

# Transition to a low carbon economy - consideration of carbon in infrastructure



**Main findings from a review  
by Halcrow Group Ltd**

***Halcrow***

**contact:**

**Mark Browning** email: [browningm@halcrow.com](mailto:browningm@halcrow.com) tel: 01733 426095, mob: 07894 491222

**Paul Stephenson** email: [stephensonp@halcrow.com](mailto:stephensonp@halcrow.com) tel: 0113 2208157, mob: 07595 646654

**Halcrow Group Ltd.** [www.halcrow.com](http://www.halcrow.com)

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# Executive summary

## Introduction and our approach

This report presents the main findings from research carried out by Halcrow, into how carbon is considered in the investment, planning, design and maintenance stages of infrastructure projects. The main objective of this review has been to identify the key drivers and barriers for considering carbon in infrastructure development and management in a systematic manner, as well as the success factors which will realise carbon reductions over the “life” of an asset .

We surveyed 15 organisations involved in the delivery of major infrastructure from the private and public sector. The key findings of the survey are presented, on a non-attributable basis, in section two of this report.

From our findings we believe that in the UK, carbon management is moving towards becoming a part of every infrastructure project to some degree, with the level of carbon consideration varying from risk of regulatory or contractual non-compliance to leading edge practices that go far beyond compliance based approaches.

## Key Findings

For many survey participants it is their own internal or external policies and standards, not regulation, that are the main driver for considering carbon in infrastructure. However, survey responses also indicate that these standards are currently not strong enough to drive the shift towards low carbon infrastructure or alternatively, that existing regulation may not promote a comprehensive approach to the consideration of carbon in infrastructure. A lack of specific regulation and standards may present difficulties for

organisations and project teams to set targets which are relevant to specific infrastructure types and which are meaningful.

From survey responses we can see that the absence of formal requirements in contracts, lack of overarching policy or scheme objectives that are focused on carbon and availability of relevant skills and knowledge are currently the main shortfalls to designing low carbon infrastructure. Survey responses emphasised the importance assigned by survey participants to skills and knowledge development, not least because the UK has to deliver relatively aggressive carbon reduction targets in a short timescale.

The survey has reinforced thinking that the greatest opportunities for reducing the carbon impacts of infrastructure projects appear to be at the early project stages such as investment planning and options appraisal. We can therefore infer that the mechanisms for considering carbon at these stages are crucial to delivering low carbon infrastructure.

## Systems thinking and carbon management

To bring about a step change in approach to the management of carbon in infrastructure, requires a systems approach which promotes carbon management throughout the “whole life” of infrastructure development and management. To develop a systems approach will require a multidisciplinary and multifunctional approach from organisations.

Each function needs to understand their role in managing down carbon and their key areas of influence. A systems approach will ensure that strategic and operational decisions are connected and “joined-up”. Applying systems thinking to carbon and infrastructure will not occur overnight but to achieve demonstrable carbon

reduction targets, requires organisations to consider their position now, in particular what a systems based approach will mean for their own organisation.

Appendix C shows a draft framework for the management of carbon in infrastructure, which we have developed based on results from this survey together with our own experiences of advising organisations on the consideration of carbon in infrastructure from a whole life perspective (i.e. from identifying the need for infrastructure through to decommissioning).

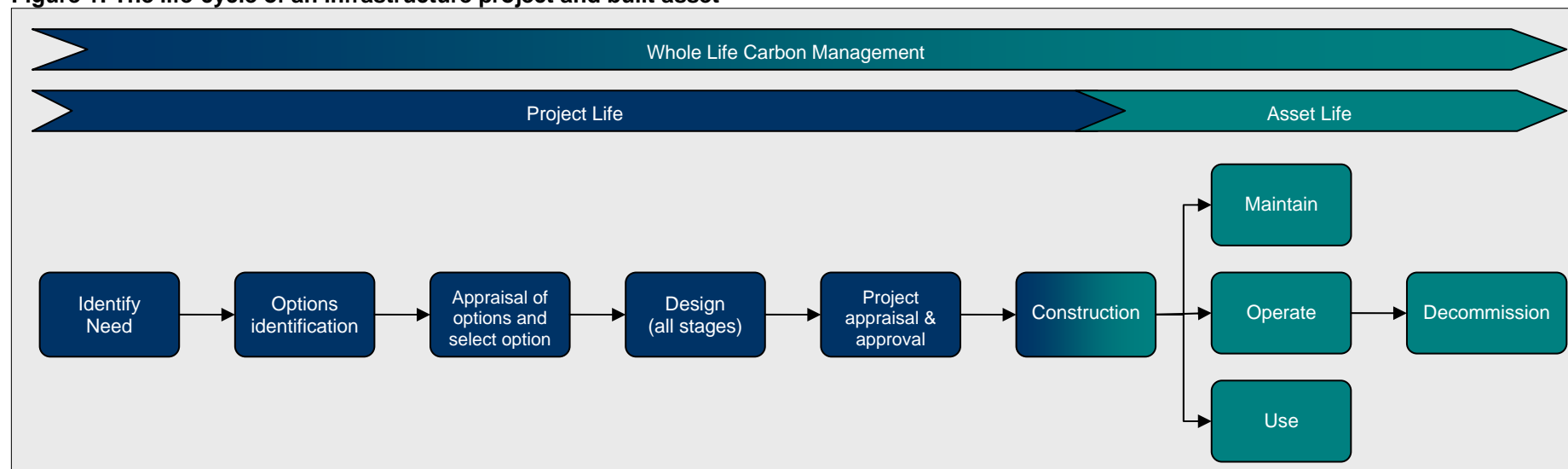
Our framework for carbon management will assist organisations in identifying their existing position with regards to carbon, potentially identify gaps and map the connections required in their own organisation to bring about a systems-based approach.



# 1. Introduction and background

Our review considers carbon management in infrastructure which includes the physical assets and management systems supporting transport, energy and water transmission and waste management. Figures from DECC suggest that infrastructure in the UK represents approximately 60 per cent of total UK carbon emissions.

**Figure 1: The life-cycle of an infrastructure project and built asset**



Halcrow has undertaken research into how greenhouse gas emissions (referred to as carbon<sup>1</sup> herein) are currently considered in the planning, investment, design and maintenance stages of an infrastructure project (illustrated as the ‘Project Life’ and ‘Asset Life’ in Figure 1). The purpose of the research is to identify the key drivers and barriers influencing the consideration of carbon during

<sup>1</sup> Carbon in this report is used as short-hand for carbon dioxide equivalents (CO<sub>2</sub>-eq) and refers to the basket of greenhouse gases covered by the Kyoto Protocol represented as the equivalent amount of carbon dioxide based on the relevant Global Warming Potential (GWP).

the project and asset life of infrastructure (termed ‘whole life carbon management’) as well as identify the opportunities and “enablers” to promote low carbon thinking and approaches which will realise carbon reductions during the Asset Life (refer to Figure 1).

We use the term infrastructure in this report to refer to the physical assets and management systems that support the transmission of people, services, goods and our basic needs such as water, energy and waste, with particular emphasis on transport, energy, water and waste sectors. Infrastructure is the back-bone to how business and society operate, it touches on all of us and every business sector. The transition to a low carbon economy will be one of the greatest

challenges businesses and organisations will face and infrastructure will be a key factor in facilitating targeted reductions and aspirations in this area.

Whilst it is acknowledged that infrastructure is “used” by business and society, if UK statistics are broken down by sector rather than attributed to the end-user, then direct emissions from infrastructure are estimated to have contributed approximately 60 per cent (374 Mt CO<sub>2</sub>e)<sup>2</sup> of the UK total of 627.6 Mt CO<sub>2</sub>e in 2008 (for the purpose of our review these figures include transport, energy and waste but do not include process emissions from the water sector). This estimate does not account for any indirect emissions associated with the construction and maintenance of infrastructure assets.

As an example, as well as the direct carbon impacts associated with road, rail and water use or treatment of waste, there are potentially significant indirect carbon impacts associated with procuring goods, services and raw materials in these areas.

Globally there is expected to be in the medium-term trillions of dollars worth of investment in new infrastructure or upgrade of existing infrastructure to accommodate global megatrends such as a rising human population and urbanisation. Each dollar spent will have a carbon impact to some degree.

For some organisations, such as those operating in the logistics, construction, information communications and consumer goods sectors, infrastructure may actually be the main enabler to unlock their low carbon potential and develop more sustainable organisational and business models where greater profile is given to sustainability issues like carbon in planning and investment decision-making.

<sup>2</sup> Based on sector contributions of 219.7, 131.9 and 22.7 MtCO<sub>2</sub>e from the energy, transport and waste sectors respectively. Data taken from DECC’s statistical release, 2 February 2010.

### The UK’s position

The UK has set a legally binding target of at least an 80 per cent reduction in carbon emissions by 2050 and at least a 34 per cent reduction by 2020. With direct emissions from infrastructure accounting for nearly two-thirds of the UK’s emissions and an expected increase in demand for new infrastructure globally, there is ever a greater need for the consideration of carbon in infrastructure. Moreover, with lengthy lead in times for new and upgraded assets it is important that current systems in place to facilitate infrastructure development and management are reviewed and potentially revised to promote a more holistic and systems based approach to carbon management.

### The survey - our approach

Halcrow surveyed 15 large organisations involved in the delivery of major infrastructure from the private and public sector to consult on how carbon is currently considered in the design, planning and management of infrastructure. Our main aim has been to gain insights into the drivers and barriers for considering carbon in infrastructure as well as identify opportunities to enable low carbon thinking and systems.

The survey participants included representatives from four UK government agencies or regulatory bodies, two energy generating and distribution companies, one water company, three private companies managing infrastructure and five professional advisory firms specialising in infrastructure. The majority of the survey participants are from the UK with two from overseas. We were unable to identify the roles and responsibilities of all participants in the survey, but where we were able to confirm the roles and responsibilities of participants the majority had a management or advisory role related to environmental or sustainability issues including carbon.

We present the key findings of the survey, on a non-attributable basis in section 2 of this document. A copy of the survey template and summary of all the results is provided in the appendices. We recognise that the sample size is not being statistically representative of any one infrastructure sector type.

Appendix C shows a draft framework for management of carbon in infrastructure which we have developed based on results from the survey together with our own experiences from advising organisations on the management of infrastructure and carbon from a whole life perspective.

