Neighbourhood Emissions Assessments

Demonstrating net zero through ambitious emissions reduction

Introduction

Neighbourhoods offer unique opportunities to accelerate towards net zero.

The neighbourhood opportunity

A neighbourhood is both a place and its people. As a place, the neighbourhood includes the infrastructure and buildings, the public and natural assets. The people include residents, workers and visitors of all ages, genders, races and abilities, and with different needs.

A neighbourhood is a system that consists of buildings, roads, pavements, green spaces, and systems that produce and distribute energy, process waste, provide water, lighting, and access to transportation.

It is a discernible area that is 'more than a building and less than a city' and is primarily defined by its geographic boundaries, which, at a minimum, must incorporate infrastructure beyond a single building.[1]

The Green and Thriving Neighbourhoods guidebook describes ambitious net zero ('green') and people-centred ('thriving') neighbourhoods, places that people want to live in, work in and visit, that minimise ecological impacts, regenerate biodiversity, and promote health and wellbeing.[2]

Neighbourhoods offer unique opportunities to accelerate towards net zero. When designing a new neighbourhood or beginning a major district-scale regeneration project, local governments, developers and communities can set a clear vision and step-up ambition on climate objectives. Taking advantage of the balance between scale and agility, neighbourhood projects can pioneer new policy, trial innovative partnership arrangements, consider creative ways to increase citizen participation and test new technologies or products that can support the overarching vision.

Neighbourhood-wide

If you are reading this from a long-term neighbourhood-wide planning perspective, then Assessment steps 1-5 will help you implement this plan.

Individual action

If you are reading this from the perspective of a specific action, then Assessment steps 4-5 are the most relevant, with the previous three steps providing some important neighbourhood-wide context.

Why this guidance is needed

Given the growing interest and focus on neighbourhoods in cities across the globe, there is a need to agree how to undertake emissions assessments that demonstrate significant and long-lasting emissions reductions that align with the 1.5˚C ambition of the Paris Agreement. While the Green and Thriving Neighbourhoods guidebook introduces a foundational framework for neighbourhood-level emissions assessment it does not provide detailed guidance.

This guidance document meets this need. It serves as a holistic neighbourhood-level emissions assessment framework, capturing sources of emissions beyond building assets including water, waste, mobility, and land use. This will enable city governments, developers, and communities to understand the emissions impacts of new developments or smaller-scale targeted interventions. Understanding these emissions impacts will enable them to make decisions that set their project and the neighbourhood on a net zero trajectory. Acknowledging that there are a range of climate impacts that affect neighbourhoods everywhere, this guide is focused exclusively on emissions and mitigation action.

When to use this guidance

The guidance in this document applies to all neighbourhoods.

- Chapter 2 defines net zero at the neighbourhood-scale and the overarching emissions categories.
- Chapter 3 follows the 5-steps in the Green and Thriving Neighbourhoods guidebook and describes how to undertake an emissions assessment, whether for the whole neighbourhood, or for a smaller-scale targeted intervention.
- Chapter 4 provides an example of how the emissions assessment framework has been applied to a neighbourhood in Madrid, Spain.

Definitions

Categorising emissions

Enabling and achieving a net zero neighbourhood requires a clear and complete understanding of emissions occurring within the neighbourhood boundary.

There are different frameworks for categorising emissions. For neighbourhood-scale projects, it is most straightforward to consider these three categories: operational, embodied and consumption-based emissions.

Neighbourhoods should aim to achieve net zero operational and embodied emissions, while taking ambitious action on consumption-based emissions.

Operational emissions

These are emissions that occur continually throughout the lifetime of the neighbourhood. They are measured on an annual basis and include emissions due to energy used in buildings, public spaces and transportation, or emissions arising from processing waste.

Embodied emissions

These are emissions from the materials and construction processes of buildings and infrastructure, including new construction, retrofits and redevelopment. All embodied emissions should be assessed, including those due to material extraction, manufacturing, assembly, maintenance, repairs, replacements, deconstruction, demolition and any associated transport, waste and end of life impacts.

Embodied emissions only occur at specific points through the neighbourhood development cycle and should be assessed accordingly.

Consumption-based emissions

Goods and services in all sectors have an emissions impact and as the people in a neighbourhood buy food or clothes,travel on holiday or invest in new technology, they are increasing their emissions impact. This consumption behaviour, by residents, governments or businesses, is wide-ranging, and consumption-based emissions assessments inevitably involve more complex data and more detailed calculations.

Given this, a net zero neighbourhood emissions assessment does not need a complete consumption-based emissions inventory; rather the neighbourhood should focus on delivering tangible and ambitious actions to reduce the emissions impact of consumption.

Definitions

Achieving net zero

Achieving net zero is essential to stay within planetary boundaries and align with a 1.5˚C future. Neighbourhoods provide ample opportunity for emissions reduction; the IPCC estimate that integrated spatial planning could reduce emissions between 23-26% by 2050 compared to the business-as-usual scenario.

According to the ISO 14064-1 standard, “net zero” is the balance between the greenhouse gases emitted into the atmosphere and those removed from the atmosphere over a specified period.3

However, reaching net zero must be more than just balancing the books. Aligning with a 1.5ºC future requires a long-term approach to prioritizing emissions reduction throughout the entire development process, from planning through to operation and end-of-life. The Green and Thriving Neighbourhoods guidebook provides a framework for this in an emissions hierarchy, consisting of four main steps; avoid, reduce, convert, and compensate.

Definition

For a neighbourhood, net zero means drastic and long-lasting emissions reductions for all activities occurring within the neighbourhood, then permanently offsetting any residual emissions on an annual basis.

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Since a net zero neighbourhood will aim to minimise emissions over the lifecycle and achieve net zero at a point in time, there are two distinct phases to net zero neighbourhood development.

Net zero enabled

This is the period between when the net zero target is set and an action plan is established, and the target date itself. Since a net zero neighbourhood will aim to minimise emissions over the lifecycle and achieve net zero at a point in time, there are two distinct phases to net zero neighbourhood development.

