



Infrastructure
and Projects
Authority

Best Practice in Benchmarking

Government Project Delivery Framework



Reporting to Cabinet Office
and HM Treasury

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Foreword

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The government has ambitious plans for the UK's infrastructure over the next decade.

Building a strong delivery record and ensuring value for money will be crucial as we build back better and stronger. We must ensure that infrastructure projects are driving an increase in productivity, supporting government's levelling up and net zero ambitions and improving outcomes for citizens right across the country.

A fundamental part of this is developing a firm understanding of project costs and performance. Benchmarking – the process of comparing projected or actual project cost and performance information against information from similar projects – is critical in selecting the right projects and setting them up for success from the outset.

In 2019, the Infrastructure and Projects Authority (IPA) published the Best Practice in Benchmarking guidance¹ which set out best practice benchmarking methodology in seven steps. This publication has now been updated to ensure alignment with:

- The refreshed Transforming Infrastructure Performance: Roadmap to 2030 soon to be published will set out the government's ambitious and long term vision for the system of the built environment.

- Government's commitment to achieve net zero emissions by 2050. This updated document sets out carbon benchmarking guidance which will enable both government and industry to make more informed and transparent decisions that support this commitment.
- The IPA's Cost Estimating Guidance², published in 2021, which sets out a best practice approach to cost estimating for infrastructure projects and programmes.

Going forward, we must continue to drive the application of cost and performance benchmarking on all major infrastructure projects. This will enable a step change in the quality of benchmarking and make the approach more consistent across projects initiated in the public sector.

This updated document is another step in that journey, moving us closer to our ambition of nothing less than world class delivery and ultimately improving outcomes that benefit every citizen of the United Kingdom. Through this publication, I am setting the expectation that all projects use benchmarking to ensure the right carbon, cost and performance measures are set.

¹ 'Best Practice in Benchmarking', Infrastructure and Projects Authority, March 2019.

² Cost-Estimating Guidance, Infrastructure and Projects Authority, March 2021.

Best practice in benchmarking

The Infrastructure and Projects Authority (IPA) is the government's centre of expertise for infrastructure and major project delivery. The IPA supports the successful delivery and continuous improvement of all types of infrastructure, working with government and industry to ensure projects are delivered efficiently and effectively.

Transforming Infrastructure Performance (TIP)³ is the IPA's ambitious change programme for infrastructure, and the refreshed *TIP: Roadmap to 2030*, soon to be published has data at its heart. **As part of TIP, the IPA established a team to lead benchmarking initiatives across government, and going forward this will include carbon benchmarking alongside cost.** The team aims to establish and help embed a consistent approach to benchmarking across major infrastructure projects and programmes through the project lifecycle.

Benchmarking for infrastructure projects involves using data from other projects to better inform project development and decision making. Too often, inaccurate estimates on capital and lifecycle cost and expected benefits can lead to unrealistic expectations and a failure to deliver desired outcomes.

Consistent and effective benchmarking should help underpin government and industry decisions on project selection and delivery. It can play an important role across the project lifecycle but is needed most at the start of the process, where wrong or ill-informed choices can derail a project's chance of success. There is unavoidable uncertainty (on cost, carbon, schedule and expected outcomes) at this early stage, where project scope is still being defined and multiple options are being considered.

Benchmarking will help to provide an additional level of informed challenge and assurance during this critical phase, leveraging data and experience from previous projects.

This document outlines the IPA's recommended methodology for cost and performance benchmarking. It introduces the concept and includes a step-by-step guide to undertaking, or commissioning a benchmarking exercise. It sets out why sponsors and delivery bodies, such as HM Government departments and relevant Arm's-Length Bodies (ALBs), as well as consultants and suppliers, could benefit from using benchmarking to improve project performance.

"Benchmarking has the potential to drive performance in infrastructure delivery by providing both project sponsors and delivery bodies with strong evidence on which to base their targets and ambitions."

Bernadette Kelly

Permanent Secretary, Department for Transport

³ 'Transforming Infrastructure Performance', Infrastructure and Projects Authority, December 2017.

The proposed methodology has been formulated in collaboration with a range of partners across government and industry. It builds on previous publications, including 'Government Construction: Cost Benchmarking Principles and Expectations'⁴ and the 'Infrastructure Cost Review'.⁵ It is also in step with the Department for Transport's (DfT) Transport Infrastructure Efficiency Strategy (TIES).⁶ TIES outlines a strategy to address seven challenges to improve transport infrastructure efficiency and provide better outcomes for transport users. Improved benchmarking is a key part of the strategy to improve cost confidence and assurance.

The application of the seven benchmarking steps has been exemplified for greenhouse gas emissions on a whole life basis. This example has been formulated in collaboration with a range of partners across government and industry. It builds upon the current embedded practice demonstrated by the Environment Agency (EA), available standards for carbon measurement and management as well as guidance and recommendations from professional institutions such as Royal Institution of Chartered Surveyors (RICS), Royal Institution of British Architects (RIBA), Institution of Civil Engineers (ICE), Institution of Structural Engineers (IStructE) and other industry experts and forums.

Benchmarking and cost estimating are two sides of the same coin. This guidance document should be used in conjunction with the IPA's cost estimating guidance document in order to set out and support robust cost estimating practices across the project lifecycle, but it's particularly important during the early stages of the project.

For many large and complex projects, a benchmarking methodology can act as a valuable tool to build understanding and confidence in expected project outcomes from the start. At the project initiation stage, benchmarking is essential to ensure the government selects the right projects.

The guidance intends to promote a step change in the quality and consistency of benchmarking approaches in projects initiated by the government and to learn from and influence best practice in industry. It is primarily aimed at project sponsors, clients, Senior Responsible Owners (SROs) and project delivery bodies, all of whom will benefit from a shared understanding of best practice in benchmarking.

The IPA supports the development and application of benchmarking by facilitating the consistent collection, collation and sharing of comparable data across infrastructure delivery. Our aim is to build mutual understanding of, and confidence in, the data which underpins successful benchmarking. For example, the IPA worked with the British Tunnelling Society (BTS), ALBs and private infrastructure organisations to share data to produce an accepted benchmark for tunnelling cost and production rates.^{8,7} The IPA has shared experiences from this process internationally including through the G20's Global Infrastructure Hub and the Organisation for Economic Co-operation and Development.

The IPA will continue to provide support and advice on benchmarking, as well as gather and share benchmarking information. The IPA has worked with government departments and industry under the Construction Metrics initiative to establish a set of common metrics aligned to the government's strategic objectives. These will help us to better understand construction performance across government and support organisations in improving delivery. We will be

⁴ 'Government Construction: Cost Benchmarking Principles and Expectations', Cabinet Office, 10 February 2012.

⁵ 'Infrastructure Cost Review', HM Treasury, 21 December 2010.

⁶ 'Transforming Infrastructure Efficiency Strategy', Department for Transport, December 2017.

⁷ 'Case Study: UK Tunnelling Benchmarking Forum', Infrastructure and Projects Authority, 6 December 2018.

recommending that project sponsors, delivery bodies and their consultants use those metrics as part of their approach to benchmarking.

“As we look to invest billions in the country’s infrastructure, we need to ensure we get the most for our money and that communities see the real benefits of what we deliver. By embedding this guidance, the UK can have confidence in its decision making and its ability to finance and deliver innovative, world leading, well designed projects, long into the future.”

Sir John Armitt

Chair, National Infrastructure Commission

IPA Benchmarking

Methodology – a summary

Benchmarking uses historical information and experience to identify standards and best practice. In reference to project delivery, the benchmarking process involves the comparison of projected (or actual) project performance information against output data and information from other past completed projects to support project investment decisions.

The IPA benchmarking methodology guidance includes seven steps (see figure 1), summarised below, with more detail set out later on.

Step 1: Confirm the project objectives and set the metrics

Each project and programme has distinct objectives. For example, a major rail project might look to improve operational performance (e.g. by increasing capacity and reliability on the network) delivering benefits to users and/or to deliver economic benefits to a region.

Each objective can then be linked to a benchmark. The IPA recommends benchmarks to be used to measure not only project costs, but also whole life carbon and project performance (i.e. across construction and operation). Project performance will include outputs (such as schedule), operational performance in addition to wider outcomes (e.g. economic, environmental and social benefits).

Each benchmark should be underpinned by a set of metrics. This can be a simple cost metric, whole life carbon methodology and life cycle assessment stages (linked to PAS 2080), a productivity metric such as time saved by passengers, or a metric of wider economic benefit.

Step 2: Break the project up into major components for benchmarking

Components could be assets (e.g. tunnels, stations and track) or non- assets and functions (e.g. land or project management costs). These components can be compared to those from a range of other projects to produce a Benchmark Indicative Asset Cost (BIAC) or Benchmark Indicative Non-Asset Cost (BINAC).

Step 3: Develop templates for data gathering

Before gathering data, templates developed collaboratively with delivery partners will help ensure relevant stakeholders understand how the project metrics should be calculated.

Step 4: Scope sources and gather data

Project information and data is critical to successful benchmarking. Data may be generated internally by the project team or organisation, or externally sourced either through collaboration with other organisations or procuring data from a third party supplier. Care should be taken to ensure information and data are relevant, reliable and comparable. An open and collaborative approach across government and industry is welcomed in this process.

Step 5: Validate and re-base data

Once raw data is collected, data should be validated and re-based to allow for direct comparisons (e.g. across countries). An appropriate inflation model and index should be considered.

Step 6: Produce and test the benchmark figure

This figure should relate directly to the components developed at Step 3 and clearly explain the project performance. Summing all asset and non-asset costs together will create a single range, known as the Benchmark Total Design Cost (BTDC).

Step 7: Review and repeat, if necessary, before using data for benchmarking

If the resulting benchmarking information is insufficient to make robust benchmarking analysis then return to Step 1 and source additional data from third parties if necessary.

Benchmarks need to be supported by a clear and expert explanation of differences between projected outputs and the calculated benchmarked ranges and values. There is a risk that without contextual explanation, the use of an index could present misleading information to decision makers. For example, reducing the capital cost of a project by using less expensive materials in construction could risk increasing whole life maintenance costs of the asset, outweighing any initial cost benefits.

Benchmarking

What is benchmarking?

Benchmarking uses historical information to identify standards and best practice. In reference to project delivery, the process involves comparing projected, or actual, project performance information against similar information from past projects with the aim of improving assurance and delivery.

The benchmarking process will analyse information from past projects and programmes to create a point of reference to compare observed or predicted details of a particular project.

Given no two projects are the same, project managers and subject matter experts should be involved to help explain any differences, especially when the number of comparable projects is low.

There are two types of benchmarking activities that project teams and organisations can undertake: top-down and bottom-up. Both of these methods have their own advantages and disadvantages and should be used appropriately to suit the requirement.

Higher-level (top-down) benchmarks start with an estimated complete, or total, figure for a project or programme, which is then broken down into smaller pieces. A top-down approach is therefore better suited to strategic decision making which looks to consider the overall benefit of a project. This is different to Reference Class Forecasting.⁸

Lower-level (bottom-up) benchmarks are developed using information which references units or aspects of a project. For example the costs of labour, plant and materials are bottom up benchmarks, which can be added together to produce an overall cost. Whilst this information is often more readily available and understood by industry, an existing design is needed to provide cost estimates. It is therefore difficult for bottom-up benchmarks to support early decisions on quality and affordability, for example, which are based on hypothetical or proposed schemes.

To illustrate: a simple low-level (bottom-up) benchmark might show the average hours of an operator's time taken to find and fix each leaking water pipe, whilst a high-level (top-down) benchmark might show the overall water loss from leakage per household served and the cost per household of repair work.

Different organisations and industries will have varying views about which types of benchmarks should be used, with different types being more appropriate at certain stages of a project. Bottom-up benchmarks may be less appropriate for use in the early decision-making stages of project delivery, although the two processes can complement each other at later stages.

⁸ Reference Class Forecasting takes a project/programme "entirety" approach to challenging forecasts by looking at the performance of past projects or programmes of a similar type. Mapping the probability distribution of these actual results allows a quantified view of the risk of poor performance associated with a new project. The approach encourages risks to be managed at a portfolio level

Why do we need benchmarks?

A firm understanding of cost, carbon and performance is critical to good decision making and successful project delivery. Inaccurate estimates can lead to unrealistic expectations which can derail a project's chances of success.

Benchmarking helps both government and industry make informed decisions about our infrastructure, particularly around capital investment and delivery efficiencies. It uses previous experience and industry best practice to provide the evidence and analysis needed to make decisions on project performance progress with greater confidence and helps avoid increased costs and missed benefits.

A consistent approach to benchmarking allows for greater transparency in decision making. When properly applied, benchmarking supports better project governance and assurance, more robust design, planning, selection, investment and budgeting decisions, in addition to continuous improvement in delivery. A benchmarking approach which looks beyond initial costs alone to overall performance, will support decision making that considers infrastructure assets at a whole life basis.

By supporting benchmarking, the IPA has two goals:

1. To deliver better performance. This covers the use of cost, carbon, schedule and performance benchmarks to support the selection, budgeting and design of projects for government sponsored infrastructure projects. This will in turn support increased productivity and better environmental and social outcomes.
2. To foster greater collaboration when it comes to sharing and understanding data from projects. This aligns with the National Infrastructure Commission's recommendations as set out in 'Data for the Public Good'.⁹

Supporting benefits include:

Driving deliverability

Benchmarking helps ensure both clear expectations for project deliverability (e.g. time, cost, carbon & outcomes) and performance monitoring throughout delivery and operation. A consistent approach to benchmarking should help to root out any under or over-estimation of project costs or benefits, before the delivery phase.