The framework consists of a matrix showing a spectrum of carbon management practices which vary at the extremes from “At Risk” to “Leading Edge”. The framework allows organisations to benchmark where they are in terms of managing carbon risks and developing appropriate policy to ensure regulatory and/or contractual compliance. The framework should also promote a systems approach to carbon management, which we believe is a fundamental factor for ensuring that carbon reduction is given appropriate profile in decision-making and that specific actions to reduce carbon are efficient and practicable. In addition, for those organisations wishing to work beyond regulatory requirements the framework details carbon management practices that can be employed for a more comprehensive consideration of carbon and potentially promote more innovative low-carbon thinking and practices.



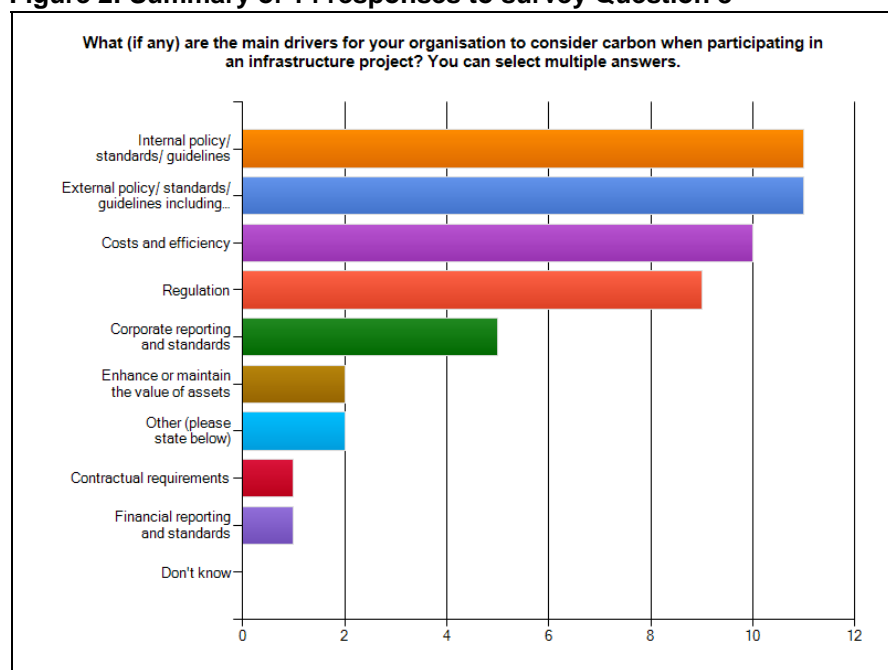
## 2. Main findings

*The survey responses indicate that the two main drivers for considering carbon in infrastructure projects are policy and standards developed internally by an organisation, together with external policies and standards including Government policy.*

### Drivers

As part of the survey we asked organisations what they consider as their main drivers for considering carbon in the planning, investment and design and management of infrastructure. In simple terms these drivers may be regulatory or non-regulatory. (Background on regulatory and non regulatory drivers for considering carbon can be found in Appendix D). The responses to this question are shown in Figure 2.

**Figure 2: Summary of 14 responses to survey Question 8**



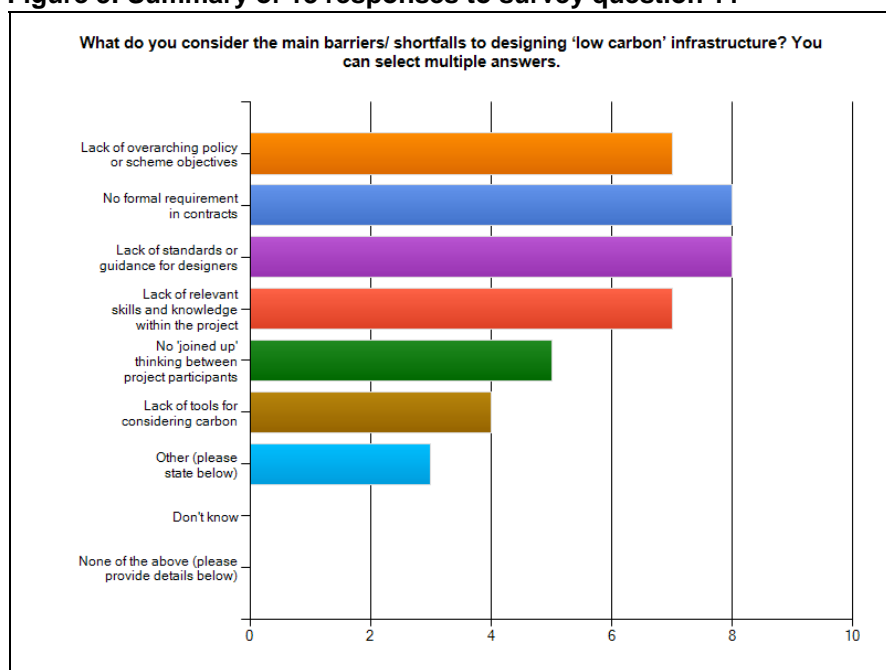
The survey responses indicate that the two main drivers for considering carbon in infrastructure projects are policy and standards developed internally by an organisation; together with external policies and standards (the latter includes Government policy). Costs and efficiency also appears to have a significant part to play together with regulation, albeit regulation is not as prominent as expected and that may be down to the fact that regulation of carbon in infrastructure development and management may not have had as much focus as it has in some other business sectors, although from our sample size we can not confirm this.

Evidence is suggesting that sector policies, standards and guidance for carbon management currently go beyond (or is looking to move beyond) regulatory compliance in terms of simply considering emissions that are covered by key regulation. There is a move towards considering other emissions associated with infrastructure management including those due to construction, operation and maintenance of assets. Going beyond regulatory compliance may in some ways be more difficult to implement since organisations and markets have to set meaningful targets and standards in areas where currently few or no benchmarks exist.

However, survey responses are also indicating that organisations see current policies, standards and guidance as one of the “shortfalls” or “barriers” to successfully designing low-carbon infrastructure (see Figure 3), perhaps indicating that these measures are not currently strong enough to drive the shift towards low carbon infrastructure or alternatively that they don’t promote a systematic approach to the consideration of carbon in infrastructure.

**Key Issue box 1:**

Survey responses suggest that policies, standards and guidelines are mainly driving carbon considerations in infrastructure rather than regulation. However, responders also see these measures as a 'shortfall' in promoting a shift to low carbon infrastructure.

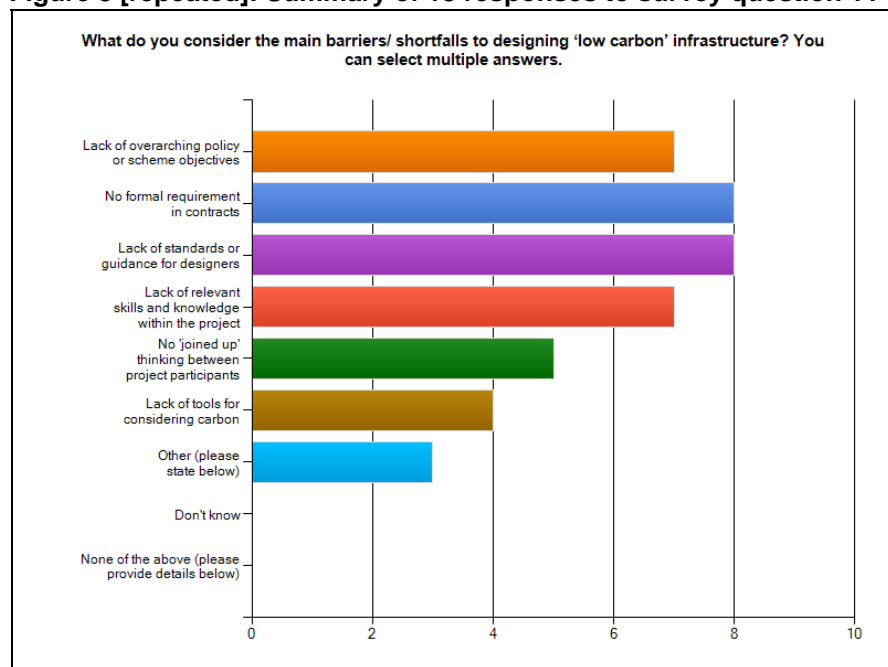
**Figure 3: Summary of 13 responses to survey question 11**

*Lack of formal requirements in contracts, lack of overarching policy or scheme objectives and lack of relevant skills and knowledge are considered the main shortfalls to designing low carbon infrastructure. These factors are considered to be 'very important' to successfully realising carbon reductions.*

### Barriers and shortfalls

In the previous section on drivers it was noted that survey responses indicate that current standards and guidance are seen as one of the main shortfalls to designing low carbon infrastructure.

**Figure 3 [repeated]: Summary of 13 responses to survey question 11**



The other main shortfalls appear to be the lack of formal requirements in contracts, the lack of overarching policy or scheme objectives set in a scheme or project and the lack of relevant skills and knowledge within the project. For the purposes of this survey,

knowledge is practical experience of applying low carbon thinking to management systems and projects.

Additional comments in reply to question 11 were themed around cost drivers taking precedence and the lack of weighting given to carbon in option appraisal and cost benefit analysis (CBA) methodology. It should be noted that defra have stated in their **Draft Structural Reform Plan** that they intend to 'revise guidance on Impact Assessments, the Green Book and other policy appraisal guidance to take account of sustainability and the value of nature' in order to promote a low-carbon economy.

### Main Success Factors

Turning around the questioning about barriers and shortfalls, the survey asked organisations about what they see as the main success factors in considering carbon in infrastructure projects. The question was asked in the context of facilitating carbon reductions and promoting the systems-based approach.

The survey responses are indicating that the top three factors considered as 'very important' for successfully realising reductions are; formal requirements in contracts and briefs, overarching policy or scheme objectives and regulation (see Figure 4). Notably, the current lack of these factors is seen as a 'shortfall' (see Figure 3).

The survey responses and our own experience suggest that there is potentially a need for greater consideration of carbon in the procurement process and decision making related to management of infrastructure. This might include for example, requirements in

the project brief, pre-qualification questionnaires, employer's requirements and design/framework agreements as well as performance clauses in contract agreements.