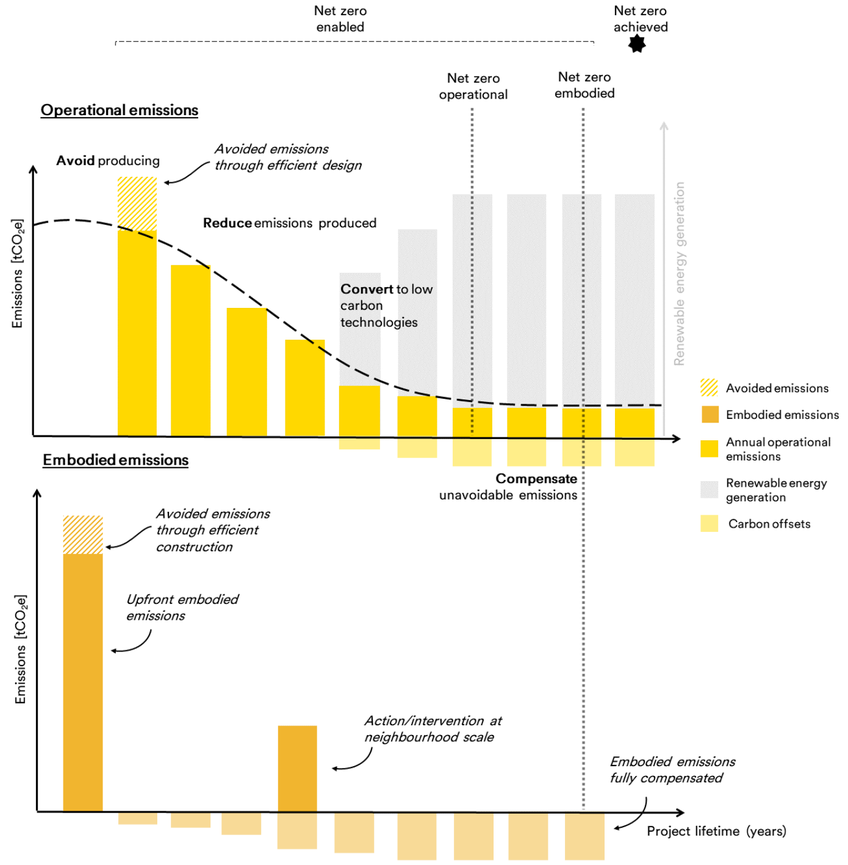
Net zero achieved

This is the period after the net emissions reach zero and continues to be monitored annually to ensure this continues. Where there are new construction works, including replacement or deconstruction, the compensated emissions may need to be increased.

A distinction can be made between achieving net zero operational and net zero embodied emissions:

- Achieving net zero operational emissions means prioritising measures that reduce energy demand ensuring highly efficient buildings and infrastructure. How the energy is supplied to meet the remaining demand varies e.g. on-site vs. off-site, but it must be from 100% renewable sources.

- Achieving net zero embodied emissions requires low emissions intensity materials, careful design and innovation, and full compensation for all residual embodied carbon emissions



Assessment

Introduction

An emissions assessment can be used to better understand neighbourhood emissions sources and plan actions that deliver drastic and long-lasting emissions reduction on the pathway to net zero.

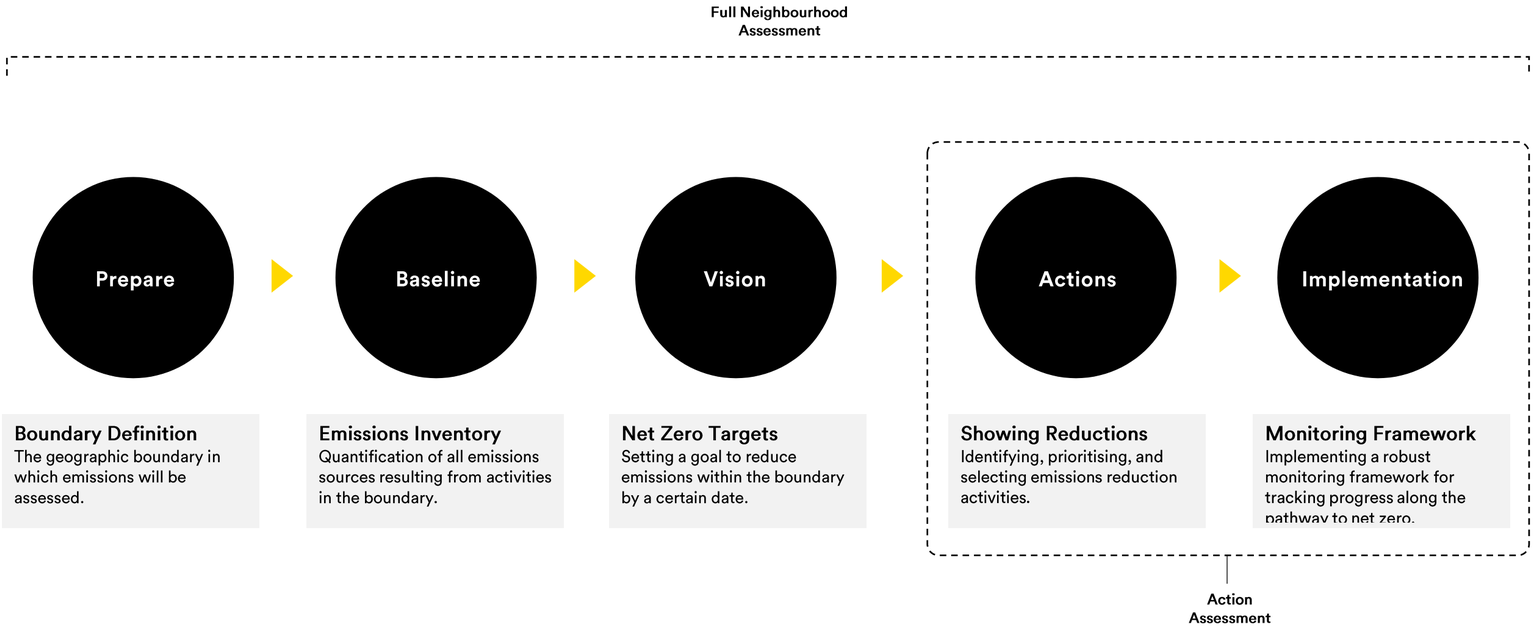
This chapter will provide an overarching guide for carrying out a neighbourhood emissions assessment across five steps:

- Prepare: Define the neighbourhood boundary
- Baseline: Develop an emissions inventory
- Vision: Target net zero
- Actions: Evidence reductions
- Implementation: Create a monitoring framework

The assessment should inform decision-making throughout the lifecycle of new and existing neighbourhoods, including which actions to implement. Therefore, an emissions inventory must be developed as early as possible for any neighbourhood development or action.

If you are reading this from a long-term neighbourhood-wide planning perspective, either for a new development or existing neighbourhood regeneration project, then the full assessment framework, steps 1-5, will help you implement this plan.

If you are reading this from the perspective of a specific action, then the final two steps of this 5-step process are the most relevant, with the previous three steps providing some important neighbourhood-wide context.

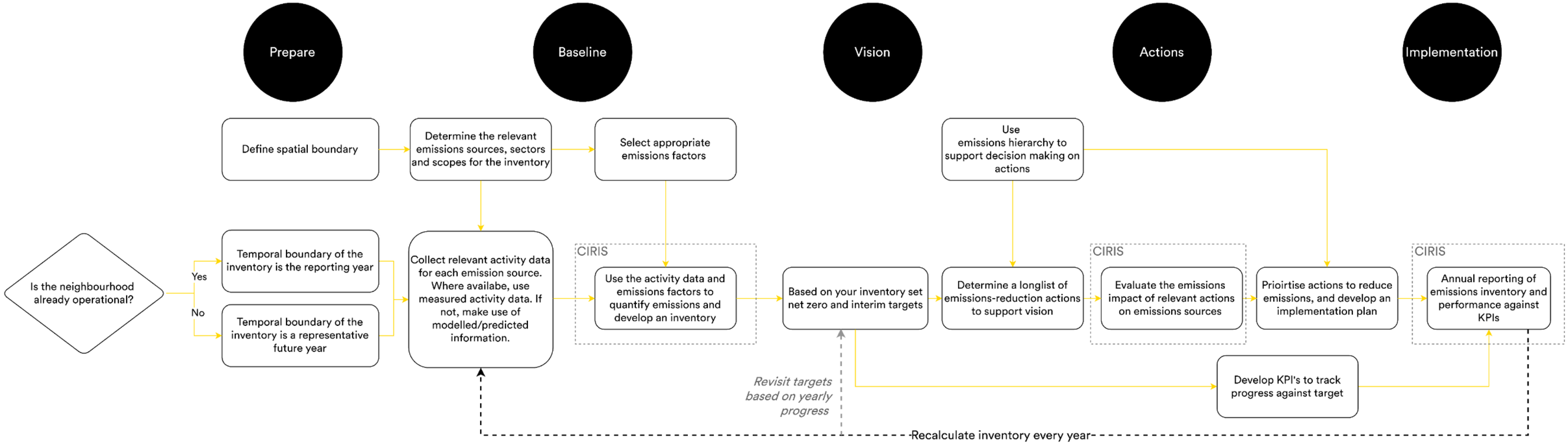


A framework for neighbourhood emissions assessments

Assessment

Assessment process

This process flowchart summarises the key input data, decisions points, analytical steps and outputs for a full neighbourhood-wide emissions assessment.