Reducing benefit erosion

Benchmarking should ensure a clear link between a project's key strategic priorities and its agreed measures of success as set out in the business case. This should help safeguard from benefits erosion by providing a clear performance assessment framework.

Valuing what matters

The development and sharing of benchmarks should help identify the primary factors which impact performance. This should further empower decision makers to control those factors. Performance measures will strengthen business cases to help government and other sponsors in selecting the right projects to deliver the best possible outcomes.

⁹ 'Data for the Public Good', National Infrastructure Commission, 14 December 2017.

Case Study: Environment Agency cost and carbon alignment

The Environment Agency (EA) is responsible for managing the risk of flooding in England.

The EA has operated both a cost database (Project cost tool) and a whole life carbon tool (ERIC) as part of their cost and carbon alignment ambition, focusing on improved performance, access to data, efficiency and effectiveness.

These tools hold records of relevant capital project cost and carbon performance data, in addition to details of the assets. To support EA's ambition to improve both its digital capability and greater alignment of cost and carbon into one system, and providing an evidence based approach to its decision making. Cost and Carbon Tool



is EA's future whole life estimating system and builds upon the success of existing cost database and Eric tool, which have now been in place for over five years, and have collected over £1 billion of cost data, covering more than 800 projects. This has enabled the provision of carbon intensity metric for capital and whole life carbon per £10k spend.

Supporting performance and assurance

Benchmarking exercises provide project teams with confidence that selected performance metrics are achievable. Once metrics are set, benchmarking moves into performance monitoring. The use of benchmarks over the project lifecycle should also support effective development of management reports.

Separating project performance from fixed cost elements

Effective benchmarking practices should assist delivery teams to identify fixed cost and carbon elements, which may seem to fall outside the project-specific remit, such as the cost of land for the project or carbon associated with a particular material type. Although these "fixed costs" fall outside the control of the project team or organisation, the volume or requirement of these non-addressable elements can be considered and challenged. For example, an improved design which minimises the required land footprint of the project could bring down environmental requirements and reduce land costs and associated carbon, with the corresponding trade-off in performance and outcomes.

Figure 2 below shows how project costs can be split into addressable and non-addressable costs. A similar distinction can be made between measures in schedule and lifecycle performance estimates. For example, the completion date may be fixed, as in the case of the 2012 Olympics Parks project, or the minimum performance may be fixed, such as a new flood defence to protect houses from flooding in a 1 in a 100 year flood event.

Figure 2: Model highlighting key component costs of a project

Cost Breakdown	Escalation	Costs relating to changes in market prices during a project lifecycle, such as inflation and market factors, interest rates or applicable taxes.
	Land and property	Costs relating to acquisition of land and allocation of property for the project, including costs of relocation and movement where applicable
	Admin.	Costs related to general business overheads such as owner's costs or the sunk development costs during early development stages
	Indirect costs	Costs incurred that cannot be attributed to any one section of the works; they may be fixed or time-related. This includes for example design costs
	Direct costs	Costs incurred on labour, material, plant and equipment, etc., i.e. costs that are directly accountable to the project including overhead & profit, temporary works. The direct costs are likely further broken down in discipline-specific and (preferably) industry-standard and asset specific Cost and Work Breakdown Structures. Direct cost elements should also include embodied carbon costs.

Who should benchmark?

This methodology is a recommended approach to benchmarking for the attention of decision makers, project sponsors and delivery teams across the private and public sector, along with third party providers who provide benchmarking services for delivery organisations. The IPA will work to promote this methodology across government.

When to benchmark?

Supporting business cases with benchmarking

Top-down benchmarking during the early development of a business case is crucial in enabling SROs and project teams to understand the cost, schedule, performance and outcomes at the outset of the project initiation stage. Providing robust evidence and confidence about project deliverables allows government and industry to select the best projects and programmes to deliver the best outcomes.

The application of effective benchmarking practices should support and underpin a project or programme's business case and drive for efficiencies, by:

- Bringing additional focus on good design and planning to the decision-making process, with enhanced understanding of cost implications and whole life carbon when making decisions.

- Demonstrating that the proposed project sits within agreed ranges (cost, whole life carbon, benefits, outputs) for similar completed projects.

“The public sector will spend hundreds of billions on infrastructure in the next decade. The country’s 2050 net zero goal means the whole construction industry needs to reduce greenhouse gas emissions at pace in the next 5 years. Placing carbon alongside other performance data and aligning it to cost is vital and will encourage more firms to focus on carbon intensive areas and designing out the need for items such as concrete and steel.”

Emma Howard Boyd

Chair of the Environment Agency

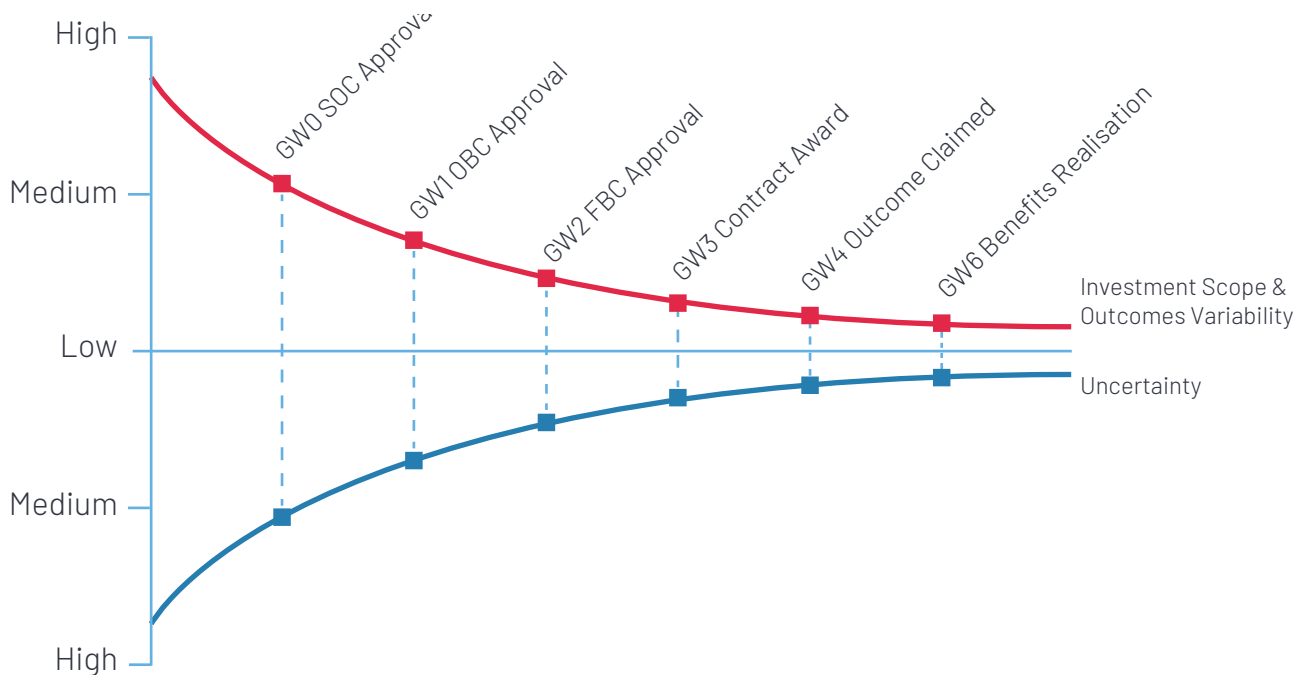
Benchmarking throughout the project lifecycle

Good benchmarking practices are integral to monitoring a project as it develops. We recommend project outputs and performance should be considered against identified benchmarks throughout the project lifecycle, rather than as a one-off exercise.

The accuracy and quality of investment decisions depend on the quality of information available. Less robust information will equate to more uncertainty (see figure 3). Benchmarks derived from comparable projects will help narrow and support any information gap. Benchmarks should also improve as more information becomes available over the project lifecycle. The earlier project teams engage with data for the purpose of benchmarking, the more valuable (and less arduous) later benchmarking exercises will be.

Benchmarking top-down at the early stages of the project (e.g. the strategic outline and outline business cases) should be considered over bottom-up estimating. The more detailed approach of bottom-up estimating at an early stage of a project, when project information is limited, is not only costly in terms of resources, data and potential cost (including time) but also could create unrealistic and inaccurate estimates. There is also a risk that any assumptions considered at an early stage to allow for bottom-up estimating may end up being incorrectly embedded into the project design.

Figure 3: Model showing how uncertainty of benchmarking confidence is linked to project detail



Aligning benchmarking to project gateways (GW)

The five gateways outlined in the 'Guide to Developing the Project Business Case'¹⁰ provide milestones and a framework for SROs and project leaders to review the progress of the project/programme. Insight and information provided by benchmarking exercises can be used to complement the experience and knowledge of the project/programme leadership team at each stage of the project lifecycle. Below are some of the key activities in which benchmarking could be implemented within the five case business model.

Figure 4: Key activities within the five case business model where benchmarking can contribute



GW0/Project brief – strategic assessment

Top-down benchmarking at Gateway Zero (GW0) could use comparable projects to provide robust evidence and SMART (Strategic, Measurable, Achievable, Relevant and Time bound) data. This data should support the strategic business case when little other information is available, and help sponsors better understand project options. Established benchmarks for benefits and whole life carbon could also be used to add strength to a cost benefit analysis.

For example, if the need for a new river crossing were identified, benchmarks could provide evidence to support a comparison of predicted costs, whole life carbon and benefits of, for example, a tunnel versus a bridge.

A benchmarking exercise at GW0 could answer questions such as:

- What would the additional costs, carbon, benefits and outcomes be if the project scope was increased/decreased (e.g. including more technologically advanced systems)?
- What benefits and improvements to performance or whole life carbon can we expect from different technical solutions and hence the levels of investment?

GW1/Strategic outline case – business justification

At Gateway 1 (GW1) benchmarking could be used to analyse the 'preferred option' and client requirements, and in turn provide assurances the project is deliverable within the funding envelope or not.

A benchmarking exercise at this stage could measure the variability and differences between options raised and determine whether the preferred option delivers optimal value for money, supports whole life carbon reduction requirements and remains in line with the objectives of the project/programme. For example, benchmarking at this stage will highlight whether value engineering or innovative techniques have the potential to yield benefits.

Any benchmarking activities undertaken at this stage, in terms of data and information capture, should prove valuable in the later stages of the project.

¹⁰Guide to Developing the Project Business Case', HM Treasury, 2018

Case Study: Transport for London 'estimating book'

In 2013, Transport for London commissioned the development of an 'estimating book' which enables sponsor teams to identify the capital costs and to build up a level of detail which can support business cases by providing ranges of costs based on historical project values.



A key challenge was to develop management procedures for data capture and analysis that utilised a common and agreed cost feedback structure. By applying consistency to data management data could be compared on a like-for-like basis, bringing confidence to the outcome. As more data is collected, using the book becomes more ingrained as a business-as-usual process and there is a greater level of confidence in the outputs.

A benchmarking exercise at GW1 could support questions such as:

- What are the additional costs, carbon, benefits and outcomes in having a smart motorway opposed to a traditional motorway?
- What are the additional costs, carbon and benefits if we wanted to raise the protection level of the flood embankment from a '1 in 50 years' to a '1 in 100 years' event?

GW2/Outline business case – delivery strategy

The scope of the preferred option of a project or programme is shaped and defined by a number of outline and detailed design activities. These will define attributes such as project length, scope and performance, which can be used to generate a bottom-up cost and whole life carbon estimate for the project or programme. The benchmarking exercise can be instrumental in providing an intelligent framework to test existing bottom-up estimates (see illustrative example in table 1) and provide sponsors more evidence on cost projection.

Bottom-up analysis can support and complement top-down benchmarks. This will allow project stakeholders greater confidence that the project/ programme will achieve target deliverables.

Table 1: Showing a comparison between top-down and bottom-up benchmarking for challenge

Results from Top-Down Benchmarking	136 - 150 weeks	£92 - £110M	360 - 440 Units	1,120 - 1,340
Bottom-up Estimates	154 weeks	£109M	420 Units	1,000

Metrics generated from this analysis (top-down and bottom-up) can then be used as a baseline against which outcomes and benefits can be monitored. This should help mitigate against any benefits erosion.

GW3/Full business case – investment decision to contract award

During the procurement process, benchmarks can be used to assess tender returns and estimates from the supply chain against the agreed scope, outcomes and deliverables. Benchmarking can also be used to agree and set a robust contractual performance incentive mechanism for the supply chain, using data from previous projects and activities to set challenging yet realistic performance targets that link to incentive payments. An example of this could be tunnelling rate.

Case Study: Project/Programme Outcome Profile

The Project/Programme Outcome Profile is a method and a tool developed by the IPA, and trialed with projects and programmes across government, to develop stronger business cases by:

- Exploring how their project or programme will support the delivery of government’s priority outcomes
- Using consistent metrics to document a project or programme’s contribution to those priority outcomes

Completing the Project/Programme Outcome Profile will support teams to understand the specific contribution of their particular intervention to the delivery of relevant priority outcomes. Whether the proposal is for a programme within a strategic portfolio or is a project within a programme, its objectives need to be understood in terms of its individual contribution to the wider group of interventions of which it is part. This continuity of alignment and support is sometimes known as a “golden thread”.

A Project/Programme Outcome Profile should be developed when undertaking the Strategic Assessment, and revisited and reviewed at each stage of the Business Case development process.

As contracts are developed they would benefit from the inclusion of a data requirements clause. This will mandate the supply chain to provide data at certain stages of the projects, in an agreed format using the organisation or project team's system and process.