**Figure 4: Summary of 14 responses to survey Question 20**

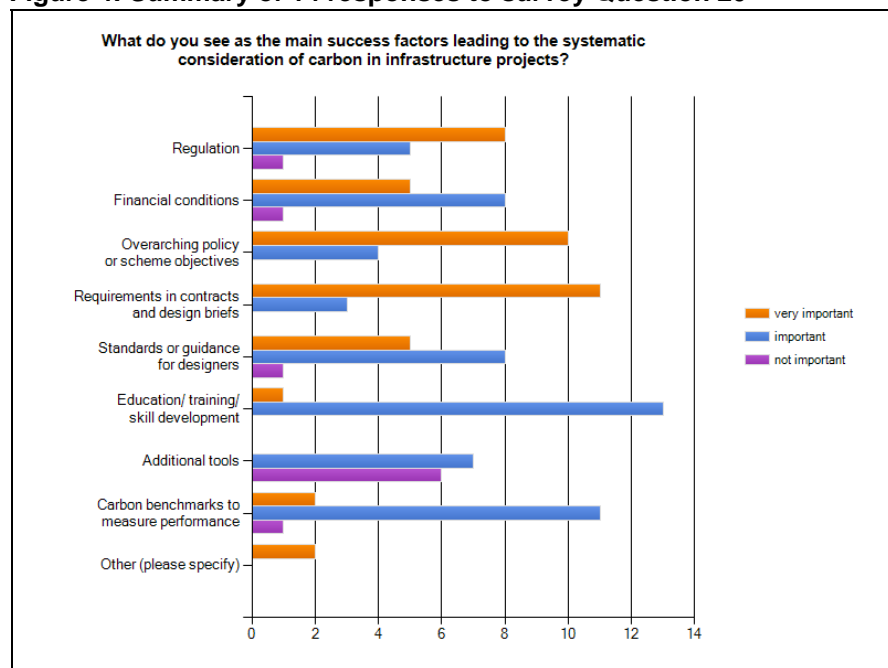


Figure 4 shows that the top three factors considered as 'important' for successful consideration of carbon are; skills development, carbon benchmarks to measure performance and, tied jointly in third, standards for designers and financial conditions. Our survey sample showed that more tools to support the assessment of carbon are not a priority.

From our own experience, we agree with the importance assigned by survey participants to human capital, and in particular skill and knowledge development, not least because the UK has to deliver relatively aggressive carbon reduction targets in a short time scale. We can infer that skill development needs to be given greater

attention by organisations, professional bodies and trade associations. The responses signify a need for further work to be able to define what skill development is required and where this is best applied in an organisation, market or industry.

At this stage we believe that skill development needs to focus firstly on those areas or organisational functions likely to bring about greatest influence to realise carbon reductions. Secondly it needs to focus on "bottlenecks" to produce a change in thinking and approach. There will be no one solution to this and skill development is a significant issue to address in itself. Finally, we suggest that there needs to be a recognition that skills and training programmes need to evolve to reflect the fact that knowledge and learning will progress with experience. Skill development also needs to be structured and staggered to reflect an individual's and/or organisations position on the learning and knowledge cycle, which again is likely to be dependant on experience gained and organisational priorities and strategy.

The survey also asked organisations "If you could change one area to improve the consideration of carbon in infrastructure projects what would that be?" The majority of responses were themed around improving carbon valuation (traded and non-traded) for use in the framework of broader CBA as well as giving more weight to carbon in the decision-making process.

The UK Government released a revised approach to carbon valuation in UK policy appraisal<sup>3</sup>; however, approximately half the survey responders said they were unaware of the guidance. Circumstantial evidence from the survey is suggesting that an inconsistent approach is being taken to valuing carbon emissions. There is uncertainty in how to reflect the indirect carbon emissions and impacts (that is, other consequential emissions such as those associated with the construction of infrastructure)..

<sup>3</sup> Carbon Valuation in UK Policy Appraisal: A Revised Approach, DECC July 2009

**Key Issue Box 2:**

Survey responses suggest that carbon requirements in contracts are 'very important' for successful carbon management in infrastructure. Developing and applying low carbon thinking skills to infrastructure also appears to be 'important' for realising reductions.

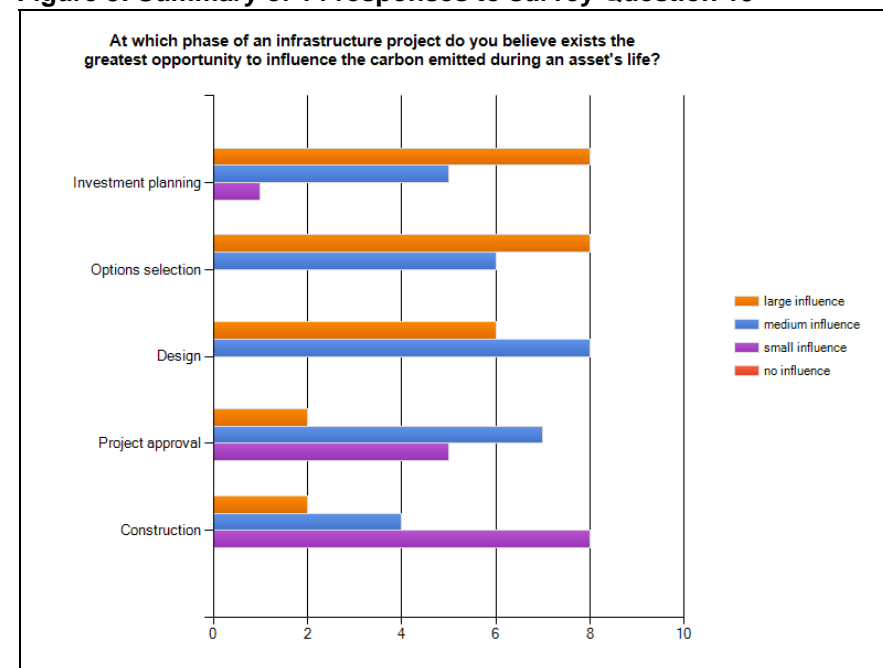
**Opportunities to Influence Carbon**

The survey responses gave insights on where those involved in infrastructure projects see the greatest opportunities to influence the shift to low carbon infrastructure. Figure 5 illustrates that the greatest opportunities to reduce carbon impacts appear to be early on in a project life, during investment planning and options selection. There appears to be a moderate opportunity to influence carbon through design and project approval and a small opportunity to influence carbon in construction.

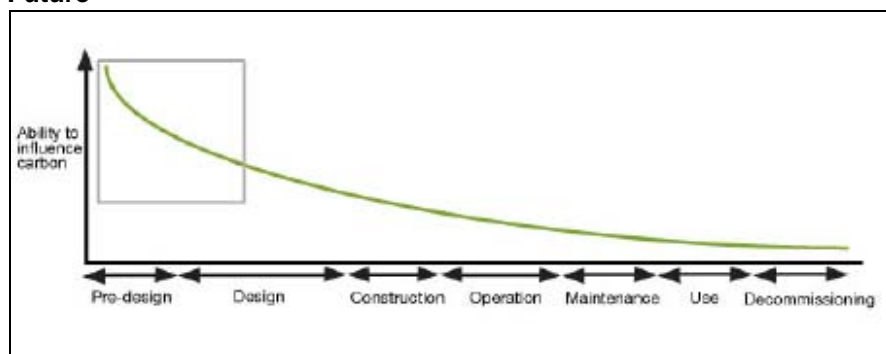
The survey responses reinforce the hypothesis put forward in the Forum for the Future e21c project report Carbon Management Framework for Major Infrastructure Projects, that the ability to influence the carbon impact of a project is likely to follow a similar trend to the cost-curve of a project. Figure 6 indicates that the opportunity to reduce the carbon impact of an asset is probably greatest at the early project stages.

We can infer from these results that the mechanisms for considering carbon at early project stages such as investment policy, planning and decision making and options selection are crucial to realising carbon reductions in new infrastructure. This point suggests that access to capital for infrastructure investment needs to be better tied to carbon planning and reduction and this may be an area which requires greater attention in terms of development of financial policy and planning, portfolio

measurement and management and potentially financial covenants included in agreements as well as financial mechanisms to incentivise carbon reduction.

**Figure 5: Summary of 14 responses to survey Question 19**

**Figure 6: Ability to influence carbon throughout a project. Ref: Carbon Management Framework for Major Projects, Forum for the Future**



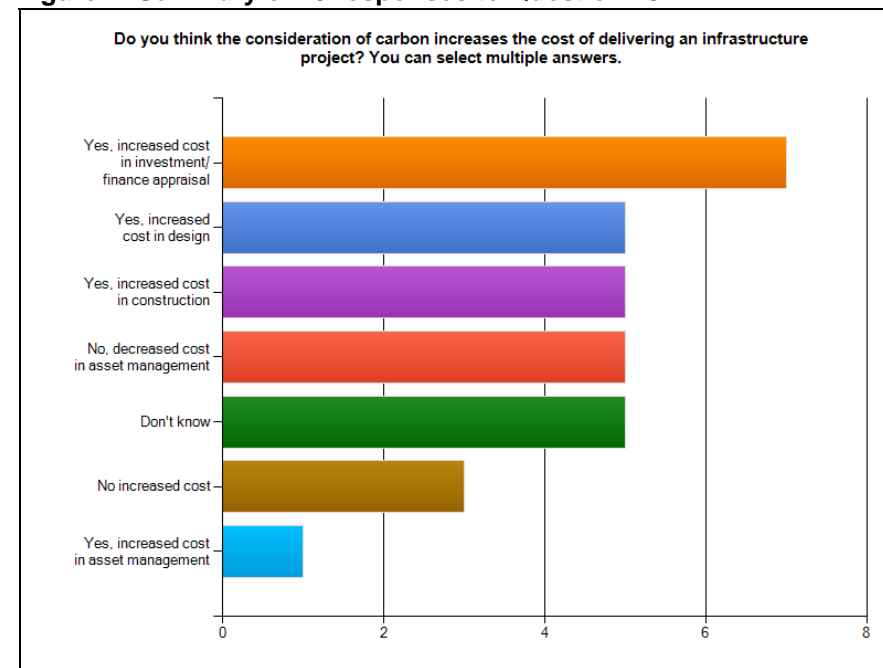
**Key Issue Box 3:**

The greatest opportunities for reducing the carbon impacts of infrastructure projects appears to be at early project stages such as investment planning and options appraisal; therefore, we can infer that the mechanisms for considering carbon at these stages are crucial to realising carbon reductions over the life of an asset.