Prepare

Assessment

Step 1: Boundary definition

The assessment shall consider all emissions occurring within the geographic boundary of the neighbourhood, as well as emissions from outside the boundary due to neighbourhood activity.

Geographic boundary

The geographic boundary should be consistent with the boundary of the neighbourhood in planning documents and should align with community expectations of the neighbourhood's border.

Where there may be inconsistencies between the boundary set out in planning documents and community expectations, efforts should be made to incorporate the larger geography into the emissions boundary.

For new neighbourhoods developed in stages, the geographic boundary should include the whole extent of the planned neighbourhood. This will allow for the incorporation of new parts of the neighbourhood into the net-zero target as construction is completed and they become occupied.

As part of the boundary definition, key stakeholders should be identified, along with their influence over different emissions sources.

Temporal boundary

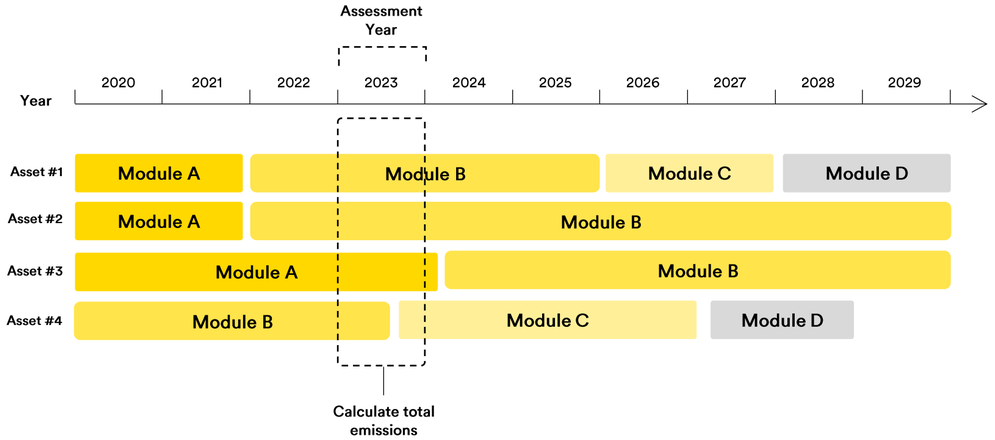
As per city-wide emissions reporting, a neighbourhood emissions inventory captures the emissions occurring in the assessment year.

The reporting period should align with city-wide reporting to allow for comparisons with other neighbourhoods and the city itself.

It is important to recognise that annual reporting is not the same as the lifecycle approach used to assess the whole life emissions of a specific asset. The whole life approach splits emissions into Modules A-D, each representing a sequential stage in an asset lifecycle.

- Module A: Construction
- Module B: Operation (including transport)
- Module C: End-of-life
- Module D: Beyond the lifecycle (reuse, recovery, and recycling)

A neighbourhood emissions inventory should consider all relevant assets, but rather than reporting whole life emissions, a neighbourhood emissions inventory should include emissions from any lifecycle stages that occur within the assessment year.



Prepare

Assessment

Emissions boundary

Since a neighbourhood is a subset of a city, the emissions inventory should adopt the Global Protocol for Community-Scale Greenhouse Gas Emissions Inventories (GPC) standard.[4] The GPC groups emissions into three Scopes, depending on where the emissions occur relative to the geographic boundary of the neighbourhood. Under each scope, emissions are reported according to the source.

Operational emissions

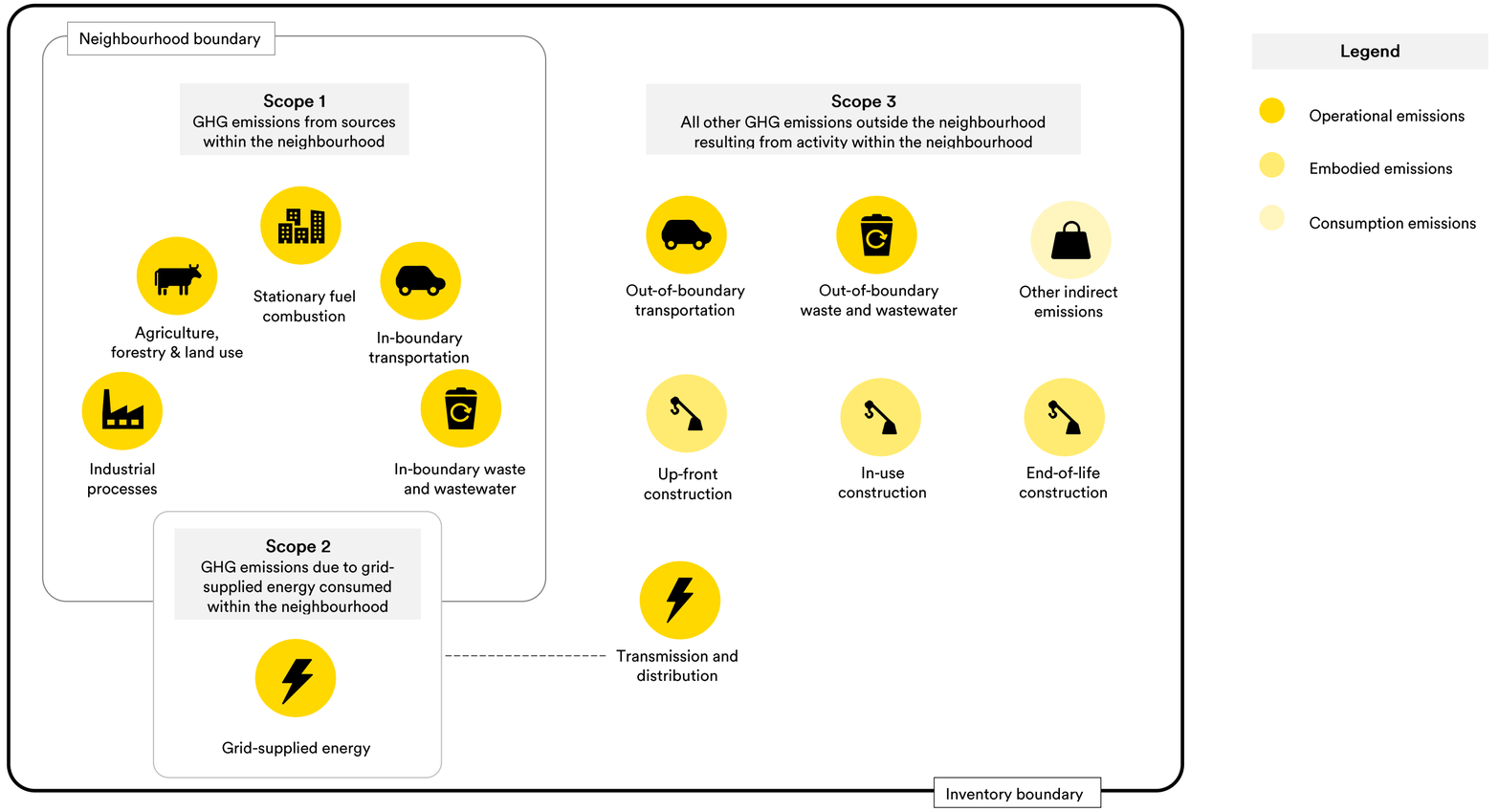
Following the BASIC reporting level in the GPC, the assessment must include Scope 1 and 2 emissions from stationary energy and transportation, as well as Scope 1, 2 and 3 emissions from waste.

