Guide to calculating a base case carbon footprint for land transport infrastructure projects: a case study

Scope changes and how this impacts a base case carbon footprint

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NZ TRANSPORT AGENCY
WAKA KOTAHI

Te Kāwanatanga o Aotearoa
New Zealand Government

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1. Purpose

The purpose of this case study is to support the NZ Transport Agency Waka Kotahi (NZTA) *Guide to calculating a base case carbon footprint for land transport infrastructure projects* (referred to as 'the Guidance' throughout this document). This case study aims to illustrate a scenario that a project might find themselves in whilst needing to calculate a base case carbon footprint (base case). It will use a worked example to illustrate how the base case calculations can be undertaken. This case study will outline recommended approaches for base case calculations when a scope change occurs during project delivery. It provides worked examples using 'Project A', based on the Guidance.

2. Scenario

NZTA has confirmed funding to proceed with Project A. The key features of Project A include:

- A new 16-kilometre highway, comprising of four lanes (two lanes in each direction).
- Two bridges, which span 400m and 200m respectively.
- Four grade-separated interchanges.
- A shared user pathway (SUP) spanning the length of the road, including a 20-metre bridge.
- A river with significance to local mana whenua.

Project A has completed reference design[1] and is progressing through detailed design. The Project has received a schedule of quantities associated with the cost estimate for the reference design, which included a breakdown of the material types and quantities.

User Tip: *To use the schedule of quantities within a cost estimate to calculate a base case, it would need to contain a sufficient breakdown of material types and quantities. This would need to be in alignment with the data entry cells within the PEET tool. If the schedule of quantities does not contain a sufficient amount of detail to input into the PEET tool, there are a number of options a project could take:*

1. *Rely on the second order of the PEET Tool to calculate the base case.*
2. *Extract material types and quantities from the design models.*
3. *Liaise with the cost estimator to produce a sufficient breakdown during the next phase of design.*

2.1. Scope change

During the detailed design phase, NZTA requested Project A add a bus lane running in each direction. This changes the scope for the project team, as it increases the road to six lanes (three lanes in each direction)[2]. This change results in the original base case being inaccurate, specifically it will be unfairly low as it accounts for four, not six traffic lanes. This artificially low base case means it will be hard to demonstrate any carbon reductions when undertaking the carbon footprint of the final *Issue for Construction* design and the project will not be comparing 'apples with apples'. Consequently, some re-work for the base case is required and potentially the need to adopt an alternate approach.

User Tip: *Other examples of scope change on infrastructure projects may include adding of other design features such as a Shared User Path or an interchange.*

[1] Reference design is often completed prior to the tendering phase. The design indicates the alignment of the infrastructure and basic details such as bridges and intersections.
[2] This scenario assumes the additional lanes fit within the existing designation and do not require additional resource consent applications.

3. Assessment

As a result of the additional bus lanes, the material required to construct the road significantly increased. This meant the cost estimate for the reference design did not provide an accurate representation of a ‘business as usual’ version of the actual design.

In this situation, the Sustainability Lead for Project A confirmed with the team that the reference design could no longer be used ‘as is’ for the base case for the following reasons:

- The base case and actual case would not be based on equivalent scope.
- The actual case would likely have a disproportionately higher carbon footprint and/or carbon reductions achieved during design would not be evident.

Figure 1 was used to inform what base case approach was appropriate for Project A.

Section 4 of this case study document outlines two different worked examples for how Project A calculated their base case.

User Tip: *It is suggested that all Project’s use the second order estimate within the PEET tool early in the design phase regardless of formal base case approach adopted. This will assist the Project team to understand what data is available and any gaps in data. This can help shape discussions with the Quantity Surveyor / Cost Estimator as Project’s will understand what data they need. In addition, this can assist to identify any high-level carbon hotspots.*