Business and Economic Impacts

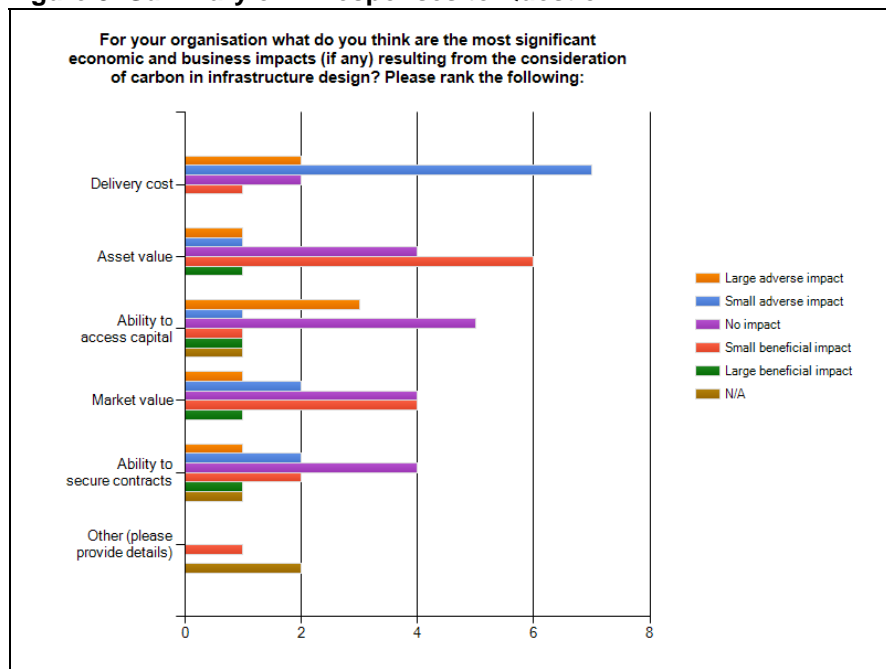
The survey responses are indicating that cost and efficiency has a part to play in driving carbon consideration in infrastructure (see Figure 2). The general premise of responses to question 13 is that carbon management could result in an increased project delivery cost but this may be countered by decreases in construction (due to resource efficiency), asset management and operational costs (see Figure 7). However, most survey participants agreed that the net cost of considering carbon in infrastructure is not yet known and that there is possibly a need to collect cost data from delivered projects in order to establish cost risks/benefits.

**Figure 7: Summary of 13 responses to Question 13**



Question 21 looked to further explore business and economic impacts resulting from the consideration of carbon in infrastructure projects. The responses reinforce those given to question 13; half the consultees believe that there may be a small adverse cost impact from considering carbon in the investment planning, options selection and design stages of project delivery (see Figure 8). The participants in the survey appear to believe that there will either be no impact on asset value or a slight beneficial impact. Interestingly the responses about the impact on ability to access capital do not give a clear message, which perhaps represents the sample size and different levels of knowledge and experience with regards to carbon and capital investment.

**Figure 8: Summary of 14 responses to Question 21**



**Key Issue Box 4:**

Most of those consulted expect that carbon management could result in an increased project delivery cost but this be countered by decreases in construction (due to resource efficiency), asset management and operational costs

### 3. Next steps and further issues for consideration

*A systems approach will promote a more joined-up and connected approach to carbon management and reduction. Skill and knowledge development should be a priority as should be the development and application of standards and benchmarks.*

A number of fundamental issues related to carbon management have been raised by our survey, which requires further consideration and evaluation. These are considered below.

For our survey participants, the main drivers for carbon management appear to be non-regulatory in terms of internal policies and external standards. This issue may present challenges to some organisations and projects in terms of setting appropriate standards and targets which set us on the right path to a low carbon economy, but at the same time are meaningful and informed.

Certainly the organisations consulted see a need for carbon benchmarks to help inform performance measurement and potentially set intelligent or relevant targets in the procurement process and contracts. Participants also see a need for standards which can be used by those designing infrastructure. The development of benchmarks, standards and indeed clauses in contracts will require cross-industry participation from both private and public sector bodies. Further work, in terms of more informed analysis of which standards are required and which will make the most difference may also be valuable, as will further work which sets the scope and parameters for industry benchmarks.

We see benefit in organisations working together to develop standard carbon related clauses in contracts and to share experiences in this area. Having contracts which consistently consider carbon will encourage a “systems” approach to carbon and potentially further encourage the investment of time and funds in the development of people’s skills and standards, by both public bodies and private sector companies.

The survey shows that participants believe carbon skills need enhancing and this may be an area which is holding back carbon management potential on infrastructure projects and in organisations. Skill and knowledge development should be a priority and requires detailed consideration and focus.

Potentially skills councils and organisations need to undertake further analysis to identify specific skill and knowledge gaps and use the findings to inform the development of structured training programmes which have a carbon and industry focus. More widely, further education establishments will have a major role in furthering skills in this area.

Our experience and information from participants suggests that the greatest scope to influence carbon is “upstream” at the early stages of infrastructure development including investment planning and decision making. Potentially further work may be required on how carbon knowledge and thinking can be used to inform investment planning and decision making. This may include setting carbon performance criteria in order to access capital and/or pricing for the carbon externalities associated with infrastructure development as well as potentially carbon related covenants in financial contracts. The latter may be a point which is picked up further and developed in contracts in particular performance management.



# Appendices

## Appendix A: Survey Form



# Transition to a Low Carbon Economy - Carbon Reduction in Infrastructure

## Introduction

\* 1. Thank you in advance for participating in this research and we look forward to sharing the results with you. Should you wish to be removed from the survey and not receive a summary of the key outcomes please tick below as appropriate. As a default you will not be contacted again about the survey if you do not reply.

- Please remove me from the survey
- I am happy to participate in the survey

Note: Only asterisk (\*) questions must be complete to move on in the survey. Other questions may be skipped if they do do apply

Halcrow Group Ltd is undertaking research into how greenhouse gas emissions (referred to as carbon) are considered during planning, investment and design stages of infrastructure projects. The purpose of the research is to identify the key drivers and barriers influencing the consideration of carbon and seek out opportunities to guide and support decisions that are key to realising carbon reductions over the life of an asset.

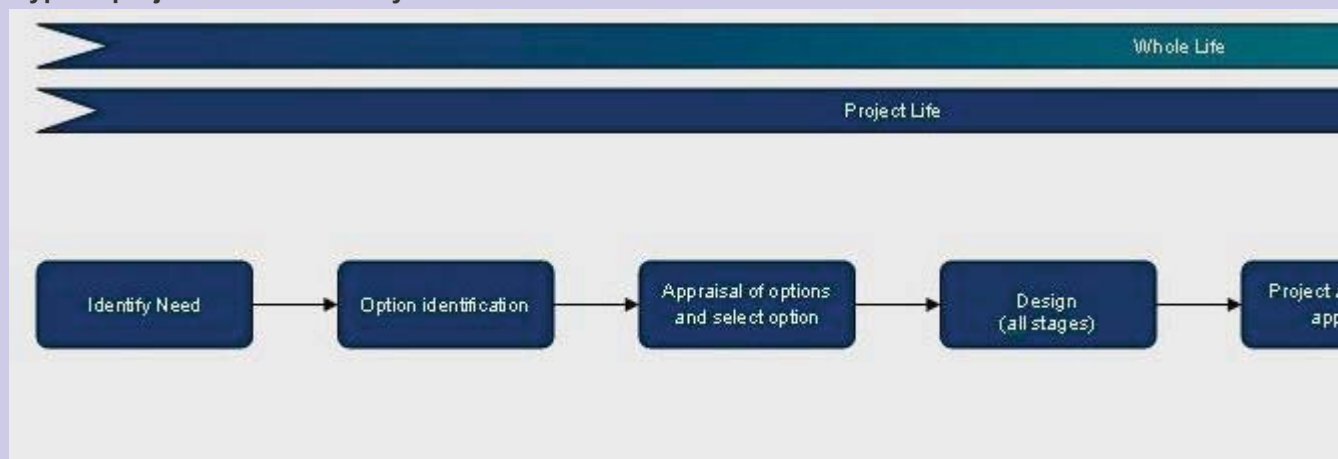
The research focuses on how carbon across the “life” of an asset (that is construction, operation and maintenance, use and finally decommissioning) is considered during the investment planning, options identification and appraisal, design stages and approval of a project (see diagram below for a typical project and asset lifecycle). We intend to use the responses provided to inform a framework to support effective carbon management in infrastructure projects and potentially help inform strategies for carbon reduction.

We would be pleased if you could spend about 15 minutes completing this questionnaire. The results from the survey will be made available on a non attributable basis, to all those who participate in this important research.

Infrastructure for the purposes of consultation means infrastructure associated with transport, water (including waste water), waste treatment and energy generation and transmission.

If you would like to make contact with the Halcrow team then please contact Paul Stephenson (stephensonp@halcrow.com; +44 (0)7595 646654) or Mark Browning (browningm@halcrow.com; +44 (0)7894 491222).

### Typical project and asset lifecycle



## Finished

Thank you, you will not be contacted again regarding the survey.

# Transition to a Low Carbon Economy - Carbon Reduction in Infrastructure

## You and your organisation

This section of the questionnaire aims to gather information on the types of infrastructure and project stages you and your organisation are involved in.

\* 2. Your name

\* 3. Your title, function or department

\* 4. Name of your organisation

\* 5. Contact e-mail address and telephone number. Please complete if you would like a copy of the results, your contact details will only be used in conjunction with this survey.