Where the necessary data is available, neighbourhoods are encouraged to additionally include Scope 3 emissions from transmission and distribution of energy and transboundary transportation. Where significant, emissions from industrial production processes (IPPU) and agricultural activities, land use change and forestry (AFOLU) should be included.

Embodied emissions

Embodied emissions should also be accounted for in the emissions assessment of the neighbourhood. This covers embodied emissions from any construction, retrofits, or redevelopment activities occurring within the neighbourhood.

Embodied emissions occurring within the neighbourhood can be Scope 1 (e.g. in-boundary construction transport) or Scope 2 (e.g. from electricity consumed during the construction process) emissions. Emissions embodied in construction materials (e.g. from material extraction outside the neighbourhood boundary) is an example of Scope 3 emissions.



A framework for neighbourhood emissions assessments

Assessment

Baseline

Step 2: Emissions inventory

Calculating the inventory

The emissions of each relevant source within the neighbourhood boundary should be assessed. The emissions inventory should be presented in a clear and easy-to-understand manner, with the calculation methods and emission factors fully and clearly disclosed.

Types of greenhouse gas emissions

The assessment should aim to capture emissions from the seven gases covered by the Kyoto Protocol[5]. While data is not always available for all gases, the emissions assessment should at least include CO_2, CH_4 and N_2O.

Emission factors

The assessment should use credible and reliable emission factors. Emission factors are used to calculate emissions by multiplying the factor (e.g., $kgCO_2e$/GWh of electricity) with activity data (e.g., GWh of electricity used). Published and referenceable national factors should be used unless more accurate, local emission factors or calculation methodologies are available. Factors should align with the assessment year, or otherwise be the most recently published.

Treatment of renewable energy

Following the GPC, neighbourhoods shall use the location-based method for Scope 2 calculations. This can be supplemented by a market-based calculation to show the impact of utility-specific emission factors, energy attribute certificates, or other contracts.

Emissions removals from land use

Although emissions from land use are not required for the BASIC reporting level, an awareness of the effect of land use on emissions removals can provide a broader understanding of the sources and sinks of GHGs within a neighbourhood. This can help identify opportunities for emissions reductions and carbon sequestration, as well as provide an understanding of the loss of sequestration that may occur due to changes in land use (e.g. from developing a greenfield land).

Non-quantification of emissions

Emissions sources must be quantified, but justifications can be provided if quantification is not feasible, practicable, or cost-effective. Non-quantified emissions must not exceed 5 per cent of the total carbon account, and tools based on input–output analysis can be useful to determine this threshold.

The following methods can be used if primary data cannot be sourced:

- Take an initial measurement as a basis for projecting emissions for future years of that source; or
- Estimate and project an emissions source (e.g. using input-output analysis tools, approximation through extrapolation or applying an uplift factor to the emissions inventory).

Where relevant emissions are non-quantified because of data or other estimation issues, this should be reflected in a data management plan, which should outline a clear strategy of how a more rigorous quantification can be achieved within a reasonable timeframe. This could include setting in place appropriate data collection processes and negotiating with stakeholders who have access to accurate data.

In some cases, activity data may be excluded for reasons of data confidentiality, in which case the data can be excluded from the inventory.

Data quality and management

Whenever possible, measured data should be used to develop the emissions inventory, with conservative estimates used only where data is unavailable. For example, operational metered energy data should be obtained from utility providers.

When assessing future developments, the inventory may be based on predictive models produced with appropriate assumptions or measured data from similar neighbourhoods. Where estimates and assumptions are used, they must be appropriately justified with respect to data availability and the relative size and nature of the estimated emission source.

Using a live, easily monitored, and collaborative data platform will help provide consistent reporting and insight to all stakeholders. This will require appropriate digital infrastructure, supported by clear governance and data-sharing protocols.

Inventory verification

A third-party verifier can provide assurance of the emissions analysis using recognised international standards. The verification can review the accuracy and completeness of calculations, including the appropriateness of emissions boundaries, methodologies, and calculations. This will help provide transparency on progress and support net zero claims or publicity.

Assessment

Baseline

Changes to the inventory

There will be changes to the emissions inventory and the approach taken to develop it over time. To ensure consistency, the emissions inventory should allow for meaningful comparison of emissions over time.

Defining a base year

To allow for fair comparisons of operational emissions over time, a base year should be selected. The base year may be a full calendar or financial year.

To establish a base year:

- Select the most recent year for which verifiable emissions and exclusions data are available. If a single year's data is unrepresentative of the typical emissions profile (e.g., due to the COVID-19 pandemic), a multi-year average should be used
- Explain the selection of the base year

It is worth noting that the base year selection only applies to operational emissions and not to other stages in the neighbourhood life cycle.[1]

When assessing the emissions of future neighbourhood developments, projections should be made to a representative year in the future with relevant assumptions about activity and emissions data. Once the development is complete and operational, a base year inventory can be produced from which annual changes in operational emissions are reported on and monitored.

Base year recalculation

A base year recalculation is required where there have been structural changes that have a significant impact on the neighbourhood's emissions. Structural changes could include:

- Geographic boundaries: For example, an expansion of the neighbourhood boundary due to a new development, or a reduction in size due to demolition.
- Operations: Outsourcing or insourcing of emitting activities
- Calculation methods: Changes in activity data calculation or revisions to emission factors that result in a significant impact on total emissions.
- Errors: Discovery of significant errors, or several cumulative errors, that are collectively significant.

Chapter 5 of the GHG Corporate Standard provides additional guidance on base year recalculation approaches that can be used as a guide for such disclosure.[6]

Acknowledging changes over time

Any significant changes or errors (an increase or decrease of more than 5 percent) discovered over time should be calculated and disclosed. Transparent documentation of changes and errors is important to allow stakeholders to understand factors driving year-on-year emissions variation, including the emissions reductions attributable to neighbourhood actions.

Making use of CIRIS

The City Inventory Reporting and Information System (CIRIS) is an Excel-based tool used for managing and reporting city-level GHG inventory data in an accessible, and flexible way.6 The tool is based on the GPC standard and facilitates a transparent calculation and reporting of emissions across scopes and sectors relevant to cities. CIRIS can also be used for a neighbourhood-level emissions inventory.

