Cambridge Waste Water Treatment Plant Relocation Project
Anglian Water Services Limited

Planning Statement: Strategic Whole-Life Carbon Assessment

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0	20/01/2023	Toby Hiram	
1	25/04/2023	Toby Hiram	No changes, issued as Revision 1
2	18/12/2023	Toby Hiram	Notes added regarding demolition emissions at Milton
3	16/02/2024	Toby Hiram	Explanation of difference in treatment plant emissions added

Cambridge Waste Water Treatment Plant Relocation Project

Strategic whole-life carbon assessment

February 2024

savills

Contents

Non-technical summary

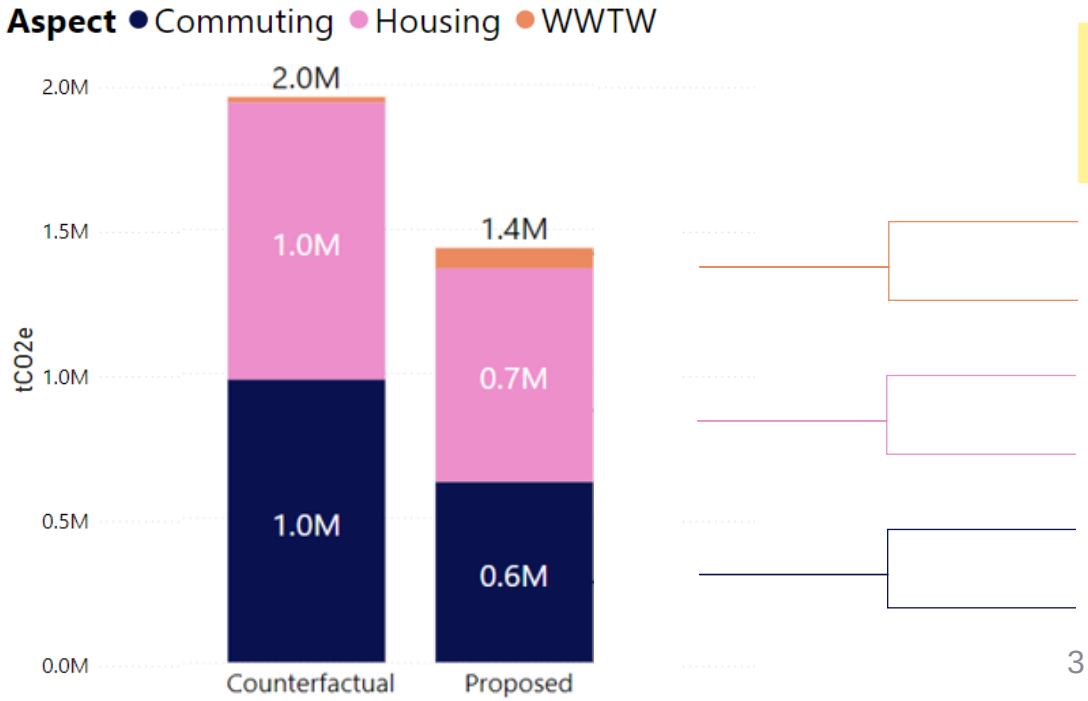
Background context

Anglian Water is proposing to build a modern, low carbon waste water treatment plant for Greater Cambridge on a new site area within the Cambridge Green Belt. The new facility will provide a long-term solution as to how best to treat waste water from a growing Greater Cambridge population. The decommissioned site in North East Cambridge will then be made available for the delivery of 8,350 new homes, which are of critical importance to the sustainable and continued success and growth of the city and region of Cambridge.

The assessment has been broken down into the following three main Aspects, all of which significantly contribute to carbon emissions:
Aspect 1: Emissions associated with constructing the Waste Water Treatment Works (WWTW)
Aspect 2: Emissions associated with the housing development and associated infrastructure (Housing)
Aspect 3: Emissions associated with commuting (Commuting)

The assessment accounts for carbon emissions associated with both materials and construction processes, i.e. embodied carbon, and carbon emissions associated with the use, management and maintenance of the WWTW, housing, infrastructure and vehicles, i.e. operational carbon.

Overall comparison under mid-point scenario



This is a high-level comparative assessment that broadly follows the RICS carbon assessment principles and incorporates a range of scenarios designed to make best use of the available data. While a level of uncertainty is inherent in this type of analysis, the findings themselves are not that surprising. The magnitude of the difference between the modelling scenarios is such that we can have confidence in the overall direction of the findings, even if there is some variation in the actual amount of emissions that are realised in practice.

The assessment offers three scenarios in terms of options to apply policies to reduce carbon emissions across all three Aspects. This graph shows our central estimate, but we have also tested the high-end and low-end scenarios, as outlined later in the report.

The emissions associated with each of these three aspects has been considered under two modelling scenarios:

Proposed development: Existing plant decommissioned, new plant built in Greater Cambridge and delivery of 8,350 new homes on decommissioned North East Cambridge site
Counterfactual (alternative) scenario: Expansion and modernisation of the existing plant in-situ and delivery of 8,350 new homes in suburban location

Key takeaways:

- The counterfactual produces ~40% more carbon emissions than the proposed development
- This difference remains broadly consistent across a range of policy scenarios and housing delivery timescales

- Aspect 1 WWTW produces relatively few carbon emissions
- Decommissioning the current WWTW and building a new modern facility will produce more carbon emissions than upgrading the existing facility
- Aspect 2 produces almost half of overall carbon emissions, the majority of which are embodied carbon from the construction of homes and associated infrastructure
- Aspect 2 is a major driver of the difference between the proposed development and counterfactual
- Aspect 3 produces almost half of overall carbon emissions, the significant proportion of which are operational carbon related to commuting
- Aspect 3 is a major driver of the difference between the proposed development and counterfactual

Contributors

This report was created using generous input from Anglian Water, Useful Projects and Bioregional. While the analysis could not have been delivered without these contributors any subsequent errors can be attributed to the core project team at Savills.

Contributors

Anglian Water

Anglian Water provided data relating to the Waste Water Treatment works, the bulk of which is in the Cambridge Waste Water Treatment Plant Relocation Project Environmental Statement. Anglian Water are leading the way in the water industry in terms of carbon reduction, and this project demonstrates this. They were the first water company to set ambitious targets on reducing both capital and operational carbon.

Useful Projects

Useful Projects are a sustainability consultancy driving positive change for their clients and society. They help clients find added value in delivering sustainable development by providing expert independent insight. In this project, they have done this by providing data regarding housing-related embodied and operational carbon emissions.

Bioregional

Bioregional provide a range of sustainability consultancy services that make it easier for people to live sustainable lives. They have worked closely with Greater Cambridge Shared Planning on their spatial options appraisal which informed the Local Plan 2041. To undertake this appraisal, a modelling tool that calculates the level of carbon emissions for different location categories was developed. A major element of these carbon emissions relates to transport and Bioregional's modelling tool was used to produce context-specific transport-related emissions data.

Core project team

Savills

Savills consultants advise and guide clients through the various, and often complex, aspects of the planning process. These include planning applications, appraisals and appeals, regeneration and urban design, economics, stakeholder engagement, sustainability and environment, and planning policy.

Introduction

Background context to this study

Anglian Water is proposing to build a modern, low carbon waste water treatment plant for Greater Cambridge on a new site area within the Cambridge Green Belt. The new facility will be able to receive and treat increased flows, meet tightened regulatory standards, increase resilience to storm flows and flooding, and ultimately provide a long-term solution as to how best to treat waste water from a growing Greater Cambridge population.

Once operational, it will replace the existing Waste Water Treatment Works (WWTW) in Cambridge and Waterbeach, which will accordingly be decommissioned. The decommissioned site in North East Cambridge will then be made available for the delivery of new housing which is of critical importance to the sustainable and continued success and growth of the nationally important city and region of Cambridge. The new development will bring with it 8,350 new homes, 15,000 new jobs and a wide range of community, cultural and open space facilities, helping South Cambridgeshire District Council and Cambridge City Council achieve their long held ambition of developing a new low-carbon city district on Cambridge's last major brownfield site.

The project is currently in the pre-application phase for a Development Consent Order (DCO), the consent required to allow the development to proceed.

Purpose of this analysis

The purpose of this analysis is to undertake a higher-level strategic whole-life carbon assessment to compare the proposed relocation of the Cambridge WWTW with a plausible and reasonable counterfactual (alternative) scenario. The results of the analysis will be used within the Planning submission to:

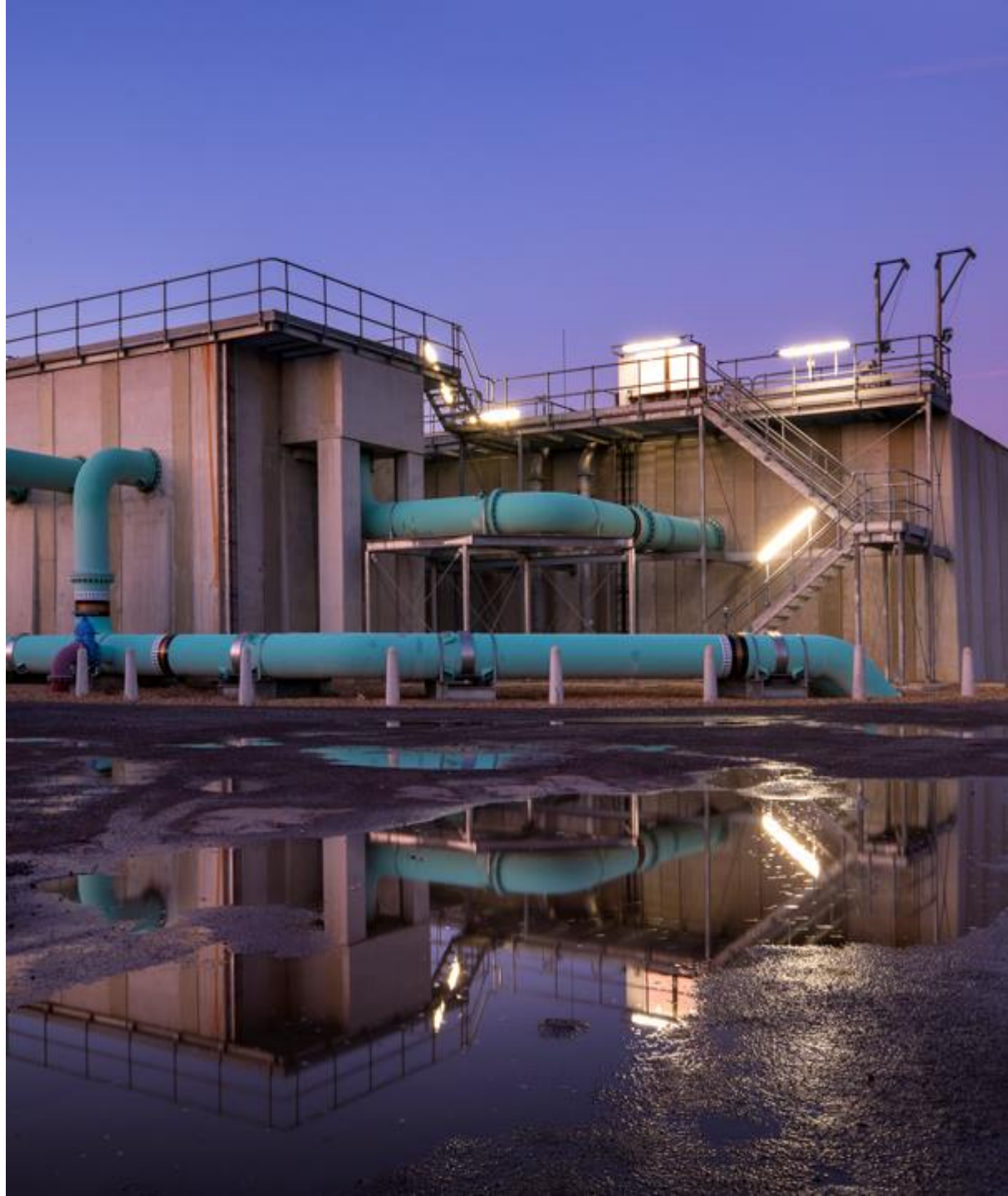
(a) Support the credibility of the site, in carbon terms, against other reasonable alternatives for the purpose of the Environmental Impact Assessment (EIA) for the relocation of the WWTW as part of the DCO process;

(b) To set out the benefits of the scheme as part of the planning balance exercise; and

(c) Justify why the Local Plan, when further progressed, is likely to continue to support the approach to North East Cambridge as set out in the North East Cambridge Area Action Plan and Reg. 18 draft Local Plan.

