Jacobs

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Reinventing tomorrow.

# Beyond Carbon

*A holistic approach to net zero cities*

# A message from our executives

The global pandemic has been nothing short of devastating for so many people. Lives and livelihoods have been lost and inequalities have grown. It has shown us just how interconnected we all are and just how much we need those connections to thrive. Because, rather than in spite of this, we must remain focused on addressing the other most pressing global issue of our time: climate change. Left unchecked, no other single challenge has such great potential to disrupt and devastate so many. If addressed in time, no other single opportunity has such great potential to change the world for the better for so many.

As a purpose-led company, we know we have a pivotal role to play and we're stepping up and defining the legacy we want to leave behind for future generations. Incubating ideas and accelerating solutions that address the climate emergency, an issue that underpins so many aspects of sustainable development, is one area where we can have lasting influence and impact.

Addressing climate change involves a two-pronged approach – adapting and learning to live with a changing climate and reducing or removing carbon emissions at the source. The latter requires us to rapidly decarbonize our economy and society. And nowhere do the two overlap more than in our cities. Cities are major contributors to climate change and decarbonizing cities will play a vital role in reaching global net zero emissions.

In this paper we explore the challenges and limitations of the current approach to decarbonizing cities and discuss how a more holistic, programmatic approach, that brings city stakeholders together to co-develop solutions, could help accelerate the transition to net zero at a neighborhood, district, and city scale, while at the same time create new opportunities to address entrenched social issues and inequalities in communities. In the race to net zero, we cannot stand to leave any potential path unexplored. We hope this paper will inspire others to think a little differently and plan beyond today for a more sustainable tomorrow.

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# Executive summary

Even as we respond to other pressing global challenges, climate change remains one of the biggest threats to life on this planet as we know it. Momentum is slowly building as more and more governments and private sector organizations commit to net zero targets and seize the opportunity to incorporate green stimulus into their post-COVID recovery plans.

**Cities are major contributors to climate change, consuming 78% of the world's energy and producing more than 60% of greenhouse gas emissions.[1]**

As concentrated centers for people, trade and industry, cities are major engines of social and economic innovation and opportunities. But they are major contributors to climate change, consuming 78% of the world's energy and producing more than 60% of greenhouse gas emissions.[1] Decarbonizing cities and all the activity that takes place within their geographic boundaries will play a key role in achieving global net zero. But it's a complex challenge for a number of reasons.

First, decarbonizing the energy grid—and subsequently electrifying key city infrastructure—won't happen in time to mitigate the worst impacts of climate change.

Second, defining net zero and the scope of what is and isn't included in emissions reporting is far from definitive. There are multiple iterations of both, which can cause confusion.

Third, city progress towards net zero currently depends on the individual performance of many stakeholders, some of whom are moving quickly to decarbonize, while others seem to be standing in place.

Lastly, focusing on decarbonizing individual projects or assets has its limitation - it is often impossible or cost prohibitive to reduce carbon emissions totally at the source. And while Energy Attribute Certificates (EACs) or carbon credits are a cost-effective way to address unavoidable emissions, this approach does have some drawbacks, most notably that investing in EACs or carbon credits doesn't often contribute to the local economy or help reduce local emissions.

Embracing a more holistic, programmatic approach to decarbonization and looking for synergies between different projects, assets, and stakeholders, could create opportunities to collectively reduce emissions on a neighborhood, district, or city scale. These collaborations would allow asset owners to follow a model similar to the purchase of EACs or carbon credits but create local projects that maximize emission reductions at the source. At the same time, investments in local carbon reduction and removal projects could also be targeted to help address a range of other community issues and challenges.

SO, WE ASK THE QUESTION:

**What if city stakeholders used a programmatic approach, looking beyond traditional project and asset boundaries to co-develop solutions that reduce carbon AND address the most urgent and aspirational needs of the community?**

This paper explores how program management principles and approaches used to successfully deliver mega programs around the globe can be applied to the net zero cities challenge, and how a cross-boundary, multi-stakeholder approach to decarbonization could reduce carbon emissions and address other key community challenges. It presents a roadmap for cities wanting to implement this approach to accelerate their journey toward net zero while also creating a more livable city that improves the lives of the people in their communities.

*CHAPTER ONE*

# Introduction

## **Decarbonizing cities:** global progress

Since 1896 when Swedish chemist, Svante Arrhenius, concluded that human activity—in this case burning coal—enhances the natural greenhouse effect,[2] scientists have understood, although certainly not agreed on, the potential for human activity to impact climate on this planet. Fast forward 125 years and the fact is no longer disputable. The sixth and latest Intergovernmental Panel for Climate Change (IPCC) Assessment Report states unequivocally that "human influence has warmed the atmosphere".[3]

In the intervening period, numerous policies, frameworks, and initiatives have been launched to tackle the climate challenge but it is only now, as we stand at the point of no return, that momentum is finally building. The number of governments and private sector businesses committing to net zero targets has roughly doubled over the last year,[4] and some countries are embracing the opportunity to deliver stimulus measures aimed at reducing carbon emissions as part of their post-COVID economic recovery.[5] OECD countries have to date committed around US $336 billion to green stimulus as part of their planned COVID recovery.[6]

And it is just as well, for the United Nations has described 2021 as the "make or break year" for action on climate change.[7] Here, the recently released IPCC Report makes for a confronting read. Temperatures are expected to reach the 1.5 degrees centigrade warming target threshold world leaders agreed upon back in 2015 far sooner than previously expected. Based on our current trajectory, it's estimated we will reach the threshold sometime between 2030 and 2035, rather than somewhere between 2030 and 2052 as previously predicted.[8]

**Clearly, the time for talking has passed; there is now an undeniable and unequivocal need for urgent action.**

## The net zero city challenge

Cities are major contributors to climate change. They consume 78% of the world's energy and produce more than 60% of greenhouse gas emissions.[1] City emissions come from a broad range of activities – from driving a car or riding the bus, to treating drinking water, to the food waste we generate in our homes. Decarbonizing our cities has a vital part to play in reaching global net zero emissions but this aspiration is not without significant challenges.

It is clear that it is in cities where the battle for sustainability will be won or lost.[9]

# Challenge 1

## Decarbonizing our energy systems is a long-term solution, but it may not happen fast enough

Decarbonizing the energy grid is a critical part of the decarbonization process but fully decarbonizing the grid is going to take almost 30 years in most regions of the world, and even longer in some.[10] 30 years is far too late to address the current climate crisis.

To accelerate the transition and successfully mitigate the worst impacts of climate change we must pursue solutions from both ends of the spectrum - a top-down approach to decarbonize the grid and a bottom-up approach to aggressively cut emissions by reducing our energy consumption and reducing emissions from other city sectors too.

# Challenge 2

## Current net zero reporting can be confusing

Many cities are embracing the net zero challenge. To date 799 cities have joined the UN Climate Change Climate Ambition Alliance[11] and initiatives like C40 Cities[12] have shown that cities are leading the way ahead of most national and state governments with regard to outlining and implementing roadmaps that will help them to meet their climate action ambitions.

These commitments are admirable and necessary to catalyze action, but announcements highlighting progress toward, and even the achievement of net zero emissions, can be at best confusing and at worst misleading. As yet, there is no standard carbon accounting framework for cities. Depending on which standard is applied, there can be enormous variation between what is quantified and reported and what isn't.

For example, some cities report on emissions from government or city-council owned buildings and operations alone, while others report on emissions from all activities that occur within their geographic boundaries. Some report embodied and operational carbon while others report operational carbon only. There can also be huge discrepancies in the geographical area covered and the population captured within the definition of "city" depending on how it is interpreted.

## Embodied vs operational carbon

In the built environment, embodied carbon refers to the emissions associated with constructing a building or asset, including the materials selected. On the other hand, operational carbon refers to the emissions associated with operating the building or asset over its lifetime.[13]

# Challenge 3

## Focusing on individual assets produces limited results

In theory, if every project or asset that was a source of greenhouse gas emissions was to achieve net zero, we'd be well on our way to solving the climate crisis. Unfortunately, there are many real-world limitations to what can be achieved when looking at individual emission sources. In most cases, it is just not possible to achieve net zero within a discrete project or asset boundary.

This is particularly true in a city context. Take your typical high-rise residential building for example. When considering the building footprint alone, achieving net zero would be very difficult if not impossible because of the large amount of floor area relative to roof and land area that might realistically be used for on-site renewable energy generation. By comparison, a typical single-family home has a much better chance of achieving net zero. If the goal is net zero within a project or asset boundary, this suggests high density residential should be avoided.

However, when we consider high rise residential buildings in the context of their surrounding infrastructure, the amount of carbon emissions per capita is actually much lower than for a single-family home due to the increased embodied and operational carbon emissions from the infrastructure and transportation needed to support low density developments, as illustrated in Figure 1. In fact, recent research suggests that the "sweet-spot", from a carbon per capita perspective, is somewhere in the middle.[14] The point is that net zero buildings are not always the best or most cost-effective solution when looking at a city as a whole.

Further, while there are many rating tools, standards and frameworks to help new developments achieve low or net zero emissions, there are millions of existing assets around the world that were designed and developed with no such goal in mind. Retrofitting existing buildings to improve sustainability performance and achieve net zero emissions can be a costly process and most owners are unlikely to target such ambitious goals without some meaningful incentive to act. Even worse, tearing down existing assets and replacing them with high-performing assets is costly and would result in greater embodied carbon emissions from new construction.

**FIGURE 1** Comparing residential density and carbon density


- High volume of space under a small roof area
- Limited renewable energy potential relative to demand
- Very low potential for net zero carbon emissions within the asset boundary
- Medium to low carbon per capita / medium to low carbon per floor area


- Medium volume of space under a medium roof area
- Moderate renewable energy potential relative to demand
- Moderate potential for net zero carbon emissions within the asset boundary
- Low carbon per capita / low carbon per floor area


- Small volume of space under a small roof area
- High renewable energy potential relative to demand
- High potential for net zero carbon emissions within the asset boundary
- Medium to high carbon per capita / medium to high carbon per floor area

# Challenge 4

## The current approach to decarbonizing cities is siloed

Some sectors and organizations are moving quickly to decarbonize, while others seem to be standing in place. Some asset owners are fully committed to decarbonizing their buildings, while others do not have the financing, knowledge, or motivation to work toward net zero. All these things create a patchwork of high and low performing stakeholders, in some ways working against one another and slowing progress toward net zero at a city scale. And while working alone may be easier for the individual stakeholder, it may result in a higher cost per ton of carbon reduction overall.

