoning regulations, building codes, and other policies that would make it easier for building developers to track whole life carbon.

Here are some specific examples of what city governments can do to work with building developers and other stakeholders to develop voluntary whole life carbon tracking programmes:

- *Establish a whole life carbon tracking task force:* This task force could bring together representatives from city government, building developers,

environmental organizations, and other stakeholders to develop a plan for a voluntary whole life carbon tracking programme.

- *Establish a baseline of building sector environmental impact:* To establish embodied emission targets and report on achievements, cities need to determine the appropriate baselines for projects (new, retrofits, and infrastructure) to measure against. Currently, there is no standardized guidance on how to establish a baseline. In 2017, the CLF published the Embodied Carbon Benchmark Study for North American buildings. Since then, the practice of whole-building life cycle assessment (WBLCA) has grown rapidly in the Architectural Engineering and Construction (AEC) industry, and it has become clear that more robust and reliable benchmarks are critical for advancing work in this field. The new CLF WBLCA Benchmark Study (Version 2) will build upon research and insights from the 2017 study.¹² For updated information on the study, see [CLF WBLCA Benchmark Study v2](#). In addition, Ramboll provides a guide on establishing a baseline in their white paper, [Setting the baseline. A bottom-up approach](#). It can be done in different ways, depending on the city resources, but may include the following:
 - Selecting several types of buildings and infrastructure representative of the city's typical urban fabric.
 - Collecting the embodied emissions results per m² of each of the selected through LCAs, ideally in the design phase and using the same material database and scope.
 - Determining the average kgCO₂/m² of each building type.
 - Using the averages as your baseline to set reduction targets and embodied emissions limits.
- *Provide and promote the Whole Life Carbon Assessments Guidance Document for Practitioners.* This toolkit, written alongside the WCLA model policy, provides building developers with the resources they need to track whole life carbon, such as calculators, software and databases.
- *Provide funding for whole life carbon tracking projects:* This funding could be used to support building developers who are participating in voluntary whole life carbon tracking programmes, as well as to procure and integrate the information technology infrastructure needed to accurately and efficiently compile and report on the emissions KPI's mentioned below.
- *Launch a whole life carbon tracking pilot programme:* A pilot programme is useful to test the feasibility of a voluntary whole life carbon tracking programme and identify any challenges that need to be addressed. A short guide is provided in Appendix D: Launching a Carbon Tracking Pilot Programme.

5

Suggested Methodologies for Tracking Success

5.1

Suggested KPIs

Here are some key performance indicators (KPIs) that a city can use to measure the success caused by tracking whole lifecycle carbon emissions in its building sector:

- *Reduced total embodied carbon emissions:* The total amount of carbon dioxide emitted during the construction, operation and end-of-life of a building.

- *Reduced annual operational carbon emissions:* The amount of carbon dioxide emitted each year from the operation of a building, including emissions from heating, cooling, lighting and other energy-consuming activities.
- *Reduced carbon intensity:* The amount of carbon dioxide emitted per square foot of building space.
- *Increased renewable energy use:* The percentage of energy used by a building that comes from renewable sources, such as solar, wind, or hydroelectric power.
- *Increased energy efficiency:* The amount of energy used by a building to perform a certain function, such as heating, cooling, or lighting.
- *Increased number of private sector entities:* Those engaged and participating in tracking and reporting their WLCA data.
- *Reduced cost of compliance:* The amount spent for participating entities to be in compliance with the given mandates.

These are just a few examples of KPIs that can be used to track whole lifecycle carbon emissions in the building sector. The specific KPIs that are most relevant for a particular city will depend on the city's climate, energy mix and building stock.

5.2

Five methodologies to address embodied carbon

[The Embodied Carbon Review](#) by One Click LCA identified five methodologies to address embodied carbon. The following table outlines the carbon reduction methods from most basic to most advanced, as evaluated based on their ability to reduce carbon emissions. The ranking of categories should be considered indicative, as within each approach the implementation determines much of its efficiency. A too-permissive carbon cap will not challenge projects to improve in a meaningful manner. However, here it is considered a more effective measure than carbon rating, as it is mandatory to meet.¹³