Report structure

- Provides a summary of approach taken and the methodology used.
- Provides the results with separate breakdowns of the three major emissions drivers covered by the assessment, namely 1) the WWTW itself, 2) the housing and 3) the transport.
- Provides an analysis of the data including what can be reasonably inferred from the results together with any caveats that should be taken into account.



Methodology overview: Assumptions

Three main aspects

The strategic whole-life carbon assessment has been broken down into three main aspects:

- Aspect 1: Emissions associated with constructing the Waste Water Treatment Works (WWTW)
- Aspect 2: Emissions associated with the housing development & associated infrastructure (housing)
- Aspect 3: Emissions associated with commuting (commuting)

Modelling scenarios

The emissions associated with each of these three aspects has been considered under two modelling scenarios:

	Aspect 1 WWTW	Aspect 2 Housing	Aspect 3 Commuting
Proposed development	Existing plant decommissioned and new plant built in Greater Cambridge	Regeneration of North East Cambridge, delivering a total of 8,350 high-density homes, 5,600 of which will be delivered at the Core Site	Commuting from high-density and the well-connected North East Cambridge housing development
Counterfactual (alternative) scenario	Expansion and modernisation of the existing plant in-situ	Development of 8,350 new homes in a suburban location in Greater Cambridge	Commuting from suburban development with good public transport connections into and out of Cambridge

N.b. For the purpose of this report, where we refer to 'counterfactual', we could have used 'alternative scenario'.

Time periods

The assessment has been broken down into three time periods:

Period 1 2026-2042: Mid-plan year 2034
Period 2 2042-2061: Mid-plan year 2052
Period 3 2061-2080: Mid-plan year 2071

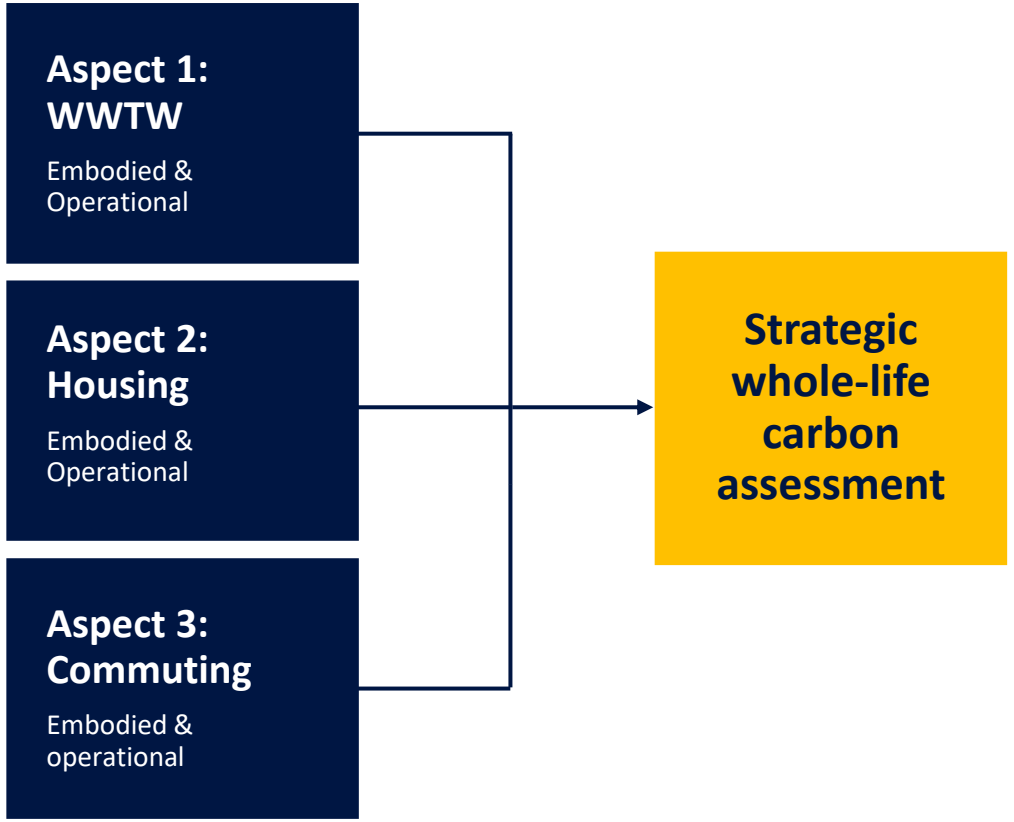
Data note: This assessment broadly adheres to overarching RICS carbon assessment principles. However, this was a relatively brief and high-level comparative assessment where the level of detail about the proposed and counterfactual scenarios is sometimes limited.

Types of emissions

The emissions associated with each of the three aspects have been broken down into two types:

Embodied – carbon emissions associated with materials and construction processes of the WWTW, housing development and vehicles.

Operational – carbon emissions associated with the use, management and maintenance of the WWTW, housing development and vehicles.



A more detailed list of model methodology assumptions and uncertainties is presented in the appendix.

Methodology overview: Assumptions

Policy scenarios

This assessment offers a range of options to apply policies to reduce carbon emissions across all three Aspects. The following three policy scenarios have been modelled:

Zero carbon policies: Best practice scenario that is based on the use of the most up-to-date and lowest carbon materials, processes, approaches and management practices.
Mid-point scenarios: Central scenario that is based on a partial shift towards the use of low carbon materials, processes, approaches and management practices. This central estimate, given that it is a middle ground between these extreme scenarios, is largely used to present comparisons in this report.
Business-as-usual: Worst case scenario that is based on the use of current typical materials, processes, approaches and management practices.

Housing delivery scenarios

This assessment offers a range of options in relation to the timescale of the delivery of the housing. The following two housing delivery scenarios have been modelled:

Optimistic scenario: All 8,350 homes are delivered in Period 1. This would require a rapid build out rate of homes.

Conservative scenario: 3,900 homes are delivered in Period 1 and 4,450 homes are delivered in Period 2. This would require a moderate build out rate and is based on the Greater Cambridge Shared Planning Local Plan.

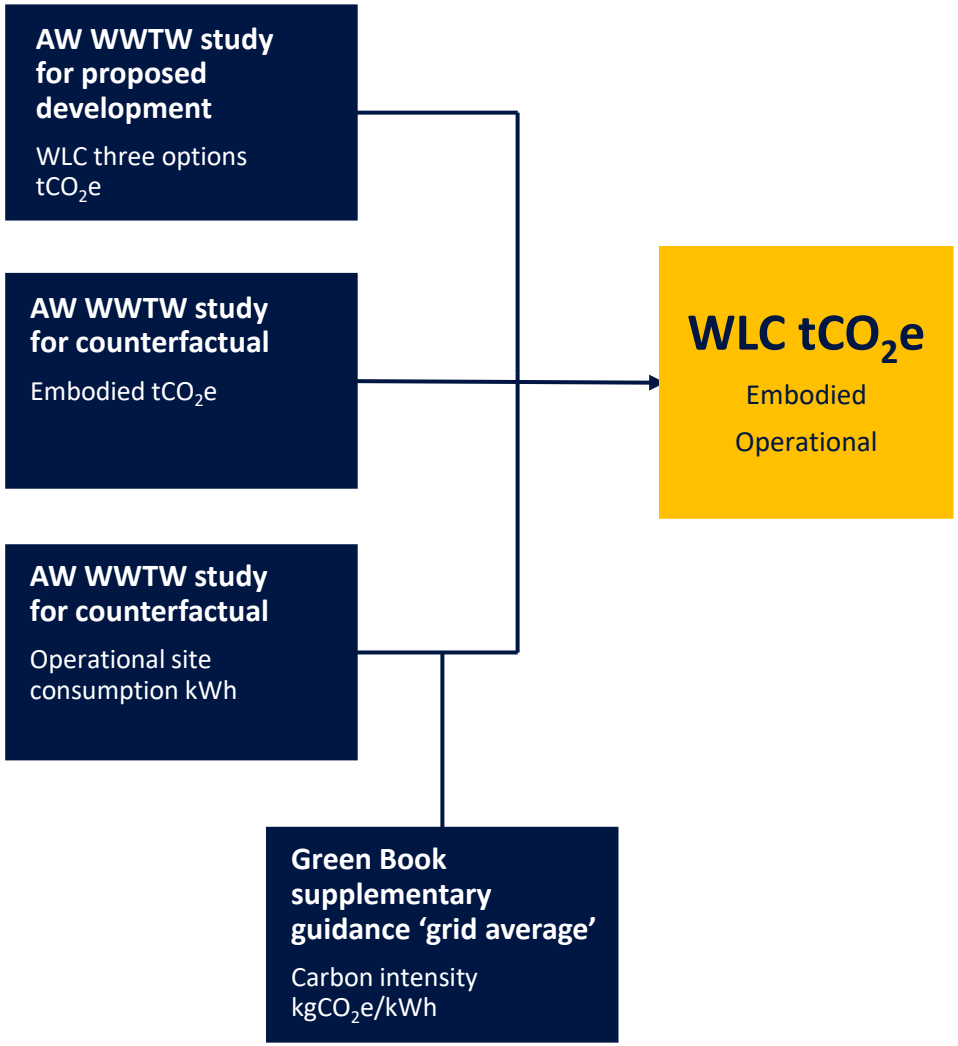
N.b. Aspect 1 WWTW carbon emissions are the same under both housing delivery scenarios.

Given the limited data and assumptions that have had to be made and the high-level strategic nature of this assessment, these scenarios have been used as sensitivity testing. In reality, it is likely that the pace of housing delivery and policy regimes will fall somewhere in between the two scenarios modelled.

The assumptions underpinning each assumption are set out in more detail in the below table:

	Zero carbon policies	Mid-point	Business-as-usual
Aspect 1 WWTW	DCO preferred option.	The alternative proposed development worst case scenario.	Baseline DM0 model.
	Biomethane export, sequestration impacts and reduced (compared to baseline model) construction emissions.	Biogas use in CHP engines, sequestration impacts and reduced (compared to baseline model) construction emissions.	Business-as-usual design for construction and operational emissions. It is a pre-value-engineered design which represents an early view of how the existing Cambridge WWTP would likely have been rebuilt through conventional processes and approaches.
Aspect 2 Housing	Project aspiration.	Good practice.	Business as usual.
	Mid-rise low-carbon concrete frame blocks (proposed)/typically low-rise timber panellised or CLT homes (counterfactual). Target WLC (kgCO2e/m^2): residential 625; mixed use (retail) 535; mixed use (commercial) 535; office 750; school 540; parking barns 535; and community uses 540. Public realm proposed 50/counterfactual 30. Ultra-high performance fabric specification, heat pump led scheme. Target EUI (kWh/m^2): residential 35; mixed use (retail) 55; mixed use (commercial) 55; office 55; school 60; parking barns 25; and community uses 55.	Mid-rise low-carbon concrete frame blocks (proposed)/typically load bearing masonry and timber homes (counterfactual). Target WLC (kgCO2e/m^2): residential 800; mixed use (retail) 690; mixed use (commercial) 690; office 970; school 675; parking barns 690; and community uses 690. Public realm proposed 50/counterfactual 30. Medium performance fabric specification, site wide heat networks with heat pumps. Target EUI (kWh/m^2): residential 50; mixed use (retail) 70; mixed use (commercial) 70; office 75; school 70; parking barns 35; and community uses 70.	Typically, mid-rise traditional concrete frame block (proposed)/typically load bearing masonry and concrete floor homes (counterfactual). Target WLC (kgCO2e/m^2): residential 1,200; mixed use (retail) 1,050; mixed use (commercial) 1,050; office 1,400; school 1,000; parking barns 1,050; and community uses 1,050. Public realm proposed 50/counterfactual 30. Medium performance fabric specification, space heating with radiators and electric boiler. Target EUI (kWh/m^2): residential 100; mixed use (retail) 130; mixed use (commercial) 130; office 130; school 130; parking barns 50; and community uses 130.
Aspect 3 Commuting	Transport emissions based on future improvements to current practices.	Average of the zero carbon policies and business as usual scenarios.	Transport emissions based on current practices.
	Accounts for increased sustainable travel initiatives and a rapid uptake of electric vehicles (~100% of car market by 2042).	Electric vehicle projection (~75% of car market by 2042).	Based on LSOA of 2011 Census and latest BEIS emissions data at time (LSOA 2017). Electric vehicle projections based on current take up rate continuing at a constant rate (~50% of car market by 2042).