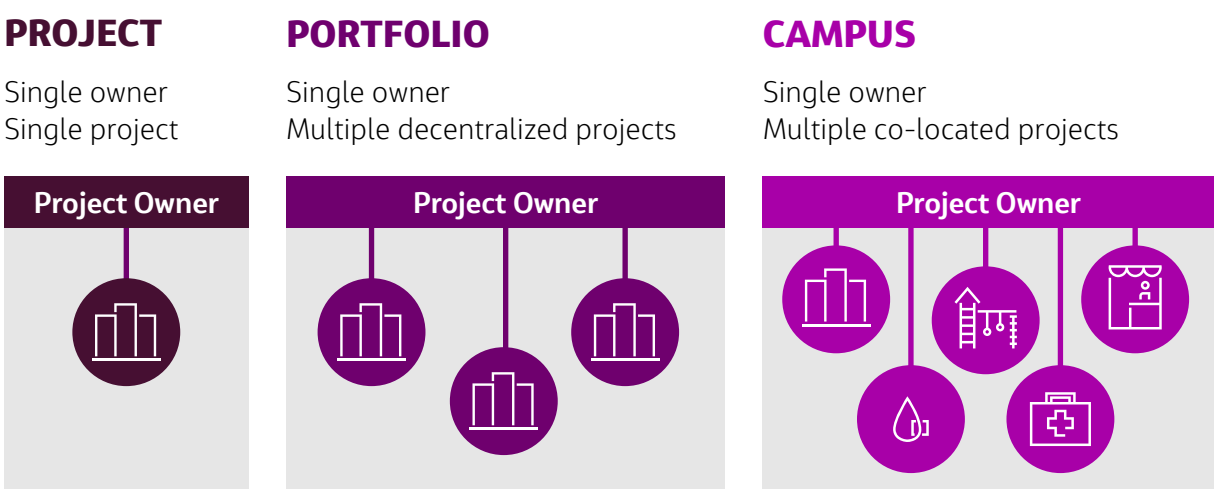
For the owners and operators that are moving to decarbonize, their focus is primarily reducing emissions from activity that falls within their own control or management, be it on a project/asset, portfolio, or campus scale.

Once they have reduced their emissions as much as possible, many then purchase Energy Attribute Certificate (EACs) or carbon credits from global markets to offset their unavoidable emissions.

This is both a practical and cost-effective approach to achieving net zero on paper, but it does have some potential drawbacks.

First, while supporting carbon reduction and removal projects in other parts of the world where the impacts of climate change may be more severely felt, it doesn't get the city itself any closer to net zero emissions in a practical sense. Second, it often directs funds to projects in other parts of the world that could be spent on local projects to help reduce or remove carbon emissions at their source.

**FIGURE 2** A siloed approach based on asset ownership




**Simplified decision making, limited dependence on others, limited potential impact**

# Embracing a more collaborative and holistic approach to achieving net zero

To accelerate the transition to net zero, cities must embrace a more collaborative and holistic approach to decarbonization. This means moving past net zero projects and assets and bringing diverse city stakeholders together to work towards net zero neighborhoods and districts as well. By looking for synergies between projects and stakeholders we could create a wide range of local projects that help reduce emissions at their source and at all scales—individual buildings, city block, neighborhood, district, and city-wide.

This "whole systems" or "programmatic approach" is based on an evolution of well-established program management principles. These principles are already being used to solve big and complex challenges and successfully deliver mega projects and programs around the globe. The same approach can be applied to city decarbonization.

Now consider just how inextricably intertwined decarbonization is with a wide range of other social, environmental and economic issues.

The UN has laid out 17 sustainable development goals for society and acknowledges both the interrelatedness of each goal and the solutions that will address them.[15] We can't address the issue of climate change without also addressing pressing social issues such as inequality, poverty, health, and food and water security.

By prioritizing and investing in local carbon reduction and removal projects, local governments and businesses can do more than remove greenhouse gas emissions, they can invest in the future of their local community; delivering projects that help address other urgent challenges too.

SO, WE ASK THE QUESTION:

**What if city stakeholders used a programmatic approach, looking beyond traditional project and asset boundaries to co-develop solutions that reduce carbon AND address the most urgent and aspirational needs of the community?**

*CHAPTER TWO*

# Establishing the rules of the game

Before we can explore an approach to achieving net zero cities, we must first establish the rules of the game. A clear method for calculating the carbon footprint of cities is the foundation for any net zero goals and is necessary to ensure that decarbonization efforts are measurable, comprehensive, and credible.

**This raises three core questions:**

- What exactly do we mean when we say "net zero"?
- What method for calculating the carbon footprint of cities should we use?
- How do we define the geographic and carbon boundary of the city?

## Defining net zero

A growing number of governments and private sector organizations have committed to net zero goals, but different definitions of net zero are being used. Some definitions allow for offsets through the purchase of renewable energy or carbon credits that reduce emissions, but many others conform to the basic idea that greenhouse gases going into the atmosphere should be balanced by the removal of greenhouse gases out of the atmosphere.

**The Science Based Targets initiative is currently working towards establishing the first science-based global standard for corporate net zero targets, to help companies translate aspiration into action.**[17]

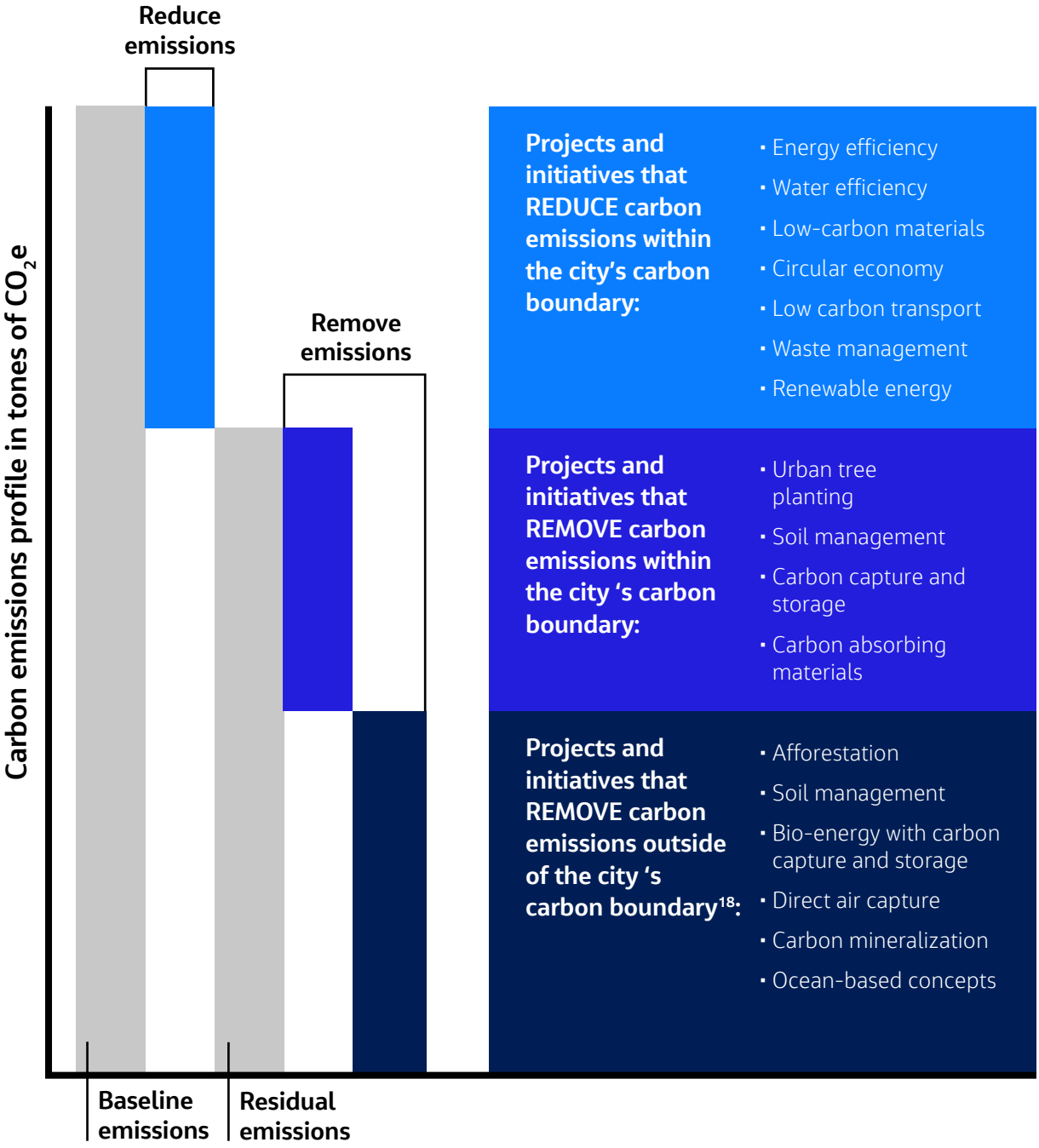
For the purposes of this paper, we have adopted the Carbon Trust's definition of net zero for cities and regions, which states:

**A net zero city or region will set and pursue an ambitious 1.5°C-aligned science-based target for all emissions sources covered within the BASIC+ reporting level of the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC).**

**Any remaining hard-to-decarbonize emissions can be compensated with certified greenhouse gas removal (GGR).[16]**

Most notably, this definition requires that residual emissions that cannot feasibly be eliminated be managed by permanently removing an equivalent amount of greenhouse gas as shown in Figure 4 which illustrates a pathway to achieve a net zero city target.

**FIGURE 4** The path to a net zero city



# Carbon accounting 101

Carbon accounting is a process used to identify and quantify the greenhouse gas emissions of a project or organization. There are several existing standards and frameworks available but the GHG Protocol Corporate Standard is one of the most familiar and widely used.[19] The Corporate Standard and its associated sector-specific tools provide the basic guidance and emission factors required for organizations to calculate their emissions from various sources, such as fossil and biomass fuel combustion, industrial processes, land use changes, indirect impacts from electricity purchases, and other sectors.

## Understanding reported carbon

With a few small exceptions, reported carbon/greenhouse gas (GHG) accounting usually includes six types of GHGs – carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O$), sulfur hexafluoride ($SF_6$), perfluorocarbons (PFCs), and hydrofluorocarbons (HFCs). Of these, carbon dioxide and methane are most relevant to city-wide GHG emissions. Because the different GHGs have varying impact on atmospheric warming, the global warming potential of each gas is used to express the overall climate change impact which is reported in units of metric tons of $CO_2$ equivalent ($CO_2e$).[20]

## Carbon accounting for cities

Carbon accounting for cities, as opposed to corporate entities, is somewhat different. First, there are many published standards and guidance for climate action at the local government level, with no one standard more popular than others.