6. What areas of infrastructure is your organisation involved with? You can select multiple answers.

- |   |   |  |
|---|---|--|
| <input type="checkbox"/> Rail                       | <input type="checkbox"/> Urban water (including water supply and waste water) | <input type="checkbox"/> Energy storage      |
| <input type="checkbox"/> Airports                   | <input type="checkbox"/> River structures                                     | <input type="checkbox"/> Energy transmission |
| <input type="checkbox"/> Highways                   | <input type="checkbox"/> Dams and embankments                                 | <input type="checkbox"/> Waste treatment     |
| <input type="checkbox"/> Shipping (including ports) | <input type="checkbox"/> Energy generation                                    |  |

Other (please specify)

7. What stages of an infrastructure project is your organisation involved with? You can select multiple answers.

- |  |   |   |
|--|---|---|
| <input type="checkbox"/> Investment planning/Finance     | <input type="checkbox"/> Design (all stages)            | <input type="checkbox"/> Asset management |
| <input type="checkbox"/> Options identification          | <input type="checkbox"/> Project appraisal and approval | <input type="checkbox"/> Decommissioning  |
| <input type="checkbox"/> Options appraisal and selection | <input type="checkbox"/> Construction                   |   |

Other (please specify)

## Carbon Drivers and Barriers in Infrastructure Projects

This section of the questionnaire aims to uncover some of the drivers and barriers to considering carbon in infrastructure projects.

**8. What (if any) are the main drivers for your organisation to consider carbon when participating in an infrastructure project? You can select multiple answers.**

- |   |  |   |
|---|--|---|
| <input type="checkbox"/> Regulation   | <input type="checkbox"/> Costs and efficiency                    | <input type="checkbox"/> Other (please state below) |
| <input type="checkbox"/> Contractual requirements   | <input type="checkbox"/> Enhance or maintain the value of assets | <input type="checkbox"/> Don't know                 |
| <input type="checkbox"/> Internal policy/ standards/ guidelines                             | <input type="checkbox"/> Corporate reporting and standards       |   |
| <input type="checkbox"/> External policy/ standards/ guidelines including Government Policy | <input type="checkbox"/> Financial reporting and standards       |   |

Additional information

**9. Do your infrastructure projects have to take account of climate change adaptation (i.e. prepare for a changing climate)?**

- Yes all projects take account of climate change adaptation
- Yes some projects take account of climate change adaptation
- Projects do not take account of climate change adaptation
- Don't know

Additional information

# Transition to a Low Carbon Economy - Carbon Reduction in Infrastructure

**10. Do climate change adaptation issues present barriers or opportunities to considering carbon reductions in projects?**

- Climate change adaptation issues present barriers [please provide additional information]
- Climate change adaptation issues present opportunities [please provide additional information]
- Don't know

Additional information

**11. What do you consider the main barriers/ shortfalls to designing 'low carbon' infrastructure? You can select multiple answers.**

- Lack of overarching policy or scheme objectives
- Lack of tools for considering carbon
- No formal requirement in contracts
- Other (please state below)
- Lack of standards or guidance for designers
- Don't know
- Lack of relevant skills and knowledge within the project
- None of the above (please provide details below)
- No 'joined up' thinking between project participants

Additional information

**12. Are there regulations or planning guidance which inhibit the consideration of carbon emissions when appraising options or designing infrastructure?**

- Yes [please provide details below]
- No
- Don't know

Additional details

## Transition to a Low Carbon Economy - Carbon Reduction in Infrastructure

13. Do you think the consideration of carbon increases the cost of delivering an infrastructure project?

You can select multiple answers.

Yes, increased cost in investment/ finance appraisal

No, decreased cost in asset management

Yes, increased cost in design

No increased cost

Yes, increased cost in construction

Don't know

Yes, increased cost in asset management

Additional information

## How carbon is considered in infrastructure projects

This section of the questionnaire aims to gather information on how carbon is currently considered during the planning and design of infrastructure.

**14. At what stage of an infrastructure projects do you consider carbon? You can select multiple answers.**

- |  |  |
|--|--|
| <input type="checkbox"/> Investment planning | <input type="checkbox"/> Design (all stages) |
| <input type="checkbox"/> Options selection   | <input type="checkbox"/> Project approval    |
| <input type="checkbox"/> None of the above   |  |

**15. If carbon is considered, which phases of the asset lifecycle are included? You can select multiple answers.**

- |   |  |
|---|--|
| <input type="checkbox"/> Construction                           | <input type="checkbox"/> Decommissioning   |
| <input type="checkbox"/> Maintenance                            | <input type="checkbox"/> Whole life        |
| <input type="checkbox"/> Operation                              | <input type="checkbox"/> Don't know        |
| <input type="checkbox"/> Use (includes transport network users) | <input type="checkbox"/> None of the above |

Additional information

**16. Which 'carbon calculator' tools do you use to support the consideration of carbon in infrastructure projects?**

- Rely on advisors to use the appropriate tools
- Use our own in-house tools
- Use 'off the shelf' tools [Please provide further details]
- Don't know

Additional information

## Transition to a Low Carbon Economy - Carbon Reduction in Infrastructure

17. Do you think carbon prices should be applied in project appraisal to monetise carbon?

- Yes, and we are doing it already
- Yes, but we are not currently doing it
- No
- Don't know

Additional information

18. Are you aware of the latest UK guidance on valuing carbon published by the Department of Energy and Climate Change (DECC) in July 2009? The DECC recommends carbon prices to be used in appraisals for the traded and non-traded sector up to 2050. Where UK guidance is not relevant is there any other guidance you follow developed by public or private bodies [provide details in Additional information]?

- Yes, but we don't use it
- Yes, and we're using it
- No, but we would like more information on it

Additional information

## Opportunities for influencing carbon in infrastructure projects

This section of the questionnaire aims to reveal the opportunities that exist during an infrastructure project for influencing the carbon emitted across the life of an asset.

**19. At which phase of an infrastructure project do you believe exists the greatest opportunity to influence the carbon emitted during an asset's life?**

	large influence	medium influence	small influence	no influence
Investment planning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Options selection	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Design	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Project approval	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Construction	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**20. What do you see as the main success factors leading to the systematic consideration of carbon in infrastructure projects?**

	very important	important	not important
Regulation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Financial conditions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Overarching policy or scheme objectives	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Requirements in contracts and design briefs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Standards or guidance for designers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Education/ training/ skill development	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Additional tools	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Carbon benchmarks to measure performance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (please specify)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Additional information

# Transition to a Low Carbon Economy - Carbon Reduction in Infrastructure

21. For your organisation what do you think are the most significant economic and business impacts (if any) resulting from the consideration of carbon in infrastructure design? Please rank the following:

	Large adverse impact	Small adverse impact	No impact	Small beneficial impact	Large beneficial impact	N/A
Delivery cost	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Asset value	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ability to access capital	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Market value	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ability to secure contracts	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (please provide details)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Additional information

22. If you could change one area to improve the consideration of carbon in infrastructure projects what would that be? Do you have any final comments on the consideration of carbon in infrastructure development?

## Finished

You have now completed the questionnaire. Many thanks for your participation, if you provided contact details we will inform you of the results once this research and consultation exercise are complete. In the meantime if you would like to make contact with any of the core Halcrow team then please contact Paul Stephenson (stephensonp@halcrow.com; +44(0)7595 646654) or Mark Browning (browningm@halcrow.com; +44(0)7894 491222).

## Appendix B: Survey Results



# Transition to a Low Carbon Economy - Carbon SurveyMonkey Reduction in Infrastructure

1. Thank you in advance for participating in this research and we look forward to sharing the results with you. Should you wish to be removed from the survey and not receive a summary of the key outcomes please tick below as appropriate. As a default you will not be contacted again about the survey if you do not reply.

	Response Percent	Response Count
Please remove me from the survey	0.0%	0
I am happy to participate in the survey	100.0%	15
<b>answered question</b>		<b>15</b>
<b>skipped question</b>		<b>0</b>

## 2. Your name

	Response Count
	15
<b>answered question</b>	<b>15</b>
<b>skipped question</b>	<b>0</b>

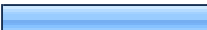
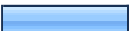
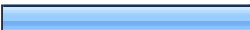




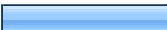



## 3. Your title, function or department

	Response Count
	15
<b>answered question</b>	<b>15</b>
<b>skipped question</b>	<b>0</b>

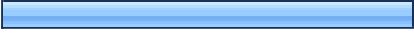
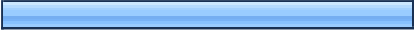







<b>4. Name of your organisation</b>	
	<b>Response Count</b>
	15
<b>answered question</b>	<b>15</b>
<b>skipped question</b>	<b>0</b>

<b>5. Contact e-mail address and telephone number. Please complete if you would like a copy of the results, your contact details will only be used in conjunction with this survey.</b>	
	<b>Response Count</b>
	15
<b>answered question</b>	<b>15</b>
<b>skipped question</b>	<b>0</b>




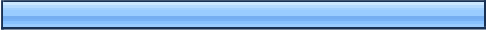
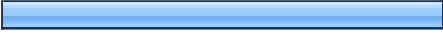




**6. What areas of infrastructure is your organisation involved with? You can select multiple answers.**




		Response Percent	Response Count
Rail		33.3%	5
Airports		20.0%	3
<b>Highways</b>		<b>40.0%</b>	<b>6</b>
Shipping (including ports)		20.0%	3
Urban water (including water supply and waste water)		33.3%	5
River structures		13.3%	2
Dams and embankments		13.3%	2
Energy generation		26.7%	4
Energy storage		0.0%	0
Energy transmission		26.7%	4
Waste treatment		13.3%	2
Other (please specify)		13.3%	2
<b>answered question</b>			<b>15</b>
<b>skipped question</b>			<b>0</b>




**7. What stages of an infrastructure project is your organisation involved with? You can select multiple answers.**

		Response Percent	Response Count
Investment planning/Finance		66.7%	10
Options identification		66.7%	10
Options appraisal and selection		60.0%	9
Design (all stages)		53.3%	8
Project appraisal and approval		60.0%	9
Construction		53.3%	8
Asset management		60.0%	9
Decommissioning		40.0%	6
Other (please specify)		20.0%	3
		<b>answered question</b>	<b>15</b>
		<b>skipped question</b>	<b>0</b>








**8. What (if any) are the main drivers for your organisation to consider carbon when participating in an infrastructure project? You can select multiple answers.**