Aspect 1: WWTW



Methodology

Proposed development

Anglian Water's Cambridge Waste Water Treatment Plant Relocation Project Environmental Statement 5.2.10 (Chapter 10: Carbon) provides the emissions figures for the proposed development proceeding as planned. The chapter presents the findings of an Environmental Impact Assessment (EIA) completed in relation to the potential impacts of the proposed development on carbon. The assessment considers the following aspects of the proposed development:

- Construction: emissions associated with construction materials, transport of materials to the Proposed Development, and construction activities
- Land use change: carbon sequestration potential from proposed landscaping plans
- Operation: emissions associated with operational energy use and other operational processes
- Decommissioning: emissions associated with decommissioning of the existing site
- Whole life carbon: emissions of operation of the Proposed Development to 2080, including replacement of assets.

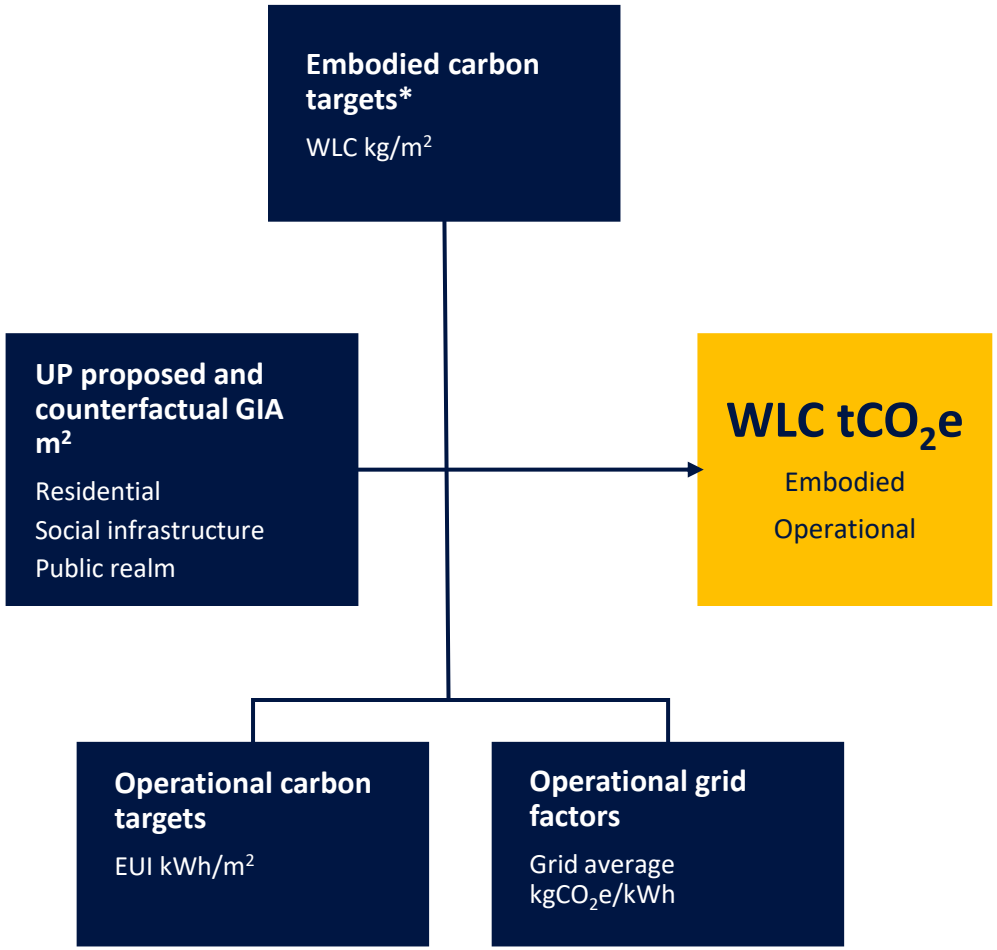
Three options are presented in the chapter: preferred option with biomethane production (zero carbon policies); proposed development worst case scenario with CHP generation (mid-point); and baseline DM0 (business-as-usual).

Counterfactual

Anglian Water have provided embodied carbon figures for the expansion and modernisation of the existing plant, broken down into an implied design and detailed design. They have also provided operational carbon site consumption that has been discounted to account for the decarbonisation of the electricity grid into the future. It is assumed in this assessment that there is no land use change as a result of the plant development.

*Data note: Emissions from the demolition of the existing WWTW are not included in the results presented in this report given that it is not part of the assessment of this project and will be considered as part of a separate planning application in due course. However, Anglian Water undertook an assessment of the indicative scale of demolition emissions (including Waterbeach), which are conservatively estimated to be 4,065 tCO2e (~6% of WWTW emissions; <1% of total emissions for the proposed development). The independent report commissioned by Save Honey Hill arrived at a lower estimate of 2,800 tCO2e. Although these emissions are not negligible, they are not significant enough to change the key finding of this comparative assessment.

Aspect 2: Housing



*Data note: The same embodied carbon factors for housing and infrastructure have been used across both sites. This is likely to produce a conservative estimate of the difference in emissions, given that the North East Cambridge site will be a brownfield site and likely have a significantly lower infrastructure load.

Methodology

Useful Projects modelled the development of 5,600 homes by 2042, built over four Phases: Phase A 2026-2029; Phase B 2029-2033; Phase C 2033-2037; and Phase D 2037-2042. This number has been scaled up and modelled across two delivery scenarios to account for the full 8,350 homes that will be delivered. This was modelled for the Core Site in North East Cambridge and for the suburban counterfactual and an aspirational, good practice and business as usual scenario was provided for both developments.

Proposed development

5,600 homes will be built at the Core Site, where the Waste Water Treatment works is currently situated. The remaining 2,750 homes will be built in the surrounding area in North East Cambridge and broadly align with the development at the Core Site in terms of design and performance.

At the Core Site, buildings are expected to be mid-rise apartment blocks. The areas associated with each element of the development are: residential 646,457m^2; non-residential 214,560m^2; and public realm 545,505m^2. An average residential unit size of 77m^2 GIA is considered to reflect this high-density North East Cambridge development.

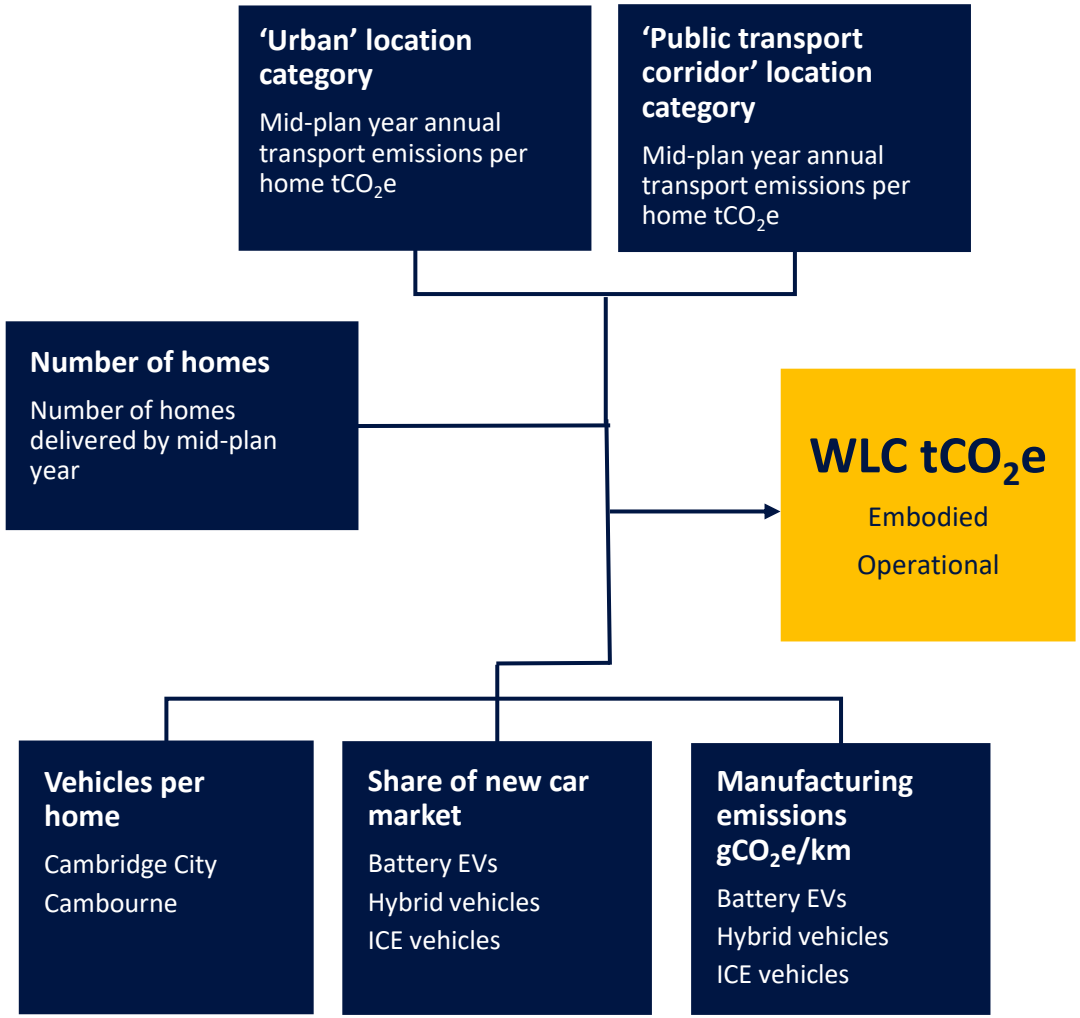
Counterfactual

In terms of a settlement that could represent a reasonable median comparator for the purposes of this strategic carbon assessment, it would seem unreasonable to compare the proposed development site both with a dispersed village settlement, or with an identical site in terms of housing density and location, given that it is these characteristics that make the North East Cambridge site unique. Hence, a generic suburban settlement, that has characteristics broadly in line with the sites on which 8,350 new homes could feasibly be delivered in Greater Cambridge, was chosen as a reasonable median comparator. The characteristics of this generic suburban location would inevitably vary in reality.

A key methodological difference is that the GIA of the proposed North East Cambridge site is smaller than the suburban counterfactual site. This is due to several factors including increased market demand for larger homes in suburban locations and National Space Standards (NSS) requirements in suburban locations compared to urban locations.

The suburban counterfactual would largely be houses and low-rise apartment blocks. The areas associated with each element of the development are: residential 834,400m^2; non-residential 214,560m^2; and public realm 2,086,000m^2. An average unit size of 100m^2 GIA is considered to reflect the lower density typologies used in suburban projects.

Aspect 3: Commuting



Methodology

Operational

Greater Cambridge Shared Planning, in the process of developing their new Local Plan 2041, have undertaken a strategic spatial options appraisal[1]. A modelling tool was created by Bioregional which analyses whether there will be different levels of carbon emissions depending on where the local plan allows new homes and facilities to be built. The model accordingly divides the different possible growth locations into six different categories within which the emissions of each home would be expected to be roughly similar.

A key element of these operational carbon emissions relates to transport and the tool distinguishes between these categories by looking at the likelihood that journeys will be walked, cycled, driven, or made with public transport in each of these locations.

A mid-plan year annual transport emissions per home figure is used for each Period that accounts for grid decarbonisation and electric vehicle uptake. This is then scaled up by the number of years in the Period to account for the transport-related operational emissions for the whole time period.

The North East Cambridge Core Site is a brownfield site located close to the City of Cambridge and within walking distance of Cambridge North Railway Station. It is hence categorised as 'urban' in the spatial options model.

The suburban counterfactual is assumed to have excellent public transport links. It would likely be linked to, for example, the Cambridgeshire Guided Busway and its adjoining cycleway, connecting the site directly to the City of Cambridge, Cambridge North Railway Station, and beyond. It is hence categorised as a 'public transport corridor' in the spatial options model. This is the second lowest location category in terms of transport emissions per home and is hence a conservative assumption.