Using CIRIS for developing a neighbourhood-level inventory

While CIRIS is designed to be used for city-scale emissions reporting, it can also effectively be used at neighbourhood level, as it aligns with the GPC standard, and a neighbourhood can be thought of as a subset of a city. If an emissions inventory has already been produced for the city in which the neighbourhood is located, CIRIS can inherit information from the city, which can save time and effort for neighbourhood-level users. For example, a city may have already collected and reported on emissions from sources like municipal operations, commercial buildings, or transportation. A city-level assessment may also already have collated appropriate emissions factors.

Neighbourhood-level users can use this information as a starting point for their own inventory reporting. This can streamline the reporting process and improve the accuracy and consistency of data across the city and its neighbourhoods.

Structure of CIRIS

CIRIS is organised across five sections that guide users through the process of collecting and organizing data for each neighbourhood emissions sector, calculating emissions, and reporting results. The tool is accompanied by a user guide which provides detailed guidance and worked examples for users to navigate CIRIS, understand the data and information requirements, and generate useful outputs.

Users can enter data directly into the tool or import data from external sources. The tool also provides standard calculation assumptions and conversion factors for different sources and sectors, which can be useful for neighbourhoods that are not able provide accurate data for all emissions sources or sectors. These values can help users generate an inventory that is based on recognised industry standards and can provide a starting point for further refinement and improvement as more accurate data becomes available.

The CIRIS tool, along with the accompanying user guide can be accessed and downloaded from the C40 Climate Action Planning Resource Centre.

To use CIRIS, neighbourhood users should have a basic understanding of Excel and greenhouse gas inventory accounting.

Vision

Assessment

Step 3: Net zero targets

Setting science-based net zero targets quantifies the level of ambition and drives progress along the net zero pathway towards alignment with a 1.5°C future.

Requirements for net zero targets

The neighbourhood should target net zero emissions in the near term, aligning with the following principles:

- At least as ambitious as any national net zero target
- Achieved more quickly than any city-wide target

This requires a pathway to net zero from the start of the project through to the net zero target year and beyond.

Pathways to net zero

The pathway will depend on several factors, including the technical, social, and political feasibility, cost and co-benefits of actions to reduce emissions, the social and political feasibility of measures to reduce emissions and the co-benefits of delivering these climate actions.

The pathways should be modelled using the base year emissions inventory.

Following the UN High-Level Expert Group on the Net-Zero Emissions Commitments of Non-State Entities, net zero pathways and targets for neighbourhoods should:

- Align with global science, i.e. decline by 50% between 2020 and 2030, and reach net zero by 2050 or sooner
- Include interim targets for 2025, 2030 and 2035
- Be announced publicly by leadership

Setting targets

To demonstrate that a neighbourhood will reach the 'net zero achieved' stage and meet the ambition of a 1.5°C future, appropriate targets need to be set. These provide the basis against which emissions and emissions reductions are tracked and reported.

'Net zero achieved' requires at least a 90% reduction in emissions, relative to a suitable base year, by the 2040s or sooner, and by 2050 at the latest. Interim targets must be set to assure progress towards this long-term target in the 'net zero enabled' phase. These could take the form of:

- An emissions intensity target, such as a reduction in tCO_2e per capita e.g. from 5 tCO_2e per capita to around 2.9 tCO_2e per capita by 2030
- A base year emissions target e.g. reduce by 40% the embodied carbon in all new buildings and construction by 2030 (from a 2018 baseline)

Targets should be stated as clearly as possible, so that stakeholders can readily understand the level of neighbourhood ambition.

Ensuring that these targets are set appropriately and achieved will require long-term ownership and oversight in the net zero enabled phase with two key steps: evidencing emissions reduction and monitoring.

Using CIRIS to support target setting

The outputs from the emissions inventory produced in CIRIS are summarised and presented in a way where trends and themes can easily be identified. Calculated emissions are broken down by source, sector, and scope, and are visualised through a range of different graphs and charts.

This allows neighbourhoods to interpret their data and answer questions such as what sector and activities emissions reduction efforts should be targeted, and what level appropriate emissions reduction could be, given the current inventory.

Assessment

Actions

Step 4: Evidencing reduction

Once net zero targets have been set, actions will need to be agreed to deliver long-lasting emissions reduction.

Estimating emissions reduction impact

It is important to understand the impact of the action on the emission sources within the neighbourhood boundary. This impact will be relative to the current neighbourhood emissions assessment, or otherwise it will be necessary to create a baseline estimate using best-available activity data (e.g. car journeys per person, or energy consumed per m^2).

The 'after' situation will be the projected emissions impact of the action on the relevant emissions sources. This should capture systemic reductions, as well as the direct impacts of the action.

This process can be used to compare the emissions reduction impact of similar actions. It should be carried out for each action, aggregating the cumulative emissions reduction potential of all actions in the neighbourhood action plan.

Evaluating trade-offs

Some actions may cause some emissions categories to increase while causing others to decrease. Trade-offs between short and long-term emission impacts will need to be made. An action may have high emissions in one category but an overall system-wide benefit in reducing emissions over the long-term.

For example, the construction of a new railway station would incur a high volume of embodied emissions, but as the station operates year-on-year, it could reduce transportation emissions as more people shift from private vehicles to train travel.

This highlights the importance of using a long-term, lifecycle perspective in neighbourhood decision-making, viewing the neighbourhood from a systemic perspective.

Emissions Hierarchy

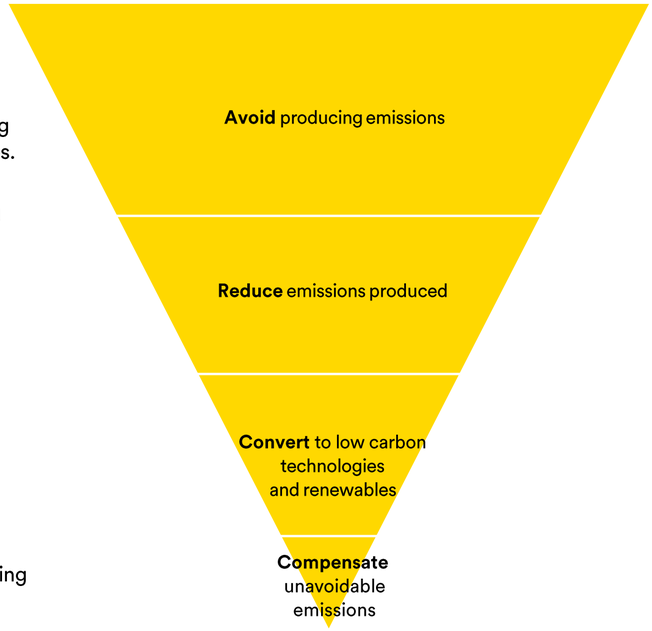
It is essential that neighbourhoods seek to minimise emissions throughout the development cycle. The net zero emissions hierarchy should underpin all decision-making and should be applied to all emissions sources.

Avoid: Preventing emissions occurring wherever possible. For instance, repurposing existing buildings will avoid the embodied emissions in new foundations and building superstructure.

Reduce: Adopt actions that reduce emissions, compared with a standard or conventional approach. An example of this may be utilizing materials from decommissioned sites when undertaking new construction.

Convert: Enable and promote renewable energy and low carbon technologies. For instance, a neighbourhood may choose to convert existing buildings with gas-fired heating to low-carbon neighbourhood heating.