Method	How does it work?	Examples	Advantages	Disadvantages
1. Carbon reporting	Calculate the construction project's embodied carbon and report it.	EN 15978, BREEAM Int'l	Reporting carbon is easy. Builds knowledge and skills.	If reporting is the only requirement, design and impacts may not improve.
2. Carbon comparison	Compare design options for carbon; for example, design baseline and proposed designs and show improvements against a self-declared baseline value.	LEED v4, Green Star, BREEAM UK	The most cost-effective way to influence. Options must be understood prior to acting.	Comparison is not necessarily leading to best option being built. This may become a formality in some projects.
3. Carbon rating	Evaluation of carbon performance. Variable scale from best to worst on which a project's carbon is rated, but no effective maximum value applied. Fixed scale or clear methodology.	DGNB, BREEM NL	Incremental performance improvements provide additional incentive via better rating.	As also a poor rating is also allowed, the less ambitious projects may not improve at all.
4. Carbon cap	Calculate the project's embodied carbon and prove it is not exceeding the CO ₂ e limit.	Énergie Carbone, MPG	All projects must meet the stipulated threshold.	Setting the cap to a level where it is effective in carbon reduction and yet cost-efficient is hard.
5. Decarbonization	Reduce carbon to a minimum, then compensate all residual emissions by own energy export or buying offsets.	Living Building Challenge, NollCO ₂	Direct cost from higher carbon emissions is an incentive to reduce as far as possible.	Systems aiming at complete decarbonization need a great deal of political will and suitable incentives to be widely applied.

Source: Embodied Carbon Review 2021

City profiles of clean construction policies implemented

In this [series of reports](#), *Making the Case for Clean Construction: City profiles*, C40 Cities unpacks how clean construction happens in six different cities – Ekurhuleni, Mexico City, Milan, Qingdao, Quezon City and Toronto. Each report provides an overview of the construction landscape in each city and proposes a series of recommended clean construction measures the city could adopt, highlighting the broader benefits this would bring locally and globally. The policy areas and recommended implementation mechanisms will be broadly transferrable to other cities and cover actions such as embodied and operation carbon reduction.

For other policy examples similar to the London WLC model policy, refer to Appendix C: Example Policies.

Towards zero-carbon buildings

For an in-depth guide on what actions to take to support a drive towards zero-carbon buildings, C40 Cities has provided [A Whole Life Carbon Buildings Playbook](#). This document outlines the WLCA framework and presents actionable interventions and tools that mayors and city officials can use to implement a WLCA approach. It expands on different tools cities can deploy – municipal procurement policies, building codes and regulations, and incentive schemes – to highlight the role that cities can play in accelerating decarbonization. This resource will be useful to support cities seeking to change how they plan, design, construct, repair and reuse buildings, working with multiple stakeholders to deliver green, healthy, resilient and thriving urban spaces.¹⁴ The playbook provides examples of policies and supporting actions cities can apply, depending on their own local and national context, to change how they plan, design, construct, repair and reuse buildings.

In addition, the Carbon Neutral Cities Alliance (CNCA) and OneClick LCA, in partnership with Architecture 2030, launched the [City Policy Framework for Dramatically Reducing Embodied Carbon report](#). This framework provides guidance for cities considering policies that can deliver the highest impact within their geopolitical contexts and regulatory systems. Over 50 existing policies from leading cities have been evaluated, categorized and scored according to their potential, cost efficiency, ease of implementation and enforceability.¹⁵

Appendix

A Guidance for Various Governance Structures

Cities and their urban agglomerations are increasingly the epicentre for climate action. As nation-states tackle the larger challenge of setting ambitious commitments to tackle the sources of emissions contributing to climate change, cities are emerging as the test beds for innovation and technology-driven solutions.

Cities have a long history of being the generators of economic growth and consequent emissions associated with that growth. Yet, cities may vary in terms of their governance structures, how urban services are administered, and who makes the decisions regarding sustainability and climate change targets. Adopting a policy that mandates whole life carbon assessments (WLCAs) requires a level of power and authority that city governments do not universally possess. Thus, it is recommended to assess the powers and levers available to your agency, given your national, provincial, or state regulatory context.

The legislative framework of governance structure is defined by the constitution of each country and powers and functions are defined for each sphere, tier or region of government based on the centralization or decentralization of service delivery mandates. Typically, there are three broad categories in which cities across the world are set up in terms of their governance structures:

1. Cities that have empowered mayors and city councils

These are typically cities that have empowered mayors and city council's that can make executive decisions on the management or urban service delivery in the city such as transport, water, electricity production/distribution, building by-laws/permits, parks/open spaces, air quality, etc. Typically in such cities, the mayor is directly elected by the people of the city and is accountable for the city's overall functioning. The city council in such cities also has the ability to make policy decisions in matters pertaining to transport, water, waste, air quality, building permits, land use planning, etc.