Embodied

This assessment uses Acorn profile overviews that present vehicles per household data for Cambridge City[2], as a proxy for North East Cambridge, and Cambourne[3], as a proxy for the suburban counterfactual. This is then scaled up to produce an overall number of vehicles for each time period. This is broken down into types of vehicles in each time period using share of new car market data[4] for each respective mid-plan year. Overall mileage is then calculated which, using embodied emissions per km driven manufacturing data[5], is used to calculate embodied carbon emissions.

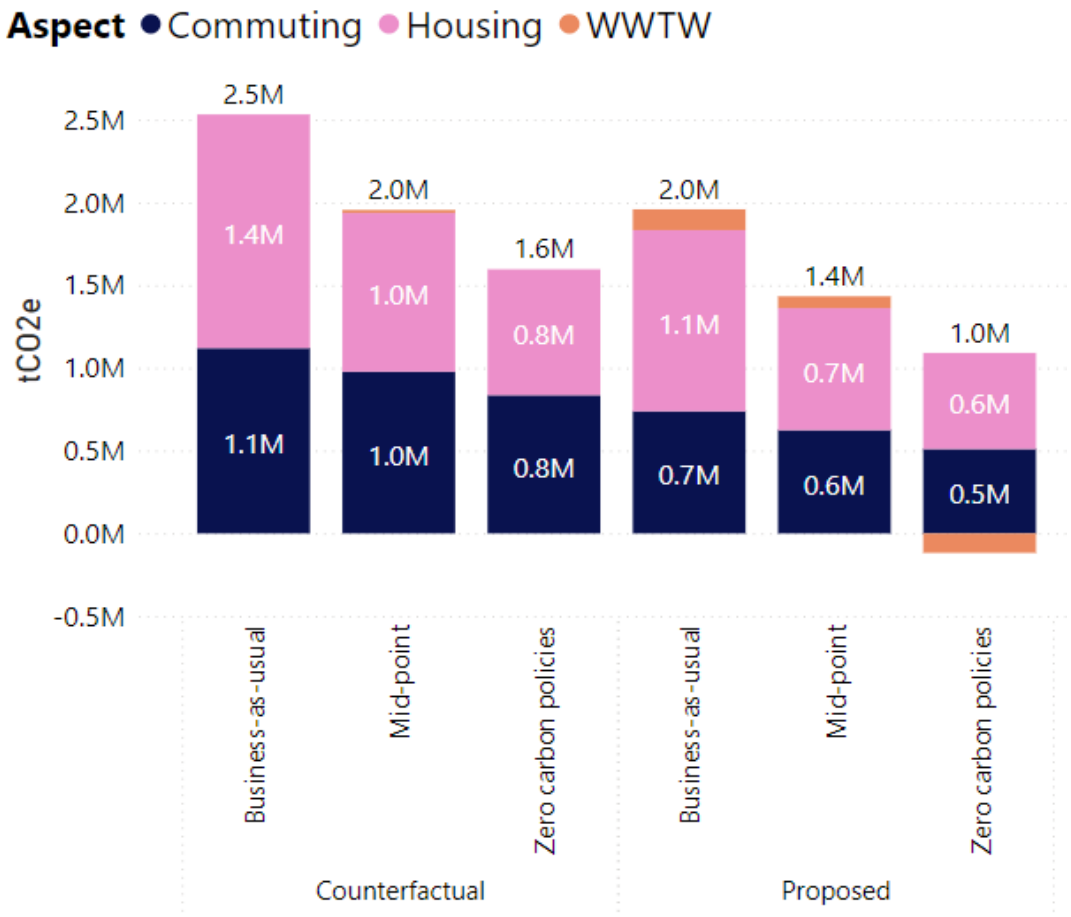
[1] https://www.greatercambridgeplanning.org/media/1389/gclp-strategic-spatial-options-assessment-implications-for-carbon-emissions-nov2020.pdf
[2] https://cambridgeshireinsight.org.uk/wp-content/uploads/2019/11/Cambridge-City-Acorn-profile.pdf
[3] https://cambridgeshireinsight.org.uk/wp-content/uploads/2019/11/Cambourne-Acorn-profile.pdf
[4] https://www.smmt.co.uk/2021/06/smmt-new-car-market-and-parc-outlook-to-2035-by-powertrain/
[5] https://www.carbonbrief.org/factcheck-how-electric-vehicles-help-to-tackle-climate-change/

Results

Conservative scenario

Please note that these results have informed the overall results in the non-technical summary

Overall results



Aspect 1 WWTW
Proposed: 4%
Counterfactual: 1%

Aspect 2 Housing
Proposed: 52%
Counterfactual: 49%

Aspect 3 Commuting
Proposed: 44%
Counterfactual: 50%

Under the mid-point scenario as outlined right.

Analysis

Under the mid-point scenario:

Commuting accounts for 44%, housing and associated infrastructure 52% and WWTW 4% of carbon emissions for the proposed development. For the counterfactual, commuting accounts for 50%, housing and associated infrastructure 49% and WWTW 1% of carbon emissions.

- Aspect 1 WWTW has a relatively insignificant effect on the overall emissions; and
- The difference between the proposed development and counterfactual, and between the policy scenarios, is largely driven by Aspect 2 housing and Aspect 3 commuting.

The counterfactual produces 36% more carbon emissions than the proposed development. This is driven by:

- Commuting producing 57% more emissions, largely due to the increased number of journeys taken by car as opposed to walking, cycling or public transport;
- Housing and associated infrastructure producing 30% more emissions, due to the increased GIA and public realm area of the suburban counterfactual development; and
- In contrast, building a new WWTW produces 294% more emissions than modernising the existing plant. However, given the scale of these emissions, this has a relatively minor impact on overall carbon emissions.

For the proposed development:

The business-as-usual scenario produces 101% more emissions than the zero carbon policies scenario. This is driven by:

- A 45% increase in commuting emissions, due to an increased number of journeys taken by car as opposed to by walking, cycling or the use of public transport, as well as a slower rollout of electric vehicles;
- An 88% increase in housing and associated infrastructure emissions, which is due to relatively poorer design and performance, demonstrated by the increased EUI and WLC targets; and
- A 207% increase in WWTW emissions, mainly due to the lack of biomethane export along with poorer construction materials and practices.

For the counterfactual*:

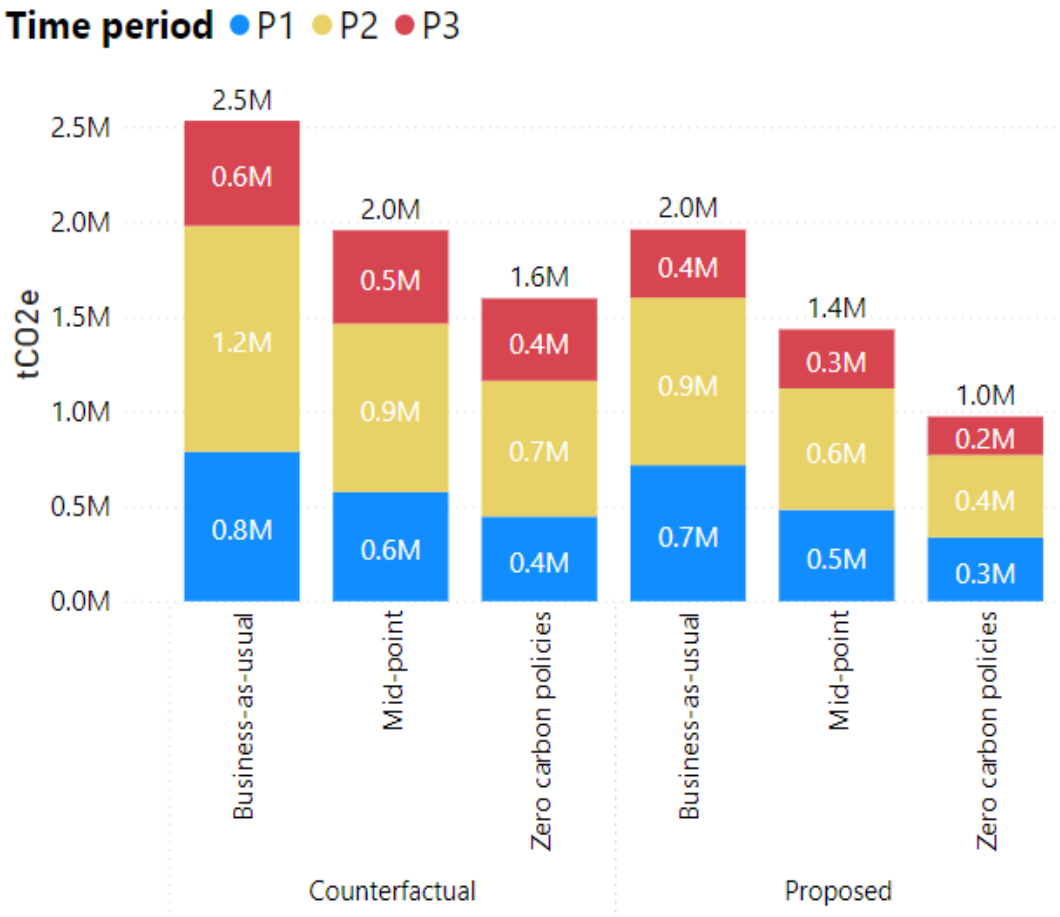
The business-as-usual scenario produces 59% more emissions than the zero carbon policies scenario. This is driven by:

- A 34% increase in commuting emissions, again driven by car use and the slower rollout of electric vehicles; and
- An 86% increase in housing and associated infrastructure emissions, again due to poorer design and performance.

The conservative housing delivery timescale reduces carbon emissions by ~10-15% compared to the optimistic scenario. Houses are delivered more slowly, which reduces the number of occupied homes that contribute to commuting emissions and allows the grid to decarbonise further.

*N.b. There is no Aspect 1 WWTW counterfactual data for zero carbon policies and business-as-usual. It is relatively insignificant compared to Aspect 2 housing and Aspect 3 commuting anyway and would not change results.

Overall results



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Period 1
Proposed: 34%
Counterfactual: 30%

2

Period 2
Proposed: 45%
Counterfactual: 45%

3

Period 3
Proposed: 21%
Counterfactual: 25%

Under the mid-point scenario as outlined right.

Analysis

Under the mid-point scenario:

Period 1 accounts for 34%, Period 2 45% and Period 3 21% of emissions for the proposed development. For the counterfactual, Period 1 accounts for 30%, Period 2 45% and Period 3 25% of emissions.

As expected, compared to the scenario in which all homes are delivered in Period 1, the Local Plan housing delivery timescale means that there is a change in the distribution pattern of emission across the study period (2026-2080). The share of emissions produced in Period 1 (2026-2042) falls significantly and the share of emissions produced In Period 2 (2042-2061) rises significantly. The share produced in Period 3 (2061-2080) stays broadly the same.

There is reduced embodied and operational emissions produced in Period 1 as less homes are now built. The treatment plant is still constructed in this Period, but those embodied emissions are relatively insignificant.

There will also be less operational emissions produced in Period 2. However, this is more than offset by the increase in embodied carbon, given that 4,450 homes are now delivered in this Period.

The counterfactual produces 19% more emissions in Period 1 than the proposed development. This is largely due to:

- The larger GIA and public realm area of the suburban counterfactual development compared to North East Cambridge and resultant higher embodied carbon.

The counterfactual produces 39% more emissions in Period 2 and 58% more emissions in Period 3 than the proposed development. This is largely due to:

- Increased commuting emissions due to more journeys being taken by car as opposed to by walking, cycling or the use of public transport once the homes are delivered; and
- Increased housing and associated infrastructure embodied and operational emissions owing to the larger GIA and public realm area at the suburban counterfactual development.

For the proposed development:

The business-as-usual scenario produces 113% more carbon emissions in Period 1, 103% more in Period 2, and 78% more in Period 3, than the zero carbon policies scenario.