Compensate: Any residual emissions must be counteracted by robust, transparent offsetting.



Using CIRIS to assess neighbourhood-level action

While CIRIS is primarily designed for producing city-level inventories, it can also be used to assess the emissions impact of specific actions or interventions at neighbourhood scale. Below are the steps that should be taken in applying CIRIS to an individual action, such as developing a cycle path in the neighbourhood:

- **Determine the scope and boundaries of the assessment**: Before using CIRIS, the scope and boundaries of the action should be determined. This includes identifying the emissions sources that are relevant to the action and the geographic boundaries of the action, as well as a representative year for the inventory. For instance, emissions from transportation, including cars and buses should be considered for a new cycle path.
- **Identify the data requirements:** Next, identify the data requirement for each relevant emissions source. This may include data on the distance and projected usage of the cycle path, and predictions on vehicle traffic before and after the cycle path is built.
- **Use CIRIS to calculate the emissions:** Calculate emissions by entering the necessary data into the relevant sections and using gathered data supplemented by the default emissions factors provided in the tool.
- **Analyse the results:** The results of the emissions calculation can be used to understand the emissions impact of the action. This might involve comparing the emissions associated with the cycle path to the emissions that would have been generated in the absence of the cycle path or comparing the emissions associated with different design options for the cycle path.

Implementation

Assessment

Step 5: Monitoring framework

Monitoring the performance of the neighbourhood or individual actions is key to understanding progress to net zero and informing subsequent decision-making.

'Net zero achieved' is not a final state but an annual status that should be continuously monitored using a framework adopted by the lead developer and shared with all stakeholders.

Key performance indicators (KPIs) can be used to model the anticipated performance of the neighbourhood development or action during planning and design, and then measured during construction and operation to test whether the expected performance is being achieved. KPIs can be grouped into 'reporting' metrics that summarise overall performance (e.g. actual emission levels) and 'monitoring' metrics that track broader progress (e.g. energy consumption or local energy generation).

Monitoring can help to identify actions that are or are not having the desired impact and highlight any significant barriers or constraints. Findings from monitoring should be shared with the wider neighbourhood stakeholder network to maintain engagement and attract ongoing support and investment.

Using CIRIS to support monitoring

CIRIS allows users to compare the current inventory against previous inventories, which helps with monitoring and tracking progress over time along the pathway to net zero. The breakdown of data by sector provides a structured format where emissions targets can be monitored, and historical inventories compared.

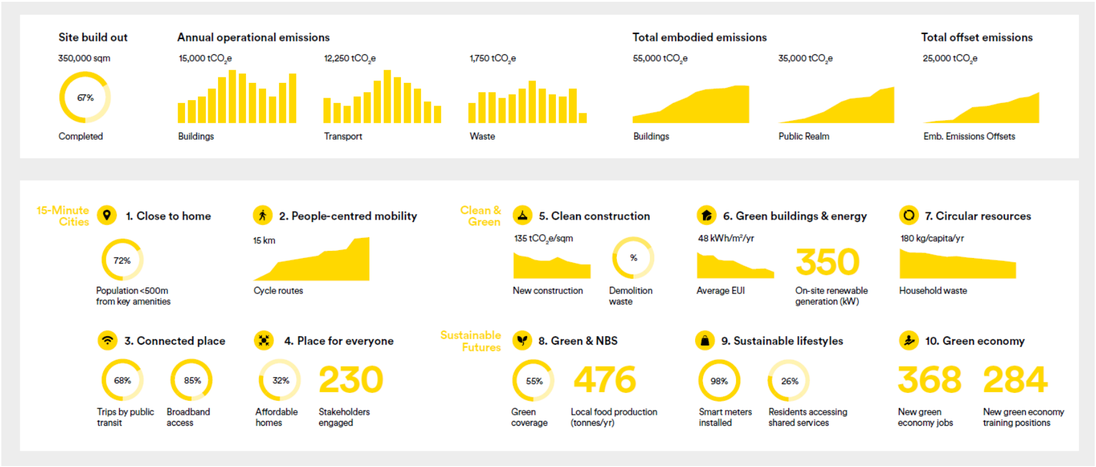
Reporting

Annual reporting should keep the public and other interested parties informed in an open and transparent manner and should include:

- Information on the total gross and net greenhouse gas emissions of the neighbourhood for the base year (where applicable) and current reporting period.
- An emissions summary table, including justification for any excluded emissions.
- Disclosure of any non-quantified emissions within the emissions boundary and any plans to improve the consistency and completeness of the emissions inventory in the future.
- Disclosure of any significant changes in the emissions inventory from previous reporting years, and relevant justifications for these changes.

The level of detail and explanation in a public report must ensure the reader has a clear understanding of the net zero ambition, how the emissions assessment was undertaken and how this informed actions to reduce future emissions aligned with the pathway to net zero.

Data privacy and ownership should be respected, and certain data may not be disclosed due to sensitivity or confidentiality.



Case study

Madrid Nuevo Norte

Madrid Nuevo Norte (MNN) is a major urban redevelopment programme in Madrid, which started construction in 2021.

The project has the objective to position the area as a benchmark for sustainable development and low GHG emission neighbourhoods in Spain and wider Europe. As part of this ambition, the development as registered with LEED and BREEAM in 2020, which are two of the most widely used green building rating systems. Specific planning regulation has already been approved for the area which goes beyond existing policy for Madrid, setting requirements for building efficiency, energy supply, water and drainage, and transport infrastructure.

To support this ambition, the development team has conducted a comprehensive evaluation of future emissions for the project. This included an assessment of operational emissions of the development in 2030 and 2050 across a business-as-usual scenario, representing the expected emissions as it is currently planned, and a decarbonization pathway scenario estimating the emissions that would occur if the development team were to implement additional measures beyond the regulations.

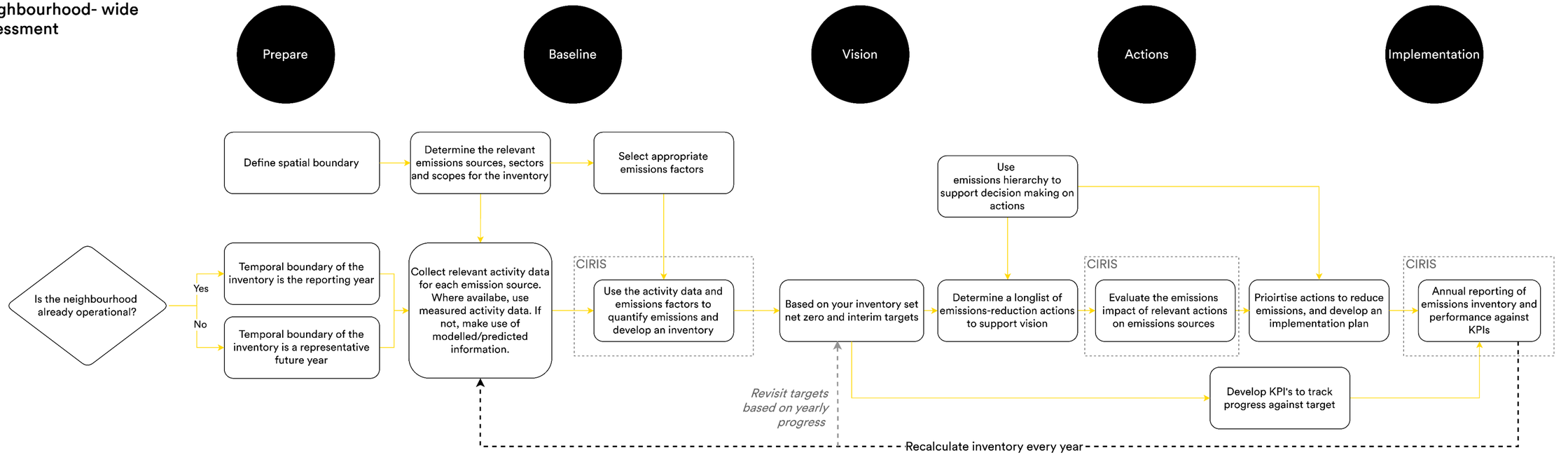
The development team assessed and identified feasible decarbonisation actions to plan a strategy that can shape the decarbonization pathway of the development throughout its life cycle. This included assessing the emissions reduction impact across the decarbonisation actions, as well as an appraisal of technologies such as carbon capture and storage, as well as evaluating potential offsetting actions such as reforestation and investing in renewable energy projects, both within and outside the MNN boundary. Following a comprehensive analysis of the operational-stage emissions of the development, and the identification of actions, a list of indicators for monitoring and updating emissions will be developed. The embodied emissions of the development will also be assessed.