In the scenario of cities having the required authority and legislative ability to amend existing regulations or enact new legislation, the following agencies in the city government must engage with the WLCA policy:

- Planning and economic development agencies of the city that lay out the long-term masterplan vision for the city

- Building permit departments that sanction all new construction and modifications to existing buildings
- Sustainability departments that align the WLCA with the overall city-wide sustainability and climate action targets

Who is the likely target audience within the city government of this WLCA Policy Adoption Playbook?

- Mayor
- City council member in charge of new building permits/code compliance
- Director of the city planning department
- Director of the city department of procurement/budget and management
- Chief sustainability officer of the city

2. Cities that have underpowered mayors and city councils

Cities that have underpowered mayors and city councils typically function under the authority and strong oversight of the state/provincial government. Often, cities that fall under this category do not have the legislative or administrative authority to make policy decisions in areas such as transport, water, energy distribution/production, building by-laws/permits, etc. In such cities, typically the mayor is only a political figurehead who may or may not be elected directly by the people of the city. Cities in South Asia, some parts of Africa and South-East Asia as well as in some places in the Global South typically fit within this governance structure. While key powers can rest with other levels of government, cities can still play a role in advocating for net-zero policy and collaborating with higher government agencies to develop key strategies and plans, such as climate action plans, consistent with the Paris Agreement.

In the scenario of cities not having the required authority and legislative ability to amend existing regulations and/or enact new legislation, the following agencies in the city and state/provincial governments will have to be involved to implement and require a WLCA policy:

- Department of municipal administration/affairs (DMA) or urban development department (UDD), or similar, which is typically a state/provincial level department headed by the chief minister or governor. This department has the legislative authority to amend and/or introduce new legislation to anchor the WLCA across the built environment in the state across all cities.
- Directorate of town and country planning, which is typically within the DMA/UDD and which looks at creating the legal planning frameworks for future development in terms of building codes, building by-laws and modifications to existing buildings.
- Urban development authority, which has the statutory authority to prepare planning frameworks for master plans.
- Environment department in the state/provincial government that the statutory authority to enact climate-change mitigation laws/legislation across both the built and natural environment.
- City council and building plan sanction cell, which authorizes the construction of new buildings in the city.
- Municipal commissioner of the city corporation who has the administrative and executive authority in the city.

Who is the likely target audience within the city and state/provincial governments of this WLCA Policy Adoption Playbook?

- Chief minister or governor of the state/provincial government
- Minister in charge of DMA/UDD
- Chairperson of the urban development authority
- Director of directorate of town and country planning or urban planning authority
- Commissioner of the city corporation
- Director of the division of building by-laws enforcement and building permits in the city

3. Cities that have metropolitan and regional governments

This category of cities is currently few in number, but is increasingly becoming common given the rapid rate of urbanization where regional governments at the metropolitan level take over the running/functioning of the metropolitan agglomeration. Typically, cities that have metropolitan-level elected governments fall under this category of governance structures.

Cities in this category have directly elected or indirectly elected mayors/governors and have executive and budgetary authority of some critical portions of urban services but not all; for example, transport, waste, electricity distribution, master planning, city-wide greening initiatives, etc. Cities in this category of governance structure are characterized by several smaller city governments coordinating as part of a larger metropolitan agglomeration. For example, in London, the Greater London Authority is an entity that functions as a strategic regional authority with 30+ local-level authorities functioning in parallel with their powers.

In the scenario of cities having metropolitan and regional governments that have the required authority and legislative ability to amend existing local regulations and/or enact new legislation, the following agencies in the metropolitan/provincial governments will have to be involved to implement and require a WLCA policy:

- Office of the mayor or governor or chief minister (metropolitan government)
- Department of municipal administration/affairs
- Office of long-term budget planning and management
- Office of sustainability
- Department or ministry of environment and climate change
- City-specific division of planning and economic development
- City-specific division of building bylaws, permits and code compliance
- City-specific division of procurement and budget management

Who is the likely target audience within the cities with metropolitan and regional governments of this WLCA Policy Adoption Playbook?