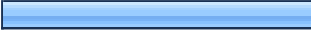

		Response Percent	Response Count
Regulation		64.3%	9
Contractual requirements		7.1%	1
<b>Internal policy/ standards/ guidelines</b>		<b>78.6%</b>	<b>11</b>
<b>External policy/ standards/ guidelines including Government Policy</b>		<b>78.6%</b>	<b>11</b>
Costs and efficiency		71.4%	10
Enhance or maintain the value of assets		14.3%	2
Corporate reporting and standards		35.7%	5
Financial reporting and standards		7.1%	1
Other (please state below)		14.3%	2
Don't know		0.0%	0
	Additional information		5
	<b>answered question</b>		<b>14</b>
	<b>skipped question</b>		<b>1</b>


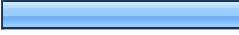



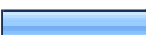

9. Do your infrastructure projects have to take account of climate change adaptation (i.e. prepare for a changing climate)?			
		Response Percent	Response Count
Yes all projects take account of climate change adaptation		28.6%	4
<b>Yes some projects take account of climate change adaptation</b>		<b>57.1%</b>	<b>8</b>
Projects do not take account of climate change adaptation		14.3%	2
Don't know		0.0%	0
	Additional information		5
	<b>answered question</b>		<b>14</b>
	<b>skipped question</b>		<b>1</b>

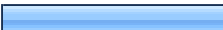
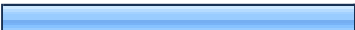



10. Do climate change adaptation issues present barriers or opportunities to considering carbon reductions in projects?			
		Response Percent	Response Count
Climate change adaptation issues present barriers [please provide additional information]		23.1%	3
Climate change adaptation issues present opportunities [please provide additional information]		30.8%	4
<b>Don't know</b>		<b>46.2%</b>	<b>6</b>
	Additional information		9
	<b>answered question</b>		<b>13</b>
	<b>skipped question</b>		<b>2</b>







**11. What do you consider the main barriers/ shortfalls to designing 'low carbon' infrastructure? You can select multiple answers.**





		<b>Response Percent</b>	<b>Response Count</b>
Lack of overarching policy or scheme objectives		53.8%	7
<b>No formal requirement in contracts</b>		<b>61.5%</b>	<b>8</b>
<b>Lack of standards or guidance for designers</b>		<b>61.5%</b>	<b>8</b>
Lack of relevant skills and knowledge within the project		53.8%	7
No 'joined up' thinking between project participants		38.5%	5
Lack of tools for considering carbon		30.8%	4
Other (please state below)		23.1%	3
Don't know		0.0%	0
None of the above (please provide details below)		0.0%	0
	Additional information		9
<b>answered question</b>			<b>13</b>
<b>skipped question</b>			<b>2</b>





12. Are there regulations or planning guidance which inhibit the consideration of carbon emissions when appraising options or designing infrastructure?			
		Response Percent	Response Count
Yes [please provide details below]		14.3%	2
No		50.0%	7
Don't know		35.7%	5
	Additional details		3
	<b>answered question</b>		<b>14</b>
	<b>skipped question</b>		<b>1</b>

13. Do you think the consideration of carbon increases the cost of delivering an infrastructure project? You can select multiple answers.			
		Response Percent	Response Count
Yes, increased cost in investment/ finance appraisal		53.8%	7
Yes, increased cost in design		38.5%	5
Yes, increased cost in construction		38.5%	5
Yes, increased cost in asset management		7.7%	1
No, decreased cost in asset management		38.5%	5
No increased cost		23.1%	3
Don't know		38.5%	5
	Additional information		9
	<b>answered question</b>		<b>13</b>
	<b>skipped question</b>		<b>2</b>




14. At what stage of an infrastructure projects do you consider carbon? You can select multiple answers.			
		Response Percent	Response Count
Investment planning		35.7%	5
<b>Options selection</b>		<b>57.1%</b>	<b>8</b>
None of the above		14.3%	2
Design (all stages)		42.9%	6
Project approval		35.7%	5
<b>answered question</b>			<b>14</b>
<b>skipped question</b>			<b>1</b>

15. If carbon is considered, which phases of the asset lifecycle are included? You can select multiple answers.			
		Response Percent	Response Count
Construction		57.1%	8
Maintenance		35.7%	5
<b>Operation</b>		<b>64.3%</b>	<b>9</b>
Use (includes transport network users)		35.7%	5
Decommissioning		7.1%	1
Whole life		7.1%	1
Don't know		0.0%	0
None of the above		0.0%	0
Additional information			4
<b>answered question</b>			<b>14</b>
<b>skipped question</b>			<b>1</b>

16. Which 'carbon calculator' tools do you use to support the consideration of carbon in infrastructure projects?			
		Response Percent	Response Count
Rely on advisors to use the appropriate tools		15.4%	2
<b>Use our own in-house tools</b>		<b>46.2%</b>	<b>6</b>
Use 'off the shelf' tools [Please provide further details]		7.7%	1
Don't know		30.8%	4
	Additional information		5
	<b>answered question</b>		<b>13</b>
	<b>skipped question</b>		<b>2</b>

17. Do you think carbon prices should be applied in project appraisal to monetise carbon?			
		Response Percent	Response Count
<b>Yes, and we are doing it already</b>		<b>57.1%</b>	<b>8</b>
Yes, but we are not currently doing it		28.6%	4
No		7.1%	1
Don't know		7.1%	1
	Additional information		6
	<b>answered question</b>		<b>14</b>
	<b>skipped question</b>		<b>1</b>

18. Are you aware of the latest UK guidance on valuing carbon published by the Department of Energy and Climate Change (DECC) in July 2009? The DECC recommends carbon prices to be used in appraisals for the traded and non-traded sector up to 2050. Where UK guidance is not relevant is there any other guidance you follow developed by public or private bodies [provide details in Additional information]?

		Response Percent	Response Count
Yes, but we don't use it		14.3%	2
Yes, and we're using it		42.9%	6
No, but we would like more information on it		42.9%	6
Additional information			4
answered question			14
skipped question			1

19. At which phase of an infrastructure project do you believe exists the greatest opportunity to influence the carbon emitted during an asset's life?

	large influence	medium influence	small influence	no influence	Rating Average	Response Count
Investment planning	<b>57.1% (8)</b>	35.7% (5)	7.1% (1)	0.0% (0)	1.50	14
Options selection	<b>57.1% (8)</b>	42.9% (6)	0.0% (0)	0.0% (0)	1.43	14
Design	42.9% (6)	<b>57.1% (8)</b>	0.0% (0)	0.0% (0)	1.57	14
Project approval	14.3% (2)	<b>50.0% (7)</b>	35.7% (5)	0.0% (0)	2.21	14
Construction	14.3% (2)	28.6% (4)	<b>57.1% (8)</b>	0.0% (0)	2.43	14
answered question						14
skipped question						1

**20. What do you see as the main success factors leading to the systematic consideration of carbon in infrastructure projects?**

	very important	important	not important	Rating Average	Response Count
Regulation	<b>57.1% (8)</b>	35.7% (5)	7.1% (1)	1.43	14
Financial conditions	35.7% (5)	<b>57.1% (8)</b>	7.1% (1)	1.21	14
Overarching policy or scheme objectives	<b>71.4% (10)</b>	28.6% (4)	0.0% (0)	1.71	14
Requirements in contracts and design briefs	<b>78.6% (11)</b>	21.4% (3)	0.0% (0)	1.79	14
Standards or guidance for designers	35.7% (5)	<b>57.1% (8)</b>	7.1% (1)	1.21	14
Education/ training/ skill development	7.1% (1)	<b>92.9% (13)</b>	0.0% (0)	1.07	14
Additional tools	0.0% (0)	<b>53.8% (7)</b>	46.2% (6)	0.08	13
Carbon benchmarks to measure performance	14.3% (2)	<b>78.6% (11)</b>	7.1% (1)	1.00	14
Other (please specify)	<b>100.0% (2)</b>	0.0% (0)	0.0% (0)	2.00	2
Additional information					2
<b>answered question</b>					<b>14</b>
<b>skipped question</b>					<b>1</b>

**21. For your organisation what do you think are the most significant economic and business impacts (if any) resulting from the consideration of carbon in infrastructure design? Please rank the following:**

	Large adverse impact	Small adverse impact	No impact	Small beneficial impact	Large beneficial impact	N/A	Rating Average	Response Count
Delivery cost	16.7% (2)	<b>58.3% (7)</b>	16.7% (2)	8.3% (1)	0.0% (0)	0.0% (0)	2.17	
Asset value	7.7% (1)	7.7% (1)	30.8% (4)	<b>46.2% (6)</b>	7.7% (1)	0.0% (0)	3.38	
Ability to access capital	25.0% (3)	8.3% (1)	<b>41.7% (5)</b>	8.3% (1)	8.3% (1)	8.3% (1)	2.64	
Market value	8.3% (1)	16.7% (2)	<b>33.3% (4)</b>	<b>33.3% (4)</b>	8.3% (1)	0.0% (0)	3.17	
Ability to secure contracts	9.1% (1)	18.2% (2)	<b>36.4% (4)</b>	18.2% (2)	9.1% (1)	9.1% (1)	3.00	
Other (please provide details)	0.0% (0)	0.0% (0)	0.0% (0)	33.3% (1)	0.0% (0)	<b>66.7% (2)</b>	4.00	
Additional information								
<b>answered question</b>								
<b>skipped question</b>								

**22. If you could change one area to improve the consideration of carbon in infrastructure projects what would that be? Do you have any final comments on the consideration of carbon in infrastructure development?**

	Response Count
	9
<b>answered question</b>	<b>9</b>
<b>skipped question</b>	<b>6</b>

## Appendix C: Draft carbon management framework for infrastructure

We believe that carbon management is increasingly becoming a part of infrastructure management at some level but this may not be undertaken systematically. The challenge for some organisations might be to make the consideration of carbon systematic in both organisational and project planning and to develop systems to support a whole life approach to carbon management. This will require greater profile and consideration being given to carbon, especially early on in investment planning and decision-making. A “systems” approach will promote a more joined-up and connected approach to carbon management and reduction and avoid a piece-meal or disjointed approaches which are more likely to occur if a non-systems approach is taken.

We believe existing carbon management practices in infrastructure management lie somewhere on the spectrum set out in the draft carbon management framework detailed in Table C1.