GW4/Readiness for service and GW5/Benefits realisation

At this stage, although the project and programme is complete there is still an opportunity to make use of established benchmarks. These can be used to demonstrate project performance against the business case and will also provide valuable data and lessons learned for future projects.

It is important to capture and store all data generated by the project and programme to improve existing and future benchmarking models. This data can be used to benchmark future projects.

Challenges to benchmarking

Benchmarking exercises also present challenges. The most critical challenges lie in the sourcing, validation and management of robust and complete data.

Data is a valuable asset, but the IPA has demonstrated through the tunnelling case study that there is appetite for the development of more open access to data. Effective information sharing across sectors, and internationally, has great potential to ensure that lessons from benchmarking exercises are maximised. We recognise that cross-sector and cross-border information sharing presents challenges such as commercial sensitivities. The IPA has demonstrated that this can be mitigated and reduced (see tunnelling case study) by establishing forums with clear terms of references and Non-Disclosure Agreements (NDAs) in place.

Benchmarking requires time and resources for data collection and validation. Ensuring that a validated and recognised source of carbon data is utilised for estimating and actual carbon performance data is provided and validated by supply chain partners is necessary to move industry forward. While this may present a new challenge to project stakeholders in the first instance, the benefits in supporting informed and intelligent decision making should outweigh the costs in developing your benchmarking service offering.

Further challenges exist in adopting and utilising benchmarking data to improve the cost estimation process and to help drive challenge into the early stages of projects. This will require **a cultural shift away from bottom up cost estimation as the norm** and towards early adoption of benchmarking to help drive 'should cost' estimates when defining projects. Further guidance on this can be found in the IPA Cost Estimating guidance document.

The Sourcing Playbook

Delivering outstanding public services is a critical function of government. The introduction of the Outsourcing Playbook in 2019¹¹ set out a series of simple guidelines to improve our decision-making and the way we deliver public services.

The Construction Playbook¹² published in December 2020 focuses on setting up projects and programmes for success from the outset. Whether it be the delivery of a school, hospital or major infrastructure project, the principles and policies in the **Playbook will transform how we assess, procure and manage public works projects and programmes.**

¹¹ The Sourcing Playbook, HM Government, May 2021.

¹² The Construction Playbook, HM Government, December 2020.

The Sourcing Playbook sets out practical guidance to support delivery and drive improvement on the following key policies:

- | | |
|--|--|
| ✓ Publication of commercial pipelines | ✓ Requirement for pilots |
| ✓ Market health and capability assessments | ✓ Key Performance Indicators (KPIs) |
| ✓ Project Validation Review (PVR) | ✓ Risk allocation |
| ✓ Delivery model assessments (previously known as 'make versus buy assessments') | ✓ Pricing and payment mechanisms |
| ✓ Should Cost Modelling | ✓ Assessing the economic and financial standing of suppliers |
| | ✓ Resolution planning |

The Sourcing Playbook emphasises that the delivery of public services is collaborative, involving colleagues from commercial, finance, project delivery, policy and other professions.

Should Cost Modelling

Should Cost Model (SCM), is the term used in the Sourcing Playbook and the Construction Playbook to describe the key policy of whole life cost modelling. The term 'Should Cost Model' (SCM) introduces a standard terminology for contracting authorities to formalise existing cost modelling activities and set clear guidance for what good SCMs look like.

Benchmarking costs for various categories of a project will be a valuable resource in developing early thinking around SCMs, and will help inform initial top down views on aspects of project costs.

The Sourcing Programme has produced a number of Guidance Notes and best practice templates on Should Cost Modelling regarding sourcing services and public works projects or programmes. It is recognised that Should Cost Modelling applies to other types of sourcing and wider decision-making processes for projects. **Effective Should Cost Modelling** will also involve multiple professional functions, including Finance, Commercial or Economic disciplines.

A SCM provides a forecast of what a service, project or programme 'should' cost over its whole life and differ in design as requirements change over the procurement lifecycle.

For public works projects, SCMs forecast costs over a period including the build phase and the expected design life. This includes costs of additional market factors such as risk and profit and provides an understanding of **whole life costs and carbon**, including the impact of **risk and uncertainty on cost, carbon and schedule**. Notably, the key factor is **'whole life cost'** and not the initial purchase price. SCMs should be used early in the procurement process to:

- Inform the delivery model assessment (DMA), which considers both cost and non-cost criteria, such as the whole life carbon assessment;
- Drive a better understanding of the whole life costs and the risks and opportunities associated with different options and scenarios;
- Drive more realistic budgets by providing greater understanding of the impact of risk and uncertainty on both cost and schedule;
- Inform the first business case (Strategic Outline Case for departments and ALBs); and

- Inform engagement with bidders and the appropriate commercial strategy, including methods to incentivise the supply chain to focus on whole life value

SCMs can be used throughout the procurement lifecycle to support wider requirements such as demonstrating value for money or protecting the government from 'low cost bid bias'. As requirements change and more information becomes available beyond top down benchmarking data, SCMs will evolve and the level of detail, which can vary significantly, should be iteratively developed over time.

For further information please refer to the Sourcing Programme [publications on gov.uk](#).

IPA Benchmarking Methodology

Introduction

With the development of a consistent methodological approach to benchmarking, our aim is to support greater transparency and collaboration between project managers, sponsors and sector experts across government and industry. It will also allow teams to have a shared approach to benchmarking, which project teams can build on.

The IPA has worked extensively with UK Government Departments, infrastructure delivery organisations and consultancies in developing and testing a top-down benchmarking methodology. We have demonstrated through the tunnelling case study, that the methodology allows organisations to compare like for like assets across and within sector.

Top-down benchmarking

Infrastructure projects are complex, often bespoke and rarely repeated. Whilst it is difficult to benchmark a project in its entirety using a top-down approach and a universally accepted single metric, **it is possible to do this once the project is broken up into components.** Breaking down a large infrastructure project into components also helps ensure costs are not double counted.

The IPA recommends a top-down approach to benchmarking, initially establishing a range of performance metrics to reflect the project objectives. The approach breaks the total project down into components, or asset groups, comparable across a range of other projects.

For example, a rail project is made up of stations, viaducts, tracks, drainage and tunnels etc. which can be compared to components in other sectors. A tunnel from a railway project can be compared to a tunnel from e.g. a road, metro or a utility project.

Benchmarks for each component are sourced from these projects, using a structured and disciplined data process that sets the cost in the context of the chosen metrics and desired performance and project objectives.

An appropriate cost or carbon benchmark for each component is established and these are aggregated to form a composite benchmark total design cost. This “Should Cost” and associated “carbon target” is set within an appropriate range that can be used to support decision makers and aid transparency throughout the various stages of the project life cycle.

The IPA recommends that benchmarks should be used **to measure not only project cost and other inputs, but also overall project performance** during both construction and operation (i.e. over the whole life of a project) in terms of outputs (such as schedule), operational performance and outcomes (such as economic, environmental and social benefits).

Step 1:

Confirm the project objectives and set the metrics

Project deliverables and performance metrics should be inextricably linked. Metrics should be based on project deliverables, and also help drive behaviour, and in turn performance, in the project's delivery.

We set out here methods which may assist SROs and project teams with the development of project deliverables and setting metrics accordingly.

Setting out and agreeing consistent metrics

A government-endorsed set of unified asset definitions, standard units of measurement for performance and outcome metrics (such as embodied carbon, quality and resilience) and methods of data collection will significantly ease a consistent approach to benchmarking across industry by enabling the interoperability of data and information between organisations and project teams in and outside their sector or operation.

For example, by agreeing metrics and units of measurement, there will be no need to convert a metric from when data and benchmarks are shared to make direct comparisons between organisations. This is a particular issue for new metrics such as carbon, where one organisation may measure CO₂ associated with transporting materials (see below), wherea another will not.

Case Study: Environment Agency's carbon calculator

The Environment Agency carbon calculator measures the greenhouse gas impacts of construction activities in terms of carbon dioxide equivalency (CO₂e). It does this by calculating the embodied CO₂e of materials plus the CO₂e associated with their transportation providing a CO₂e tonnage (t) value.

Having a readily available library of sector agreed performance and outcome metrics can support a 'plug & play' approach in creating a consistent and aligned balanced scorecard for projects and programmes, where specific outputs and outcomes might be required as per project/funding approval. This library could also incorporate sector or organisation specific metrics that support project stakeholder preferences or remits (i.e. improving reliability of service, habitat creation, reducing waste to landfill).

Models for agreeing metrics

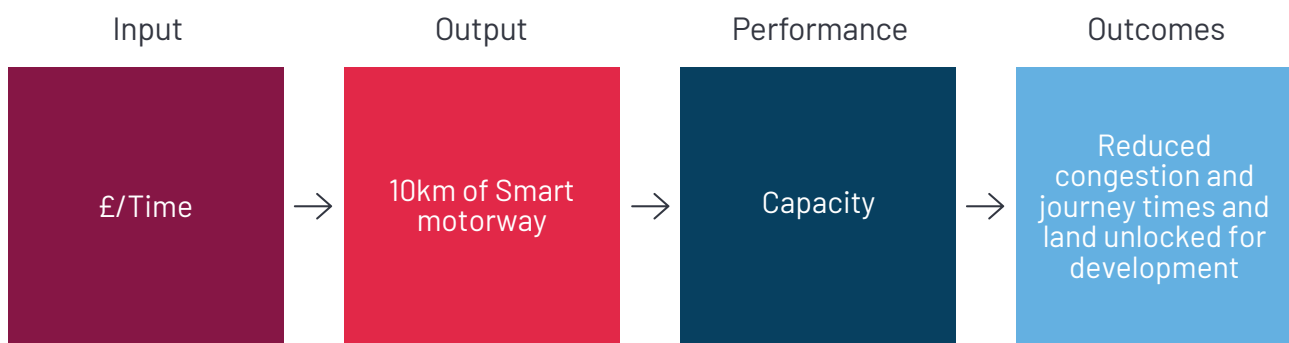
The IPA recommends projects choose a consistent approach to agreeing metrics. Three approaches are outlined below.

(1) Input, Output, Performance, Outcome (IOP0)

Traditionally, costs (input) have been a core focus of project benchmarking. We recommend that benchmarking practices will be of most benefit when they extend to include project outcomes and performance.

The IOP0 model expands this to include output (e.g. schedule), operational performance and outcome (e.g. benefits).

Figure 5: Example of an IOP0 model for a smart motorway project



(2) System, Network, Asset and Project (SNAP)

As set out in Transforming Infrastructure Performance the SNAP framework (figure 6) encourages project sponsors and government delivery organisations **to consider project outcomes and benefits against objectives at different tiers** to allow for a bigger-picture understanding of the project objectives, benefits and performance.

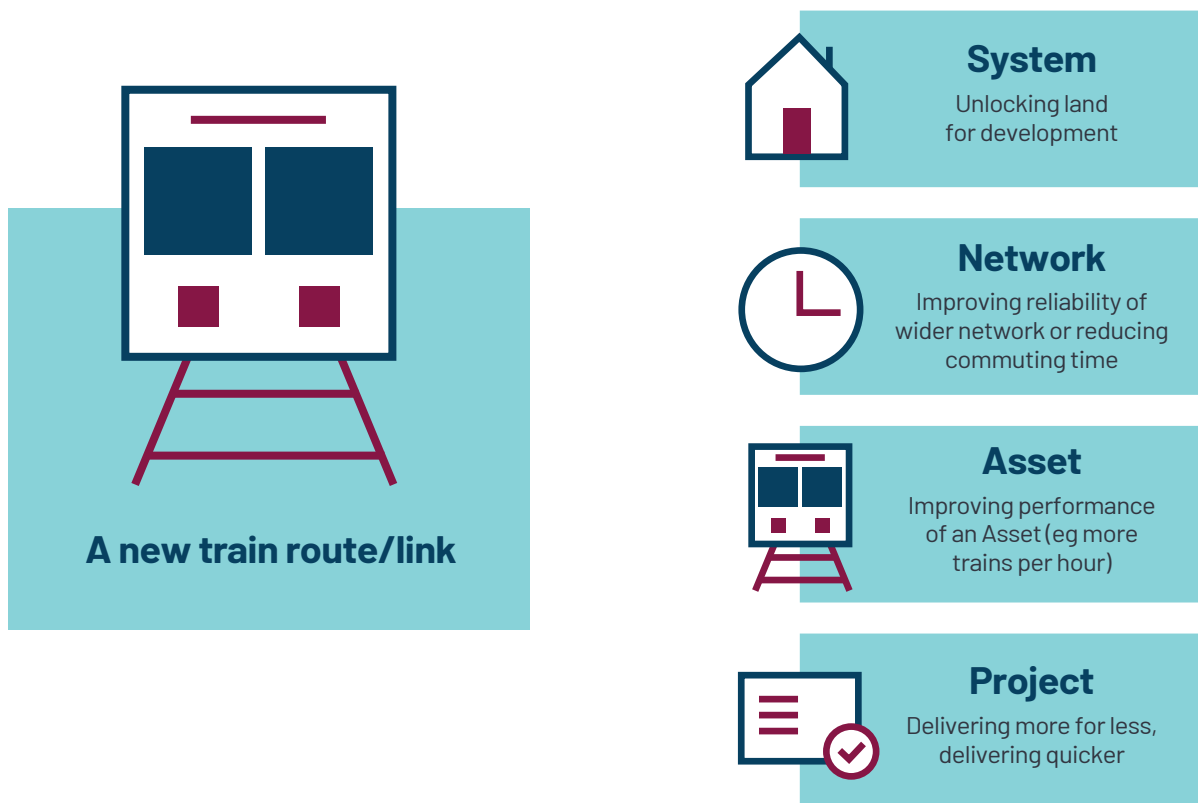
- **Project** level, traditional benchmarks and performance indicators measure the delivery of the capital phase of the project, driving improved performance and competitiveness.
- Once constructed, further performance indicators are used to measure delivery of benefits and operational performance indicators for the **asset**.
- Completed assets often integrate into an existing **network**: for example, a new motorway will form part of the strategic road network. Measures at a network level assess performance of the wider network: for example, overall lane availability of the network or customer satisfaction.
- **System** level measures assess how interconnected assets and networks support the delivery of the wider economic, business and social and environmental objectives of the government, including job creation, boosting productivity and economic growth.