The standards fall into two general categories:

- **Municipal accounting standards,** which focus on emissions from operating city functions such as water, wastewater, solid waste, road maintenance, and other services. Typically, city managers have some ability to directly impact these emissions.
- **Community accounting standards,** which focus on all emissions from within the geographic boundaries of the local government, including sources which are not in the control of city managers. Managing these emissions requires public policy, regulation, and stakeholder support.

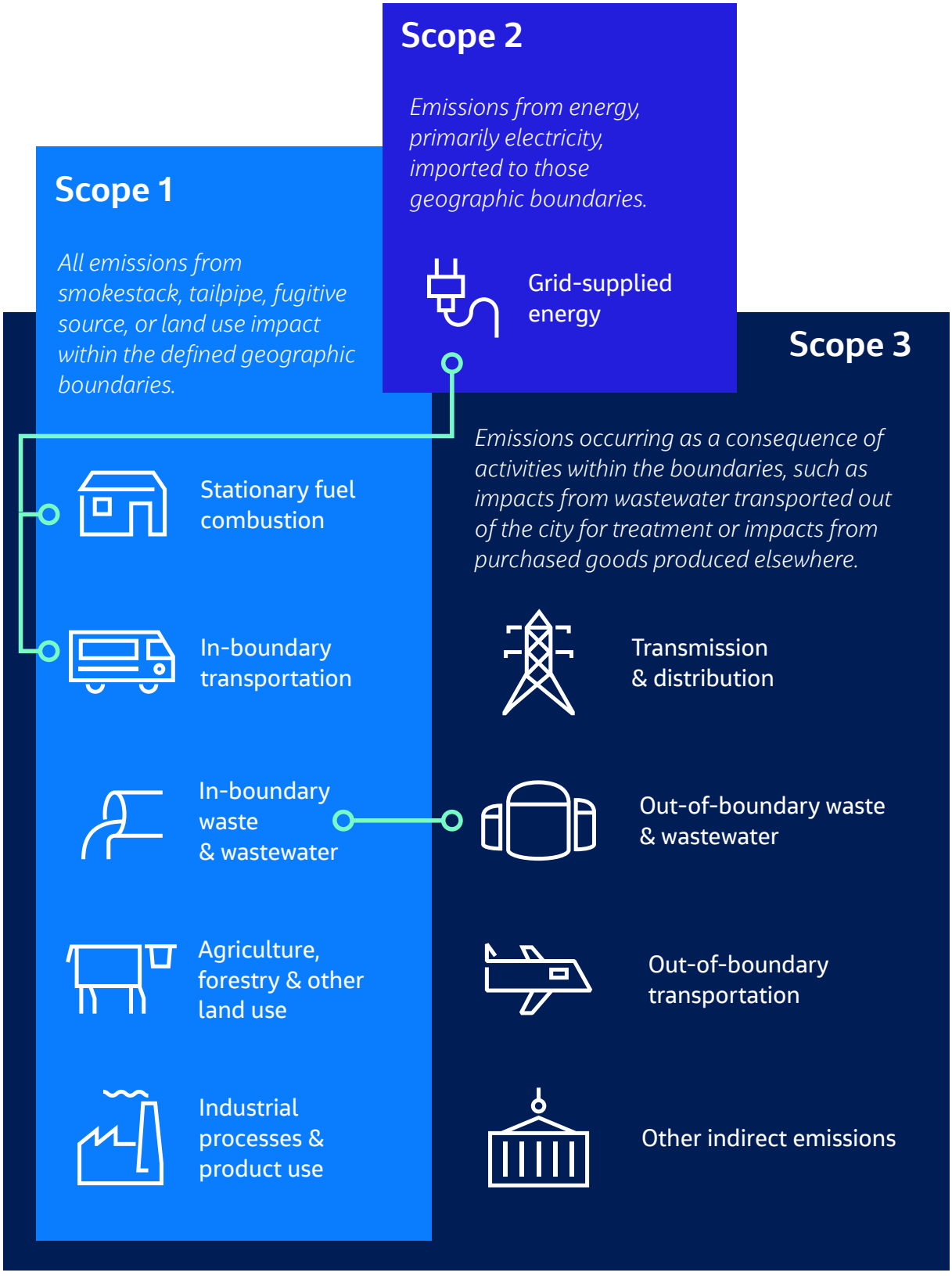
Because they capture all the emissions within the geographic boundaries of a city, community accounting standards are better suited to cities wanting to measure, track, and report on progress towards net zero.

The GHG Protocol for Community-Scale Greenhouse Gas Emission Inventories: An Accounting and Reporting Standard for Cities is one such community accounting standard.[21] It builds off several similar documents, including the GHG Protocol Corporate Standard we mentioned earlier, for quantifying impacts from stationary energy, transportation, waste, industrial processes and product use, agriculture forestry and other land uses. Under the Standard, emissions are reported across three different areas or scopes, as shown in Figure 5. Cities can choose between reporting a BASIC level of completeness and detail which encompasses Scope 1 and 2 only, or a BASIC+ level which encompasses Scope 1, 2 and 3.

We include the GHG Protocol for Community-Scale Greenhouse Gas Emission Inventories here as an example of a community accounting standard cities can use to quantify all emissions within their geographic boundary. There are others. Just which standard cities adopt is arguably much less important than the fact they adopt just one. Cities pursuing city-wide decarbonization at all scales need to identify a single carbon accounting framework, shared across all stakeholders, if they are to collaborate to reduce emissions, hold all participating stakeholders accountable to their commitments, and accelerate city-wide transition to net zero.

**FIGURE 5** Sources and boundaries of city GHG emissions[21]

Under the GHG Protocol for Community-Scale Greenhouse Gas Emission Inventories, emissions are reported across three areas:



# Defining the geographic and carbon boundary of a city

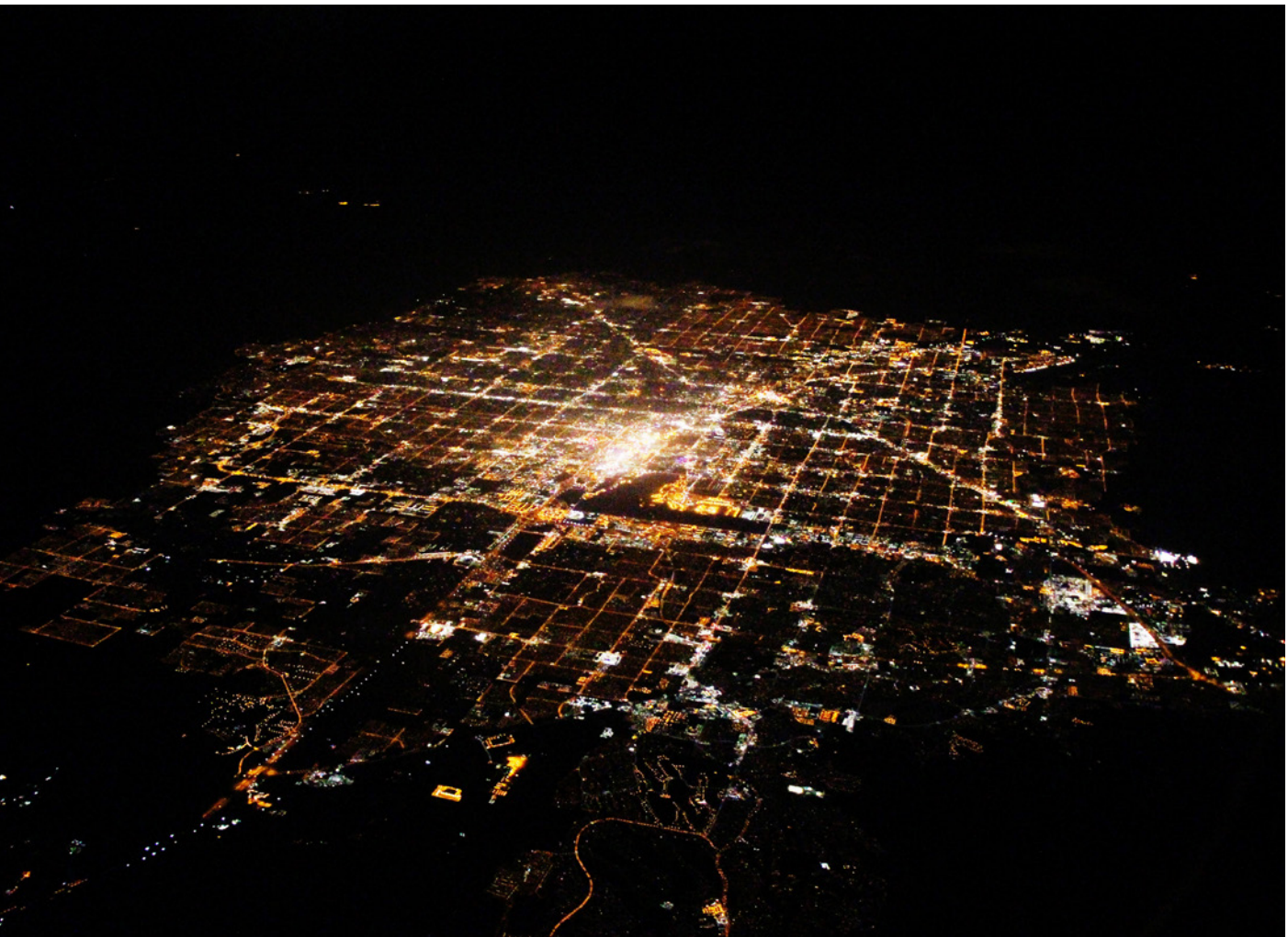
The last thing city stakeholders must agree on is the extent of the geographic area that that they are working to decarbonize. The term "city" can be subjective and just how it is interpreted and defined can have significant implications from a carbon accounting and net zero perspective.

Take the city of New York for example. Do we mean the political entity, "New York City", which covers an area of around 300.4 square miles (778 $km^2$) and has a population of a bit more than 8,200,000?[23] Or do we mean the "New York Metro Area", covering an area of around 4,669 square miles[22] (12,093 $km^2$) with a population of about 19,200,000?[24]

Or is it any of a series of possible statistical measure such as "metropolitan statistical areas", "core-based statistical areas", or "combined statistical areas"?

The key point here is that each city may define their boundary for their carbon inventory differently, which is okay, as long as all stakeholders agree on the boundary definition and understand the implications on their carbon reduction goals.

For the purpose of this paper, when we talk about decarbonizing cities, we are referring to the definition used in the GHG Protocol for Community-Scale Greenhouse Gas Emissions Inventories, which states that the term city "refers to any geographically discernable subnational entity, such as a community, town, city, or province, and covers all levels of subnational jurisdiction as well as local government as legal entities of public administration".[21]



*CHAPTER THREE*

# A programmatic approach to decarbonizing cities

Now that we've established the rules of the game, we can return to the topic of a programmatic approach. This approach is already being used to address complex challenges and successfully deliver mega programs around the globe, and the key learnings can be applied to accelerate city decarbonization and the transition to net zero.