Table 1 shows four levels which vary at the extreme from “At Risk” to “Leading Edge”. We recognise that organisations may not be at the same level across all areas. At risk, indicates that organisations and/or projects are at risk of regulatory non compliance, failure to follow industry standards and good practice and may also be at risk of not attracting contracts or investment/capital. Standards related to carbon management are continually improving and what may currently be viewed as “Forward Thinking” will become classed as “Compliant” with time.

Each area (or cell) of the table shows expected management practices at that level. It is intended to present a generic indication of expected standards and practices at different levels. It is recognised that it does not show every issue and the intention is that users can build from the text shown to develop a framework which is potentially more specific to their organisational needs as well as identify gaps, areas of priority and requiring greater development.

For each area, expected Strategic (**St**) and Operational (**Op**) standards are shown. The Strategic aspects principally relate to the high level position taken by an organisation to consider and manage down carbon. Operational aspects include steps taken to implement or apply policy to projects and programmes.

Organisational policies do not necessarily have to explicitly name carbon but an organisations policies and guidance should give appropriate profile to these issues, so that they are considered in all relevant organisational decision making. It is the strategic aspects which drive operational responses and operational practices and experiences , which should then be used to inform strategy. Both areas support the “systems” approach to carbon management we refer to.

The intention of Table C1 is to allow those involved in the management of infrastructure to identify their current position as well as the changes required to move forward with carbon management.



**Table C1: Draft Carbon Management Framework for the consideration of carbon in infrastructure (levels shown have been devised and reproduced by Halcrow Group Ltd)**

	Creating conditions for action	Ownership and responsibilities	Procurement & contracts	Finance and Investment	Supply chain engagement	Measurement and reporting
<b>No carbon management in infrastructure projects</b>						
<p><b>Level 1</b></p> <p><b>At Risk</b></p>	<p>Strategic (St): No formal adopted policy /position on carbon or programme setting out priorities.</p> <p>Operational (Op): Carbon not seen as an issue by project delivery team or carbon issues dealt with on ad-hoc basis if at all. Carbon does not feature in the scheme objectives. Little awareness of regulatory carbon requirements or industry standards</p>	<p>St: No dedicated resource with responsibility for carbon. Management systems do not support carbon management.</p> <p>Op: No recognised carbon management responsibility within the project team or systems developed to deliver scheme.</p>	<p>St. No consideration of carbon in existing procurement policy and supporting guidance implementing policy.</p> <p>Op: No contractual requirements for carbon management, measurement or reporting by project team and associated project partners.</p>	<p>St: No understanding of the financial cost of carbon from a regulatory, contractual standpoint.</p> <p>Op: Carbon not included in the investment decision making process and financial appraisal and supporting systems.</p>	<p>St: Procurement policy and guidance does not recognise or support engagement with suppliers on managing carbon.</p> <p>Op: No engagement with contractors/suppliers on management of carbon in the value chain.</p>	<p>St: No organisational policy to measure and report carbon impacts.</p> <p>Op: No determination or reporting of carbon at any of the key decision points during planning, design, build and operation of infrastructure.</p>
<p><b>Level 2</b></p> <p><b>Compliant with requirements</b></p>	<p>St: Organisation has a commitment to consider environmental impacts and to comply. Systems are in place to track and act on current and pending legislation related to carbon.</p> <p>Op: Carbon is considered on projects where stipulated by regulation and project requirements. No substantive track record in considering carbon.</p>	<p>St: There are formal lines of responsibility to manage carbon largely associated with direct emissions/impacts.</p> <p>Op: The project team has basic knowledge of carbon and understands relevance to the project/scheme. The design team may consider operational carbon emissions in the context of regulatory requirements/industry standards.</p>	<p>St: Some consideration of carbon in contracts but this is not systematic and/or no strategic analysis of spend/ planned programmes to identify priority areas to manage down carbon.</p> <p>Op: Contracts related to projects include general sustainability criteria. Minimal application of these in terms of selection of contractors.</p>	<p>St: Cost of operational emissions and energy consumption taken into account if a regulatory or contractual requirement.</p> <p>Op: Existing systems monitor and measure cost of carbon compliance.</p> <p>There is no dedicated programme to fund low carbon innovation.</p>	<p>St: Procurement makes commitments to environmental and sustainability criteria. Some/generic engagement with supply chain but this is not informed by analysis of procurement strategy. No long term programme developed to identify or “map” high carbon impacts along the supply or value chain.</p> <p>Op: Systems to support project delivery implicitly address carbon where this is a regulatory or contractual requirement.</p>	<p>St: Carbon measurement and reporting is in line with corporate policy, and regulatory requirements.</p> <p>Op: Normal focus is on direct emissions and electricity use from the operation of the asset.</p>
<p><b>Level 3</b></p> <p><b>Forward thinking</b></p>	<p>St: Strategically the organisation has a detailed corporate sustainability strategy containing a clear vision on carbon and commitments to reduction. The importance of considering whole life carbon at key decision points is acknowledged.</p> <p>Op: Clear mandate and “organisational” culture to consider carbon on projects. Policies and systems support this aspiration. Carbon aspirations shared by project partners. Carbon considered and planned for across the life of asset.</p>	<p>St: Resources and line of responsibility to manage carbon both associated with direct and indirect impacts. Integration of carbon into appropriate management systems. Recognition that consideration of carbon across the life of assets requires multidisciplinary and multi-departmental approaches from across the organisation.</p> <p>Op: Dedicated and focused resources to manage down carbon on project in line with project specific targets to reduce carbon and captured data on carbon performance to inform future planning and target setting.</p>	<p>St: Recognition that carbon performance is integral to award of contracts on the basis of value for money and quality.</p> <p>Op: Carbon measurement and reporting requirements are introduced into project contracts. There may be trialling of tender questions and assessment criteria together with the development of model clauses for procurement contracts and design briefs.</p>	<p>St: A commercial appreciation of the current and future financial risk s associated with carbon by both operational and financial teams at organisation. Risks associated with carbon (and climate change) recognised in organisational risk register.</p> <p>Some strategic review and analysis to measure the “hidden” costs of carbon. May be some pricing of services/contracts to reflect carbon risks and impacts or initial trials to evaluate the potential to do this.</p> <p>Op: Ongoing carbon emissions associated with operating the asset are considered in the investment decision process. Carbon maybe monetised using DECC’s traded and non traded prices for use in Cost Benefit Analysis. Ad hoc but targeted financing is given to stimulate low carbon innovation across the value chain.</p>	<p>St: Strategic analysis of value/supply chain to evaluate and understand carbon impacts and “high” carbon risk items. Information from analysis used to inform procurement policy and supporting procurement guidance. Strategic plan to manage down carbon impacts associated with high risk items.</p> <p>Op: Key suppliers are targeted for engagement to identify and address ‘carbon risks’ on projects. There is dissemination of basic sustainability knowledge amongst the project team. Carbon management requirements are clearly communicated to project delivery team and supply chain. Training may be undertaken to assist suppliers with measurement and reporting requirements.</p>	<p>St: Strategically carbon is integral to reporting to senior management/board either as a standalone KPI or as part of reporting other metrics. Commitment to adopt appropriate industry and international reporting standards such as GHG Protocol Corporate Standard, Defra Guidance on Measuring and Reporting Emissions.</p> <p>Long term commitment to monitor and report on carbon so as to inform ‘whole life’ low carbon programme.</p> <p>Op: Consideration is given to the measurement and reporting of other consequential emissions including those associated with construction, maintenance and use. Whole life carbon analysis is trialled on projects with a view to informing future design decisions.</p>

	Creating conditions for action	Ownership and responsibility	Procurement & contracts	Finance and Investment	Supply chain engagement	Measurement and reporting
<p><b>Level 4</b></p> <p><b>Leading edge</b></p>	<p>St: The organisation has established systems in place to identify and manage down carbon in all relevant aspects of its organisational and business planning. Commitment to carbon management is acknowledged and detailed in the corporations' business strategy.</p> <p>Op: Whole life carbon<sup>4</sup> is a key consideration and constraint in the project option selection and design process. Criteria are developed to score or analyse different options. Scheme delivery is aligned to scheme objectives and an overarching sustainability strategy that contains clear whole life carbon reduction targets. The project team is involved in managing carbon through knowledge of low carbon developments in other infrastructure networks.</p>	<p>St: Systems clearly define roles and responsibility to address carbon. Carbon metrics integrated into organisational performance metrics and people development programmes.</p> <p>Op: Performance of projects are measured and audited against whole life carbon reduction targets set in design briefs and contracts. All delivery partners and the wider supply chain have responsibility for actively contributing to the delivery of low carbon infrastructure.</p>	<p>St: Track record of carbon/sustainability being core to informing the organisations procurement strategy. Organisation seen as a leader in low carbon development and uses this to differentiate its elf from similar organisations.</p> <p>Op: Whole life carbon reduction, measurement and reporting requirements are within design/ construction brief, pre-qualification questions, employers' requirements and procurement contracts. Performance Indicators have been agreed with suppliers and barriers to sustainable procurement are recognised with a long term commitment to remove these.</p>	<p>St: Comprehensive understanding of short and long term risks associated with carbon. Analysis undertaken to value these risks and measures taken to remove or mitigate key carbon risks and liabilities. Carbon considered in strategic financial planning and investment decision making. Analysis used to inform other core business functions such as procurement, measurement and reporting and contingency planning.</p> <p>Op: Cost benefit analysis, whole life costing and value for money is revised to include whole life carbon and account for all externalities through the life-time. Approval of funding is dependent on the scheme meeting carbon criteria. Low carbon solutions are incentivised through of finance. Low carbon innovation is proactively funded and analysis has been undertaken on where and how to intervene along value chain to bring about material reduction in carbon emissions.</p>	<p>St: High carbon impact activities/items associated with supply or value chain are "mapped" and known. A programme to engage with supply chain is in place and adopted by senior management /board at the organisation as well as senior management at partner organisations. Quick wins are known and may have already been realised. Carbon integral to value judgements made on supplier selection and engagement.</p> <p>Op: Carbon is a key agenda item for project briefings and meetings. Whole life carbon reduction is integral to the culture of the project team with training /specialist support provided where required. There is a two way communication between scheme promoter and supply chain and best practice is disseminated.</p>	<p>St: Organisation has a track record associated with reporting on carbon and measures taken to manage risks and opportunities. Organisation follows good and best practice associated with organisational reporting in this area such as GHG Protocol Corporate Standard, Defra Guidance on Measuring and Reporting Emissions.</p> <p>Reporting systems developed with strategic partners to capture and monitor carbon data associated with direct and indirect carbon emissions. Data used to inform whole life carbon and cost impacts associated with management of infrastructure. Results used to inform and innovate low carbon design.</p> <p>Regular audits of organisational systems and controls in place to capture and report carbon data.</p> <p>Op: Whole life carbon is systematically and consistently estimated (using standard models) and reported at all key decision points including: appraisal of options, design, project approval and funding approval. Asset construction, operation, maintenance and user data is gathered from operational assets to inform future whole life carbon estimates.</p>
<b>Leading edge carbon management in infrastructure projects</b>						

<sup>4</sup> Whole life carbon in this context refers to a life-cycle approach that accounts for all consequential emissions over the life-time of an asset, including: construction, operation, maintenance and decommissioning

## Appendix D: Background on regulatory and non regulatory drivers for considering carbon in infrastructure

The following text provides an overview of the main regulatory drivers and UK Government policy relevant to carbon management. The latter parts of this appendix also provide industry specific initiatives, policy and guidance.