Figure 6: SNAP model for considering metrics

Objectives		Measures
Productivity, growth, low carbon, Industrial Strategy & NIC objectives	System	UK GVA, jobs & apprentices, SME proportion, carbon intensity
High performing networks - capacity, resilience, availability, interconnected	Network	Customer satisfaction, network performance, availability & resilience
Asset performance, benefit delivery, availability, sustainability, resilience, technology enabled	Asset	Whole life cost & carbon, benefit delivery, availability, resilience, user satisfaction
Safe, on-time, on-budget, low carbon, digitally enabled delivery	Project	Cost, schedule, quality, health & safety, skills, supplier performance, carbon

The below example (figure 7) illustrates, using the SNAP model, how a new train route could help to rebalance the economy by unlocking land for development:

Figure 7: SNAP model for a new train route



(3) The Project/Programme Outcome Profile

The Project/Programme Outcome Profile (figure 8) allows SROs and project teams to set metrics and monitor their contribution to the overall project/programme vision and outcomes. As illustrated below, the Project/Programme Outcome Profile has three levels of outcomes and metrics linking the individual project or programme outcomes to department outcomes. Outcomes can also be grouped using up to six themes: Economy, Society, Environment, Health, Security, and Global

Figure 8: A model showing the outcomes and metrics a Project/Programme Outcome Profile scorecard may include

		Themes					
		Economy	Society	Environment	Health	Security	Global
Levels	Department outcomes	For each level and theme, the Project Outcome Profile describes: <ul style="list-style-type: none"> ■ The outcomes that the project or programme supports ■ The metrics used to measure the outcomes ■ The contribution of the project or programme 					
	Portfolio outcomes <i>(optional)</i>						
	Project or programme outcomes						

Step 2:

Break the project into major components for benchmarking

The core components of a project include asset costs and non-asset costs that can be compared to similar components on other projects (see figure 9).

A **Benchmark Indicative Asset Cost** (BIAC) can be allocated to infrastructure assets such as stations, viaducts, tracks, drainage and tunnels.

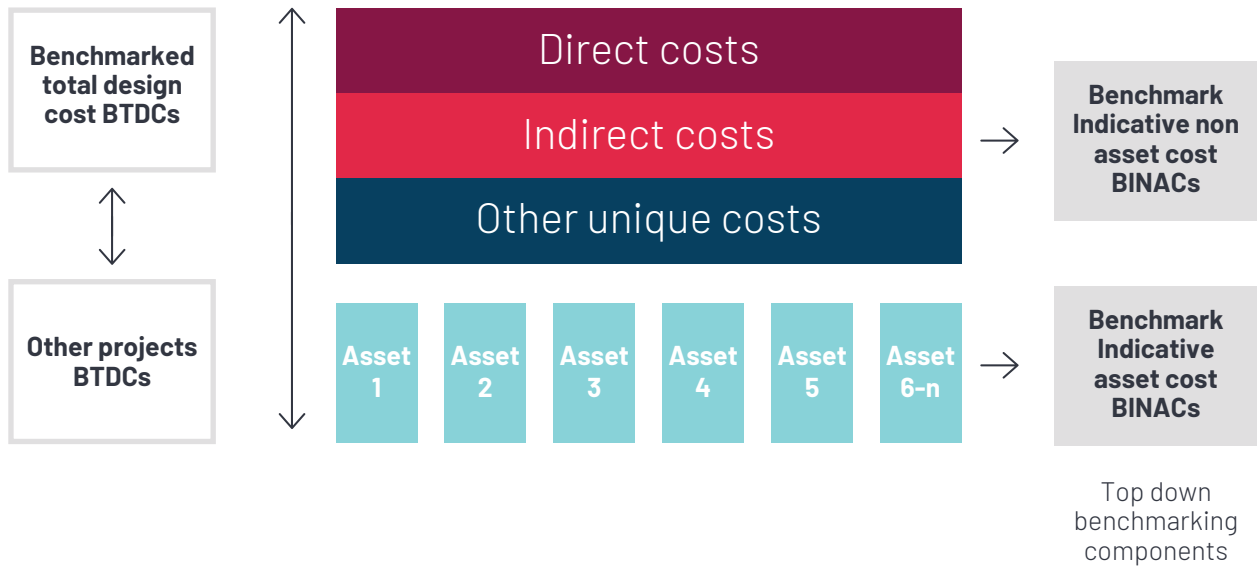
A **Benchmark Indicative Non-Asset Cost** (BINAC) can be allocated to non-asset components. These can in turn, be divided into direct, indirect and unique cost categories as required for each project. For example, land and property are direct costs, whilst client or project management costs are indirect. The BINAC should be included to provide a wider and more comprehensive view of the factors which impact a project.

With the support of experienced individuals, each component or asset can be robustly benchmarked, using agreed metrics, against other comparable examples, either as standalone projects or as part of a larger scheme.

Each of these benchmarks can be brought together and expressed as a **Benchmark Total Design Cost** (BTDC), calculated by aggregating relevant BINACs and BIACs – as illustrated below. From this, the desired performance and outcome metrics can be designed. This BTDC should be expressed as a range of costs built up from the BIAC and BINAC.

The BINAC and BIAC approach references cost, but this approach can also be used to benchmark indicative assets or non-assets in terms of schedule or benefits such as CO₂ and environmental impacts.

Figure 9: Model showing how a project or programme can be split into BIACs or BINACs



Step 3:

Develop templates for data gathering

To aggregate, manage and validate data for benchmarking quickly and efficiently, it is important to have a robust data structure which outlines protocols for the measurement and inclusion of information alongside data templates. This should help when procuring or sourcing data from third parties.

By clearly setting out standards, requirements and expectations, at the start of the collection process benchmarking practitioners will help to ensure that any data procured is high quality, high value, handled securely, and can be acted on quickly.

Developing data templates

Templates should include the drivers of key project outcomes and benefits, as developed in Step 1. For example, if a railway project's objective is to improve the reliability and speed of a line, the benchmark across multiple assets (tunnel, tracks, station) should include performance benefit metric (e.g. speed and capacity of the track).

Subject matter experts can provide valuable insight in developing a suitable template.

For example, during the development of the Tunnelling BIAC, IPA brought together members of the British Tunnelling Society and client organisations to add expertise and ensure that the key cost and performance drivers were included.

Templates should be reviewed at each gateway of the project lifecycle, as the data becomes more detailed and matures as the project progresses.

When developing a template for your project/programme, it is worth considering:

- The metrics which form the basis of the benchmark, and the underlying information required to build an informative benchmark.
- Whether a suitable template already exists from another source (e.g. through a chartered body or the relevant supply chain), which could be used or amended.

Case Study: Benchmarking tunnelling costs and production rates in the UK



In September 2018, the IPA Benchmarking team, in collaboration with the British Tunnelling Society (BTS), hosted a pilot tunnelling forum to help formulate a best practice in benchmarking methodology.

Tunnels were chosen as they have been successfully benchmarked in the past and allow effective testing of the methodology. Industry stakeholders from multiple sectors came together to share information on tunnelling costs, with additional data provided directly from HM Government departments, sponsors and programmes involved in tunnelling activities.

As part of a data gathering process, the IPA team initially asked participating client organisations to submit their own tunnelling data for analysis. This data was unstructured, unformatted and lacked critical information. This impacted the team's ability to generate robust and accurate benchmarks. It was also clear that the key cost and performance drivers (cost and performance being the key metric needed by the participants) for tunnels and tunnelling projects were unknown to the IPA team.

Due to these issues the IPA team set up a tunnelling forum which brought together client organisations (those that provided raw data) as well as subject matter experts (members of BTS). The expertise and experience from this group was used to develop a template (BIAC) for capturing key tunnelling information, which included the key attributes for cost and performance drivers. Since the template was developed with the forum's participation, all parties understood the definitions and what the data requirements were.

The exercise demonstrated that, when done in an appropriate format, there is considerable appetite for collaboration and data sharing in a non-commercial environment between public and private organisations for the purpose of robust benchmarking. The methodology was well received and accepted as a recognisable standard and best practice.

It also demonstrated the applications of this process. Each participant contributed to this exercise with their own data. The resulting collated, cleaned and analysed data has helped to enhance their own benchmarking and decision-making capabilities by complementing and enriching their own individual insights as we continue to collect data on UK's tunnels.

- Testing the template with subject matter experts.
- Ensuring there is a balanced level of detail to the data request.
- Storing the data as it could be reused for similar projects.
- Setting up a benchmarking community to include other organisations who might have an interest in collaborating or sharing BIAC & BINAC data they have already developed.
- Ensuring a shared understanding of requirements and data definitions when procuring data from a third-party source.

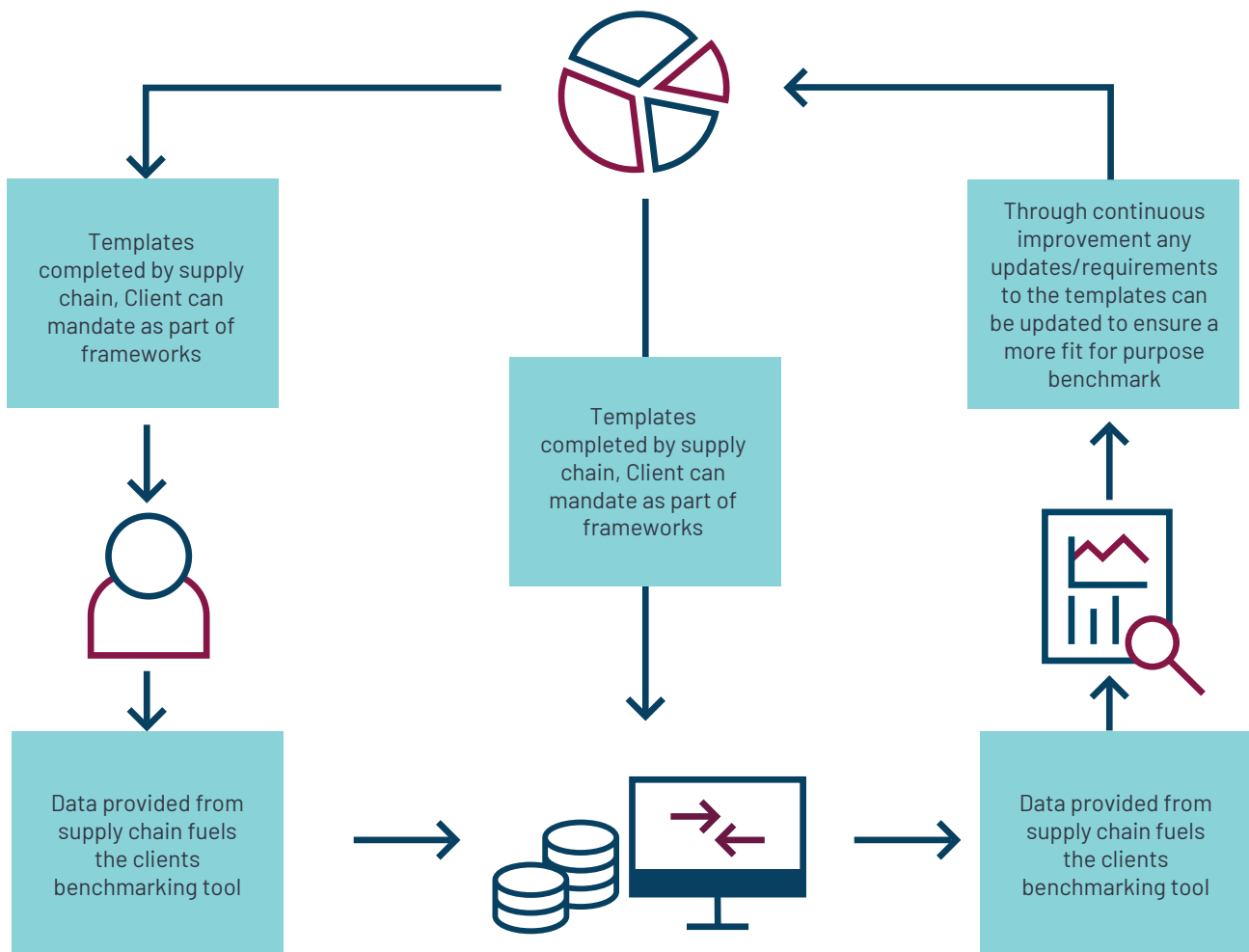
Sharing and re-using of templates

The IPA encourages the sharing of BIAC and BINAC data templates across organisations and project/programme teams. This will reduce the need for individual teams to create new templates, and for data providers to interpret them.

The IPA will look to hold a library of BIAC and BINAC benchmark information on behalf of the sector and provide the sector with updates when new information is added.

Data templates can be used as a top-down Cost Breakdown Structure (CBS) for an internal benchmarking tool/system by using the template's specifications to structure data within the benchmarking database. This will allow an organisation to access, share and develop new benchmarks efficiently (see figure 10).