Overall, the MNN development serves as a prime example of how new developments can use neighbourhood level emissions assessment to set and achieve ambitious decarbonization targets.

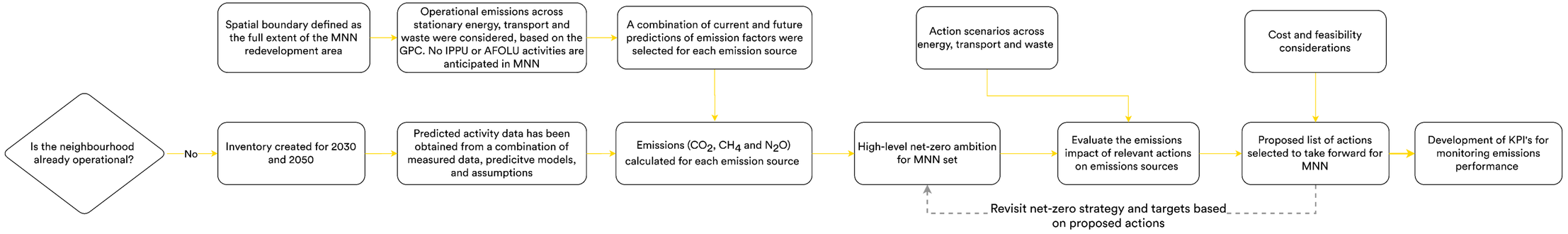
The diagrams on the following pages map the MNN project against the guidance provided in this document. This sets the project both in the context of a neighbourhood-wide assessment, but also assesses individual emissions-reduction actions at neighbourhood scale. Two examples of actions are described: one assessing the impact of implementing a district heating network in the area, and another evaluating the emissions savings from a strategic last-mile logistics hub in the area.