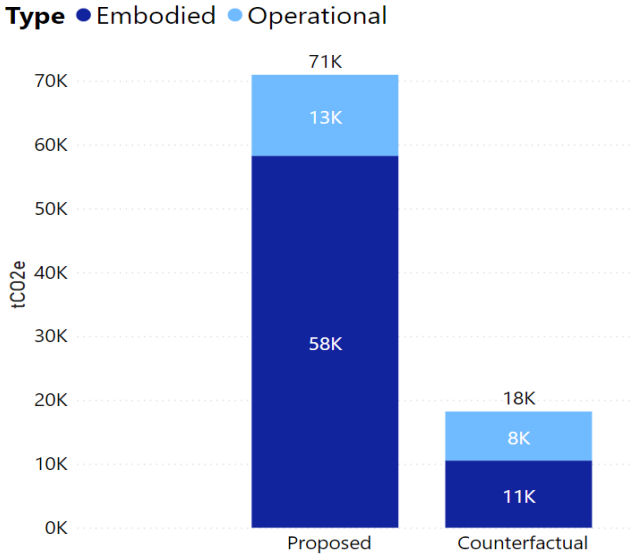
For the counterfactual*:

The business-as-usual scenario produces 77% more carbon emissions in Period 1, 66% more in Period 2, and 27% more in Period 3, than the zero carbon policies scenario.

This is broadly consistent across both housing delivery timescales.

*N.b. No Aspect 1 WWTW data provided for zero carbon policies and business-as-usual scenarios. It is relatively insignificant compared to Aspect 2 housing and Aspect 3 commuting data so comparison still made.

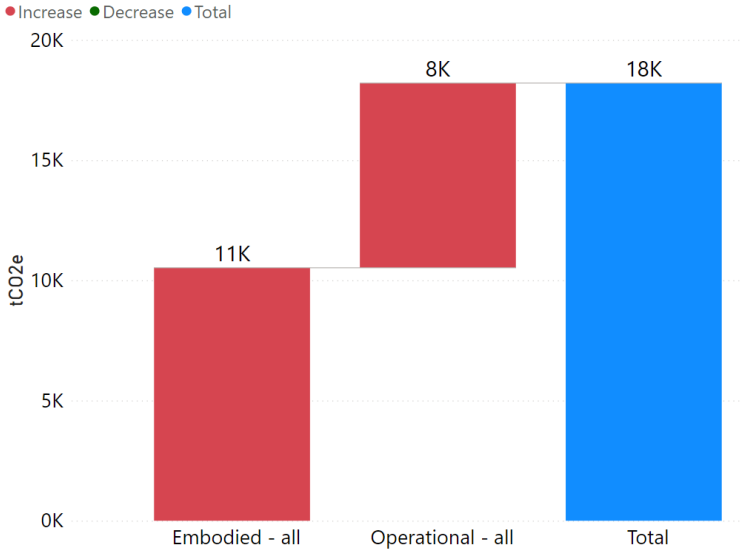
Aspect 1: WWTW



Overall WWTW breakdown under mid-point scenario

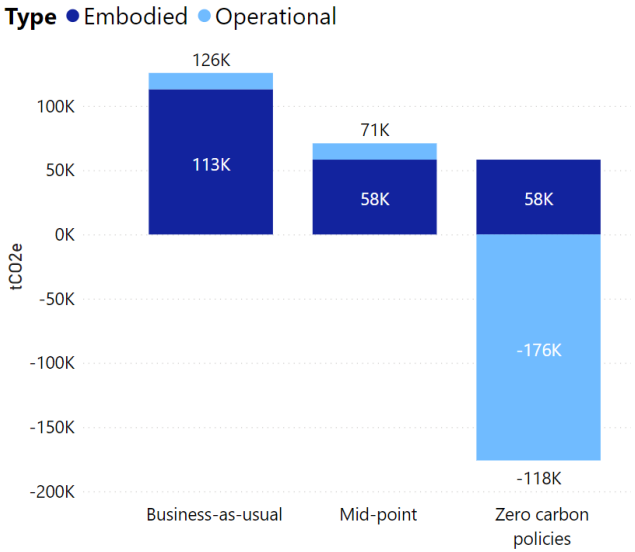
No data was available for the business-as-usual and zero carbon policies. The mid-point scenario is therefore used for comparison purposes.

Developing a new treatment plant produces 294% more emissions than modernising and upgrading the existing facility.



Counterfactual breakdown by WWTW emission category under mid-point scenario

The breakdown of categories for the counterfactual modernisation of the existing plant is much more limited than for the proposed new plant. A relatively small amount of emissions would be produced both during the construction and operation of the upgraded treatment plant.



Proposed WWTW breakdown by policy scenario

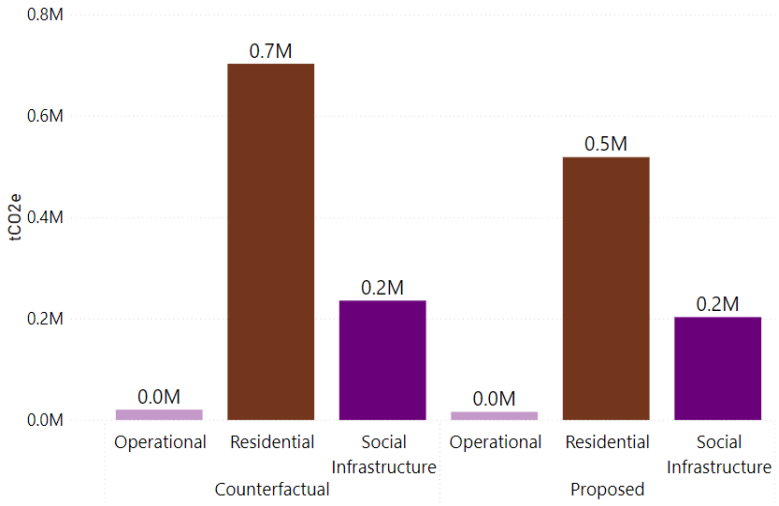
The business-as-usual scenario produces 207% more emissions than the zero carbon policies scenario, whilst the mid-point scenario produces 160% more emissions.

The operational emissions of the zero carbon policies are significantly negative due to the treatment facility producing and exporting biomethane. This is not the case for the mid-point and business-as-usual scenarios, making operational emissions positive.

In terms of embodied carbon, for both the zero carbon and mid-point scenarios, best-practice construction techniques and materials are used, unlike in the business-as-usual scenario.

Aspect 2: Housing

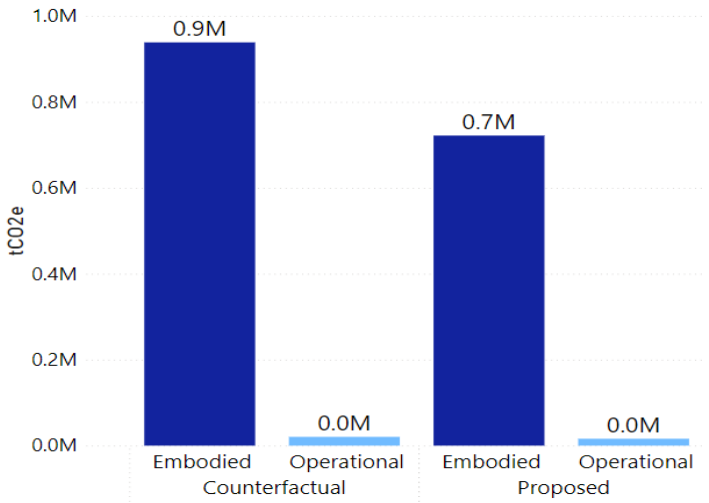
All breakdowns are under the mid-point policy scenario.



Breakdown by housing emission category

For both the proposed development and counterfactual, approximately 71% of emissions are associated with residential properties, 27% with social infrastructure and 2% with operational emissions. Social infrastructure includes: mixed use (retail); mixed use (commercial); office; school; parking barns; community uses; and public realm.

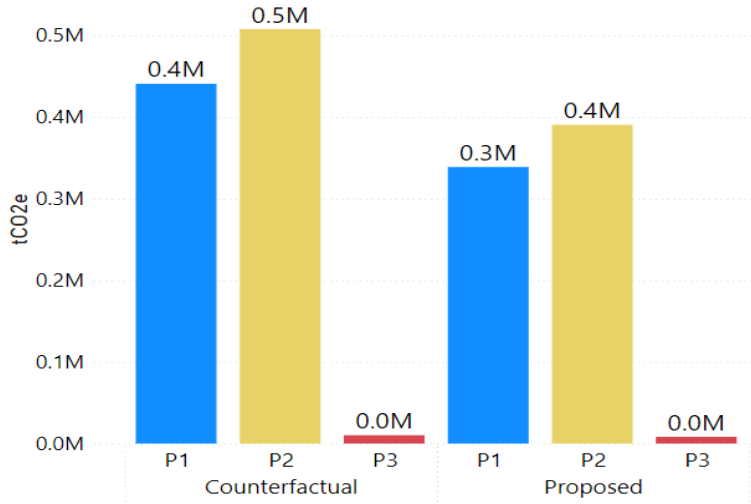
As expected, the change in housing delivery does not significantly affect this breakdown.



Breakdown by housing emission type

For both the proposed development and counterfactual, 98% of housing carbon emissions are embodied carbon whilst operational carbon makes up a relatively insignificant 2%. The construction of housing and social infrastructure produces significantly more carbon emissions than the operation of these assets does.

This is largely unchanged by the pace of housing delivery.



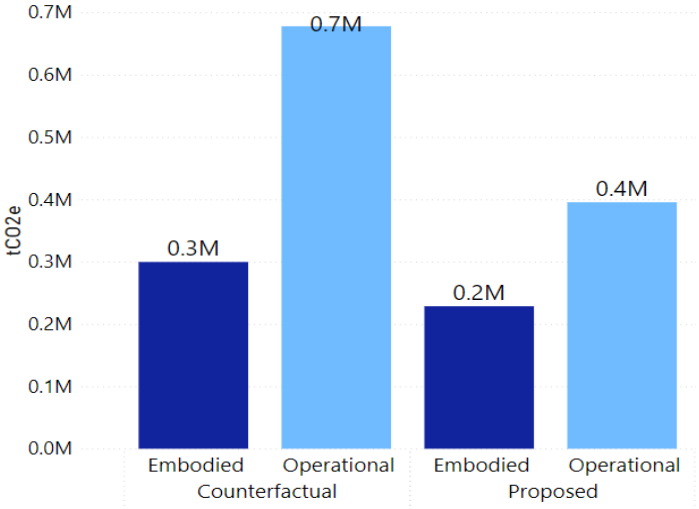
Breakdown by housing emission time period

For both the proposed development and counterfactual, 46% of carbon is emitted in Period 1, 53% is emitted in Period 2 and just 1% is emitted In Period 3.

The largest proportion of emissions are produced in Period 2 and Period 1 when 4,450 homes and 3,900 homes are produced respectively, hence producing significant embodied carbon. Operational carbon, in comparison, is relatively insignificant.

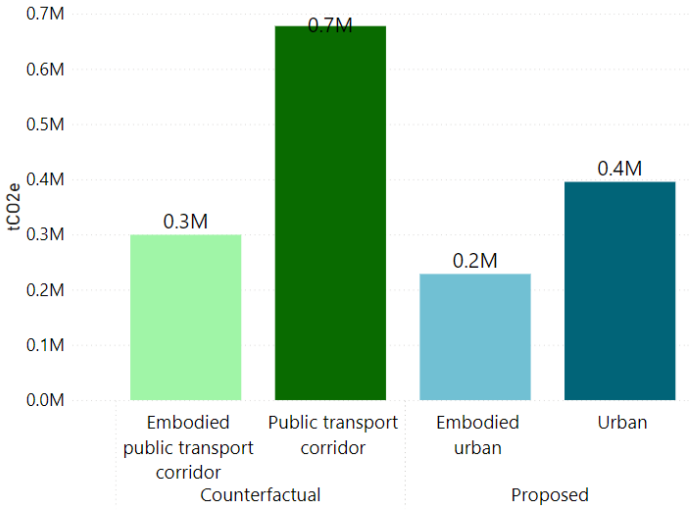
Aspect 3: Commuting

All breakdowns are under the mid-point policy scenario.



Breakdown by commuting emission type

For both the proposed development and counterfactual, approximately 66% of commuting carbon emissions are operational carbon whilst embodied carbon makes up approximately 34%. Compared to their manufacturing process, using cars and public transport produces more carbon emissions. This is unchanged by changing the pace of housing delivery.