Figure 10: Process model showing the data structure laid out within the templates can provide additional benefits



Furthermore, templates can be used to define the standards and requirements that the supply chain should complete as the project progresses. These could be mandated as part of the contract or framework to ensure the client can make use of their own data when it comes to assessing similar projects in the future.

Step 4:

Scope sources and gather data

Reliable data is integral to good benchmarking. As demonstrated by the IPA tunnelling case study,¹³ there is a strong appetite in the sector to work together as part of a benchmarking community and use data to mutual advantage, under proper management. This section explains how and where infrastructure organisations and project teams can find reliable data.

As a premium asset, procuring or exchanging data from third parties can be subject to a number of issues and constraints. Firstly, the quality and value of the data may be poor due to age, low levels of detail or attributes and lacking performance metrics. Secondly, acquiring, validating and formatting the data can be time and resource intensive.

Consideration should be given to the safe and secure handling of information. For example, information should be properly redacted to ensure the sources are unidentifiable and organisations should be made aware of the intended uses of the information they provide. See 'The economic value of data: discussion paper'¹⁴ for further details.

Data sources

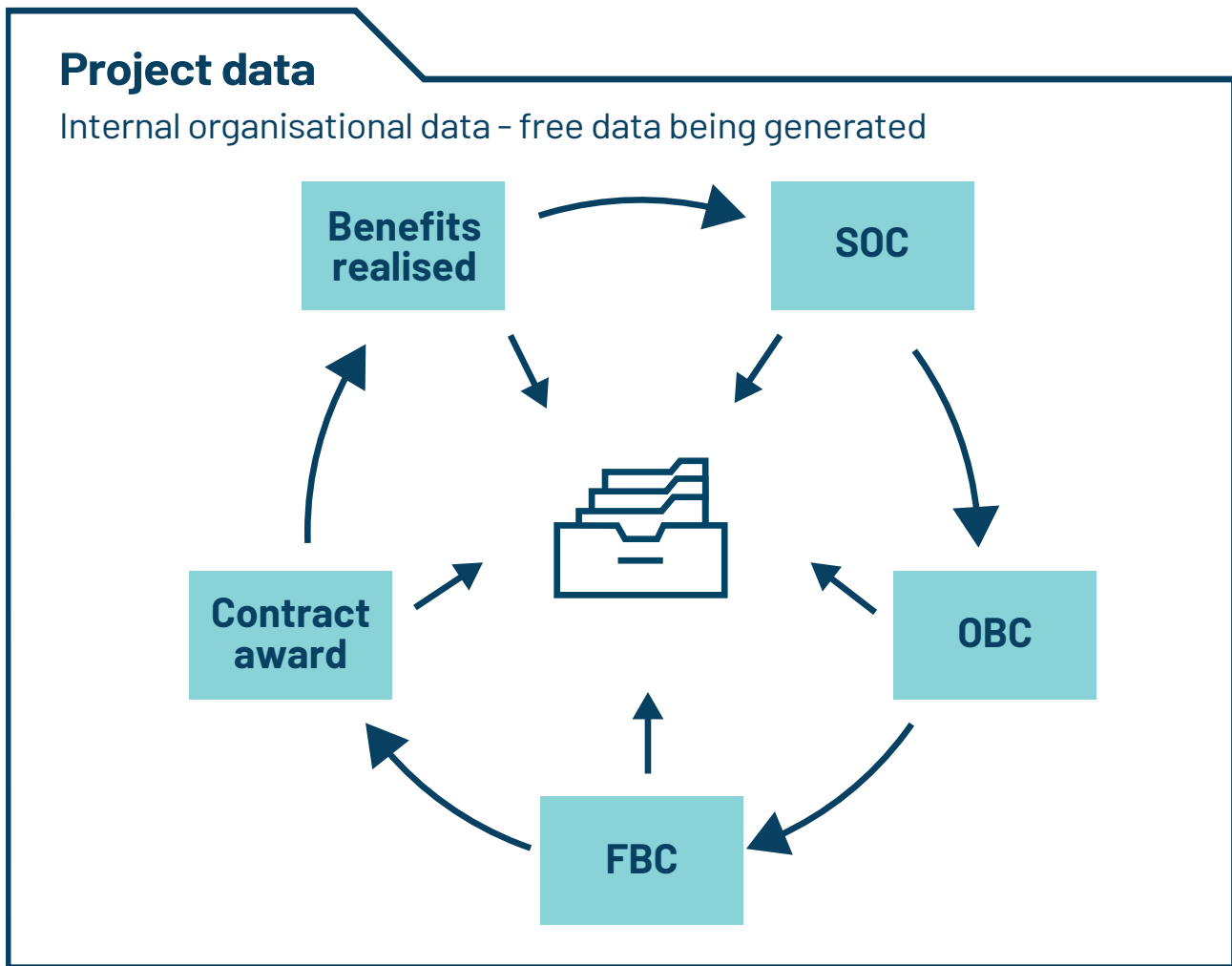
Internal: the first step is to understand whether a dataset of relevant records already exists and is being maintained (see figure 11). This may be a case of accessing an organisation's financial or operational systems or reviewing historical reports to extract a series of relevant data points. This data can be augmented using external data.

Whether or not data is already available internally, organisations should consider an internal data acquisition strategy to capture any valuable data they themselves are generating from ongoing projects and programmes. As benchmarking practices develop, the most useful data points will become more apparent.

¹³ Case Study: Benchmarking tunnelling costs and production rates in the UK', Infrastructure and Projects Authority, 6 December 2018.

¹⁴ 'The economic value of data: discussion paper', HM Treasury, 2 August 2018.

Figure 11: Model showing how useful benchmarking data is generated as the project progresses through its lifecycle



External: In some cases, the projects and assets delivered by government and industry are relatively bespoke or unique. It may therefore be difficult to find component relevant historical data from which to construct a benchmark. In these situations, it might be possible to:

- Find relevant benchmarks from comparable ALBs across government and organisations in the private sector.
- Build component benchmarks based on the performance in other countries (bearing in mind differences due to exchange rates, safety standards and other factors that could affect comparability).
- Share benchmarking data across sectors, e.g. support activities and indirect costs, procurement and project management may be similar enough across sectors to provide a useful, generalised benchmark.
- Use the BI(N)AC methods to break down the project into components which are capable of being benchmarked. For example, a unique ship-building project may have no relevant comparators, but the more generic components of design, construction, fit-out and commissioning may be capable of being benchmarked against (bearing in mind important components that, due to their uniqueness, are responsible for significant project risk and uncertainty and therefore difficult to benchmark).

- It should be noted that an extra level of scrutiny could be necessary when sourcing information from and sharing it with external partners to ensure that it is fully anonymised and there is mutual understanding on the appropriate use of the information between third parties. To this end, a mutually agreed Memorandum of Understanding (MOU) or Non-Disclosure Agreement (NDA) may be required.

IPA Benchmarking Hub

To support projects in obtaining good data, the IPA will be establishing a benchmarking hub underpinned by the IPA's Mandate¹⁵, to share and exchange information on key and repeatable assets. The IPA will be making this data available to all government projects that span across not only social and economic infrastructure, but also IT & Transformation projects.

International

International projects can provide additional data to the benchmarking exercise. Clients that use benchmarking data from beyond their own country will broaden the range of comparisons, thereby receiving a far more detailed perspective of best practice.

Benchmarking on an international level can provide data when little or no historic comparison in the home country is available, for example with unique projects, projects undertaken within a regulated industry or in sectors which are not traditionally international (e.g. house building).

A high-speed rail proposal in the UK would be a good example of a unique project where international project information (for example from Japan, France or South Korea) will help develop a robust benchmark.

For components specific to high-speed rail, any benchmarking would therefore rely heavily on international comparisons to establish optioneering and funding envelopes before sufficient design maturity is achieved to facilitate bottom-up estimate completion. However, for components which are not particular to high speed rail, such as embankments, international comparison would not be as critical.

Once estimates are developed, continued benchmarking exercises which compare international projects to domestic may even prove robust enough to reveal location-specific market trends and/or macro-economic differences such as supply/demand variations, differing work practices or the effects of varying legislative constraints.

It should be noted that there are a number of considerations to bear in mind when collecting data internationally. These are outlined in step 6.

Data management

The IPA has facilitated collaboration between infrastructure organisations to enable data sharing. Critical to success is establishing an appropriate forum or community for benchmarking which sets the ground rules in terms of data sharing and commitments of the participating organisations and supporting consultants.

Once a benchmark for a functional unit has been established for carbon, this can be linked to the cost of the asset for the same categories, i.e. capital, operational and user costs. This allows carbon metrics to be reported per unit cost which is a prioritised step for continuous improvement.

¹⁵'IPA Mandate', Infrastructure and Projects Authority, 2021.

Case Study: PSACE

The Public sector Advisory Community for Estimating (PSACE), formerly CWEst, was set up in 2019 with the remit to develop Cost Estimating Capability through the sharing of leading practices, lessons learned, learning & training and data across UK Government Departments and Delivery Bodies.

To date, there are nearly 40 organisations involved, with the majority regularly participating in monthly PSACE meetings. The forum is an opportunity to bring together subject matter experts to provide advice and guidance, and to wrestle with the challenges of cost estimating (environment/system?) within government projects in a peer-to-peer community. PSACE are planning to hold the first conference dedicated to the estimating function to increase the importance of Estimating across the public Sector.

The PSACE community is helping to shape and deliver on a number of work streams in order to improve cost estimating in projects; these include:

- New accredited training
- The sharing and collaboration of data
- Leading practice(s) for creating, managing and communicating estimate outcomes
- Advisory service to address specific challenges raised within or outside PSACE.

Lastly, members of PSACE are able to commission data requests and benchmarks to the PACE members. This provides a rich source of data and benchmarks through the leveraging of the community in addition to importantly understanding the providence and detail behind the data, helping to provide robust and trusted data for comparisons.

Examples of this include: the benchmarking of indirect costs versus direct costs between organisations and the benchmarking of expenditure and time between HMT milestones.

Step 5:

Validate and re-base the data

Poor data which leads to inaccurate benchmarks can be more detrimental than having no data at all. Project sponsors with inaccurate information could misinterpret expectations on project performance or allow projects and programmes to continue when a review may be required. Data therefore needs to be carefully validated, cleansed, and re-based.

Validating data

A robust data validation process and system for governance will be needed. This activity should be refreshed regularly to ensure the integrity and quality of any benchmarks being used for decision making. Whilst a well-formulated and clear data template will help reduce the need for

data validation, there is always the potential for human error, particularly when it comes to large datasets. A quality assurance process should help mitigate these risks.

Items for consideration include:

- Data validation rules and processes (e.g. ensure all data points are in the same currency).
- The rules for quickly identifying data exceptions for review (i.e. identifying missing key information/attributes quickly).
- Processes for reviewing, investigating and fixing data issues (if issues are not resolvable, then it might be advisable to remove or quarantine certain data points).

In some instances, when data is procured or shared, it is important to undertake a data validation and quality review prior to incorporating the data into your existing database. This will prevent contamination of your data set, which could be time consuming to resolve.

Re-basing data

Having selected your dataset you may need to re-base data points (which may have been collected using different measurement techniques) to make all records in the dataset comparable and consistent. Particular factors to consider when rebasing data include risk, international data and inflation.

It is important that data used in each exercise is re-based consistently, with each provider having a clear understanding of the re-basing requirements.

Re-basing for risk, uncertainty and project contingency

The inclusion of risk and uncertainty in completed project information, and contingency in predicted project information, needs to be appreciated and accounted for when benchmarking to ensure accurate comparisons can be completed. Without adjusting for risk and uncertainty and project contingency, the validity of any benchmark analysis could be compromised.

Outturn cost information is likely to include crystallised project risks and uncertainty (for example poor ground conditions that require deeper piling) being transferred from a contingency fund to outturn costs.

Best practice in identifying and adjusting for risk and uncertainty in benchmarking is to firstly identify whether the benchmark information is an estimate, tender return or outturn project cost, and whether risk and uncertainty and project contingency was captured separately or is incorporated within the information.

When significant risk and uncertainty is identified in the benchmark information, a transparent adjustment may need to be applied to show the costs including and excluding the contingency used to deal with the risk and uncertainty. For example, unforeseen ground conditions requiring remediation.

To achieve this options exist depending on the information available:

- If a range of project information from the same source, client or programme of works is available, then an analysis of risk and uncertainty in each project can be completed by tracking the risks identified in the risk register to the range of estimated costs incurred on the project.

- This can form a probabilistic estimate and a benchmarking lens based on the range of cost between a P50 and P90¹⁶ forecast. This may also be used to support a level of project contingency which can also be benchmarked.
- If the project under review is a standalone project, or a project whereby the risk allowance embedded in the cost information is unknown, then an industry or sector risk average could be applied to normalise the data. This is less accurate and therefore specialist advice could be required from a third-party cost consultancy to provide industry risk adjustments.

Re-basing international data

The ability to normalise international cost information can be particularly challenging as a number of variables may exist which affect the cost of a project, and typically when sourcing data from international projects the underlying project detail that can potentially explain those variables will be less visible than for UK-based projects for a variety of reasons.

Variables could include foreign exchange rates, regulatory design standards, labour productivity, environmental regulations and accessibility. Many of these may not be detailed in the benchmark information available and in such instances augmenting the benchmark data with other information sources about the general market environment may be enough to bridge the gap.

Aside from project-specific variables, several methods are utilised to normalise for international locations. Most cost consultancies provide location factors which can be applied to normalise project costs based on costs collated from countries they operate in. Eurostat, World Bank and the IMF also produce Purchasing Power Parities (PPPs) which indicate price level differences between countries.