Case study

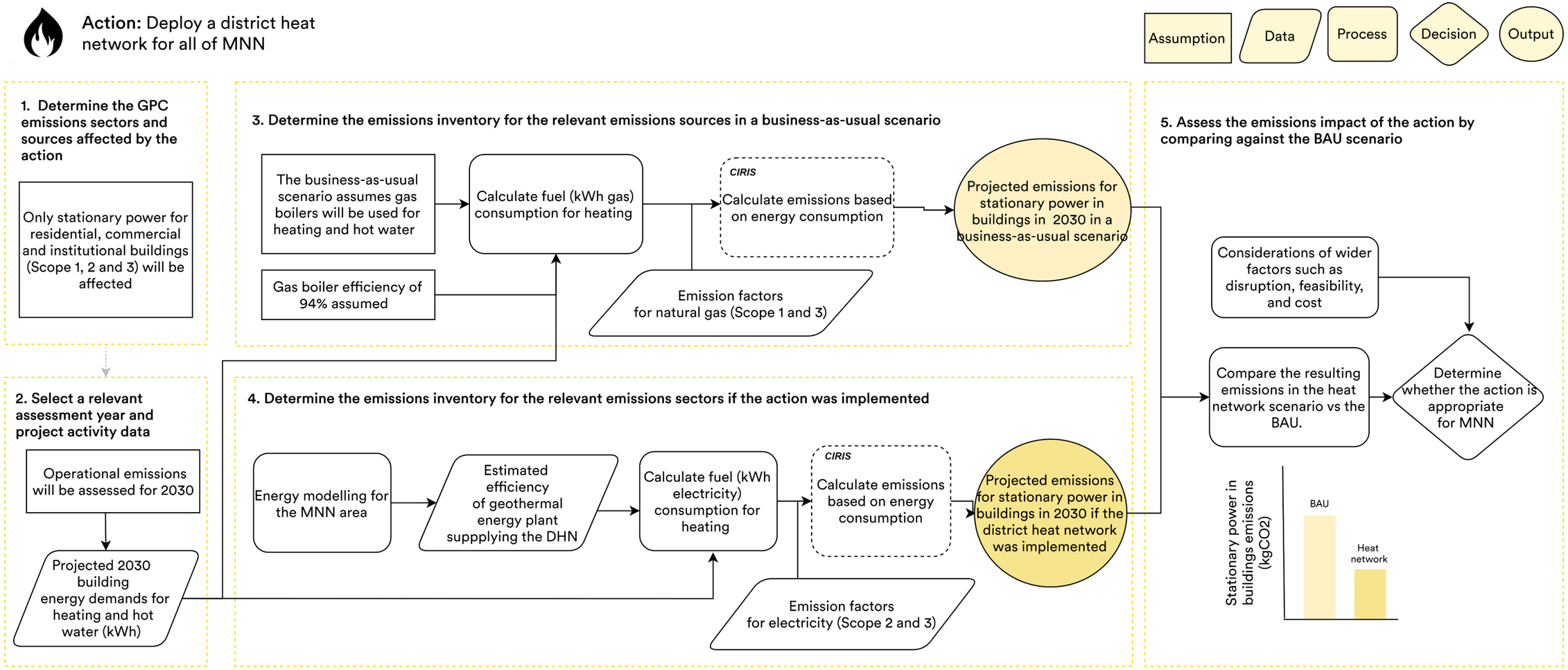
Neighbourhood- wide assessment



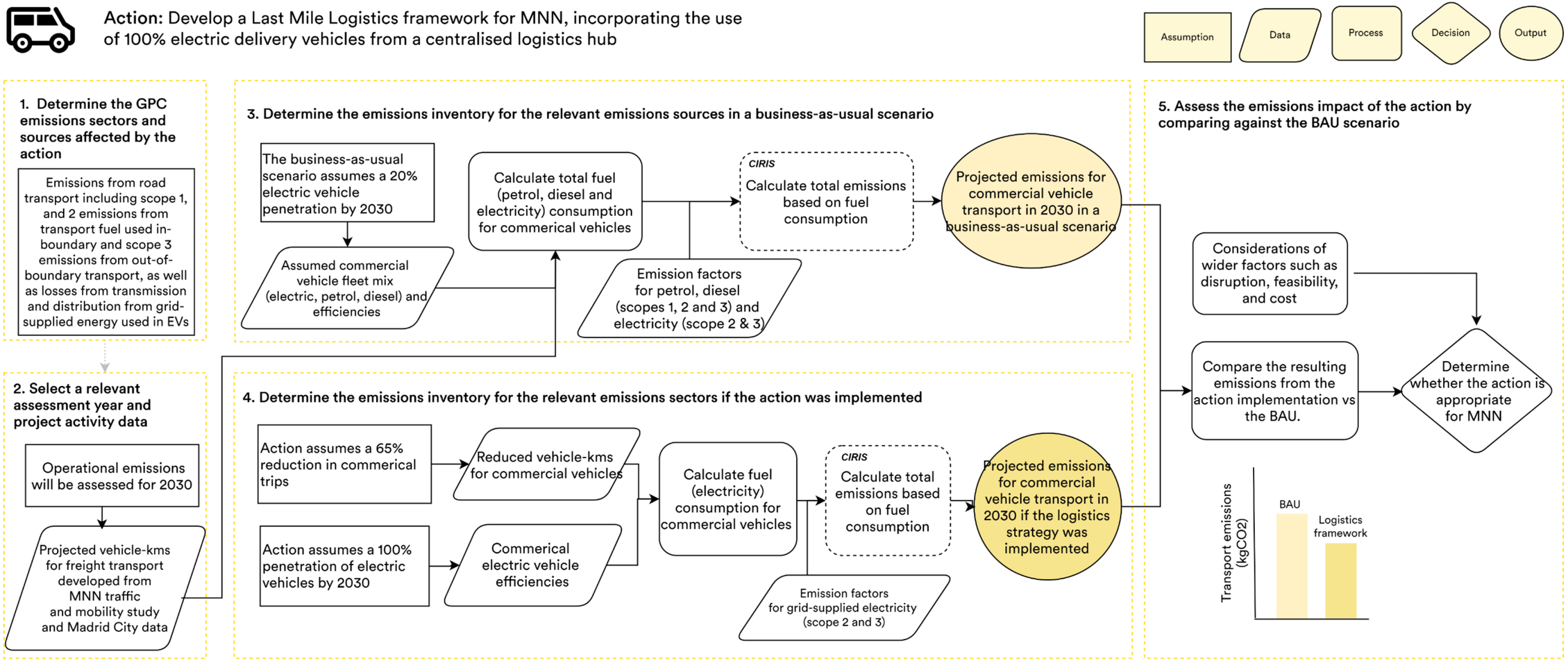
Madrid Nuevo Norte



Case study


Action: Deploy a district heat network for all of MNN
Assumption
Data
Process
Decision
Output
1. Determine the GPC emissions sectors and sources affected by the action
Only stationary power for residential, commercial and institutional buildings (Scope 1, 2 and 3) will be affected
2. Select a relevant assessment year and project activity data
Operational emissions will be assessed for 2030
Projected 2030 building energy demands for heating and hot water (kWh)
3. Determine the emissions inventory for the relevant emissions sources in a business-as-usual scenario
The business-as-usual scenario assumes gas boilers will be used for heating and hot water
Calculate fuel (kWh gas) consumption for heating
Gas boiler efficiency of 94% assumed
CIRIS
Calculate emissions based on energy consumption
Emission factors for natural gas (Scope 1 and 3)
Projected emissions for stationary power in buildings in 2030 in a business-as-usual scenario
4. Determine the emissions inventory for the relevant emissions sectors if the action was implemented
Energy modelling for the MNN area
Estimated efficiency of geothermal energy plant suppplying the DHN
Calculate fuel (kWh electricity) consumption for heating
CIRIS
Calculate emissions based on energy consumption
Emission factors for electricity (Scope 2 and 3)
Projected emissions for stationary power in buildings in 2030 if the district heat network was implemented
5. Assess the emissions impact of the action by comparing against the BAU scenario
Considerations of wider factors such as disruption, feasibility, and cost
Compare the resulting emissions in the heat network scenario vs the BAU.
Determine whether the action is appropriate for MNN
Stationary power in buildings emissions (kgCO2)
BAU
Heat network

Case study


Action: Develop a Last Mile Logistics framework for MNN, incorporating the use of 100% electric delivery vehicles from a centralised logistics hub
Assumption
Data
Process
Decision
Output
1. Determine the GPC emissions sectors and sources affected by the action
Emissions from road transport including scope 1, and 2 emissions from transport fuel used in-boundary and scope 3 emissions from out-of-boundary transport, as well as losses from transmission and distribution from grid-supplied energy used in EVs
2. Select a relevant assessment year and project activity data
Operational emissions will be assessed for 2030
Projected vehicle-kms for freight transport developed from MNN traffic and mobility study and Madrid City data
3. Determine the emissions inventory for the relevant emissions sources in a business-as-usual scenario
The business-as-usual scenario assumes a 20% electric vehicle penetration by 2030
Assumed commercial vehicle fleet mix (electric, petrol, diesel) and efficiencies
Calculate total fuel (petrol, diesel and electricity) consumption for commerical vehicles
Emission factors for petrol, diesel (scopes 1, 2 and 3) and electricity (scope 2 & 3)
CIRIS
Calculate total emissions based on fuel consumption
Projected emissions for commercial vehicle transport in 2030 in a business-as-usual scenario
4. Determine the emissions inventory for the relevant emissions sectors if the action was implemented
Action assumes a 65% reduction in commerical trips
Reduced vehicle-kms for commercial vehicles
Action assumes a 100% penetration of electric vehicles by 2030
Commerical electric vehicle efficiencies
Calculate fuel (electricity) consumption for commercial vehicles
Emission factors for grid-supplied electricity (scope 2 and 3)
CIRIS
Calculate total emissions based on fuel consumption
Projected emissions for commercial vehicle transport in 2030 if the logistics strategy was implemented
5. Assess the emissions impact of the action by comparing against the BAU scenario
Considerations of wider factors such as disruption, feasibility, and cost
Compare the resulting emissions from the action implementation vs the BAU.
Determine whether the action is appropriate for MNN
Transport emissions (kgCO2)
BAU
Logistics framework

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Acknowledgements

C40 is a network of the world's megacities committed to addressing climate change. C40 supports cities to collaborate effectively, share knowledge and drive meaningful, measurable and sustainable action on climate change. C40's mission is to halve the collective carbon emissions of our member cities within a decade, while improving resilience and equity and creating the conditions for everyone, everywhere to thrive.

Arup is the creative force at the heart of many of the world's most prominent projects in the built environment and across industry. Working in more than 140 countries, the firm's designers, engineers, architects, planners, consultants and technical specialists work with our clients on innovative projects of the highest quality and impact.

Arup has worked with C40 since 2009 to develop strategic analysis and research that is central to progressing our understanding of how cities contribute to climate change mitigation and adaptation. The partnership supports a strong analytical research agenda while helping city actors to identify opportunities, collaborate and develop deliverable solutions to accelerate and expand action on climate change.

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The front cover is the Lille Langebro bridge, Copenhagen and the image is by Feybian on Unsplash

Neighbourhood Emissions Assessments

This guidance was co-created and co-delivered by the C40 Cities and Arup partnership

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This guidance is complemented by the Green and Thriving Neighbourhoods training available on the UrbanShift City Academy website. The unit on emissions profiles is particularly relevant.

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