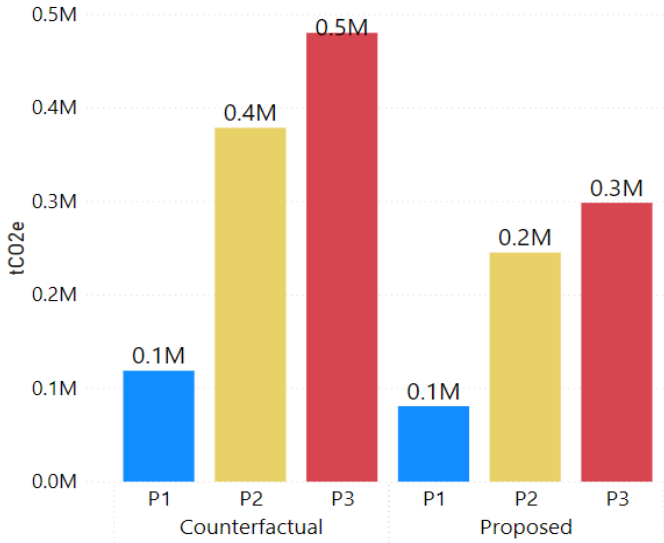


Breakdown by commuting emission category

Public transport corridor operational emissions for the counterfactual development are 72% higher than the urban operational emissions for the North East Cambridge development. The proposed site, due to its location, benefits from reduced car usage, increased public transport usage, and more walking and cycling compared to the counterfactual.

This difference in location is also reflected in the embodied carbon emissions. The increased car usage increases average vehicles per household and means that the suburban counterfactual produces 31% more embodied carbon emissions than North East Cambridge.

As expected, the change in housing delivery does not significantly affect this breakdown.



Breakdown by commuting emission time period

For both the proposed development and counterfactual, approximately 12% of commuting carbon emissions are produced in Period 1, 39% in Period 2, and 49% in Period 3.

Period 3 accounts for the largest proportion of commuting emissions because all of the homes have been delivered by its start.

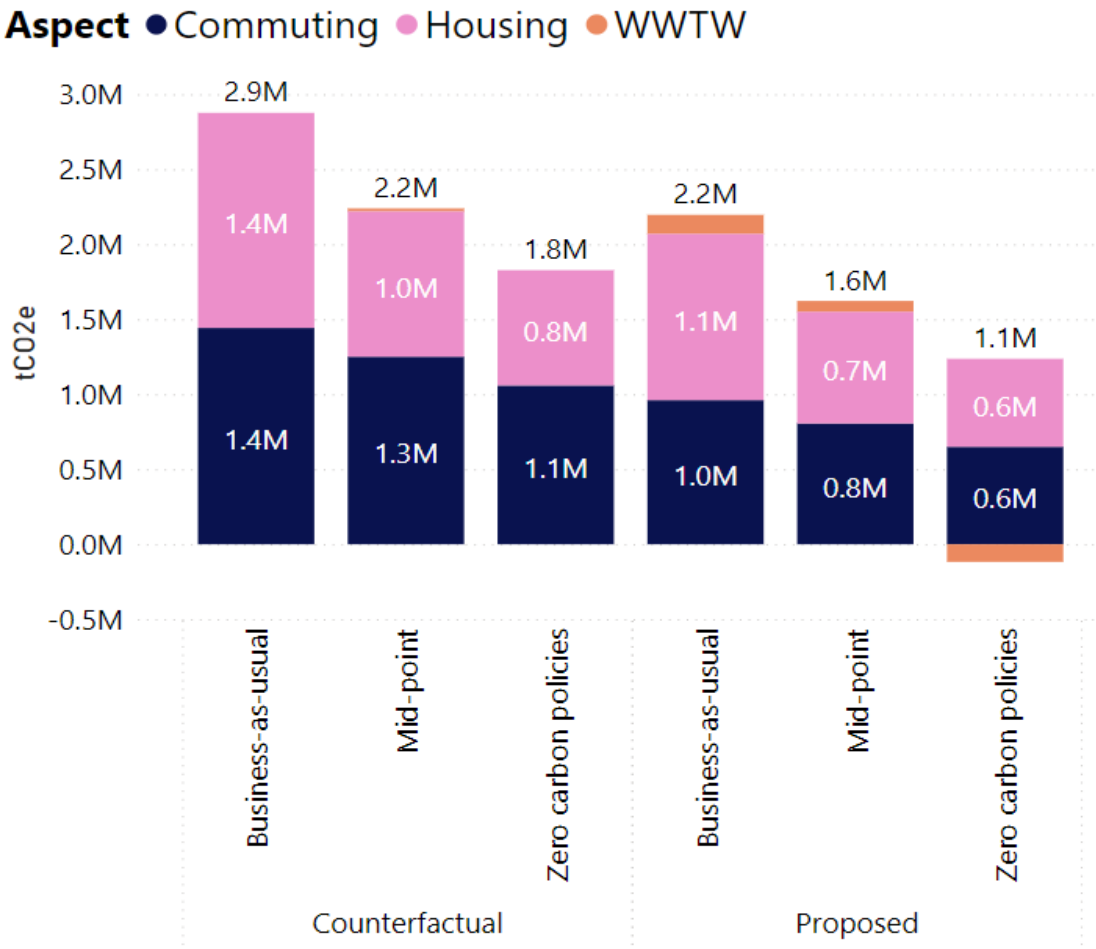
Period 2 is also a significant proportion of emissions given that 3,900 homes are delivered by its start, and more are delivered throughout the Period.

Period 1 makes up a relatively small proportion of emissions. On average across the time period, given the linear build out rate, only half of the 3,900 homes are delivered and thus contributing to operational emissions. As expected, the change in housing delivery does affect the distribution of commuting emissions across the study period.

Results

Optimistic scenario

Overall results



Aspect 1 WWTW
Proposed: 4%
Counterfactual: 1%

Aspect 2 Housing
Proposed: 46%
Counterfactual: 43%

Aspect 3 Commuting
Proposed: 50%
Counterfactual: 56%

Under the mid-point scenario as outlined right.

Analysis

Under the mid-point scenario:

Commuting accounts for 50%, housing and associated infrastructure 46% and WWTW 4% of carbon emissions for the proposed development. For the counterfactual, commuting accounts for 56%, housing and associated infrastructure 43% and WWTW 1% of carbon emissions.

- Aspect 1 WWTW has a relatively insignificant effect on the overall emissions
- The difference between the proposed development and counterfactual, and between the policy scenarios, is largely driven by Aspect 2 housing and Aspect 3 commuting.

The counterfactual produces 38% more carbon emissions than the proposed development. This is driven by:

- Commuting producing 55% more emissions, largely due to the increased number of journeys taken by car as opposed to walking, cycling or public transport; and
- Housing and associated infrastructure producing 30% more emissions, due to the increased GIA and public realm area of the suburban counterfactual development.
- In contrast, building a new WWTW produces 294% more emissions than modernising the existing plant. However, given the scale of these emissions, this has a relatively minor impact on overall carbon emissions.

For the proposed development:

The business-as-usual scenario produces 96% more emissions than the zero carbon policies scenario. This is driven by:

- A 48% increase in commuting emissions, due to an increased number of journeys taken by car as opposed to by walking, cycling or the use of public transport, along with reduced number of electric vehicles compared to internal combustion engine vehicles;
- An 89% increase in housing and associated infrastructure emissions, which is due to the relatively poorer design and performance, demonstrated by the increased EUI and WLC targets; and
- A 207% increase in WWTW emissions, mainly due to the lack of biomethane export along with poorer construction materials and practices.

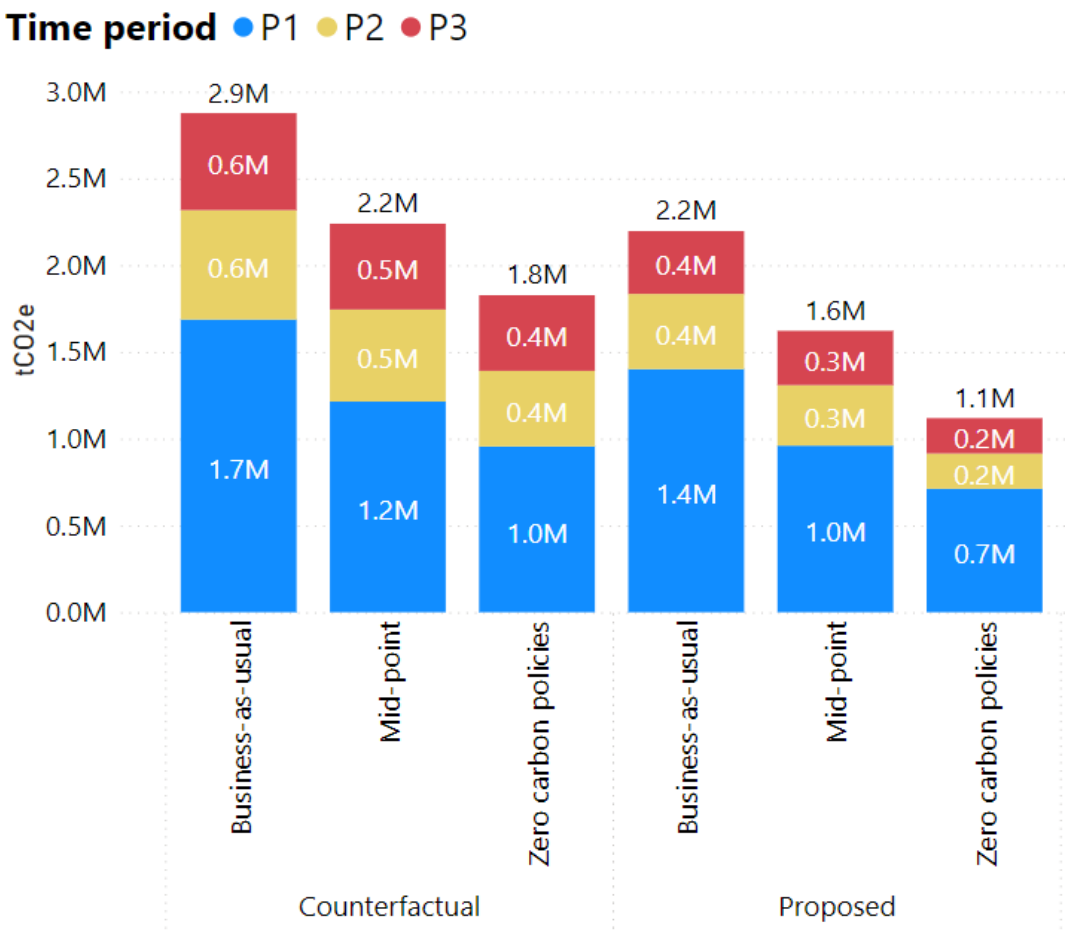
For the counterfactual*:

The business-as-usual scenario produces 57% more emissions than the zero carbon policies scenario. This is driven by:

- A 36% increase in commuting emissions, again driven by car use and the slower uptake of electric vehicles; and
- An 86% increase in housing and associated infrastructure emissions, again due to poorer design and performance.

*N.b. There is no Aspect 1 WWTW counterfactual data for zero carbon policies and business-as-usual. Given funding limitations, it is unrealistic to retrofit the existing WWTW to a high level, i.e. biomethane production. The impact of Aspect 1 is also relatively insignificant compared to Aspect 2 housing and Aspect 3 commuting anyway and would not change results.

Overall results



1

Period 1
Proposed: 59%
Counterfactual: 54%

2

Period 2
Proposed: 22%
Counterfactual: 24%

3

Period 3
Proposed: 19%
Counterfactual: 22%

Under the mid-point scenario as outlined right.

Analysis

Under the mid-point scenario:

Period 1 accounts for 59%, Period 2 22% and Period 3 19% of emissions for the proposed development. For the counterfactual, Period 1 accounts for 54%, Period 2 24% and Period 3 22% of emissions.

As expected, given that the construction of both the WWTW and all housing is to be completed by 2042, the large proportion of carbon emissions are emitted in Period 1.

Carbon emissions are then similar in Period 2 and Period 3. This is because:

- Period 2 and Period 3 are the same length;
- Decarbonisation of the grid has largely happened by the start of Period 2 and thus has little impact on operational carbon up until the end of the study period, 2080;
- 100% of the new car market is accounted for by electric vehicles by the beginning of Period 2 so there is no difference in Aspect 3 commuting embodied carbon; and
- The only difference is the electric vehicle proportion in each year. For the zero carbon policies scenario, it is 100% before the start of Period 2, hence Period 2 and Period 3 carbon emissions remain constant. However, for mid-point and business-as-usual scenarios, it keeps increasing throughout Period 2 and into Period 3, meaning that Period 3 carbon emissions are slightly lower than Period 2 as more residents will have transitioned to lower carbon vehicles.