Re-basing for inflation

Data should be normalised for inflation as accurately as possible. Projects will generally have different start and end dates, meaning the costs recorded will vary with fluctuations in inflation. To adjust for inflation, indices are utilised to normalise project costs at different price time bases.

Two types of inflation indices are used to normalise projects:

1. Tender price indices track the price of work activities as priced by contractors for clients. Tender prices include the cost of labour, plant and materials and also the contractor's overhead and profit. Tender price indices should be used to normalise projects and sub-contractor works.
2. Cost indices track the cost of the material/asset/activity for the contractor exclusive of overheads and margins. Cost indices are generally used to reimburse contractors for inflationary pressures during a project whereby the risk of inflation sits with a client.

A range of consultancy organisations produce tender price and cost indices for various sectors and work activities. A consideration of the most appropriate index should be undertaken, for example a civil engineering tender price index is more appropriate than a general building price index for normalising infrastructure projects as the data informing the tender price index are more directly relevant to the work being assessed.

There should also be a consideration of whether a bespoke index is more appropriate. This could be the case if there are limited projects to benchmark and therefore the accuracy of the

¹⁶ P50 and P90 relates to probability distribution of costs in a project.

benchmark comparison is more essential. The use of Price Adjustment Formulae Indices (PAFI or previously known as Baxter Indices) can be combined and weighted to reflect the resources utilised on a project.

Applying inflation indices to multiyear projects should either be applied to the project mid-point or to the point of maximum expenditure to ensure the adjustment to the project is applied accurately.

Location should also be considered, especially for international projects. Applying a UK inflation index to a Middle Eastern project for example would not be appropriate, since the rate of inflation differs from country to country. Projects should be normalised using an inflation index applicable to the country of origin and then further adjusted using a location factor.

Step 6:

Produce and test the benchmark figure

The production of reliable analysis and insight should be the core goal for any organisation looking to make use of benchmarking. This section looks to provide more detail on how to review the analytical output and use benchmarks to inform decisions.

Calculating a benchmark figure and range

We expect project teams will be best placed to define the metrics for benchmarking. It is therefore not the intention of this guidance to provide a detailed introduction to the statistics that may be appropriate for calculating benchmarks. There are nonetheless a few considerations to bear in mind when calculating benchmark figures.

Typically, a benchmark will comprise the mean average of a sample dataset. Having been validated and re-based, this sample dataset will contain historical observations that are sufficiently similar that variance around their average can provide a useful range for comparison.

More widely however, a benchmark could be any kind of reference point. It could be a type of average other than the mean, such as median or mode, or a more complicated model such as an econometric model. In each case, it is important to ask whether the benchmark is an appropriate and useful reference point to compare the particular project in question.

How appropriate is your benchmark figure?

Comparing predicted figures against a benchmark only works if the benchmark is a valid figure itself. Stating the robustness and quality of your benchmark, and the data from which it is derived, is therefore good practice.

At this point, it will likely become apparent if the data provided on a project- by-project level was of sufficient quality, with the correct attributes. The team should consider a benchmarking maturity review (see Step 7 for further details) if the benchmark figure is shown to be unfit for purpose.

Teams should use properties such as range and standard deviation, or goodness-of-fit measurements such as the coefficient of determination (R^2) to express this validity objectively. It may also be useful to express visual confidence in the benchmark subjectively, using tools such as bar charts, waterfall diagrams and visual markers or 'heat maps'.

Those responsible for calculating and communicating benchmarks should be suitably experienced in relevant statistical techniques.

Removing or including outliers

An outlier is an observation that lies an abnormal distance from other values. Outliers provide an opportunity for analysts to question data and potentially identify poor measurement, poor recording or simple inaccuracies.

Outliers can also reveal unintended and truthful insight, since the outlier could result from a particular reason or issue with the project or asset which is worth capturing or considering. For example, the project cost derived from an outlier might have been higher if construction had taken place in a secure site (such as an airport) and was therefore constrained by security requirements. Only if a new project were not taking place on a secure site should this outlier be removed.

Step 7:

Review and repeat, if necessary, before using data for benchmarking

The IPA aims to support continuous improvement of benchmarking practices which make use of better-quality data and metrics. Each review is an opportunity to identify areas for improvement and development (in particular data governance and the data acquisition strategy), as well as to ensure that the benchmarking exercise is meeting the organisation's or sponsor's requirements. It is worth noting that each exercise may require a number of reviews before being ready for publication. If the initial benchmark figure proves inadequate, teams should return to Step 1 and consider undertaking a benchmarking maturity exercise (outlined below).

Organisations and project teams should also make use of reviews to consolidate, adapt and evolve their benchmarking practices to suit a changing infrastructure landscape. These should reflect new pressures which could emerge from factors such as population growth, sustainability challenges, changes to regulations and policies, or new technology and data techniques (such as big data, APIs and open data).

Benchmarking capability

In 2020 the IPA published its benchmarking capability tool¹⁷. The capability tool provides a framework and assessment for organisations and project teams to better understand their benchmarking capability and any opportunities for improvement. The tool provides organisations with the opportunity to compare their own capability against other organisations and look for opportunities to share learning and best practices.

¹⁷ Benchmarking capability tool', Infrastructure and Projects Authority, 2020

Summary

A consistent approach to benchmarking across government and industry has the potential to significantly improve project delivery and performance, doing away with the prevailing assumption that projects consistently fail to meet their performance targets.

While benchmarking is an exercise requiring expertise, it can be used to **make an impact at every level of an organisation** – from the most senior levels of management to people on the ground. It should be emphasised that reliable information and knowledgeable subject matter experts are critical to the success of benchmarking.

The final point to note is that benchmarking, by providing a platform for transparent communication, is **mutually beneficial to all parties**. Project sponsors and senior management can make use of the data to question progress and targets in a productive manner, while delivery professions can use the same data to justify and explain their decisions.

This point should be emphasised when it comes to sharing the data, which is critical to robust benchmarking.

In addition, the commitment to Net Zero carbon by 2050 and other climate and environmental challenges require the same discipline and robust benchmarking approach to ensure key principles are embedded from the onset, decision making is informed by evidence and performance against targets is tracked and corrected, over the life of projects.

There is a demonstrable appetite for a more consistent approach to benchmarking and for the sharing of data within a secure environment, especially when that data is being used to support the delivery of projects. **The IPA benchmarking team looks forward to supporting organisations to make use of best practices and develop structures for sharing information and data.**

Annex A: Applying the seven benchmarking steps to carbon on a whole life basis

The UK Government has a legally binding commitment to reach Net Zero emissions by 2050 and intermediary reduction targets legislated in the Carbon Budgets. This will require action across all sectors of the UK economy. Priorities and frameworks for investment need to be updated in order to tackle a changing climate and wider environmental and biodiversity challenges.

This annex exemplifies how the seven benchmarking steps of the IPA Best Practice in Benchmarking Guidance can be applied to carbon to enable projects to set up robust measurement and benchmarking practices and inform decisions that support the commitment to Net Zero carbon by 2050.

The key principles underpinning carbon benchmarking should be:

- Proportionality and a well understood rationale for benchmarking at all levels of governance
- Whole life benchmarking from the onset, understanding modules separately and as a whole
- A coherent set of metrics underpinned by a consistent assessment framework
- Clear and transparent assumptions recorded for the various project stages
- Recognition of underlying characteristics of projects when comparing or setting targets
- Similar examples could be developed for other environmental and climate adaptation measures

Introduction and context

In 2013, HM Treasury published the Infrastructure Carbon Review (ICR) which recognised that investment in new and existing infrastructure can be aligned with the decarbonisation long term goals, and concluded that **reducing carbon emissions¹⁸ reduces costs and fosters innovation**. Four of the ten recommended actions focused on consistent measurement and reporting of carbon emissions and incorporation of whole life assessments into the business case guidance.

Most recently, the Construction Playbook¹⁹ recommended the use of whole life carbon assessments throughout the life cycle of construction projects starting with the early stages of project definition and option assessment and the introduction of processes and systems in place to manage carbon emissions and drive reductions.

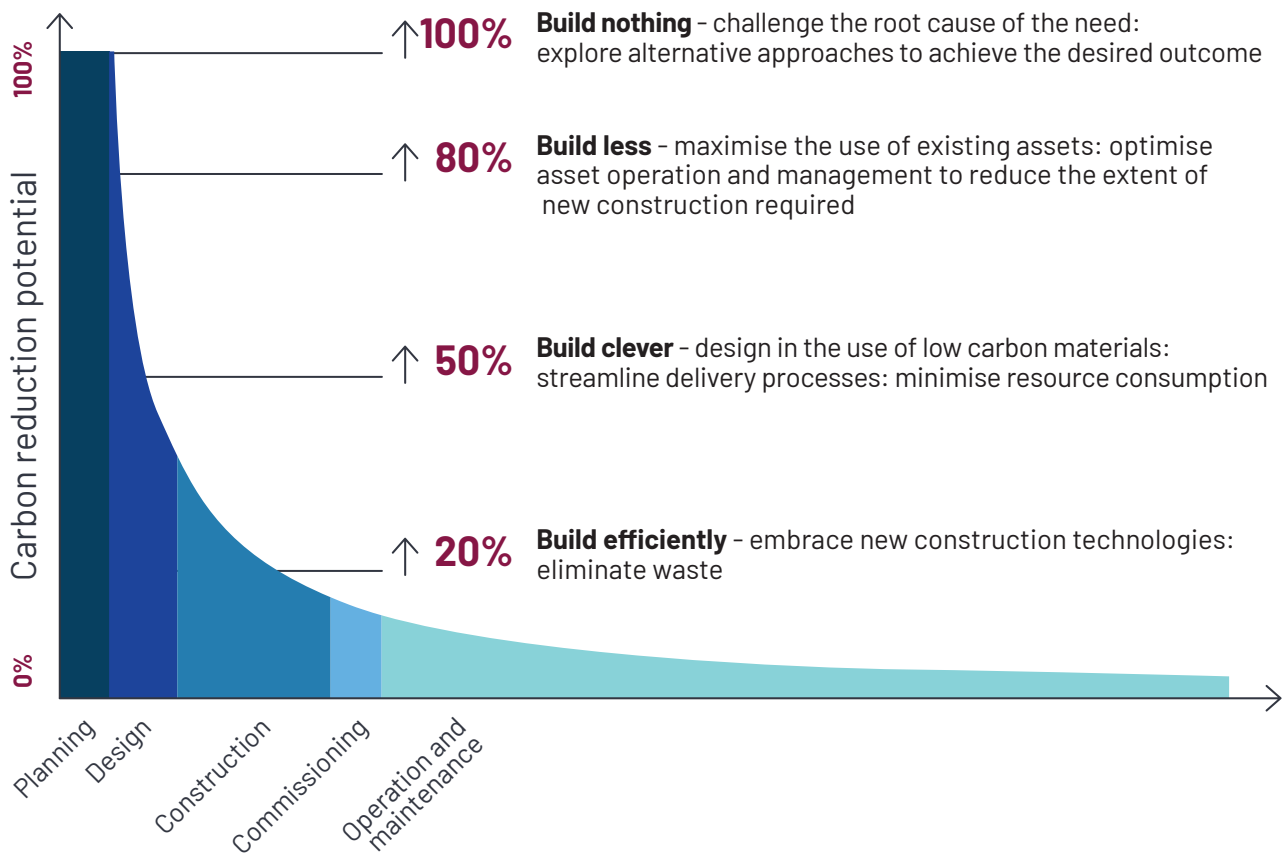
These publications, including a recent update by the Institution of Civil Engineers (ICE) of the analysis underpinning the ICR²⁰ and other studies, point to a mixed picture of progress and highlight the need to consistently embed a carbon perspective in each step of the decision making process. The early stages of project development are crucial to making consequential decisions regarding carbon.

¹⁸ Throughout this example carbon or carbon emissions has been used to signify greenhouse gas emissions (GHG) expressed as CO₂ equivalent (CO₂e)

¹⁹ 'The Construction Playbook', Cabinet Office, 2020.

²⁰ Institution of Civil Engineers (ICE), Carbon Project – Workstream 3, 2020

Figure 12: A graph showing the carbon reduction curve from Infrastructure Carbon Review, HM Treasury, 2013



One of the biggest impediments to the incorporation of carbon into project decision making and development is the lack of consistent data measurement and reporting. This annex has been developed to guide organisations to create a robust carbon tracking and benchmarking system to support their decision making and project development from early stages through to completion and operation.

Step 1: Confirm the project objectives and set the metrics

Carbon measurement and benchmarking should be proportionate and aligned with the overall objectives of the project. Due to their nature and impact, emissions from projects should be understood and monitored, and reductions should be explored at each stage. In addition, due to the legally binding targets in the UK's Carbon Budgets it is important that such projects do not inadvertently imply future breaches of targets.

The first step is setting a consistent set of metrics that are suitable for relevant project and asset typologies, underpinned by a consistent framework of assessment with clear and transparent assumptions corresponding to the various stages of project maturity. The framework for reporting and benchmarking is set out in standards such as BS EN 15978:2011²¹, BS EN 17472:2021²² and BS EN 15804:2012+A2:2019²³. The framework is **whole life carbon**²⁴ aligned with the cradle to grave approach (from sourcing, through construction and use to end of life), as a minimum and separately considering benefits beyond the system in Module D,

²¹Sustainability of construction works – Assessment of environmental performance of buildings – Calculation method

²²[publication expected in summer 2021] Sustainability of construction works – Sustainability assessment civil engineering works – Calculation methods

²³Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products

²⁴Throughout this document whole life carbon and life cycle carbon have been used interchangeably

where possible. A whole life carbon approach is encouraged²⁵ to broaden thinking and framing of carbon in decision making. For example, this could be associated with consideration of modal shift for a transport project, or a shift away from using fossil fuels for an energy project and can be very important to consider alongside capital/embodied, operational and user carbon.