## Defining mega programs and their relevance to the net zero conversation

A **program** is a collection of individual projects linked together by physical proximity or complementary function and delivered under a common governance framework.

**Mega programs** are large scale, complex, transformational programs, costing US $1 billion or more, that have regional, national, or international significance. Mega programs are characterized by having multiple stakeholders and asset owners who must work together within a governance framework to deliver a shared vision. These can be major infrastructure programs, large-scale mixed-use urban developments, or global event programs such as Olympic Games or World Expos.

**Program management** is a delivery approach for complex and interconnected projects—or a program—especially those that challenge existing delivery capability to achieve success, such as mega programs mentioned above. As delivery complexity increases so does strategic opportunity, and the program management approach is designed to help unlock these opportunities and increase the likelihood of success by managing the interdependencies and integration across the program.

Programs that occur within a city, such as an Olympics or a World Expo, are the most complex in terms of stakeholder engagement and community impact. This makes them a valuable model for decarbonizing cities where cross boundary, multi-stakeholder solutions are required to address the complex challenges.

**FIGURE 6** A program approach based on collaboration and shared objectives


**Complex decision making, significant dependence on others, significant potential impact**

# Applying key learnings from program management of mega programs to decarbonizing cities

Drawing on our experience program managing the delivery of mega programs around the world, we've identified four areas where program management principles can support a more holistic, collaborative approach to decarbonization.

## LEARNING 1:
## Measuring and managing the right information

Achieving net zero emissions at a city scale is an ambitious goal, but how do we know if we are making progress? How do we know when we have reached the goal?

Program controls are an important part of the program management delivery approach. They represent the integrated management and reporting of scope, schedule, cost, risk, change and performance to support efficient delivery against defined goals. They allow scope and progress to be communicated among the stakeholders and performance to be compared across projects.

When establishing program controls, the initial objective is to develop and agree a program baseline against which future performance can be measured, managed, and reported.

A system of integrated tools and processes is then used to monitor performance and report on all projects within the program, as well as to integrate data from other programs and projects that could affect whether the program acheves its goals. The system reports timely and auditable data, revealing areas of potential risk or opportunity and highlighting recurring problems or best practices that can be addressed at both the project and program levels.

Once developed, the program baseline becomes the roadmap for delivery, translating program scope into a logical sequence of interactions over time. It allows the program team to manage the overall program and to understand impacts of performance among the individual projects and stakeholders. It also allows decision makers to understand critical milestone and decision points, quickly identify required resources, and recognize potential risks early enough to mitigate potential impacts.

### Applying the learning to net zero cities

Utilizing the principles of program controls along with the GHG Protocol for Community-Scale Greenhouse Gas Emission Inventories, we can determine what type of information is needed and the level of detail required to build a baseline carbon inventory for a city. Because of the complexity of cities and the volume of data that may be available, it is critical that only the most relevant data is collected and monitored to ensure that the required effort is achievable.

From there, the program baseline can be developed. The baseline will be the basis for measuring, managing and reporting against city decarbonization goals.

## LEARNING 2:
# Managing performance

Managing performance includes establishing key program goals, defining desired outcomes, determining how to measure progress toward these outcomes, and developing a data collection methodology to support the process.

Once the program baseline is clearly defined, setting performance targets at the individual project and program levels are the next step. This allows individual stakeholders with responsibility for projects within the program, to understand how their project's performance supports the overall goals of the program. Progress is evaluated against the agreed-upon performance targets and adjustments are made to ensure that the overall program performance stays on track.

### Applying the learning to net zero cities

With the baseline clearly defined, we can begin to set targets for reductions across individual projects and the program as a whole, and across city sectors. Progress towards net zero goals can be measured against the baseline. The benefits of this would be threefold:

- It will allow city stakeholders and asset owners to make informed decisions about how to invest their time and money to make the greatest impact.
- It will allow government, corporate and community stakeholder to understand how their actions contribute to city-wide goals.
- It will allow multiple goals to be addressed simultaneously, unlocking a wide range of multi-stakeholder opportunities to reduce emissions and create positive impacts for the community. Not only could we measure performance against the net zero target, but we could also measure performance against other targets set to benefit the community, such as job creation, increased health and wellness, educational performance, and others.

## LEARNING 3:
# Managing complex risks

Managing and mitigating risks is critical to the success of any project or program to ensure that objectives are achieved, quality is maintained, cost is controlled, and the schedule/timeline is met. In a typical program, a risk management system is put in place to identify project and program risks and determine the likelihood and potential impact of each. This analysis allows stakeholders to focus their efforts on developing mitigation strategies for the most critical risks, and not be distracted by risks that have a minor impact or are very unlikely to occur.

The more complex the program, the more important risk management becomes to ensure emerging (unforeseen) risks are identified quickly to develop appropriate responses.

### Applying the learning to net zero cities

There are many potential risks along the path to net zero. Applying risk management principles to a net zero city program would allow stakeholders to focus their limited resources on the most important actions to reduce the possibility of failure of any individual project and would ensure that program objectives stay on track.

# Potential risks along the path to net zero

If carbon management, with a common set of carbon standards and protocols, is not adopted by city stakeholders, then there is a risk that efforts to achieve a net zero city target will be compromised and the results will lack transparency and credibility.

If the relevant city stakeholders are not included, or do not participate in the carbon management process, then there may be significant gaps in the baseline carbon inventory for a city which will undermine the net zero effort.

If policy makers are not engaged, coordinated, and supportive of the net zero city effort, then there may be policy barriers that make implementing many carbon reduction and removal strategies, particularly the multi-stakeholder strategies outlined in this paper, more difficult to achieve.

If key stakeholders are not engaged in the process, and the potential benefits beyond carbon are not clear to them, then there may be a lack of incentive to collaborate on carbon reduction and removal projects which will limit progress toward the net zero goal.

If city stakeholder only focus their time and money on reducing and removing carbon emissions, then a major opportunity to take a more holistic approach that creates co-benefits and addresses a wide range of other critical challenges facing our cities will be lost.

If decarbonization efforts are focused primarily on assets rather than neighborhoods, districts, and cities, then there may be some high performing aspects of the city, but the total reduction of the city's carbon footprint will be limited.

If cities wait for the decarbonization of the grid as the way to achieve net zero emissions, then global emissions could continue to rise over the next 30 years and increase the scale of the crisis.

If decarbonization programs focus on energy consumption from electricity alone, which accounts for less than half of a city's total energy consumption (the rest being from other sources), then there is a risk that carbon reduction goals will not be met.

If new business models that encourage multi-stakeholder and cross sector collaboration are not adopted, there may be a lack of funding to deliver carbon reduction and removal projects.

## LEARNING 4:
# Multi-stakeholder collaboration unlocks significant opportunities

Major programs can include a huge number of diverse stakeholders and, invariably, they all have their own priorities and requirements. Unless all stakeholders are understood and their priorities and requirements considered, their support for the program may be limited and unforeseen challenge and consequence will most likely arise during program delivery.

Effective stakeholder management approaches drive successful delivery and need to be started from the outset. Early activity should include creating a stakeholder map detailing the different stakeholder groups and the impact of their involvement in - and their level of commitment to - the objectives of the program. This information is critical to understanding the bounds within which future decisions can be made and agreements reached to secure program delivery.

Through collaboration, several strategic delivery benefits are possible:

- Aligning policy makers, the private sector, and community stakeholders around key program objectives results in fewer barriers and greater incentives to act.
- Common approaches to addressing legislative requirements accelerate the approval process.
- Multi-stakeholder engagement where each party benefits from the effort creates an environment where "collective good" is achieve rather than any single party receiving disproportionate benefits.
- Collective purchasing power increases through the involvement of the stakeholders, resulting in economies of scale a greater value for money.
- Collective action drives effective delivery and greater impact.
- Knowledge sharing among stakeholders result in benefits for all.

## Applying the learning to net zero cities

One of the most important aspects of addressing any issue at a city scale is stakeholder engagement and collaboration. But cities are very complex stakeholder environments and stakeholders have a diverse range of motivations and perspectives. This can make collaboration challenging. Climate change is arguably the most critical challenge facing society today, but it is not the only one, and it may not be the priority for many stakeholders. For example, a city with limited funds at its disposal may have to prioritize immediate safety and security concerns, ensuring reliable power and food supply, improvements in education, or infrastructure repairs, instead of decarbonization and climate action.

**Climate change is arguably the most critical challenge facing society today, but it is not the only one, and it may not be the priority for many stakeholders.**

Yet, a city can only decarbonize through collaboration between government, the private sector, and local communities.[25] With so many potential stakeholders required to come together to achieve net zero status in our cities, stakeholder management is an essential tool for creating the right conditions that encourage collaboration to reduce greenhouse gas emissions whilst still allowing stakeholders to make progress on other priorities. If not, stakeholders are unlikely to contribute in a meaningful way, and society will fail to address the climate crisis with any urgency.

*CHAPTER FOUR*

# Beyond carbon: delivering holistic city outcomes

## Core principles that underpin holistic city outcomes

So, just what value could a programmatic approach to decarbonization deliver? Before we look at some scenarios, there are several core principles that we believe underpin any approach that seeks to deliver social, economic, and environmental co-benefits alongside decarbonization.

## Viewing projects and initiatives through an integrated urban sustainability lens

We live in an increasingly urbanized world. Currently, approximately 55% of the global population, approximately four billion people, already reside in cities, and as people continue to relocate their lives, this is predicted to rise to an estimated 68% (approximately 6 billion people) by 2050.[26]

Now people can thrive in density. When planned well, urbanization can offer greater physical connectivity, community cohesion, and resource efficiency, and deliver highly sustainable outcomes. However, if poorly managed, urbanization can come with a range of drawbacks, including poor affordability, low quality of life, crime, lack of supporting infrastructure and environmental degradation.

The challenge as we move towards delivering net zero cities is to organize and operate the places where we work, live, and play in such a manner that they are vibrant, agile, and resilient to the pressures of growing urbanization whilst delivering decarbonization solutions.

Importantly, there is no one-size-fits-all solution to delivering net zero cities. Each city will require a unique place-based solution. Integrated urban sustainability looks to optimize the function of our precincts and cities and create a platform to share ideas and lessons learned on delivering net zero cities globally.

**There is no one-size-fits-all solution to delivering net zero cities.**

# Generating maximum social value from projects and initiatives

Social value refers to the positive impact—or value—an intervention, project, or program generates in society, including the sort of value that can be difficult to quantify using conventional market economics alone.