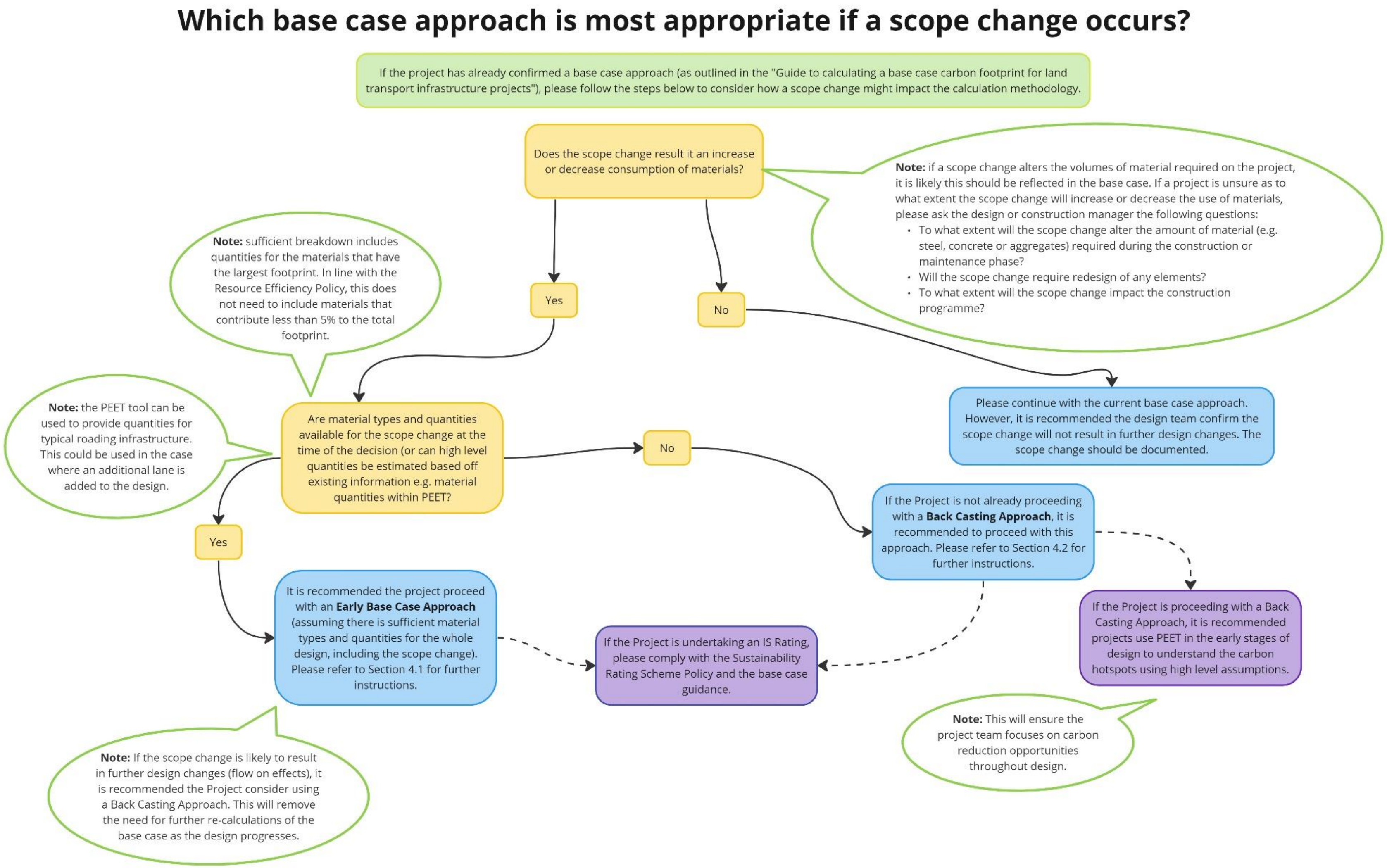


Figure 1 Approach for calculating a base case when a scope change occurs.

4. Next steps

Section 4.1 and 4.2 outline the two pathways for how Project A could calculate their revised base case footprint using an early base case and back casting approach respectively. Please note the numbers in this example are purely indicative.