### Setting the scene – regulatory drivers

**International perspective.** At an international level the main treaty introduced with the aim to reduce carbon is the Kyoto protocol, which introduced the requirements for countries like the UK to set up systems to quantify and report on carbon emissions. It also introduced carbon mechanisms, such as international emissions trading (see EU ETS) and also “flexible mechanisms” such as the Clean Development Mechanism and Joint Implementation programme, the last two being mechanisms to reduce and potentially trade carbon allowances on projects in certain geographical areas.

**UK perspective.** A number of regulatory and fiscal instruments have been introduced in the UK over the past 15 years with the primary aim of reducing direct carbon emissions. The most prominent regulations have been the Climate Change Levy (CCL), the EU Emissions Trading Scheme, and the Carbon Reduction Commitment (CRC) Energy Efficiency Scheme.

All these apply to organisations depending on their operational energy consumption level and market sector. Further details on each of these are provided below.

The **Climate Change Levy (CCL)** was introduced in April 2001; it is a tax on energy delivered to non domestic users in the UK. The aim of the CCL is to provide an incentive to increase energy efficiency and reduce carbon emissions. The tax largely applies to energy intensive industries. It does not apply to domestic users and the transport sector. Electricity generated from new renewables and approved co-generation schemes is not taxed.

The **EU Emissions Trading Scheme (EU ETS)** is a Europe Union wide cap and trade market mechanism which sets an overall cap on the total direct emissions from all the installations covered by the scheme. This is converted to allowances which are then distributed by EU member states to installations. At the end of each year installations are required to surrender allowances to account for their actual emissions. They may use all or part of their allocation but to emit more than their allocation they must buy allowances from the market. Of most relevance to infrastructure projects is the inclusion of energy combustion activities over 20MW thermal input within the scheme.

**CRC Energy Efficiency Scheme (CRC)** is a mandatory UK scheme which aims to improve energy efficiency and reduce carbon emissions. This became law in April 2010. Similar to the EU ETS, participating organisations will have to monitor their emissions due to electricity and gas consumption and purchase allowances for each resulting tonne of carbon that is emitted.



All the money raised through allowances will be recycled back to participants, according to how well they perform. The overall emissions reduction achieved by the scheme will be determined by the emissions 'cap' on the total allowances available to participants. CRC will include public and private sector organisations with an half-hourly electricity consumption over 6,000 MWhr, excluding transport and domestic accommodation. Participants from organisational sectors with responsibility for management of infrastructure are likely to include water companies, local authorities, transport operators such as train companies and government agencies.

Whilst statutory requirements to participate in the EU ETS and the CRC Energy Efficiency Scheme are bringing direct (GHG protocol scope 1)<sup>5</sup> and indirect (GHG protocol scope 2) operational carbon emissions into consideration for certain infrastructure, there are currently no statutory instruments to encourage the consideration of other consequential emissions (such as those associated with investment planning and accessing capital, construction, maintenance, use and decommission) during planning and design of new infrastructure.

The UK's transition to a low carbon economy is underpinned by the **Climate Change Act**, which became law in 2008 (which also formally introduced the CRC above). The Act sets a legally binding target for UK Government of at least an 80% reduction in GHG emissions by 2050 and at least a 34% reduction by 2020. The Act also sets a carbon budgeting system which caps emissions over five-year periods in order to help the UK stay on "track" for our 2050 target. The UK is currently the only country that has introduced a long-term legally binding framework to tackle climate change.

#### Low carbon transition planning

The UK Government reported its proposals and policies to meet its carbon budgets in the **UK Low Carbon Transition Plan** released in July 2009. This includes, amongst others, plans for our energy, transport and waste sectors. The Government is piloting a new approach in which delivery departments will have a carbon budget allocation in respect of the areas of the economy they have policy influence over. Each department has to produce a carbon budget showing how savings will be made.

Also in July 2009, the Department of Energy and Climate Change (DECC) released **Carbon Valuation in UK Policy Appraisal: A Revised Approach**. The new approach moves away from a valuation based on the damages associated with climate change; instead it refers to the cost of mitigating emissions consistent with the UK's short and long-term targets. The values are to be used in Government policy appraisal and evaluation, in accordance with HM Treasury's Green Book<sup>6</sup>. This includes '*investment in infrastructure and projects that are relatively carbon-intensive, including certain investments in the power and transport sector, and investment in low carbon infrastructure that serve to displace or defer higher intensity investments. These could include certain investments in the power and transport sectors*'.

<sup>5</sup> Refers to emission scopes as defined by The Greenhouse Gas Protocol Corporate Accounting and Reporting Standard

<sup>6</sup> HM Treasury Green Book guidance for Central Government on the appraisal and evaluation of policies, programmes and projects.



Government departments have taken the first step along the transition path by making carbon reduction part of their overarching aims and objectives. The **Department for Transport** (DfT) has a strategic objective 'to *reduce transport's emissions of carbon dioxide and other greenhouse gases, with the desired outcome of avoiding dangerous climate change*'. One of the **Department of Energy and Climate Change's** (DECC) top priorities is to '*deliver secure energy on the way to a low carbon future*' and one of the **Department for Environment Food and Rural Affairs'** (defra) priorities is to '*support a strong and sustainable green economy, resilient to climate change*'.

There are emerging policies, standards and guidelines to support the aims and objectives, which suggest we are moving further down the path of carbon management in infrastructure. DfT's Draft **Transport Analysis Guidance** (TAG)<sup>7</sup> (which is used to appraise transport studies against the governments objectives for transport) focuses on emissions resulting from the fuel and energy consumed by the users of the transport infrastructure, however it notes that '*in principle, this assessment should consider all greenhouse gas emissions, including those resulting from the production of materials used in infrastructure ...*' but '*at this stage, no assessment of these emissions is required. However, given the potential significance of these emissions in some cases, accounting for these emissions will be considered for future editions of TAG*'.

The Office of the Gas and Electricity Markets (**Ofgem**), which regulates the companies that run gas and electricity networks has secondary duties relating to the environment and sustainable development. Ofgem considers gas and electricity license applications and decides whether or not to grant a license in accordance with published objectives. Ofgem's first priority is to protect consumers; however other priorities include '*contributing to the drive to curb climate change*'. It plans to facilitate the development of lower carbon technologies through the industry rules for competitive markets.

**Ofwat** (The Water Services Regulation Authority) is the economic regulator of the water and waste water sectors and ensures water companies provide a good quality of service as well as meet the social and environmental challenges of the future. **Ofwat's climate change policy statement** notes that the '*sectors' operational activities are directly responsible for about 1% of the UK's GHG emissions. On top of this, there is also embedded carbon associated with constructing water industry assets. The sectors' supply chain also contributes to the overall footprint. Also heating the water in consumers' properties produces up to seven times more electricity than supplying and removing the water*'.

There are currently no statutory obligations on water companies<sup>8</sup> to reduce their GHG emissions; however Ofwat expect water companies to measure and report operational carbon emissions. In addition, Ofwat requested the inclusion of embodied and operational carbon in the cost benefit analysis (CBA) methodology as part of their PR09 price review process. UK Water Industry Research Limited (UKWIR) published guidance in 2008 titled **Carbon Accounting in the UK Water Industry: Guidelines for Dealing with Embodied and Whole Life Carbon Accounting**.

<sup>7</sup> The Greenhouse Gases Sub-Objective, TAG Unit 3.3.5, In Draft, January 2010

<sup>8</sup> Note that from 2010 the water and sewerage sectors will be required to participate in the CRC Energy Efficiency Scheme.



The purpose of the UKWIR report is to provide clear guidelines for UK water companies to carry out whole life carbon<sup>9</sup> accounting for investment selection, including planning for Price Review PR09.

Other non regulatory drivers which directly or indirectly touch on carbon and potentially its management in infrastructure are local government national indicators covering carbon and climate change as well as the Nottingham Declaration on climate change. There is also the Carbon Disclosure Project (CDP) which is a not for profit organisation which encourages organisations world-wide to disclose information related to carbon and climate change. In 2009 over 2450 organisations reported by CDP.

Carbon management guidance more general to infrastructure exists in the Forum for the Future e21c project report **Carbon Management Framework for Major Infrastructure Projects** published in 2009. The Forum for the Future report sets out a framework for estimating whole life carbon for infrastructure assets. The report notes that whole life carbon can often be influenced through effective design and suggests that the greatest opportunity to reduce carbon is at early pre-design project stages.

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<sup>9</sup> Whole life carbon refers to a life-cycle approach that accounts for all consequential emissions over the life-time of an asset, including: construction, operation, maintenance and decommissioning. As with all life-cycle assessments (LCA) it is important to set clear and transparent boundaries on the carbon emissions to be counted. Fundamentally, all changes in carbon emissions (from the existing condition) arising from the project should be included within the boundary. The key principal is to include all 'material' emissions.



**Halcrow Group Ltd**

Arndale House Otley Road Headingley Leeds LS6 2UL

Tel: +44 (0)113 220 8220 Fax: +44 (0)113 274 2924

[www.halcrow.com](http://www.halcrow.com)