- Metropolitan mayors, governors or chief ministers
- Minister in charge of municipal affairs and urban development
- Minister in charge of environment and climate change
- Chief sustainability officer in the metropolitan government
- Chief sustainability officer in the city government
- Director of division of planning and economic development
- Director of division of building inspectors and code enforcement officers

B Communicating Value to Real Estate Investors

For the model policy to be adopted, there must be a strong and implementable value proposition for real estate investors. If implementing the policy leads to such an uneven investment landscape where buildings that have undergone a WLCA are financially at a disadvantage and yield a lower (or even negative) return on investment, investment capital will flow to more permissive development environments where the policy has not been adopted.

The likelihood is that all cities will not universally adopt this policy, thus opportunities to draw capital away from cities that adopt this policy will exist for the foreseeable future. To mitigate this risk, the policy and complementary guidelines must include deliberate measures to make buildings that have undergone a WLCA, as prescribed under this policy, attractive for real estate investors.

Cities should recognize that high rents in a project can often support green building in some cases without any subsidy. Market rate residential green building should be encouraged as well as senior, disabled, affordable, permanent supportive, single room occupancy (SRO) and every other type of green building. The inclusion of WLCA in a major development should not be accepted as an excuse not to provide housing of all kinds in quantitatively undersupplied areas. Cities should explicitly recognize that, with very few exceptions, urban infill housing is superior to single family-track home greenfield development, considering the building type's whole life cycle carbon impact on the earth's climate. This does not mean a city should prohibit development in rural areas, only that it should prioritize a climate-friendly built environment and take positive steps to make those types of developments attractive to investors.

Investors typically evaluate the relative financial viability of projects based on the following considerations:

- Development cost
- Financing options
- Projected cash flows
- Lifecycle operating expenses

Cities should clearly articulate the potential intrinsic advantages that projects, which are applying the policy, hold for real estate investors and communicate those in external communication related to this policy. Examples can include, but are not limited to, the following;

- Lower cost of capital through access to low-interest green bonds

- Lower operational expense over a project life cycle versus a conventional building
- Additional streams of cash flow from carbon credit revenues associated with lower emissions

Beyond the implementation of the WLCA policy, cities (or the appropriate governing body) should consider further complementary policies to align with net-zero emissions goals:

- Policy to fast-track approval of well-scoring WLCA projects, especially those with affordable components. Internal policies to define “well-scoring WLCA projects” will need to be implemented based on the benchmarks determined after initial implementation of the WLCA policy.
- Policy to encourage the adaptive reuse of buildings by fast-tracking or promptly approving such projects, especially those with affordable components.
- Policy to consider the effects high scoring WLCA projects will have on their infrastructure and thus development fee schedule from first principles. If a project uses less power, water and sewer infrastructure, development fees should be materially lower than a comparable non-green project as the burden on city infrastructure will be lower. Policies may include incentives as described earlier in this document.

If possible, cities can showcase sample projects that delivered attractive returns on investment as part of the communication strategy.

One critical reality that may help ease conversations between government and builders, as it did in conversations with the California Building Industry Association (CBIA) around AB 2446/AB 43, is the fact that there is very little data on the carbon impact of construction (a reason why the LCA requirement is so important), but when carbon impact is measured it is often found to be significantly less than estimated. This opens the opportunity for the construction sector to be seen as relieving, rather than driving, the climate crisis. In addition to this reality, those conversations between the CBIA and the authors/implementers of AB 2446/AB 43 led to the inclusion of language limiting the cost increases associated with embodied carbon reductions. Additionally, it is important to recognize that significant reductions may be possible with limited to no cost increase, as shown by the Rocky Mountain Institute's (RMI) report on [Reducing Embodied Carbon in Buildings](#) which found “applying (low and no cost) solutions demonstrates embodied carbon savings potential of 19 to 46 percent at cost premiums of less than 1 percent.”

C Example Policies

London

The WLCA model policy is derived from the wording in [The London Plan 2021 Policy](#), Chapter 9 Sustainable Infrastructure – Policy SI 2 “Minimising greenhouse gas emissions.” The London Plan as a whole serves as a blueprint for the future development and sustainable, inclusive growth of London, England. Chapter SI 2 focuses on how London can become a zero-carbon city by following specific energy hierarchies, strategies and reductions. Much of the WLCA Model Policy was built on aspects of this plan.