Social value outcomes span a range of components that contribute to quality of life, including community wellbeing, equity and equality, housing, mobility, access to work and vital services, and physical and mental health. By measuring social value, we can identify and quantify how the actions of governments, businesses, and non-for-profit organizations positively affect peoples' lives.

In cities, infrastructure projects are a lever or catalyst to create social value and great outcomes in local communities. For example, infrastructure projects have been catalysts to deliver schools STEAM training, create local jobs and training, seeded and sponsored social enterprises, repurposed resumed properties and sites for temporary community uses, and partnered to create community gardens.

As cities invest in local carbon reduction and removal projects, designing projects that also address community needs and deliver social value could deliver additional wellbeing and quality of life co-benefits. Every neighborhood, district or city will have its own unique set of social challenges, but by establishing a common vision for social value amongst city stakeholders, and translating that vision into clear strategy and planning, cities can develop projects that also leave a lasting legacy in communities.

**FIGURE 7** Components of social value

**Community wellbeing**

*Connectedness, cohesion and safety*

**Equality and equity**

*Including justice and fairness*

**Work**

*Security, availability and meaning*

**Physical and mental health**

**Housing**

*Affordability and choice*

**Mobility**

*Accessibility and choice*

**Access to vital services**

*Food, water, energy and health*

If you'd like to learn more about the concept of social value and how infrastructure projects and investments can be used as a mechanism for addressing critical challenges in our community, check out **Before & Beyond the Build: A blueprint for creating enduring social value at scale through infrastructure investments.**

# Adopting a human-centered approach

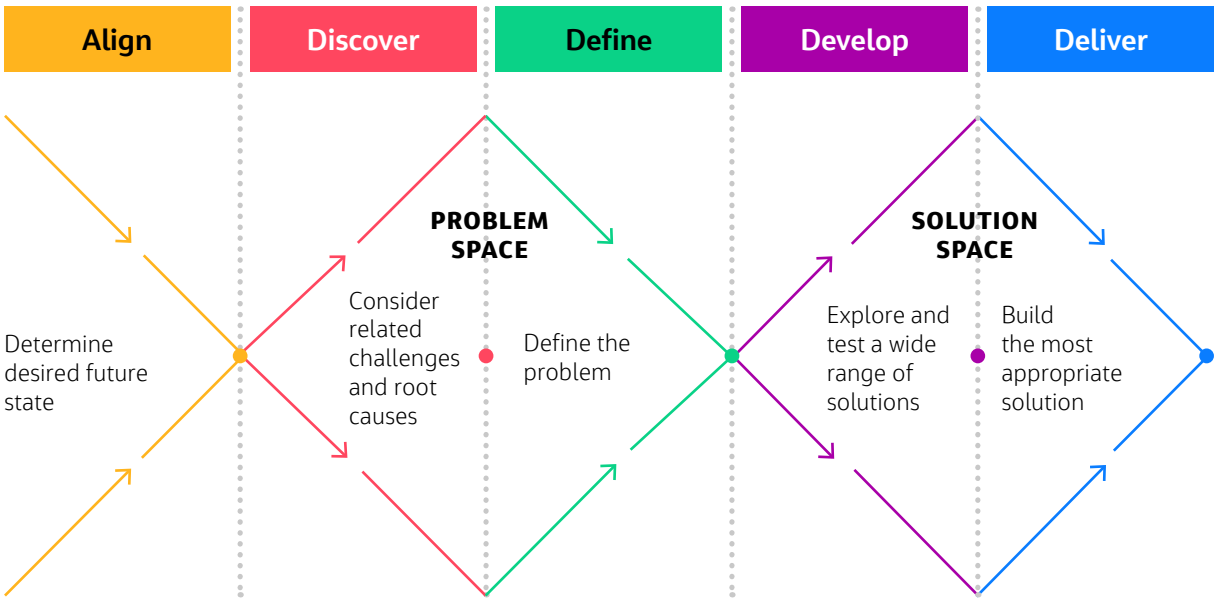
Human-centered design (HCD) places people, and their needs and wants, at the forefront of city design. After all, communities are key stakeholders in the urban design process; HCD makes them shareholders of that process too.

By adopting a human-centric approach to delivering net zero, cities can become a true representation of the community's aspirations. Engaging local communities in the design process also increases the likelihood of creating solutions that will meet the needs of the community now and into the future. There is also evidence to show that increased human participation in the design process results in a greater focus on sustainability, and more creative and innovative solutions.[27]

**In the delivery of net zero cities, the HCD process can be used to:**

- Generate a wide variety of decarbonization ideas and approaches, with a focus on the needs of the community.
- Translate ideas into prototypes or pilot projects.
- Share prototypes or pilot projects with the city communities to de-risk community acceptance of decarbonization strategies – they were part of the creative process.
- Advance a solution for release with the support of the community.
- Deliver solutions that meet community needs and advance the delivery of net zero cities.

**FIGURE 8** Typical human centered design process[27]




## Accelerating sustainability outcomes through a biomimicry approach

We have become adept at managing and mitigating the negative impacts of the built environment on people and the planet. Now, focus is shifting away from how we design to minimize our negative impact to how we design to realize a positive impact. One way we can achieve this is to look to the natural world for solutions - an approach known as biomimicry or the practice of "learning from and then emulating nature's forms, processes, and ecosystems to create more sustainable designs".[28]

Nature can provide some valuable lessons when it comes to decarbonization. After all, carbon impacts the natural world as well as the built environment, and over a period of 3.8 billion of years, it has developed its own adaptive strategies to both manage and take advantage of its presence.[29]

A biomimicry approach can inform the net zero process through the identification of technologies and products inspired by the natural world. It can showcase important insights into how nature's genius can help solve human problems and identify new methodologies to generate low-carbon energy, sequester carbon in construction materials, and rethink agricultural practices - all critical in delivering net zero solutions at scale.

## Taking a circular economy approach

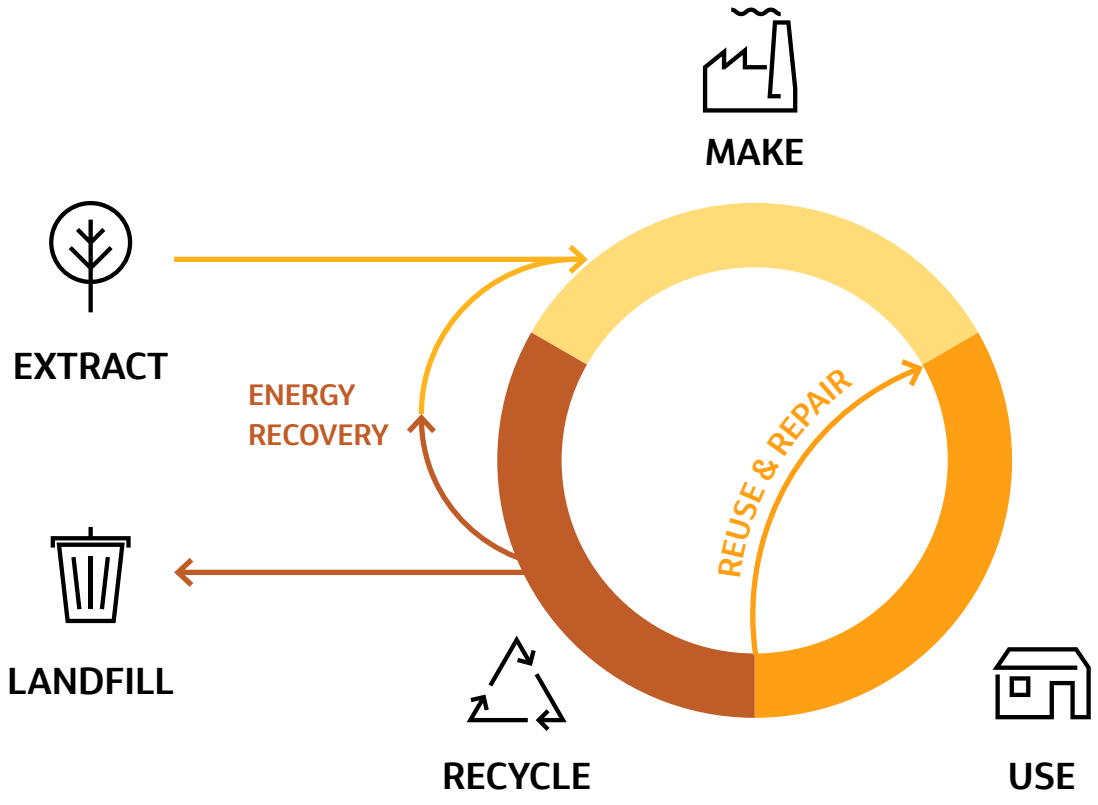
There is a need to rapidly shift away from the linear 'take, make and disposal' of resources to a more circular approach that "continually seeks to reduce the environmental impacts of production and consumption, while enabling economic growth through more productive use of natural resources."[30]

Moving to a circular economy can provide cities and their occupants with long-term economic, social, and environmental benefits, increase public amenity within a city, and positively influence community behavior leading to significant resource recovery outcomes. Everyone within a city has a role to play, and a robust circular economy strategy is likely to form a critical part of any city's net zero strategy.

**From a net zero cities perspective, a more circular economy could help:**

- Generate jobs in decarbonization industries.
- Decouple a city's economic growth from resource use, meaning the economy is no longer constrained by access to primary resources.
- Increase the robustness of a city's economy and improve resilience in critical city system.
- Decrease energy use and greenhouse gas emissions.
- Increase the accessibility of goods.
- Improve how we use valuable and finite resources and maximize the value of resources by understanding the true value of materials and giving resources more than one useful life.
- Reduce waste generation which can have a huge impact in waste management systems, traffic planning and land planning.

**FIGURE 9** Circular economy process[30]



# Embracing digital

Embracing and embedding digital infrastructure, data, and digital solutions across all facets of the city landscape is an integral component in the transition to net zero.