The counterfactual produces 26% more emissions in Period 1 than the proposed development. This is largely due to:

- The larger GIA and public realm area of the suburban counterfactual compared to North East Cambridge and resultant higher embodied carbon.

The counterfactual produces 52% more emissions in Period 2 and 58% more emissions in Period 3 than the proposed development. This is largely due to:

- Increased commuting emissions due to more journeys being taken by car as opposed to by walking, cycling or the use of public transport; and
- Increased housing and associated infrastructure operational and embodied emissions owing to the larger GIA and public realm area at the suburban counterfactual.

For the proposed development:

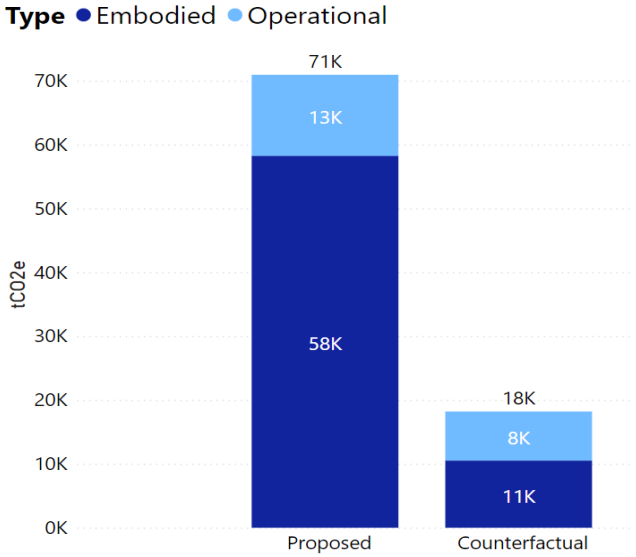
The business-as-usual scenario produces 97% more carbon emissions in Period 1, 112% more in Period 2, and 77% more in Period 3, than the zero carbon policies scenario.

For the counterfactual*:

The business-as-usual scenario produces 77% more carbon emissions in Period 1, 45% more in Period 2, and 28% more in Period 3, than the zero carbon policies scenario.

*N.b. No Aspect 1 WWTW data provided for zero carbon policies and business-as-usual scenarios. It is relatively insignificant compared to Aspect 2 housing and Aspect 3 commuting data so comparison still made.

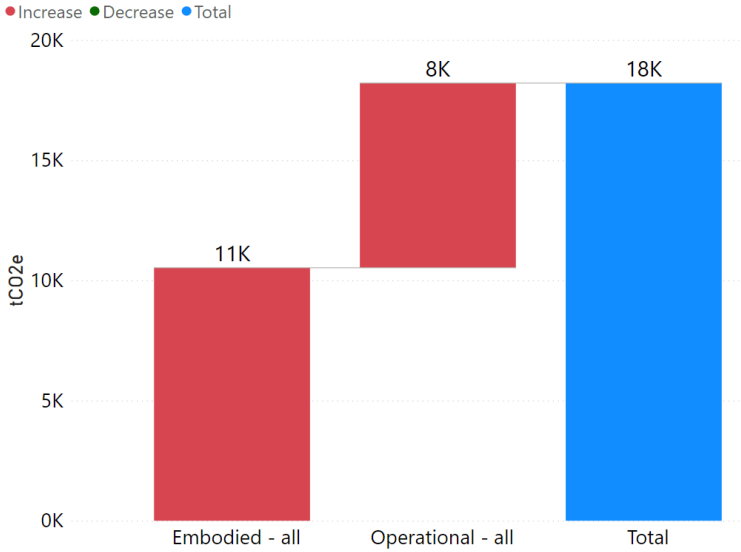
Aspect 1: WWTW (same as conservative scenario)



Overall WWTW breakdown under mid-point scenario

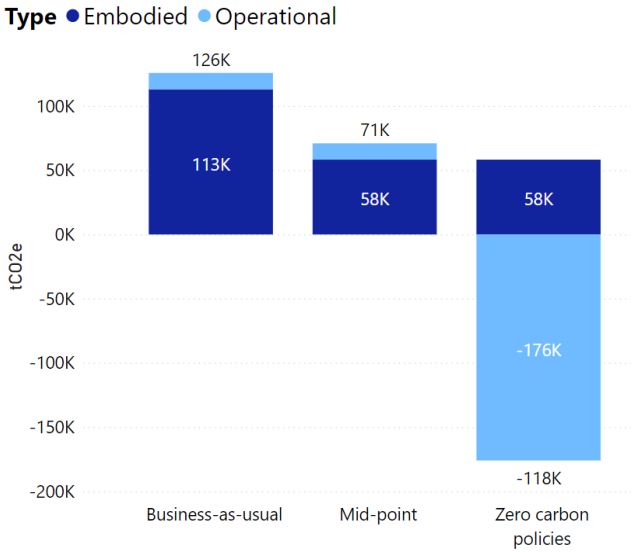
No data was available for the business-as-usual and zero carbon policies. The mid-point scenario is therefore used for comparison purposes.

Developing a new treatment plant produces 294% more emissions than modernising and upgrading the existing facility.



Counterfactual breakdown by WWTW emission category under mid-point scenario

The breakdown of categories for the counterfactual modernisation of the existing plant is much more limited than for the proposed new plant. A relatively small amount of emissions would be produced both during the construction and operation of the upgraded treatment plant.



Proposed WWTW breakdown by policy scenario

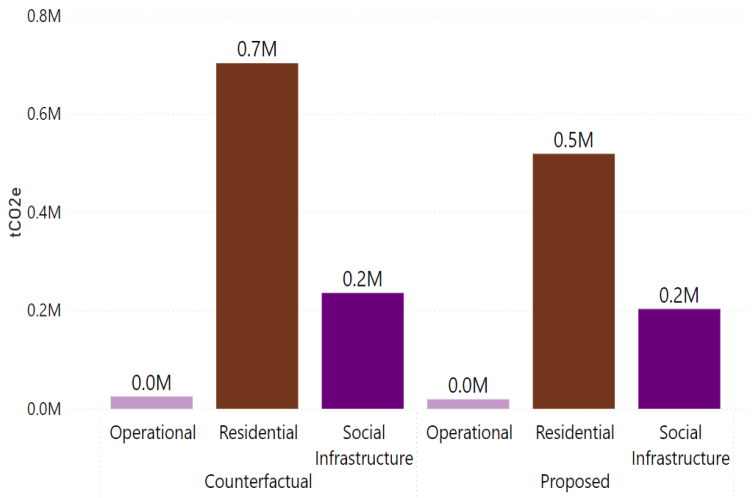
The business-as-usual scenario produces 207% more emissions than the zero carbon policies scenario, whilst the mid-point scenario produces 160% more emissions.

The operational emissions of the zero carbon policies are significantly negative due to the treatment facility producing and exporting biomethane. This is not the case for the mid-point and business-as-usual scenarios, making operational emissions positive.

In terms of embodied carbon, for both the zero carbon and mid-point scenarios, best-practice construction techniques and materials are used, unlike in the business-as-usual scenario.

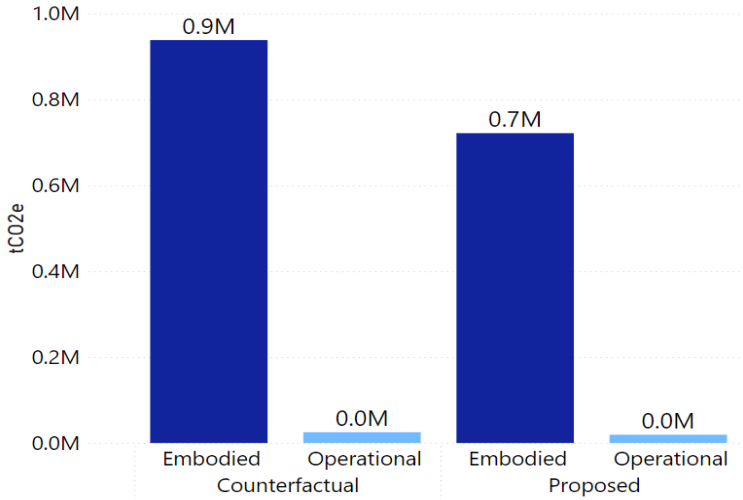
Aspect 2: Housing

All breakdowns are under the mid-point policy scenario.



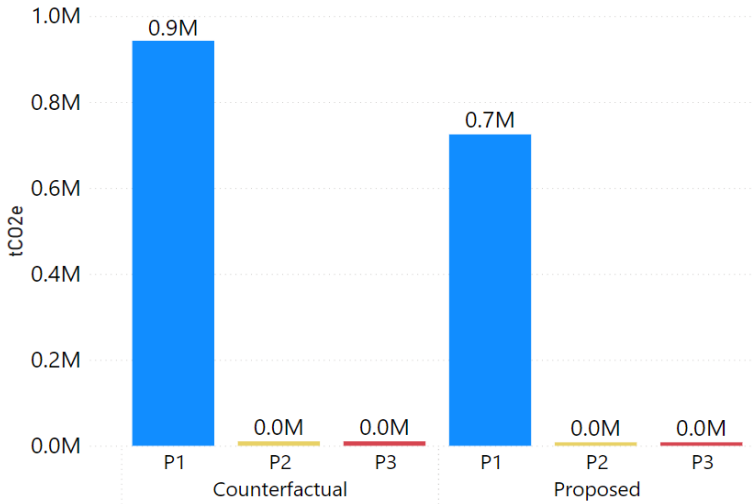
Breakdown by housing emission category

For both the proposed development and counterfactual, approximately 71% of emissions are associated with residential properties, 26% associated with social infrastructure and 3% associated with operational emissions. Social infrastructure includes: mixed use (retail); mixed use (commercial); office; school; parking barns; community uses; and public realm.



Breakdown by housing emission type

For both the proposed development and counterfactual, approximately 97% of emissions are embodied carbon, whilst a relatively insignificant 3% are operational carbon. The construction of housing and social infrastructure produces significantly more carbon emissions than the operation of these assets does.

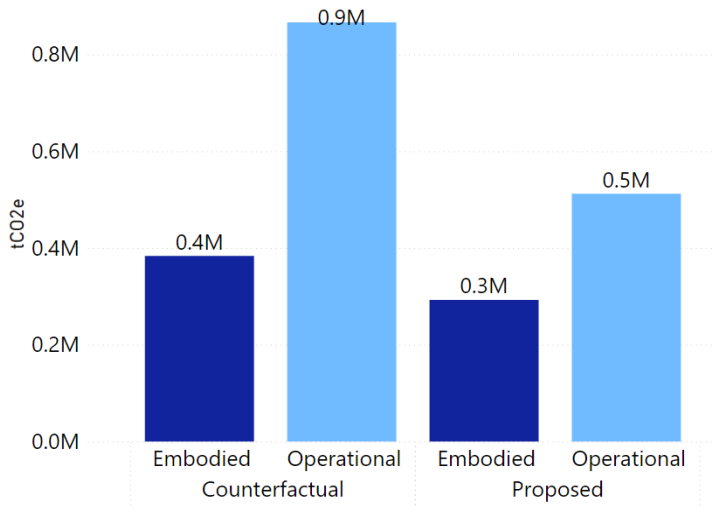


Breakdown by housing emission time period

For both the proposed development and counterfactual, 97% of housing carbon emissions are emitted in Period 1 and 3% are emitted equally across Period 2 and Period 3. This is expected given that the majority of carbon emissions are embodied and all the housing and related social infrastructure is delivered in Period 1.