Stockholm

Since 2018, Stockholm has required a carbon footprint declaration for all municipal infrastructure projects costing at least 50 MSEK (€4.7 million or US\$5.3 million). The proposal recommends that projects look at the whole life cycle, including use phase climate impacts (B1-B7) for choosing implementation method, and that the end-of-life impacts and options (C1-C4) be studied, but ultimately requires that only the material (A1-A3) or upfront (A1-A5) emissions be calculated.

Vancouver

Green Building Policy for Rezoning: Embodied Carbon Limits, Vancouver

The green buildings policy for rezoning requires a whole building life cycle assessment (WBLCA) for each distinct part of the building and for the results to be disclosed as part of their rezoning submission. The submission is to demonstrate that the project is on track to meet the Vancouver building by-law regarding embodied carbon limits expected to be in force at the time of the project's first building permit application. Vancouver's WBLCA zoning requirement became part of its building by-law, which took effect in 2023.

Amsterdam

The Amsterdam Circular Strategy 2020-2025 takes a whole life carbon approach and aims to reduce the use of primary raw materials by 50% by 2030, and to achieve a fully circular economy by 2050. The city is doing this by mapping out various material flows, from entry to processing, in order to preserve valuable raw materials. The strategy uses the Amsterdam City Doughnut from the British economist, Kate Raworth. In addition, the city will measure its progress by developing a monitor with which it can determine the social and ecological impact of the transition and to find out whether Amsterdam is on the right track. The monitor charts the extent to which Amsterdam's economy has become circular and identifies areas in which more needs to be done.

Germany

WBLCA is required for new government building projects as part of a green building rating programme specific to government projects, with points awarded based on performance against a benchmark. The country also has a private-sector voluntary green building programme with a similar life cycle assessment benchmark approach. Germany has a national life cycle assessment/EPD database and a free, national, whole building life cycle software tool.¹⁶

The Netherlands

Since 2013, new residential and office buildings with surfaces exceeding 100m² must account for their embodied impacts in the form of a whole life cycle assessment. The accounting method used converts the life cycle assessment categories into a shadow price, which is expressed in euros. All impacts are transformed into a single monetary value, which is divided by building floor area and assessment period length – 50 years for office buildings and 75 residential buildings. In 2018 this regulation was revised to set a mandatory environmental impact cap for buildings at EUR€1.00 per square metre and year. It is the first national regulation of this type in the world. Applying the method to a project requires the use of software that has been previously verified and approved by the Dutch government.¹⁷

Toronto

In May 2023, Toronto became the first jurisdiction in North America to set embodied carbon caps on new city-owned buildings, which are now required to demonstrate an upfront embodied carbon intensity (life cycle phases A1-A5) of below 350 kg CO₂e/m². This level of performance is now optional for private construction, but the city council has asked for considerations into the wider application of mandatory embodied carbon caps beyond city-owned buildings. This change was made as part of the update to the Toronto Green Standard v4.

Colombia

Colombia's National Roadmap for Net Zero Carbon Buildings, 2022

Decarbonizing the building sector in Colombia is essential to cutting greenhouse gas emissions. Colombia's National Roadmap for Net Zero Carbon Buildings includes recommendations for ensuring that improving existing homes and buildings takes a participatory, inclusive approach with communities. The use of life cycle assessments is proposed for both construction projects and materials. The roadmap also focuses on rehabilitation or readaptation of existing

buildings, the integration of sustainable material requirements in building codes and the development of standards for low-emission machinery.

Singapore

The Singapore BCA Green Mark 2021 is an internationally recognized green building certification scheme tailored for the tropical climate. It promotes data collection or information sharing programmes and includes a Building Embodied Carbon Calculator. It encourages the industry and professionals to collaborate and develop green building solutions and aims to raise standards in energy performance, designing for maintainability, reducing embodied carbon across a building's life cycle, using smart technologies, enhancing a building's resilience to climate change and creating healthier environments for building users. The scheme was launched as part of the Singapore Green Building Masterplan.

C40 Cities Whole Life Carbon Policy Playbook

Released in December 2023, this playbook was authored by C40 Cities Climate Leadership Group, a leading member of the Net Zero Carbon Cities taskforce alongside the World Economic Forum and Infosys Incorporated. [The C40 Whole Life Carbon Policy Playbook](#) outlines the WLC framework and presents actionable interventions and tools that mayors and city officials can use to implement a WLC approach. It expands on a number of tools cities can deploy – municipal procurement policies, building codes and regulations and incentive schemes – to highlight the role that cities can play in accelerating decarbonization using a WLC approach. This resource will be useful to support cities seeking to change how they plan, design, construct, repair, and reuse buildings, working with multiple stakeholders to deliver green, healthy, resilient and thriving urban spaces.