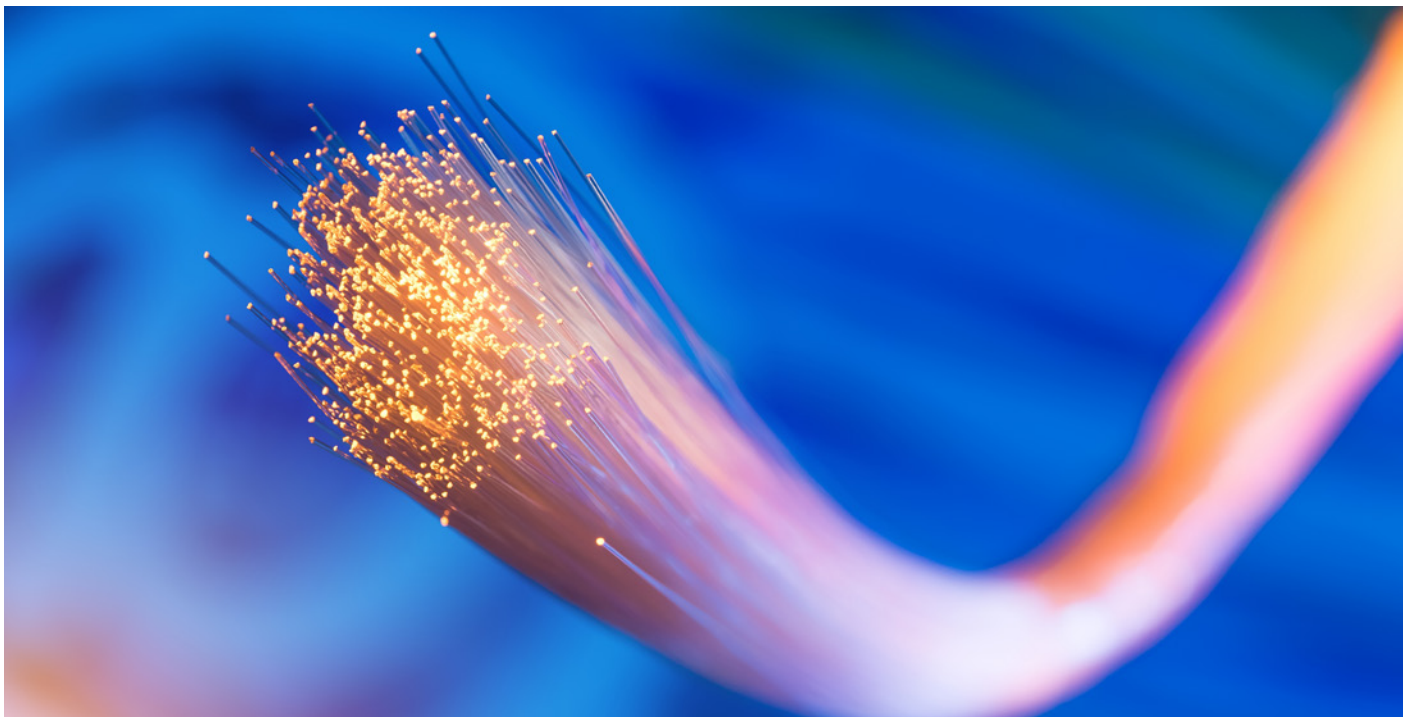
Cities around the world have typically deconstructed their digital ambitions into component parts, focusing on specific verticals or single point-solutions—think parking, waste management, lighting etc. For the owners and operators of these assets, having the right digital infrastructure and solutions in place provides the component data sources they need to decarbonize a whole host of day-to-day operations and asset management activities, inform decision making and strategy, track and monitor performance, measure success, and improve the accuracy and transparency of carbon reporting.

To support decarbonization on a city-wide scale however, cities must also consider the transverse nature of the challenge and combine vertical solutions into integrated, horizontal solutions.

For example, using artificial intelligence and machine learning as part of city-based micro energy generation (solar/wind) and storage (car, home and neighborhood scale batteries) solutions creates immense decarbonization-related possibilities, including predicting weather conditions and periods of high renewable energy generation, planning consumption activities to better match demand and supply, facilitating small scale peer-to-peer energy trading, and planning and optimizing electric vehicle charging.

A master-planned and holistic digital approach is key to unlocking value from the ever-increasing plethora of data generated through the various initiatives across the breadth of the city landscape, supporting a programmatic approach to decarbonization, informing local carbon reduction and removal projects, and delivering additional co-benefits to communities.

Digital tools such as artificial intelligence and machine learning can provide the facility to aggregate and analyze immense amounts of data rapidly, to recognize trends, develop insights and identify value which may have previously been unseen. Exposing this data for wider community use can also enable the gamification of net zero carbon as businesses and encourage consumers to alter their purchase decisions in order to improve their carbon credentials.



## Acknowledging the influential role of urban planning

Efforts to reduce city emissions have previously focused on individual projects or assets. A programmatic approach to net zero cities requires a shift in focus to prioritize decarbonization at the neighborhood, precinct, and city level—where buildings and assets are no longer viewed in isolation but as a part of an integrated and dependent wider system —and purposeful planning that drives holistic outcomes.

As the technical and political process that is focused on developing and designing land use and the built environment, and the mechanism by which cities respond to questions about how people will work, live, play, and travel, city planning has a big role to play in decarbonization.

Earlier we discussed the importance of stakeholder relations in delivering net zero cities. City planners have visibility across a whole range of cities challenges, including transportation, housing, employment, and livability to name a few. They are also in the unique position to engage in meaningful dialogue to influence individuals and affect change with stakeholders and the community.

To deliver net zero cities we must have a purposeful city planning process focused on delivering efficient low-carbon urban centers and holistic outcomes that benefit the community. Planning must go beyond simple carbon reduction policies and develop alternative mechanisms to incentivize rapid decarbonization while addressing social inequalities and the shocks and stresses of city resilience.

# How local carbon reduction and removal projects can generate holistic city outcomes

There are many carbon mitigation, reduction and removal solutions already being implemented and many more innovative solutions on the horizon but they are not the focus of this paper. Instead, we're interested in opportunities where a more collaborative, city-wide approach could lead to innovative strategies and solutions that reduce local carbon emissions AND deliver other positive co-benefits to communities.*

## Distributed energy solutions

As discussed at the beginning of this paper, decarbonizing the grid will play a key role in achieving net zero emissions, but it won't happen quickly enough to be the whole solution. Distributed energy solutions—smaller, often community-based, renewable energy generation and storage systems (such as battery energy storage solutions) that offer a greener alternative to grid supply—are another key part of the puzzle.

In a city landscape, distributed energy solutions are predominantly integrated solar and community energy schemes (co-operatives) whereby relatively small- to medium-scale renewable technologies support local demands.

When coupled with digital technologies, distributed energy solutions could create a new, dynamic energy system. We are rapidly moving to a position where artificial intelligence and digital systems will enable new and localized business models. These models will facilitate localized trading of distributed energy generation (where individuals or organizations trade their excess energy) and deliver more efficient and cost-effective use of energy.

Maximizing the use of distributed energy systems is key to offsetting the growing demand for grid power as we increase the electrification of our cities through the transition to net zero emission mobility, heating and cooling, and ensuring that additional generation capacity will not be needed to compensate for the millions of assets that continue to operate inefficiently. Not only that, they are also an obvious vehicle for addressing other challenges and delivering additional co-benefits to the community too.

**The discussion explores numerous different approaches but is not meant to be an exhaustive list.*

# **Example:** Schools as micro energy generators

| | |
|---|---|
| **Concept** | Installing rooftop solar generation in schools in low income neighborhoods to meet their energy needs and be exported back into the grid at times when supply exceeds demand. |
| **City Stakeholders** | Schools, local community, investors, energy operator, local government |
| **Decarbonization Benefits** | ▪ Reduce demands for grid power by reducing the school's power demands.<br>▪ Provide a reliable source of renewable energy back into the grid.<br>▪ Accelerate the city-wide transition to net zero.<br>▪ Support investors to meet their net zero targets and meet other sustainability and community objectives. |
| **Other Community Co-Benefits** | ▪ Provide the school with an additional revenue stream to fund priority education initiatives or in-school programs that address other challenges like food poverty. |
| **Feasibility** | There are several financial models in use today that facilitate solutions like this, from solar leasing programs, Energy Services Companies (ESCOs), and direct investment that would allow schools with limited budgets take advantage of this type of program. |

# **Example:** Electric vehicles as virtual energy storage

| | |
|---|---|
| **Concept** | Using vehicle batteries connected to charging infrastructure to store renewable energy when generation is high during the day and feed energy back into the grid when generation is low. |
| **City Stakeholders** | Individual owners, local businesses, investors, energy operators, local government |
| **Decarbonization Benefits** | ▪ Over time add significant storage capacity to the grid.<br>▪ Support investors to meet their net zero targets and meet other sustainability and community objectives.<br>▪ Accelerate the city-wide transition to net zero. |
| **Other Community Co-Benefits** | ▪ Create the opportunity for individual owners to play a role in the energy sector and benefit financially. |
| **Feasibility** | More organizations and individuals are transitioning to electric vehicles and the deployment of two-way charging infrastructure is increasing. Vehicle-to-grid technology is turning an asset that is typically not being used 95% of the time into a functioning part of a grid storage solutions and a source of revenue for the owner.[31] There are trials underway in which individuals and organizations can allocate a percentage of their vehicle battery capacity to the grid - 10% for example. In in exchange, the grid operator pays for the use of that capacity through reduced rates for energy or direct payment. |

## Urban agriculture and food security initiatives

Our current food production system contributes to a host of environmental challenges, including land clearing and habitat destruction, biodiversity loss, water and soil contamination, and carbon emissions from production, processing, transportation, and disposal of food waste. At the same time, food security is a significant issue facing many cities, and "food deserts" exist in many underserved communities where the lack of access to healthy and affordable food contributes to a range health and social issues.

In a city landscape, urban agriculture initiatives could support global and city decarbonization and food security outcomes. While it's not possible to produce all the food required to feed the occupants of cities within the city boundary, there is an opportunity to produce a percentage of the demand, and there are many points in the cycle where low-tech and high-tech methods could be used to produce, process, and dispose of food while reducing emissions and creating social benefits.

