Traditional approaches to infrastructure decision-making have tended to focus first on identifying and scoping options to meet a particular need – for example a new road to increase transportation capacity and/or to decrease journey times – and then on assessing the costs (normally the whole life costs) of each option. Typically, the cost boundary used is private financial cost, i.e. the costs incurred by the asset owner/manager. If the options are assessed to have different levels of benefit (in meeting the need) then some form of cost-benefit analysis is used to compare cost and benefit, and then we choose the option that delivers the greatest benefit for the least cost.

Commonly, such cost-benefit analyses are conditioned by appraisals of environmental and social impacts (taking account of measures to mitigate those impacts). Carbon emissions are one such impact but, to improve transparency and to avoid unintended consequences, it is important to understand: (i) carbon impacts that extend beyond the immediate project boundary; and (ii) carbon within the context of other factors (environmental and social), which together can affect the overall sustainability of the solution.

(i) Carbon emissions beyond the project boundary

While we may limit the cost analysis to those incurred by the asset owner/manager over the life of the project, it is not necessarily appropriate to use the same boundary for carbon. This is because the atmosphere is a global common good and if we reduce carbon emissions from our project only to increase carbon emissions elsewhere then our net reduction in carbon emissions, and any benefit to the atmosphere, is reduced or eliminated.

Ideally we would draw the carbon accounting boundary wide enough to capture all the changes in emissions that result from the construction, operation and use of our project – i.e. not only the emissions over which we have direct control but also other emissions we can only influence (or not at all). Of course, some of these wider impacts may require considerable effort to define and quantify, so we should focus mainly on the most significant impacts, particularly those that will affect the choice to be made.

Furthermore, when assessing the project emissions relative to a counterfactual case (typically the ‘do-nothing’) or when comparing two or more options, we must apply the same spatial and temporal boundary conditions to each case so that we are comparing like with like. Of course, this can be challenging as there may be significant uncertainties in the data. But as long as we set out our assumptions on current and future emissions, and assess the sensitivity of the comparison to these uncertainties, then this is a reasonable approach.

These wider emissions can perhaps be divided into two types – those that occur elsewhere in the asset system (of which the project is a part) and others beyond the asset system:
Carbon impacts on the wider asset system: These are those emissions beyond the immediate ‘project boundary’ that arise from changes in an existing activity (operation or use) as a result of implementing the infrastructure project. Often these are emissions over which we have some control. An example of this could be the increase in distribution network pumping occurring as a result of increasing the capacity of a water treatment works. Others we may only influence, such as the net change in emissions arising from a decrease in journeys by rail as a result of the construction of our new road.

Carbon impacts in other areas: These are many and varied but could include changes in emissions as a result of a change in demand, land-use or economic activity, occurring as a result of infrastructure development. Our project may influence such changes, but we have no control. An example of demand-related changes could be the increased use of hot water (and therefore energy-related emissions) occurring as a result of increasing the supply of treated water to an area with a growing population. An example of land-use change could be the loss of forestry as a result of constructing our new road leading to reduced carbon storage, unless this loss is offset by planting more trees (or other activity) to ensure equivalent carbon sequestration is maintained.

Beyond these, the increased accessibility achieved by the construction of a new road, or indeed any significant infrastructure improvement, may (in the long-term) lead to wider changes in economic activity, with their own consequences for emissions. In a similar manner, recycling of sewage sludge to land by a water company may result in the displacement of artificial fertiliser by the farmer, which in turns avoids the carbon emissions arising from fertiliser manufacture.

As mentioned above, it is most important to understand the relative significance of these wider emissions in the context of the decision being made. Consider, for example, two options (A and B). If the ‘primary’ emissions from Option A are lower than those from Option B but the increase in ‘secondary’ emissions from Option A is assessed to be greater than this difference then Option B may be the better choice – all other factors being equal (including cost) and depending on the consensus of opinion of interested stakeholders. Of course the choice also depends on the uncertainty in these wider emissions and the degree to which the project can influence them.

Quantities of the wider emissions will be entirely project-specific but the same principles as those used for assessing emissions directly attributable to the project apply. While it may be difficult to account in detail for such consequential changes, such emissions could be significant and where there are differences between options (including the ‘do-nothing’ option), an assessment of their direction (positive or negative), magnitude and uncertainty relative to the whole life carbon emissions resulting directly from the project should be carried out as a minimum.

(ii) Carbon within the context of other impacts

Of course, carbon emissions are typically just one (albeit an increasingly important one) of the consequential impacts of an infrastructure project – occurring during its construction, operation and use – which need to be taken into account in the decision-making process. In
the case of our new road, these could include local environmental factors (such as impacts on habitats, biodiversity and air quality) in addition to the global carbon impact, as well as social factors (from noise or congestion to amenity, health and wealth).

Let’s return to our conventional analysis: where a financial cost-benefit analysis is conditioned by an appraisal of environmental and social impacts, this tends to include a combination of qualitative and quantitative analysis with results presented using different metrics. These can range from simply adding up individual ‘scores’ to come up with an overall aggregate score to more sophisticated multi-criteria approaches with active stakeholder participation. Of course, such analyses can be complex – there are often interactions between the different factors – and the results of these appraisals can lead to much debate. There is a burgeoning literature on this subject.

Attempts are sometimes made to monetise these different impacts so that wider costs can be added to financial cost-benefit analysis. But again, these methods can be controversial since they typically involve value judgements and different methods yield different results. Although carbon emissions can be monetised, this rarely influences the decision since the carbon price is still too low for the result carbon cost to be a significant factor. Usually, it is better to keep carbon impact expressed in equivalent tonnes of carbon dioxide.

Whatever method is applied, unintended consequences can be avoided by ensuring project carbon emissions are assessed alongside the wider factors, in a transparent and consistent manner. As above, the focus should be on the direction, magnitude and uncertainty of impacts, over the spatial and temporal boundaries of the project. This ensures informed judgements can be made by the group of stakeholders with an interest in the outcome.

Again, what is perhaps most important is to develop a clear understanding of the relative significance of these social and environmental factors across the alternatives being assessed. For example, if both of our options (A and B) to build a new road reduce carbon by the same amount but Option A also improves biodiversity (all else being equal) then clearly Option A is the better choice. However, if Option B is lower carbon and also results in better health benefits then the decision becomes more difficult. The choice depends on the values of the participating stakeholders (as well as any regulatory requirements, of course). In short, carbon is just one of the factors considered by stakeholders contributing to the decision.

Having said all this, if the aim is to deliver more sustainable solutions our goal should be to seek integrated solutions that reduce carbon and improve biodiversity and improve social amenity … and reduce cost (to society). If we start with this end in mind then it is more likely our project will achieve better outcomes not only for customers of the service provided but also for those wider communities and the environment affected by the project.