The overarching whole life framework should be interpreted into a consistent and transparent set of calculation methodologies including all key assumptions; what is being estimated, when in the life of a project and for what type of project. The RICS Professional Statement on Whole life carbon assessment for the built environment²⁶ (RICS PS) sets out, in context of BS EN 15978:2011 the types of metrics that might be explored for projects and/or asset typologies. The same guidance also highlights the required steps in setting out the assumptions and provides defaults and relevant sources for data and scenarios. It is important that a wide range of metrics is considered at all levels, including programme and portfolio.

Carbon assessment and reporting is also included within the MAT 01 credits in BREEAM which encourages life cycle assessment considering a broader group of environmental indicators over the life cycle of buildings.

In addition there are also carbon management standards for infrastructure such as PAS 2080²⁷. Carbon management is also integral to CEEQUAL Version 6²⁸.

Guidance published by the major professional institutions such as RICS, RIBA²⁹ and most recently the ICE via the Carbon Project – Workstream 1³⁰, IStructE³¹ and CIBSE³², together with Product Category Rules (PCR)³³ [e.g. for buildings and infrastructure such as tunnels, bridges etc., further detail provided in Step 4] and industry publications represent resources for organisations trying to understand and set up carbon estimation, assessment, tracking, reporting and benchmarking practices.

²⁵Aligned with module D of a life cycle assessment (supplementary information beyond the infrastructure life cycle)

²⁶[RICS Professional Statement on Whole life carbon assessment for the built environment, November 2017](#)

²⁷[PAS 2080, 2016](#)

²⁸[CEEQUAL Version 6](#)

²⁹[Embodied and whole life carbon assessment for architects, RIBA, 2017](#)

³⁰[ICE – Carbon Project – Workstream 1](#)

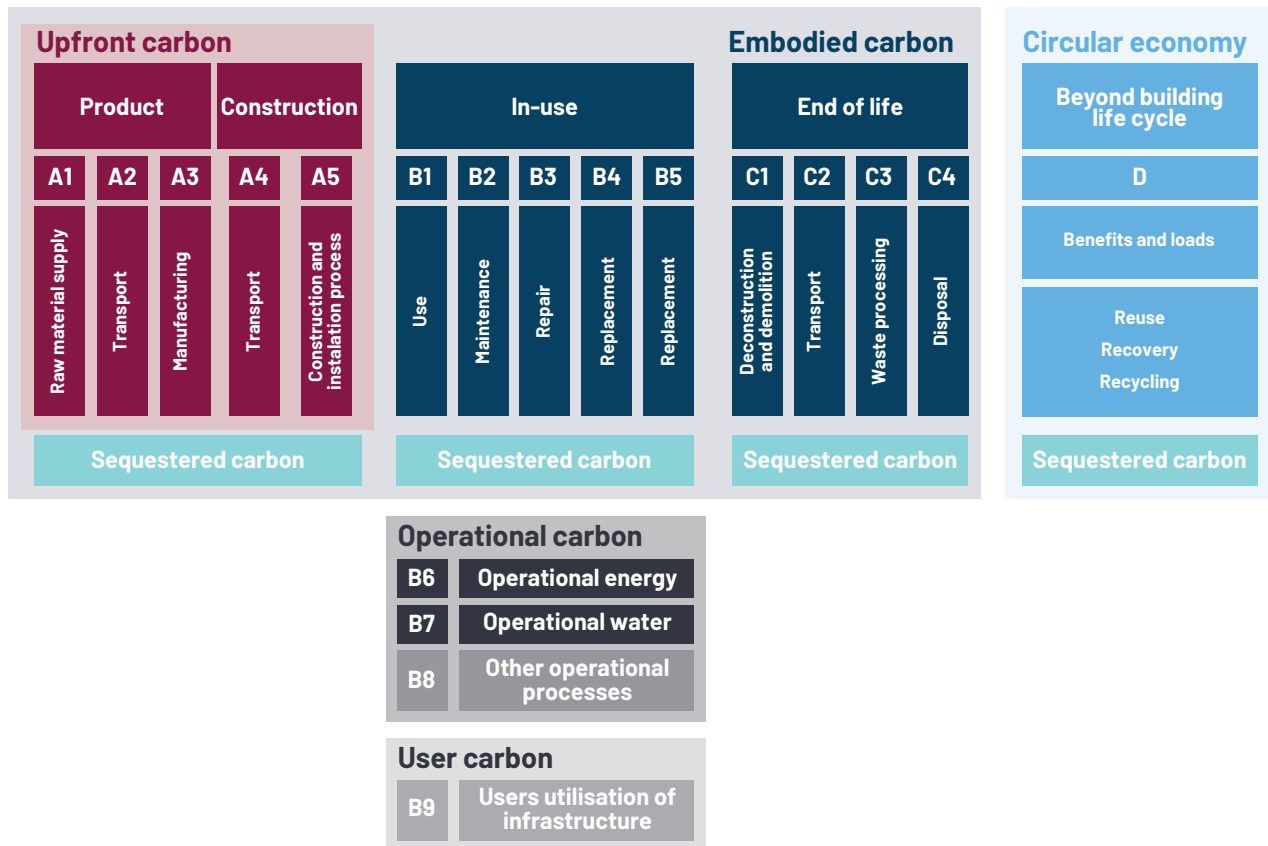
³¹[The Institution of Structural Engineers, How to calculate embodied carbon, August 2020](#)

³²TM65: Embodied carbon in building services: A calculation methodology, The Chartered Institution of Building Services Engineers, January 2020.

³³Product Category Rules

Figure 13: A diagram showing the life cycle stages from PAS 2080 and BS EN 15978:2011 (for infrastructure)

Whole life carbon



Note: The diagram shows the modules used in assessing all carbon emissions over an asset's entire lifecycle and the various terms that are used.³⁴

Note: BS EN 15978:2011 is in the process of being revised

Step 2: Break the project into components for benchmarking

The first step required is the interpretation of standards and guidance for the various project and asset typologies of an organisation's portfolio. The IPA is coordinating a cross Government Construction Metrics initiative aligned with the stated Government goal of better use of data in decision making³⁵. Early estimation and reporting of carbon on a whole life basis is one of the areas where departments and delivery agencies are working to define calculation methodologies for sector specific project and asset typologies. Additional guidance on definitions and targets is expected from professional institutions and industry ahead of the next UN Climate Change Conference (COP26). Although not entirely applicable to government projects, they should give an order of magnitude and timeframe for carbon reduction targets.

The major components for benchmarking should be aligned with the disaggregated modules of a life cycle assessment, within relevant project and asset categories. A high level benchmark can be done on the lines of capital/embodied, operational and user carbon. These categories link closely with the infrastructure value chain's ability to control outcomes and can be aggregated from the modular categories (A0-A5, B1-B9, C1-C4, D).

³⁴<https://www.leti.london/carbonalignment>

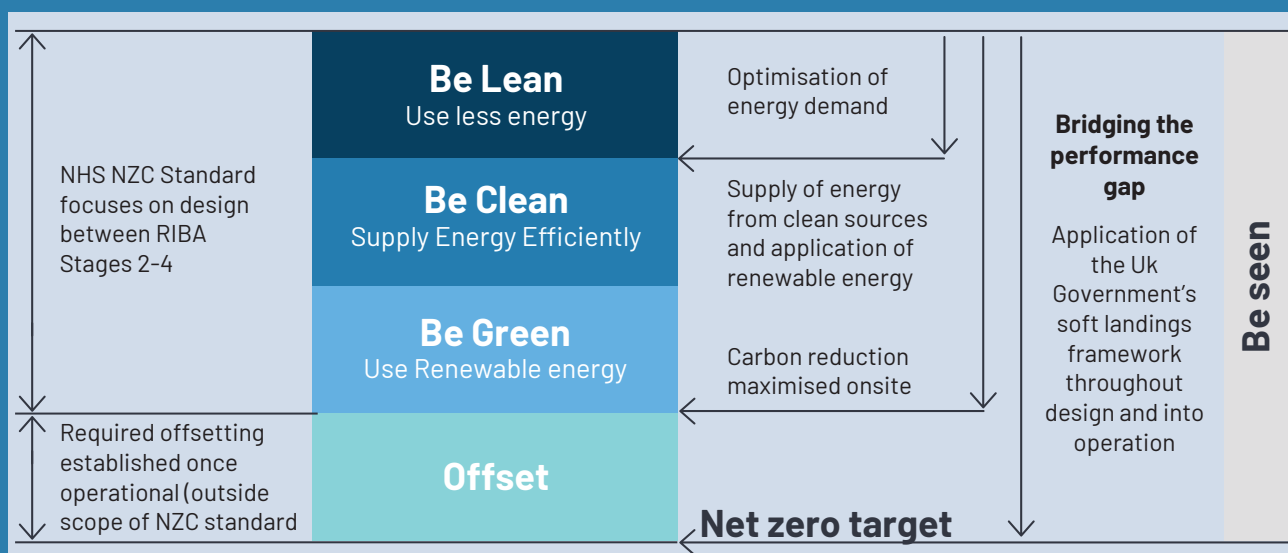
³⁵'National Infrastructure Strategy', HM Treasury, 2020

There should be a clear distinction between project, programme or portfolio level metrics and asset metrics, and the rationale for benchmarking at various levels should be stated and understood. Decisions relating to a given life cycle module should not be taken in isolation to the other modules (more details provided under Step 5). For example, asset and project level benchmarking could be employed very early on in project development with the aim to reduce emissions, identify innovations and previous good practice that can be built into the design and delivery philosophy from the onset. Programme and portfolio wide benchmarking is largely recommended to understand changes over time. **It should recognise the underlying characteristics of the projects and asset typologies and avoid forced comparisons.**

The granularity to which organisations will decide to benchmark is highly dependent on their portfolio. A tiered approach is recommended so data can be collected, analysed and compared at levels at which the organisation or project teams can make decisions and take concrete action. For example, at portfolio or programme level reducing carbon emissions might imply building expectations in procurement requirements whilst at asset or component level reducing carbon emissions might involve different design choices by the technical and engineering teams.

Case Study: NHS Net Zero Carbon (NZC) Building Standard

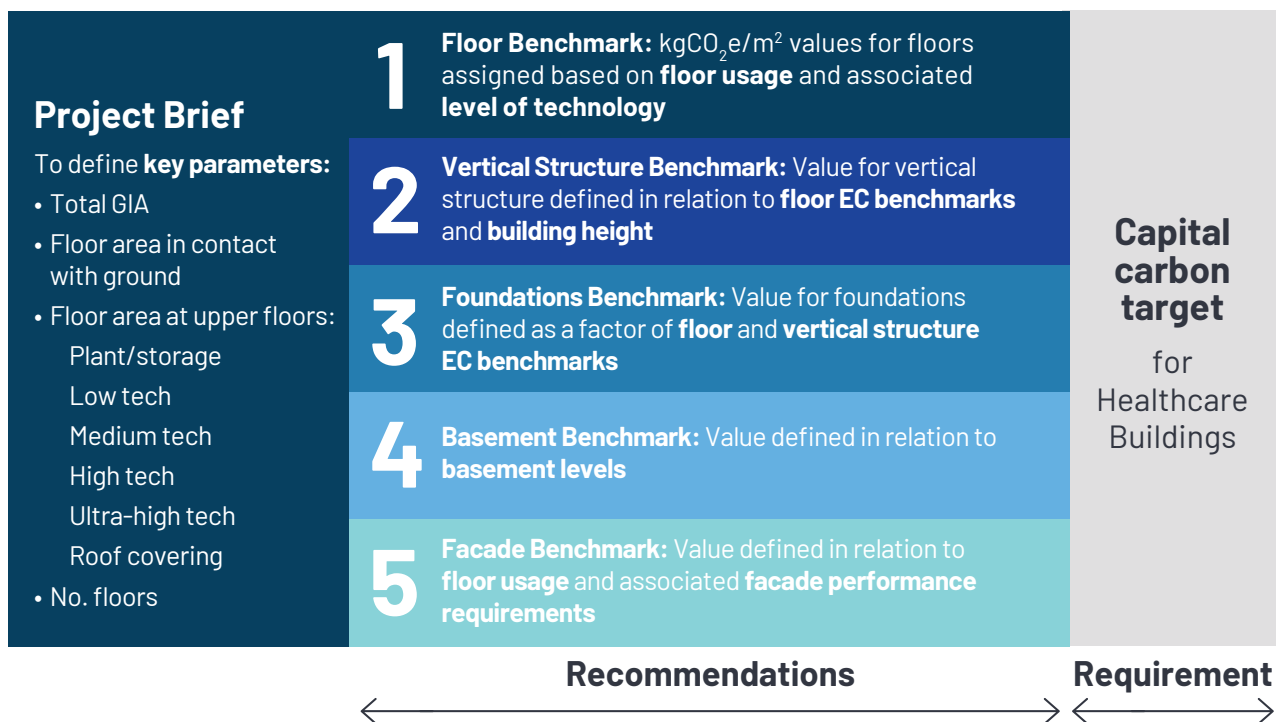
The NHS aspires to revolutionise how it delivers healthcare buildings. The NHS NZC Building Standard will set out requirements for how buildings can gradually eliminate their emissions, whilst also standardising design approaches and raising performance of new buildings. Achieving net zero carbon requires every discipline within the design team to take responsibility for reducing the energy and carbon intensity over the life cycle. The approach for operational carbon is exemplified in the diagram below:



Benchmarking categories

To benchmark carbon, different clinical spaces were split into levels of technology (low, medium, high, ultra-high or specialist units and support service) and clinical nature (non-clinical, clinical). Taking this approach allows for flexibility over the design life of a building for changing building usage. Healthcare buildings are diverse in scale, typology and location so project specific targets were derived at building component level and for different space types.