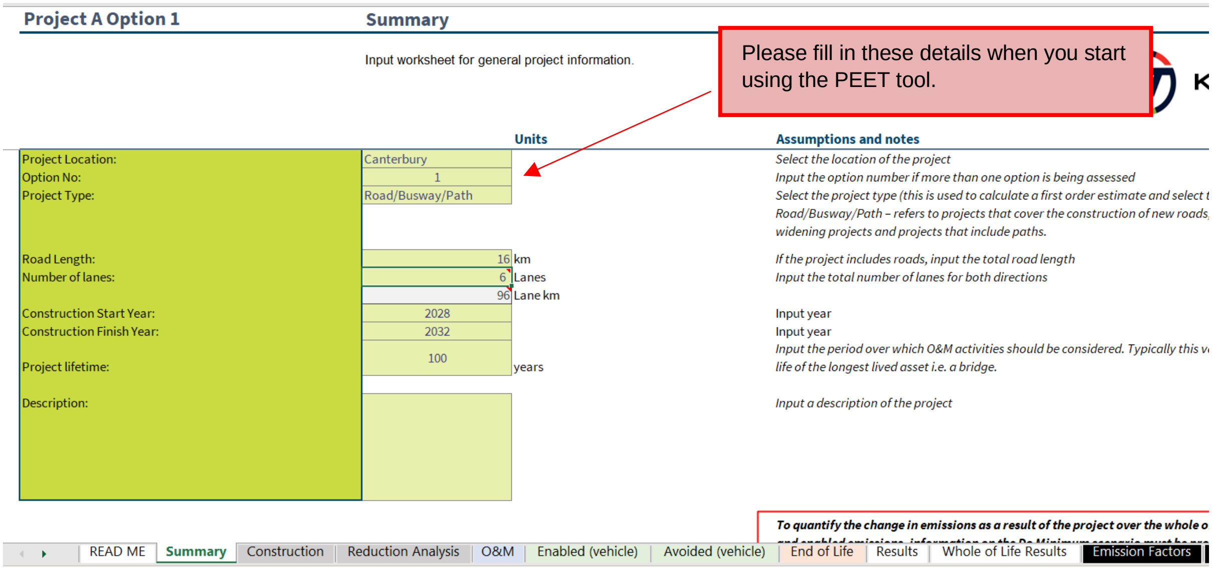
> **User Tip:** Section 3.4.1 and 3.4.2 from the *Guide to calculating a base case carbon footprint for land transport infrastructure projects* should be used to supplement the instructions detailed below.

4.1. Early base case approach

In this worked example, Figure 1 identified an early base case approach as most appropriate for Project A.

The following steps describe how Project A calculated their base case, using an early base case approach.

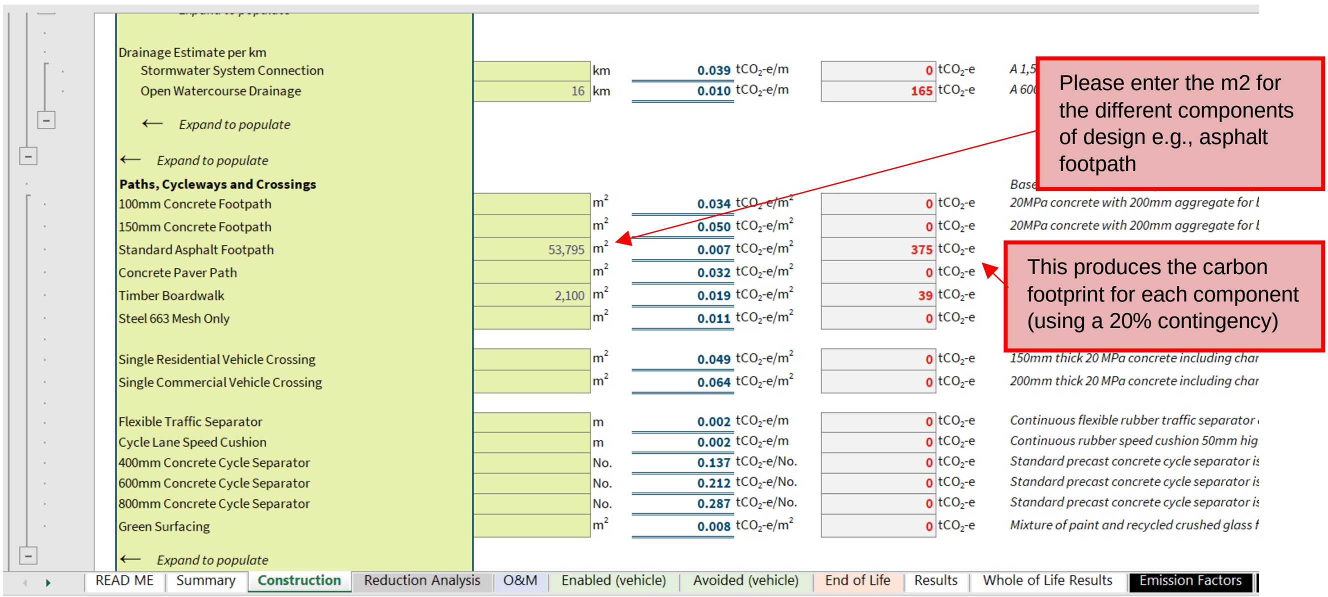
1. Project A confirmed they would use the PEET tool as the base case calculation tool. The Sustainability Advisor set up the PEET tool summary tab as described in the instructions 'READ ME' tab.