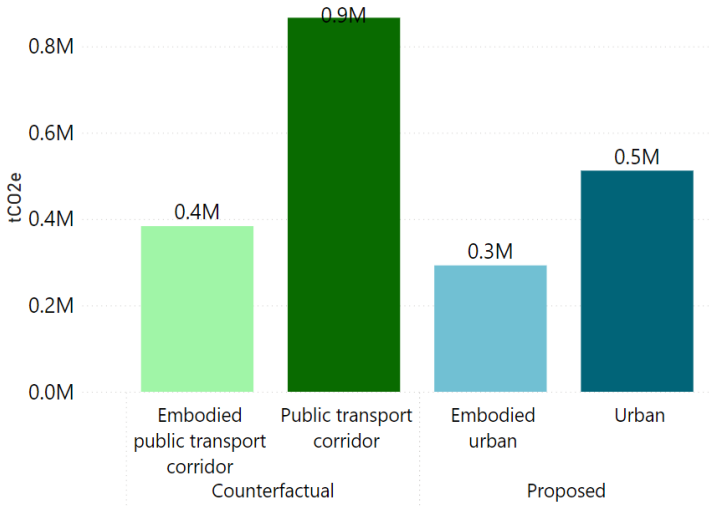
Aspect 3: Commuting

All breakdowns are under the mid-point policy scenario.



Breakdown by commuting emission type

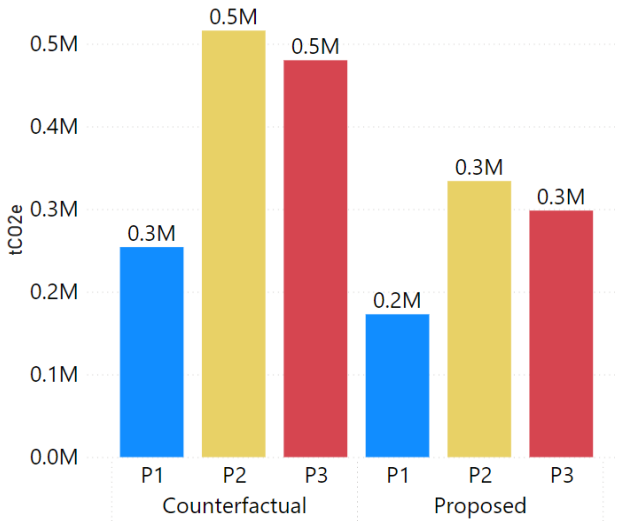
For both the proposed development and counterfactual, approximately 67% of commuting carbon emissions are operational carbon whilst embodied carbon makes up approximately 33%. The use of cars and public transport produces more carbon emissions than are produced as a result of their manufacturing process.



Breakdown by commuting emission category

Public transport corridor operational emissions associated with the counterfactual development are 69% higher than the urban operational emissions from the North East Cambridge development. The suburban counterfactual is located further away from the City of Cambridge than the North East Cambridge site and, as a result, there is greater car usage and less walking and cycling compared to the proposed development.

This difference in location is also reflected in the embodied carbon emissions. The increased car usage increases average vehicles per household and means that the suburban counterfactual produces 31% more embodied carbon emissions than North East Cambridge.



Breakdown by commuting emission time period

For both the proposed development and counterfactual, approximately 21% of commuting carbon emissions are produced in Period 1, 41% in Period 2, and 38% in Period 3. Period 1 accounts for a relatively smaller proportion of commuting emissions because:

- It is 16 years long, as opposed to 19 years in Period 2 and Period 3; and
- Homes are delivered during the whole of Period 1 and only start producing operational commuting emissions once the homes are delivered and occupied.

Period 2 and Period 3 emissions are very similar because:

- They are both 19 years long;
- Decarbonisation of the grid has largely happened by the start of Period 2 and operational carbon thus remains the same from then until the end of the study period, 2080; and
- 100% of the new car market is accounted for by electric vehicles by the beginning of Period 2 so there is no difference in embodied carbon.
- The only difference is that electric vehicles, as a share of the car market, keep increasing into Period 3 and hence, operational emissions keep falling as residents substitute internal combustion vehicles for their lower carbon electric counterparts.

Discussion and limitations

Discussion

What do the results tell us?

Proceeding with the proposed development by relocating the Waste Water Treatment works and developing the North East Cambridge brownfield site will lead to significantly fewer carbon emissions than expanding and modernising the existing plant in situ and building the 8,350 houses elsewhere in Greater Cambridge.

This result is consistent across all three policy scenarios. It is also consistent across both the optimistic and conservative housing delivery timescale scenarios.

For both the proposed development and the counterfactual, Aspect 2 housing and Aspect 3 commuting have a significant impact on carbon emissions. Aspect 1 WWTW is relatively insignificant in comparison. This means that, even though building a new treatment plant will produce more carbon emissions than modernising the existing one, this is more than compensated for by the impact of Aspect 2 and Aspect 3. Building the development in a suburban location will produce significantly more carbon emissions than developing in North East Cambridge, due to the impact of both the housing development and associated commuting.

Although altering the housing delivery timescale does not significantly change the magnitude of difference between the proposed development and counterfactual in terms of emissions, it does alter the distribution of these emissions across the study period. If all homes are built by 2042, most emissions, largely embodied, are produced in Period 1. However, as expected, when the build out rate is slower, a larger proportion of emissions are produced in Period 2, compared to Period 1. Mainly operational emissions are produced in Period 3 in both scenarios and the share of emissions it accounts for remains relatively constant.

Building the proposed new treatment plant generates significantly more carbon emissions than the modernising the existing plant. However, it is important to note that construction emissions are partially compensated for by the biomethane export and sequestration benefits of land use change associated with the development. However, in relation to Aspect 2 and Aspect 3, these emissions are insignificant.

Almost all carbon emissions associated with Aspect 2 are embodied carbon. Embodied carbon from the construction of housing and associated infrastructure is higher for the counterfactual due to a larger GIA and public realm area. The distribution of these emissions across the study period, given that they are mostly embodied, is also very much determined by the pace of housing delivery.

Almost three quarters of Aspect 3 emissions are operational carbon. Both operational and embodied carbon emissions are greater for the suburban counterfactual development than the proposed North East Cambridge development, due to increased car usage and reduced walking and cycling. The significance of operational carbon emissions means that most emissions are produced in Period 2 and Period 3, given that they are slightly longer, and it is not until during Period 2 that all homes would be delivered and occupied.

Limitations

What are the limitations of this high-level assessment?

This is a high-level comparative assessment that broadly follows the RICS carbon assessment principles and incorporates a range of scenarios designed to make best use of the available data. While a level of uncertainty is inherent in this type of analysis, the findings themselves (i.e. that higher density housing that is located more centrally to the City of Cambridge will generally lead to lower emissions that lower density housing that is located further away from the City) are not that surprising. The magnitude of the difference between the modelling scenarios is such that we can have confidence in the overall direction of the findings, even if there is some variation in the actual amount of emissions that are realised in practice.

Appendix

Assumptions and uncertainties

Assumptions

Aspect 1 WWTW
Environmental Statement 5.2.10 (Chapter 10: Carbon) provides three emissions estimates for proposed development (including transport emissions associated with construction activities).
Counterfactual operational carbon discounted by Green Book grid emissions factor to 2080 to account for the decarbonisation of the electricity grid.
Study start year 2026. In line with Aspect 2 housing Useful Projects data.
No land use change with modernisation of existing plant so no carbon sequestration benefits for counterfactual operational.
Single estimate of emissions from upgrade of existing plant provided by Anglian Water (mid-point estimate).
Proposed biomethane production option is zero carbon policies scenario. Biogas utilised in CHP option is mid-point scenario. DM0 baseline is business-as-usual scenario. As outlined in Environmental Statement.
Proposed operational carbon split into periods by number of years.
Counterfactual operational carbon site consumption is an average of five years provided (2017/18-2021/22). These were the years provided and an average was judged to be most accurate.

Aspect 2 Housing
Scaled up Useful Projects figures from 5,600 homes to 8,350 homes to account for full number of homes set out in project proposal.
Each operational phase adjusted to finish in 2080 in line with the study period of Aspect 1 and carbon assessment in general.
Carbon factors adjusted to Phase period update to give a more accurate figure that accounts for grid decarbonisation progress.
5,600 homes on NE Cambridge Core Site are the same as the 2,750 homes built off-site. Surrounding area will take its lead from the Core Site and deliver homes in same fashion.
Optimistic scenario: All 8,350 homes to be delivered in Period 1.
Conservative scenario (in line with GCSP Local Plan 2041): 3,900 are delivered in Period 1 and 4,450 are delivered In Period 2.
Green book grid emissions factor used for discounting operational carbon, in line with Aspect 1 WWTW.
Suburban development used as a counterfactual for both Aspect 2 (in line with Useful Projects) and Aspect 3. It is a reasonable median comparator for the purposes of this strategic carbon assessment given its housing density, public transport links and distance from the City of Cambridge.
NE Cambridge average residential unit size: 77m^2 Suburban average residential unit size: 100m^2 (aligned with proxy Northstowe data). Same non-residential area assumed across both sites Public realm area larger for suburban location.
Same embodied carbon factors for housing and associated infrastructure used for both sites.

Aspect 3 Commuting
Location categories distinguished by a number of factors in line with GCSP strategic spatial options appraisal. NE Cambridge categorised as 'urban' and suburban counterfactual categorised as 'public transport corridor' in line with GCSP Local Plan and Bioregional spatial options model.
Suburban development used as counterfactual for both Aspect 2 (in line with Useful Projects) and Aspect 3 for consistency. It is a reasonable median comparator for the purposes of this strategic carbon assessment given its housing density, public transport links and distance from the City of Cambridge.
Mid-plan year annual transport emissions representative of whole period as the decarbonisation of grid projected to be steady until 2050 when it is fully decarbonised, in line with Bioregional model.
P2 and P3 split into equal 19-year periods to get more representative mid-plan years for rest of period.
Constant build out rate of homes - half of homes are built by the mid-plan year, in line with Bioregional model.
Mid-point policy scenario is an average of BAU and ZCP scenarios.
Average of 2018/19/20/21 for average mileage of vehicles per year to get more accurate figure and account for Covid-19 drop off in vehicle usage. MOT data used.
SMMT data was used for average lifespan of vehicles. Constant lifespan assumed as it is likely to stay broadly constant.
Acorn Cambridge City profile as proxy for NE Cambridge and Cambourne as proxy for suburban counterfactual for vehicles per household. This was the publicly available data and these locations have broadly similar characteristics to their proxy.
SMMT high scenario used for share of new car market input data for ZCP scenario and SMMT central scenario was projected forward at current rate for BAU scenario (low scenario still had quite a rapid uptake of EVs into future).
Battery EV used is an average of Tesla Model 3 and Nissan Leaf 2019 and hybrid conventional vehicle is Toyota Prius Eco. Average European car is used for ICE vehicle. All provided in ICCT data.
Annual transport emissions per home constant from 2050 onwards. Bioregional model ends in 2050 but grid fully decarbonised by then so operational emissions should remain the same. Battery EV share of market should change for BAU and P3 projection also modelled in model end year.
SMMT share of car market used for EV projections for operational carbon. SMMT share of new car market used for EV projections for embodied carbon as study should only include embodied carbon of newly built cars.

Uncertainties

Aspect	Explanation	Uncertainty	Impact
1: Counterfactual operational	Removal of CHP generation (kWh) from Site Consumption.	Medium	Low
1: Proposed embodied	DM0 baseline construction emissions total does not align with breakdown of categories.	Low	Low
1: Proposed operational	Breakdown of operational carbon into time periods is done by years due to data limitations and does not fully account for the decarbonisation of the grid.	Medium	Low
1: Counterfactual	No zero carbon policy or business-as-usual policy scenario data provided.	Medium	Low
2: Proposed and counterfactual	NFA is 95% of GIA. Useful Projects multiplied NFA by 1.05 but we have divided by 0.95.	Low	Low
2: Proposed and counterfactual operational	Breakdown of operational carbon into time periods is done by years due to data limitations and does not fully account for the decarbonisation of the grid.	Medium	Low
2: Proposed and counterfactual	Timescale of housing delivery uncertainty. Optimistic and conservative scenario provided but likely to be somewhere in between.	Medium	Medium
3: Proposed and counterfactual operational	Bioregional modelling tool ends in 2050. 2050 data projected forward to 2052 P2 mid-plan year and 2071 P3 mid-plan year. This makes no difference for ZCP as EV share already 100% by 2050. Two figures provided for 2050 BAU to account for both 2052 P2 mid-plan year and 2071 P3 mid-plan year.	Medium	Low
3: Proposed and counterfactual operational	Bioregional modelling tool can only input a limited selection of EV percentages so not completely accurate. The inputs are just projections so some uncertainty regardless of this.	Low	Low

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