D Launching a Carbon Tracking Pilot Programme

A pilot programme is useful to test the feasibility of a governing body's whole life carbon tracking programme and identify any challenges that need to be addressed. By following these guidelines and considerations, your government agency can better select a qualified IT integration partner to establish a robust system for collecting and analysing valuable carbon footprint data from major real estate developments. This data can then be used to inform policy decisions, drive industry green building practices, and ultimately contribute to a more sustainable built environment.

Define requirements and goals

- *Focus on carbon data:* Highlight the need to collect specific whole life carbon assessment data points including embodied carbon, operational carbon and end-of-life carbon.
- *Data sources:* Identify available data sources from developers (e.g. building materials, energy consumption, waste generation).
- *Data granularity:* Define the desired level of detail for data collection (e.g. building level, individual materials).
- *Reporting and analysis:* Specify the need for generating reports and conducting analyses on the collected data.
- *Compliance and verification:* Consider any relevant reporting standards or verification requirements for carbon data.

- *Integration with existing systems:* Determine if the new system needs to integrate with existing sustainability or climate data platforms.

Evaluate partner qualifications

- *Sustainable building expertise:* Seek partners familiar with whole life carbon assessment methodologies and data standards.
- *Data integration and analytics:* Look for experience in integrating diverse data sources and building analytics dashboards.
- *Security and data privacy:* Ensure the partner can meet government security and data privacy regulations for sensitive carbon data.
- *Experience with government projects:* Prefer partners with a successful track record working with government agencies.
- *Strong communication and collaboration skills:* Prioritize partners with excellent communication and collaboration skills to work effectively with developers and agency stakeholders.

Define the selection process

- *Develop a specialized RFP:* Tailor the request for proposals specifically to carbon data collection, detailing data types, standards and desired functionalities.

- *Shortlist based on relevant expertise:* Prioritize partners with demonstrably strong experience in sustainable building data.
- *Focus on case studies and references:* Emphasize case studies related to carbon data collection and successful collaborations with government agencies.
- *Incorporate data analytics evaluation:* Include a component in the selection process to assess the partner's ability to develop insightful analytics on carbon data.
- *Visualization and reporting tools:* Include features for generating user-friendly reports and data visualizations for developers and agency stakeholders.
- *API integration capabilities:* Ensure the system can readily integrate with other relevant platforms and databases.

Additional recommendations

Technical considerations

- *Secure data platform:* Choose a secure and scalable data platform compliant with government data security regulations.
- *Automated data ingestion:* Implement data pipelines for automated data transfer from developer portals or APIs.
- *Data validation and quality control:* Integrate data validation and quality control mechanisms to ensure data accuracy and consistency.
- *Engage sustainability experts:* Involve internal or external sustainability experts in the selection process to provide valuable insights.
- *Prioritize user experience:* Make user-friendliness a priority for both developers and agency personnel interacting with the data system.
- *Plan for training and support:* Ensure the partner provides adequate training and support to developers and agency personnel using the system.

Contributors

Lead author

Joseph Upjohn
Consultant, Sustainability & Design Infosys Ltd.

Co-authors

Juliet C. Anammah
Chief Sustainability Officer, Jumia Group

Cécile Faraud
Head of Clean Construction, C40 Cities

Vincent Martinez
President and Chief Operating Officer, Architecture 2030

Yame Nkgowe
Founder, Sustainable Cities Africa

Sam Rubin
Co-Founder, Mighty Buildings

Sanjay Sridhar
Policy and Strategy Advisor

Co-leading members

André Aasrud
Senior Advisor, Clean Construction Program, C40 Cities

Anu Devi
Lead, G20 Global Smart Cities Alliance,
World Economic Forum

Cécile Faraud
Head of Clean Construction, C40 Cities

Sarah Franklin
Lead, Net Zero Carbon Cities, World Economic Forum

Nidhi Gulati
Principal, Business Consulting Sustainability
& Design, Infosys Ltd.

Madeline O'Dwyer
Consultant, Sustainability & Design, Infosys Ltd.

Joseph Upjohn
Consultant, Sustainability & Design Infosys Ltd.