2. The Sustainability Lead derived material types and quantities for the reference design (prior to the scope change) and input these into the second order estimate within the PEET tool.
3. NZTA requested Project A add bus lanes running in each direction, impacting the base case.
4. The Sustainability Lead spoke with the Design Manager to gather information required to input the scope change into the second order estimate of the PEET tool. By using the second order estimate, Project A was able to continue with the early base case approach.

> **User Tip:** *If the scope change is likely to progress through design stages under a different programme and/or further refinements of the scope are expected, it is recommended the project use a back casting approach to reduce any future or iterative re-calculations.*

5. The Sustainability Lead entered the scope change data into the second order of a new PEET spreadsheet.



6. The PEET tool produced the total tCO_2e associated with the scope change for Project A.

User Tip: *Involve the sustainability lead (or equivalent) in design discussions regarding the scope change to ensure the updated design is delivered in a low carbon and sustainable manner.*

7. The Sustainability Lead was then able add the tCO_2e for the scope change and reference design base case together to understand Project A's updated base case.
8. The Sustainability Lead continued to track sustainability initiatives associated with carbon reduction throughout the project life cycle. They calculated the associated 'business as usual' design using the third order estimate (eg the schedule of quantities) in the PEET tool. Material quantities were entered into separate versions of the PEET tool to ensure each initiative was tracked appropriately. Please refer to the 'sustainability initiative' case study for further information on why a 'business-as-usual' design is required and appropriate calculation methods.

User Tip: *The material types and quantities associated with 'business-as-usual design' should be added to the third order in the PEET tool. This will produce the total carbon footprint (tCO2-e) for each business-as-usual design.*

9. Project A's IFC design was completed.
10. The cost estimate for IFC was completed and this was provided to the Sustainability Lead.
11. The Sustainability Lead derived material types and quantities from the IFC schedule of quantities and input these into the third order estimate within the PEET tool.

User Tip: *If a project used the second order estimate for the base case and the third order for the actual case, please make sure you are comparing a design on a like-for-like basis. Project's may be required to re-baseline (e.g., update the base case calculation) using the third order estimate (as opposed to the second order) to ensure you are comparing elements on a like-for-like basis).*

12. Project A compared their base case to the actual case to confirm the carbon reductions achieved for the Project.

13. The Sustainability Lead followed the reporting requirements within the resource efficiency guideline and reported the base case to NZTA.

General Tips:

The second order estimate is useful when a project does not have a full breakdown of material types and quantities. However, this also means the base case will not be as accurate. This may require re-baselining in some circumstances.

If the Design Lead provides material types and quantities for certain design elements, they could be inputted into the third order estimate (while still relying on the second order estimate for other elements), to produce a more accurate carbon footprint. However, if both the second and third order are used in one calculation, only the highest order estimate will be reported in the 'results' tab. If this is the case, it is recommended the total calculation is completed in a separate excel spreadsheet. Based on the current functionality of PEET, it will be easier for projects to track initiatives in a separate version of the PEET tool.

The emissions calculations for standard design elements in the second order estimate include a contingency of 20% to provide an estimate appropriate for the initial stage of project assessment.

Don't wait until completion to undertake the sustainability initiative calculations – if left too late, the ability for the design team to provide support with quantifying the savings could be lost.

For the reporting requirements, please refer to the NZTA specifications: P48 Resource Efficiency Specification and P49 Sustainability rating scheme application during tender and delivery of capital works project.

4.2. Back casting approach

The Sustainability Lead spoke with the Design Manager to understand if material types and quantities for the scope change could be readily provided by the design team and/or through the models.

The Design Manager confirmed the models did not currently contain sufficient material quantities to calculate the scope change.

Following the process outlined in **Error! Reference source not found.** for this worked example, a back casting approach was identified as the most appropriate method for Project A.