# **Example:** The community as food producers

| | |
|---|---|
| **Concept** | Developing community gardens, rooftop gardens, productive landscapes, and found space vertical gardens as community food production projects, eliminating several steps in the current commercial model. |
| **City Stakeholders** | Individuals, community organizations, local businesses, food producers, local government |
| **Decarbonization Benefits** | ▪ Reduce pollution resulting from traditional agricultural practices.<br>▪ Reduce the demand on the traditional food supply chain and stress on existing farmlands.<br>▪ Reduce emissions generated by getting food to the consumer by minimizing the need for large-scale equipment involved in harvesting, transport, cold storage or freezing.<br>▪ Reduce waste resulting from the traditional supply chain. |
| **Other Community Co-Benefits** | ▪ Provide a stable source of leafy greens and other small crops in cities.<br>▪ Improve access to healthy and affordable produce.<br>▪ Promote health, wellness, and food security.<br>▪ Provide small business opportunities that deliver economic and health benefits. |
| **Feasibility** | Singapore's 30 by 30 Initiative to produce 30% of its nutrition needs locally[32] is a good example of how cities with very limited space for food production can embrace the idea of urban agriculture. |

## **Example:** Food rescue programs

| | |
|---|---|
| **Concept** | Innovative food rescue programs that collect unused food from grocery stores, restaurants and hotels and distribute to those in need. |
| **City Stakeholders** | Individuals, community organizations, local businesses, food producers, local government |
| **Decarbonization Benefits** | ▪ Divert organic waste from landfill.<br>▪ Reduce methane gas emissions.<br>▪ Reduce value chain emissions associated with food production. |
| **Other Community Co-Benefits** | ▪ Improve community access to health and affordable food.<br>▪ Address poverty and disadvantage in the community.<br>▪ Provide small business opportunities that deliver economic and health benefits. |
| **Feasibility** | Start-ups and not-for-profit organizations around the world are already leveraging digital and artificial intelligence tools to gather detailed data on food waste, for example from hotels and restaurants, and identify patterns in wastage that allows food that would normally go to waste to be redistributed to those in need.[33] |

## **Example:** Food waste recovery and recycling

| | |
|---|---|
| **Concept** | Innovative food waste recovery and recycling programs that collect food waste and process the waste to be reused as nutrients in vertical farms and greenhouses. |
| **City Stakeholders** | Individuals, community organizations, local businesses, food producers, local government |
| **Decarbonization Benefits** | ▪ Divert organic waste from landfill.<br>▪ Reduce methane gas emissions. |
| **Other Community Co-Benefits** | ▪ Support local food production initiatives.<br>▪ Improve access to healthy and affordable fresh produce.<br>▪ Provide small business opportunities that deliver economic and health benefits. |
| **Feasibility** | Companies in urban centers are already implementing circular economy principles and turning organic waste into a valuable, sustainable resource and reducing carbon emissions in the process.[34] |

# Mobility and access solutions

Transport accounts for around 20% of carbon dioxide emissions globally and nearly half of this stems from road passenger transport.[35] Getting people out of their cars and onto public transport and other greener modes of transport is key to decarbonizing our cities. Undoubtedly, the future of mobility in cities is electric, but if we are to address decarbonization and mobility challenges more holistically, backing projects and initiatives that encourage the right modes of transport is critical.

**Transport accounts for around 20% of carbon dioxide emissions globally and nearly half of this stems from road passenger transport.**

Cities by definition are places where a lot of people and activities occupy relatively little space. Some congestion is desirable - it's part of what makes cities exciting, stimulating, and vibrant - but too much and mobility, accessibility, livability, and wellbeing can be severely impacted. As such, the challenge is as much about land use as mobility. Mixing uses and increasing densities brings activities and destinations closer together, reducing the need to move about and increasing the range of mobility options.

Almost always, mobility is a means, not an end, and the goal is access. Access to goods, access to services, access to nature, access to other people.

At the same time, space in cities is at a premium. Therefore, the goal is to reduce both the carbon footprint of mobility and the dimensional footprint of mobility solutions. Modes that occupy too much space should be discouraged.

Dimensionally, an electric vehicle is no better for the city than a gasoline engine vehicle. Per rider, a bus or train requires much less space, as do walking and cycling. So, while electric vehicles will certainly contribute to regional mobility strategies, within city centers, neighborhoods, and other key mixed-use districts, their use, particularly for single-passenger trips should be discouraged, not for their carbon impacts but because they occupy too much space.

Instead, city projects and initiatives to address decarbonization and mobility goals should focus on mass transit and dimensionally appropriate forms of micro-transit such as e-bikes, new energy vehicles, cargo-bikes, scooters, and skateboards, and active transport, rather than single-passenger electric cars. This approach will open up a wide range of opportunities to enhance peoples' quality of life, while also reducing the carbon footprint of cities.

# **Example:** 20-minute community / 30-minute city

| | |
|---|---|
| **Concept** | 20-minute communities where people can meet most of their daily needs within a 20-minute walk or cycle distance from home and access significant employment opportunities with 30-minutes travel using public transport combined with soft mobility. |
| **City Stakeholders** | Local government, transit authorities, developers, investors, community stakeholders, urban planners, mobility produces, service providers |
| **Decarbonization Benefits** | ▪ Reduce carbon emissions from use of personal vehicles. |
| **Other Community Co-Benefits** | ▪ Improve air quality.<br>▪ Promote the use of walking, cycling and other forms of micro-transit.<br>▪ Promote health and wellness.<br>▪ Deliver improved livability outcomes. |
| **Feasibility** | Cities around the world, including Dubai and Singapore, are actively pursuing the concept, by prioritizing better integration between land use and transport near existing and planned public transport. |



## Nature-based solutions

Historically, city planners and engineers have utilized gray infrastructure (dams, seawalls, pipes, treatment plants etc.) to deal with challenges like storm water management, erosion protection, coastal protection, and urban heat island mitigation. In recent years, the trend has been to rely less on gray infrastructure and more on Nature-Based Solutions (NbS), or what some refer to as green infrastructure, that integrate ecosystem services and natural solutions to solve challenges.

Nature-based solutions "harness the power of nature to reduce greenhouse gas emissions and also help us adapt to the impacts of climate change. They are win-win solutions that involve protecting, restoring and sustainably managing ecosystems to address society's challenges and promote human well-being.[36]

In cities, nature-based solutions and green infrastructure can take many forms, including urban parks and forests, community orchards, created wetlands, street trees, green walls and roofs, and sustainable drainage systems. Individually, each project may not have a huge impact on the carbon footprint of a city, but if coordinated at a city-wide level, these types of solutions can play a meaningful role in the decarbonization of cities, not only because they reduce and remove greenhouse gas emissions, but because they also provide a wide range of co-benefits that contribute to the health of the city and its people, such as cleaner air, reduced urban heat island effect, access to nature, and promotion of active lifestyles.

## **Example:** Community parks and green spaces

| | |
|---|---|
| **Concept** | Community parks, pocket parks, and green spaces in urban areas. |
| **City Stakeholders** | Local government, city planners, developers, community organizations, individuals |
| **Decarbonization Benefits** | ▪ Remove emission from the atmosphere.<br>▪ Promote walkability, which reduces transport related emissions.<br>▪ Reduce urban heat island effect, which reduces emissions generated by buildings. |
| **Other Community Co-Benefits** | ▪ Improve physical and mental health by providing access to nature and supporting active lifestyles.<br>▪ Improve air quality in the urban environment be removing pollution.<br>▪ Increase resilience of the city by contributing to sustainable drainage systems. |
| **Feasibility** | Cities around the world already create and manage urban parks and green spaces. There is an opportunity to collaborate with the private sector to deliver carbon reduction and removal projects and initiatives that incorporate nature-based solutions. |

*CHAPTER FIVE*

# A roadmap for implementing a programmatic approach to achieving net zero cities

Summarizing the learnings of this paper, we can start to lay out a roadmap for cities to implement a programmatic approach to achieving net zero goals that reduces emissions and addresses other key community challenges.

**FIGURE 10** Roadmap for implementing a programmatic approach to achieving net zero cities

1. Establish the program organization and governance structure
2. Establish the carbon management framework
3. Engage key stakeholders
4. Develop a baseline carbon footprint
5. Identify multi-stakeholder opportunities
6. Plan and implement projects and initiatives
7. Monitor and report performance against targets

# 1 Establish the program organization and governance structure

For a typical program, there is an organization that takes responsibility for leading it, establishing the governance structure, and facilitating the involvement of other key stakeholders.

In the context of a net zero city effort, the lead organization could be an existing local government department or a purpose-built organization made up of key city stakeholders. A purpose-built organization could be modeled after a mega-event programs, such as an Olympic Games, where a multi-stakeholder Local Organizing Committee (LOC) is established to manage the program. A similar carbon "committee" could be established to lead the net zero city program.

**Key activities:**

- Establish the program organization, roles and responsibilities, and governance structure.
- Manage scope, schedule, and budget through program controls.
- Manage risks and opportunities.
- Manage stakeholder relationships and facilitating stakeholder collaboration.
- Manage performance (setting targets and monitoring progress).

# 2 Establish the carbon management framework

Establishing the carbon management framework and the carbon accounting rules are a priority for a net zero city program. As discussed earlier, it is very important to consider all the emission sources of a city to ensure that the baseline carbon footprint is comprehensive. With this in mind, the GHG Protocol for Community-Scale Greenhouse Gas Emission Inventories is recommended for a city-wide carbon accounting effort, but other city-wide standards could also be considered.

**Key activities:**

- Select the GHG Protocol for Community-Scale Greenhouse Gas Emission Inventories, or another appropriate standard, to ensure that the baseline carbon footprint for the city will be comprehensive and will serve as a basis for the net zero effort.
- Develop awareness and training program to ensure that all parties understand the protocols and standards and can work together on the development of the baseline carbon inventory for the city and on reduction and removal opportunities.
- Establish the monitoring and reporting process.

# 3 Engage key stakeholders

Achieving net zero emissions at a city scale while also addressing community challenges requires the cooperation of multiple stakeholders from government, the private sector, and the community. This will be one of the most difficult aspects of a net zero city program, but it is also essential to reduce the total emissions of the city, and more importantly, to unlock significant opportunities to address other chronic issues affecting the city.

**Key activities:**

- Create a stakeholder map identifying key stakeholders who could participate in carbon reduction activities, or who may be the beneficiaries of program initiatives.
- Conduct materiality analysis of stakeholders to understand their priorities, constraints, and needs.
- Develop incentives (and potentially penalties) to encourage participation.
- Set priorities and incentives.

# 4 Develop a baseline carbon footprint

With the standards and protocols set and key stakeholders on-board, the task of developing the baseline carbon inventory can begin. As mentioned earlier, the most relevant greenhouse gas emissions in a city carbon footprint are carbon dioxide ($CO_2$) and methane ($CH_4$), but all six GHGs that make up most carbon inventories should be accounted for and reported in units of metric tons of $CO_2$ equivalent ($CO_2e$).

**Key activities:**

- Develop carbon database structure.
- Develop data collection process and tools.
- Carry out data collection and sector analysis with key stakeholders.
- Identify gaps and mitigation strategies.
- Continue to improve the quality and completeness of the baseline inventory over time as new information becomes available and issue annual updates with a revised baseline.

# 5 Identify multi-stakeholder opportunities

Developing cross-sector, multi-stakeholder projects and initiatives is central to this approach to net zero cities and creates the potential for significant positive impacts on communities. The "committee" along with key stakeholders will identify, develop, and deliver carbon reduction and removal projects that can accelerate the transition to net zero while also addressing other stakeholder priorities.