Task force members

Juliet C. Anammah
Chief Sustainability Officer, Jumia Group

Lisa Brown
Executive Director, State and Federal Government
Solutions, Johnson Controls

Alice Charles
Director, Cities, Planning & Design, Arup

Hubert Danso
Chief Executive Officer and Chairman, Africa Investor
(Ai) Group

Corey Glickman
Expert Sustainability & Digital Transformation

Noelia Jiménez Martínez
Head of Insights and Machine Learning, Nature Metrics

Jeff Kavanaugh
Chief Learner & Sharer, Infosys Knowledge Institute

Krishan Kumar
former Chief Financial Officer, Durban Metro Council

Meghan Lewis
Senior Researcher, Carbon Leadership Forum

Swapnil Madhukar Joshi
Director, Sustainability & Design, Infosys

Vincent Martinez
President and Chief Operating Officer, Architecture 2030

Yame Nkgowe
Founder, Sustainable Cities Africa

Audrey Nugent
Director of Global Advocacy, World Green
Building Council

Sam Rubin
Co-Founder, Mighty Buildings

Sanjay Sridhar
Policy and Strategy Advisor, Urban Movement
Innovation Fund

About the G20 Global Smart Cities Alliance

The G20 Global Smart Cities Alliance accelerates the responsible adoption of technology for urban transformation goals. Established in June 2019, the alliance unites municipal, regional and national governments, private-sector partners and cities' residents around a shared set of principles for the responsible and ethical use of smart city technologies. The World Economic Forum, the International Organization for Public-Private Cooperation, serves as the secretariat for the alliance. Through the alliance, global experts from government, private-sector partners and civil society are compiling and analysing policies from around the world to identify model policies necessary for successful, ethical smart cities.

More model policies and details about the alliance can be found at:
<https://globalsmartcitiesalliance.org>.

Endnotes

1. Major development is defined within the local context or as the total cost of the construction or renovation as a portion of the market value of the structure, or the number of occupants that will move in or must relocate while work is taking place. Any construction, retrofit, renovation, or refurbishment that requires planning approval is considered a major development.
2. [Whole Life Carbon Policy Briefing—Page 10 \(ipaper.io\)](#)
3. [Just Transition Report Jan 20.pdf \(undp.org\)](#)
4. [What is just transition? And why is it important? | Climate Promise \(undp.org\)](#)
5. [“Decent Jobs are the Backbone of Clean Construction” video by BWI Global Union](#)
6. [Guided Learning ‘How to embed equity and inclusivity in climate action planning’ \(c40knowledgehub.org\)](#)
7. [Achieving the just transition: A toolkit for city leaders across the globe \(c40knowledgehub.org\)](#)
8. [Goal 11: Sustainable cities and communities - The Global Goals](#)
9. [What is just transition? And why is it important? | Climate Promise \(undp.org\)](#)
10. For further guidance to assess your political and cultural context while considering implementing the WLC Policy, see [New Approaches to Policy Implementation](#) by Ramboll. Inside are analytical tools and frameworks to guide this assessment, such as the: Consolidated Framework for Advancing Implementation Science (CFIR); The Behavior Change Wheel, Organizational Readiness to Change Assessment (ORCA); and Evidence-Based Practice Attitude Scale (EBPAS).
11. [Whole Life Carbon Policy Briefing—Page 6 \(ipaper.io\)](#)
12. <https://carbonleadershipforum.org/clf-wblca-v2/>
13. [Embodied Carbon Review 2021.pdf \(oneclicklca.com\)](#). Page 21
14. [Article Detail \(c40knowledgehub.org\)](#)
15. [Embodied Carbon Policy | City Policy Framework to Reduce Embodied Carbon](#)
16. [The embodied carbon review: Embodied carbon reduction in 100+ regulations and rating systems globally \(c40knowledgehub.org\)](#)
17. [The embodied carbon review: Embodied carbon reduction in 100+ regulations and rating systems globally \(c40knowledgehub.org\)](#)



COMMITTED TO
IMPROVING THE STATE
OF THE WORLD

The World Economic Forum, committed to improving the state of the world, is the International Organization for Public-Private Cooperation.

The Forum engages the foremost political, business and other leaders of society to shape global, regional and industry agendas.

World Economic Forum
91–93 route de la Capite
CH-1223 Cologny/Geneva
Switzerland

Tel.: +41 (0) 22 869 1212
Fax: +41 (0) 22 786 2744
contact@weforum.org
www.weforum.org