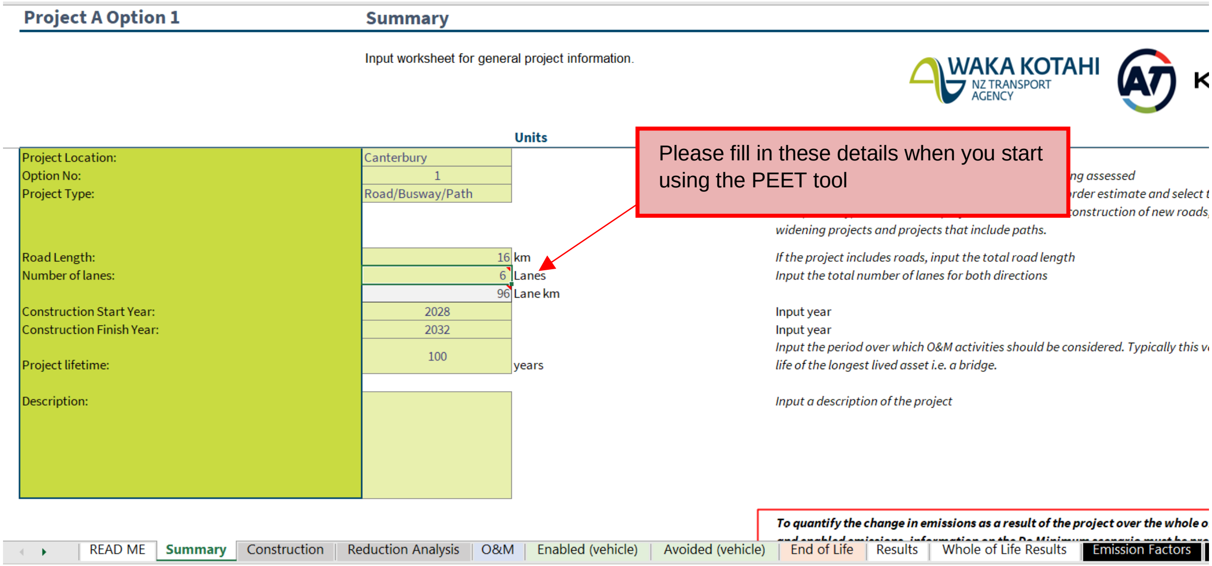
The following steps describe how Project A calculated their base case, using the back casting approach.

User Tip: *The back casting approach is most appropriate if the scope change is likely to progress through design stages under a different programme and/or further refinements of the scope are expected. This approach will remove the need for further iterative re-calculations of the base case as the design progresses.*

1. NZTA requested Project A add bus lanes running in each direction, impacting the base case.
2. Detailed design (including the scope change) continued to progress.

User Tip: *Involve the sustainability lead (or equivalent) in design discussions regarding the scope change to ensure the updated design is delivered in a low carbon and sustainable manner.*

3. Project A confirmed they would use the PEET tool as the base case calculation tool. The Sustainability Advisor set up the PEET tool summary tab as described in the instructions 'READ ME' tab.



4. The Sustainability Lead continued to track and calculate sustainability initiatives associated with carbon reduction throughout the project life cycle using the third order estimate in the PEET tool. Material quantities for a 'business-as-usual' design were quantified and entered into separate versions of the PEET tool to ensure each initiative was tracked appropriately. Please refer to the 'sustainability initiative' case study for further information on why a 'business-as-usual' design is required, and appropriate calculation methods.