## Key activities:

- Develop categories for potential projects and initiatives such as:
  - Integrated infrastructure
  - Land use and planning
  - Mobility and access
  - Buildings
  - Agriculture
  - Water
  - Biodiversity
  - Energy
  - Waste
  - Materials
- Develop a multi-criteria analysis process that will be used to evaluate potential projects.
- Identify reduction and removal opportunities using a range of methods to generate a diverse portfolio of projects.
- Identify potential stakeholders for each project to build support and identify potential benefits to stakeholders and communities.
- Initiate stakeholder collaboration.

# 6 Plan & implement projects

Once projects have been evaluated and approved to move forward, tradition project management processes can take over and the projects can be delivered by one or more stakeholder.

## Key activities:

- Define projects.
- Define roles and responsibilities for each project.
- Carry out planning activities for each project (studies, analysis, financing, legal, etc.).
- Initiate project.
- Develop project (detailed planning, design, engineering, etc.).
- Deliver project (construction, installation, integration, etc.).
- Operate project (ongoing operations and reporting).

# 7 Monitor & report performance against targets

With multiple project and initiatives underway, monitoring and reporting performance against the city-wide targets is critical to gauge progress and make the necessary adjustments to achieve the overall goal of net zero emissions for the city.

## Key activities:

- Ongoing data collection from projects.
- Regular reports on the progress toward carbon performance targets and the overall net zero goal.
- Regular reports on the progress toward other performance targets.

*CHAPTER SIX*

# Conclusion

In the next 10 to 15 years, we face the very real scenario of average global temperature increase exceeding the 1.5 degree warming threshold set out in the Paris Agreement in 2015. From more extreme weather events, sea level rise, and temperature rise, to land and marine ecosystem destruction and biodiversity loss, the impacts of a changing climate on people and planet are widespread and far-reaching. The need for decisive action to decarbonize our economy and society on a global scale has never been more urgent.

Decarbonizing our cities is a complex challenge, but it is a challenge we must overcome to avoid the worst effects of climate change.

There are limitations to what individual developers, owners, and operators can achieve alone. Neither does the current siloed approach serve us well. Instead, moving towards net zero carbon emissions in cities requires the deliberate coordination, cooperation and positive participation of a diverse group of city stakeholders.

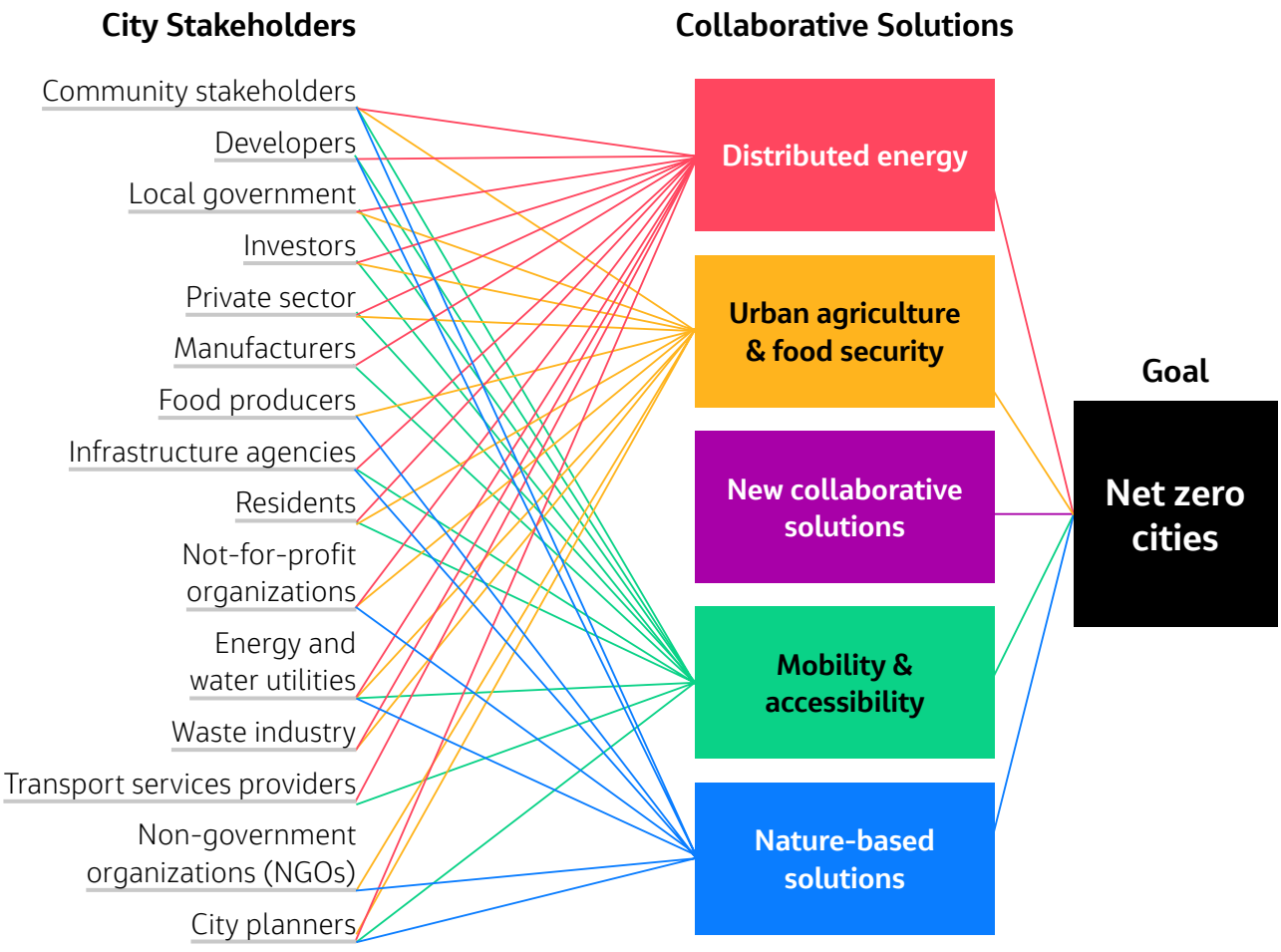
Adopting a more holistic approach to decarbonization, that draws on established program management principles that support the successful delivery of complex mega programs around the world, is one way to encourage investment in local carbon projects that reduce carbon emissions at their source and accelerate the transition to net zero.

However, decarbonization challenges are not the only challenges cities face and may not even be the priority. Social inequities and environmental emergencies often overlap. Cities face a host of other social, environmental, and economic challenges that often impact on the same communities and must also be addressed.

A programmatic approach also presents the opportunity to pursue local carbon reduction and removal projects that deliver additional co-benefits and leave a lasting legacy in communities.

Working together, diverse city stakeholders could deliver collaborative solutions that can help accelerate the transition to net zero, as shown in Figure 11. As mentioned earlier, this list of potential solutions is not exhaustive. It is up to all of us to identify effective collaborative solutions that will contribute to thriving and successful net zero cities around the world.

**FIGURE 11** Multi-stakeholder, cross-sector solutions to achieve net zero



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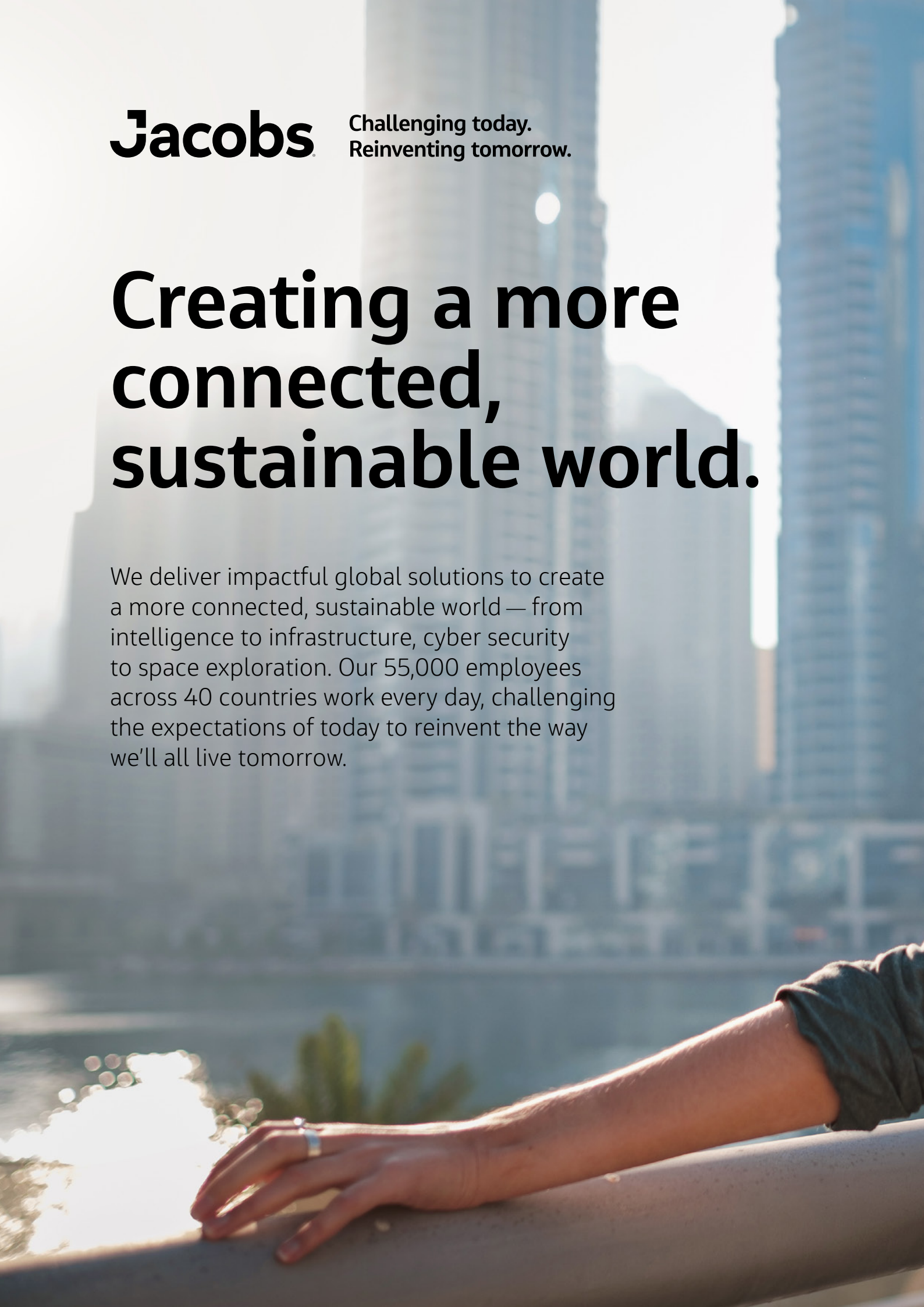

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