The diagram shows this granularity for capital/embodyed carbon, but a similar approach was developed for operational carbon. For capital/embodyed carbon there is an expectation to use the best available data at initial project stages to drive reduction of quantities. At later project stages, requirements for Environmental Product Declarations (EPDs) will be included to provide robust data.



The Standard intends to inform future buildings and further drive carbon reduction in existing ones. This is reflected within the requirements for capturing and publicly reporting data across all design stages that covers energy consumption, carbon emissions, whole life carbon, and performance parameters against the targets set in the standard. The initial focus of the embodied carbon targets within the Standard are on upfront carbon (lifecycle module A), where there is greatest data confidence and where materials have a long lifespan. Measurement and data reporting is required for module B and C and future iterations of the Standard will incorporate the learning gained into appropriate targets for these stages.

Step 3: Develop templates for data gathering

Carbon standards and available guidance provide ample information for those seeking to develop tailored data collection; reporting templates and the **RICS PS specifically includes such examples**. Irrespective of the format of templates for data collection and reporting, **it is essential that key assumptions have been clearly identified and data has been aligned with the relevant modules in the standards**.

Where organisations use carbon modelling tools or calculators, guidance manuals accompanying these should be made available and clearly articulate the assumptions

underpinning calculations. When using such tools, organisations should ensure that they follow BS EN 15978:2011 and RICS PS and that the scope covers modules A-C as a minimum. Module D should be assessed but, because it is beyond the system boundary and the majority of available tools do not include it, this can be done outside the software. The version of any carbon database(s) referenced by the tool should always be recorded when reporting. Experience from industry shows that discrepancies in assessments are more likely to occur due to the assumptions made in the input data and less due to the tool/calculators used, even when such tools are aligned with whole life standards.

Another consideration is the process and enforcement of data collection and reporting. Organisations can develop processes and controls that are most suitable for their own internal ways of working and aligned with the relevant standards such as PAS 2080. The IPA, via the Construction Metrics initiative is one of the places where departments and delivery agencies will be required to report data, aligning with their calculation methodologies, primarily for their pipeline of infrastructure investment and procurement.

Step 4: Scope sources and gather data

For carbon there are generic and product-specific data sources. The former are used at early stages of project development or design and give generic factors for materials that are likely to be used whilst the latter are product-specific data which become available as the project progresses through design and construction stages.

One key source of generic data to be used at early stages of project definition and option assessment is the **Inventory of Carbon and Energy (ICE) database**³⁶. This is a leading embodied energy and carbon database for UK building materials. The database is free to access with registration, it is widely used and is embedded in a range of bespoke calculators used by infrastructure clients such as the Environment Agency and Network Rail. The database covers over 200 materials split into 30 main material categories, uses cradle to factory gate scope (A1-A3) and all core data comes with a set of data quality indicators.

There are also commercial databases such as the **Building Research Establishment's (BRE) Impact database**³⁷ that has over 350 entries. This is designed to integrate with BIM software, allowing users to conduct whole building assessment schemes like BREEAM. Most data on materials comes from ecoinvent³⁸ data adapted to the UK electricity mix.

In the ICE database most data on materials is from BS EN 15804:2012+A2:2019 compliant Environmental Product Declarations (EPDs). EPDs provide a standard way of declaring the impacts of manufacturing and using products through life cycle assessments. Construction products are assessed using a single set of PCRs ensuring consistent reporting for similar products. There are national databases for construction products which can provide generic data for products without EPDs, as well as EPDs. Most of these databases are also digitised.

More information about how these databases can be accessed and on EPDs more generally can be found in the guidance issued by The Alliance for Sustainable Building Products³⁹. **Client organisations should use generic databases in the definition and option assessment of projects and engage as early as possible with the supply chain to request EPDs once projects have been contracted.**

³⁶Inventory of Carbon and Energy (ICE) database

³⁷Building Research Establishment's (BRE) Impact database

³⁸<https://www.ecoinvent.org/>

³⁹The Alliance for Sustainable Building Products

In addition to generic and product-specific information there are also relevant defaults provided in the RICS PS for service lives, transport, end of life routes and a series of benchmarking databases that can be used to benchmark carbon emissions for general project typologies.

The RICS Building Carbon Database⁴⁰, an evolution of the formerly known WRAP Embodied Carbon Database (249 projects), aims to allow users to identify where associated carbon emission reductions can be made. The database allows users to enter construction project data into the database, both for theoretical and completed projects, to estimate/benchmark whole life carbon emissions. This tool is currently undergoing a series of updates. Upcoming versions of the database should consider the inclusion of infrastructure projects. Another similar database has been recently compiled for the **Scottish Futures Trust buildings benchmarking tool⁴¹** and includes 532 projects grouped in seven categories including educational and healthcare project types, accessible to public bodies in Scotland.

Many organisations have developed their own benchmarking data for different infrastructure projects or assets, however this information is not generally publicly available.

The IPA Benchmarking Hub, leading on from the work undertaken for the Construction Metrics initiative, could become the central repository for open data on government sponsored projects, particularly for typologies such as schools, hospitals, prisons and larger infrastructure schemes in the transport and energy sector, linked to other publicly available databases.

Step 5: Validate and re-base the data

As previously acknowledged, benchmarking carbon data, particularly on a whole life basis, has been hampered by the lack of consistent data collection and transparent use of methodologies and assumptions.

Once an organisation has developed initial baselines it should consistently validate these with actual data in order to refine and set suitable targets. Once carbon data from a number of projects for similar typologies has been gathered using the bottom-up approach, it can be used as a top-down benchmark for new projects. For example, on existing assets or projects, tracking their performance against the B submodules can help identify problems and improve carbon performance in addition to providing real data for benchmarking on future projects (more details on Step 6).

Applying a whole life lens instead of focusing on discrete parts of a carbon assessment should be prioritised due to the long lasting implications that it can have on behaviours and decisions.

For instance, Road Design A may have a lower capital/embodied carbon than the alternative Road Design B, but the asphalt used in Road Design A may require more frequent and heavier maintenance over the life of the road, resulting in more operational carbon or, the same Road Design A may create greater rolling resistance for road users (user carbon) leading to greater fuel consumption and emissions over its lifetime. The interaction between capital/embodied, operational, user and whole life carbon cannot be ignored. Capital/embodied carbon investment plays a role in locking in systemic, whole life carbon behaviours. Any target adopted should respect and facilitate the carbon reduction of major sources of operational carbon. Whilst capital/embodied and operational carbon can be directly influenced, changes by the asset owners/managers can also lead to significant user carbon reductions.

⁴⁰ RICS Building Carbon Database, July 2019

⁴¹ Scottish Futures Trust buildings benchmarking tool

The results of Module D should also be considered alongside but always separately from the whole life carbon results (modules A-C). This is because Module D shows the benefits beyond the project system such as the potential benefits of recycling at the end of life or of exporting electricity from an asset. The relevance and importance of these future benefits may change over time due to the changing context such as decarbonisation of industry and the grid. For example, a bridge made of largely virgin material may show significant benefit in Module D if it is recycled however a similar bridge made of recycled material will have lower whole life carbon (modules A-C) because of its recycled content but will not show any benefit in Module D and may even show a disbenefit. For these reasons, it is important to consider Module D separately and carefully in the decision making.

Step 6: Produce and test the benchmark figure

As benchmarking will be used primarily at the start of the project, much of the carbon information for the upfront stage can be derived from Building Information Modelling (BIM) data which aligns to generic datasets. BIM should be used to determine the materials needed by running a bill of quantities. Some BIM models also integrate into carbon tools that are able to calculate the embodied carbon of the materials for the 'before use' stage. PAS2080 refers to this as "**measured**" data and will often only focus on stages A1-A5 of a whole life carbon assessment. There are two key sources of measured data that can be used for capital/embodied carbon: **spend** data and **actual** construction data.

Direct spend data with a supplier can be used as a proxy to determine the quantity of material purchased, if the overall unit prices are known. Industry evidence suggests that most infrastructure projects will purchase up to 10-15% more materials than is actually used in construction (evidence for buildings suggests less than that) to minimise the risk to the programme from damaged or spoilt materials. When estimating capital/embodied carbon using spend data, the excess purchase or wastage should be assessed in Module A5 and assumptions should be clearly recorded.

By using available technology and collaborating with the supply chain, projects could also track actual quantities of materials that are delivered and/or taken from site. Some projects use automated machine learning to scan goods received and capture the quantities of materials used. The bill of quantities from this data can be exported and converted into carbon emissions. More application of such automated solutions is highly recommended to improve the speed and accuracy of data collection. This would allow projects to unpick what was actually used against what was planned for, which would lead to more accurate forecasting on future projects.

In the absence of such software, it is recommended that projects are initially benchmarked against the BIM datasets. As systems mature, actual construction data sets should be used to provide further insight. In the long run both the BIM and actual construction datasets should be used to inform decision making.

To develop more accurate benchmarks for operational carbon, it is recommended that performance against the design benchmark is tracked using actual data. For example, it is possible to track actual operational carbon emissions for modules B1-B9 for existing assets, by using Facilities Management (FM) records and applying carbon factors. This, if done periodically allows for the identification of problems and improvement of asset carbon performance in addition to providing real data for use in assessing and benchmarking module B at the early stages of similar future projects.

Step 7: Review and repeat, if necessary, before using data for benchmarking

Once an organisation is confident in the data and processes established and the baseline has been satisfactorily tested, a carbon target should be set in alignment with the expected carbon trajectory at the time of project completion and the corresponding carbon budgets, which will make a significant difference. **It is imperative that targets are set on a whole life basis, instead of discrete components to avoid locking in behaviours and future carbon emissions or limiting opportunities for innovation**, as highlighted in the theoretical example under Step 5.

Targets should be set to meet the needs of the project and wider programme and portfolio. For example, some organisations might already apply very lean and efficient designs across their portfolios incorporating the most carbon reductions possible with the existing technology, therefore targets might seem “less ambitious” compared to other portfolios. Such comparisons should be avoided and targets should always be set recognising the underlying characteristics and realities of the portfolio and programme.

Aligning organisational practices with carbon management standards such as PAS 2080 allows for a structured and continuous process of quantification of GHG emissions, setting baselines and targets, monitoring and reporting. Organisations are currently at different levels of maturity in their practices, nonetheless reaching for the highest level of maturity understood as fully compliant with carbon management standards, sharing learning and setting future standards should be an immediate aim.

The duty to estimate, collect and report carbon emissions across the project life cycle should be adopted as a standard practice across all organisations and their supply chain. Also, on publicly funded projects, where the delivery agency and their industry partners are contractually removed from the overarching organisation such as a government department, it is important that data collection and reporting is embedded into funding and contractual arrangements and are followed through.

Visibility and tracking progress should be embedded in the decision-making and delivery process. Whole life carbon assessments should be produced and form part of the documentation at each stage gate, aligned with the PAS 2080 standard and recommendations of the Construction Playbook.

In summary, this annex exemplifies how the seven steps of the IPA Best Practice in Benchmarking Guidance can be applied to carbon to enable projects to set up robust measurement and benchmarking practices, and inform decisions that support the commitment to Net Zero carbon by 2050.

The annex demonstrates that by applying available standards and guidance on whole life carbon assessments, organisations can understand and set up robust carbon estimation, tracking, reporting and benchmarking practices. It is recognised that an iterative process will be required to reach greater transparency and consistency however organisations should not let perfect be the enemy of good when it comes to estimating and reducing their carbon emissions, and wider environmental and climate impacts.

The IPA benchmarking team looks forward to supporting organisations in making use of best practices and developing structures for sharing information and data.

Case Study: HS2 Whole Life Carbon Approach



HS2 Ltd was set up by the Government to develop, build and operate HS2; the UK's new high speed railway network. HS2 Ltd has adopted ambitious targets to reduce carbon emissions from the construction and operation of the programme.

Through collaborative working with – and between – supply chain partners, whole-life carbon baselines have been established for Phase One civil, station and rail system assets. The baselines have been produced in accordance with best practice standards and are a product of life cycle assessment (LCA). LCA is a systematic tool that enables the analysis of environmental loads of a system throughout its entire life cycle and the potential impacts of these loads on the environment. The baselines create a benchmark against which whole-life carbon reduction performance can be monitored and reported, and identify 'carbon hotspots' – sources of carbon emissions with the greatest impact and potential for carbon reduction – on which to focus efforts to reduce emissions.

The whole-life carbon emission baselines are essential in enabling effective carbon management. They allow for meaningful application of carbon reduction targets, monitoring of carbon reduction performance, and reporting and communication to stakeholders. The baselines are also critical in making carbon reduction performance visible throughout delivery and in informing decision-making to manage and minimise whole-life carbon emissions. The approach is already delivering substantial carbon reduction across the programme. For example, the new HS2 Curzon Street station – in Birmingham city centre – is set to reduce carbon emissions by 55% compared to the baseline.

To drive continual improvement, HS2 Ltd is developing and implementing controls that require the collection of relevant data during delivery so improved benchmarks can be created for future assets and programmes of works. In addition, through time HS2 Ltd's LCA tool will help to build an inventory of data, enabling more rapid development and improving the accuracy of future whole-life carbon benchmarks.

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