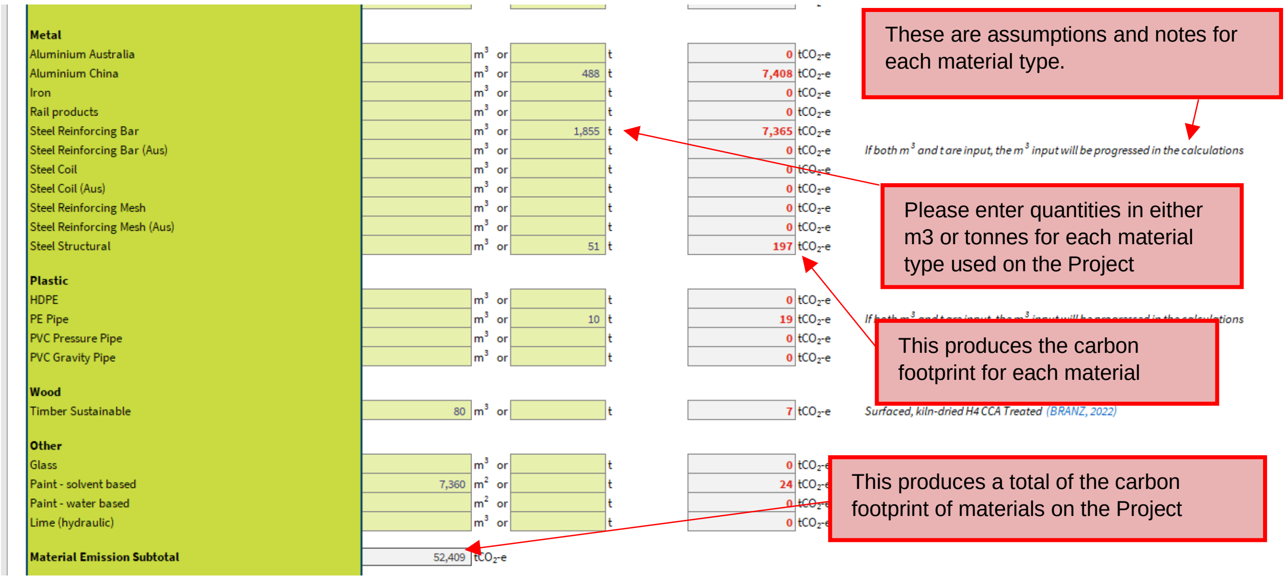
5. The Sustainability Lead engaged with the external Cost Estimator to outline the material types and quantities required to calculate the base case. This included outlining the types of materials within the PEET Tool and the volumes required as outlined below. This ensured that when Project A received the revised schedule of quantities, the information could be more easily transferred into the PEET tool.

> **User Tip:** *Engage with your Cost Estimator (within your organisation or an external company) to ensure the schedule of quantities associated with the cost estimate contain a breakdown of materials and units to calculate the base case in line with the data entry cells for PEET. Line items within the schedule of quantities often comprise of one component e.g., "bus shelter" and "road bridge", without breaking down all the separate materials. The units are also often in m^2 or per unit e.g., 5 x 3m piles. This can make it difficult for the Sustainability Team to calculate the carbon footprint.*

6. Project A's 'Issued for Construction' (IFC) design was completed.

> **User Tip:** *Discuss any timeframe requirements for your base case with your Cost Estimator prior to IFC, as this can take a month (or longer) to be received. If you are completing an Infrastructure Sustainability Rating, receiving the schedule of quantities associated with the cost estimate may be time critical for your ISC submission.*

7. The schedule of quantities for IFC was completed and this was provided to the Sustainability Lead.
8. The Sustainability Lead derived material types and quantities from the IFC schedule of quantities and input these into the third order estimate within the PEET tool.



9. Using separate versions of the PEET tool, the Sustainability Lead replaced the carbon reduction initiatives (from Step 4) with a business-as-usual designs and added this to the actual footprint to calculate the project's base case. This produced Project A's base case and actual footprint.

> **User Tip:** *The material types and quantities associated with 'business-as-usual design' should be added to the third order in the PEET Tool. This will produce the total carbon footprint (tCO2-e) for each business-as-usual design. Please refer to the 'sustainability initiative' case study for further information.*

10. The Sustainability Lead followed the reporting requirements within the resource efficiency guideline and reported the base case to NZTA.

> **General Tips:**
>
> *Based on the current functionality of PEET, it will be easier for projects to track initiatives in a separate version of the PEET tool.*
>
> *To calculate the total footprint, it is recommended you use a blank spreadsheet where you can add all the totals from each PEET tool.*
>
> *Don't wait until completion to undertake the 'sustainability initiatives' calculations – if left too late, the ability for the design team to provide support with quantifying the savings could be lost.*
>
> *Project A chose to use the PEET Tool because it was not undertaking an IS Rating and it was more efficient to use an existing tool (as opposed to creating a bespoke spreadsheet).*
>
> *For the reporting requirements, please refer to the NZTA specifications: P48 Resource Efficiency Specification and P49 Sustainability rating scheme application during tender and delivery of capital works project.*