ice
Institution of Civil Engineers

Scotland

Accelerating the decarbonisation of Scottish infrastructure

Foreword

The decarbonisation of our infrastructure, both new and existing, will be critical if we are to successfully meet Scotland's 2045 net zero target.

Though COP26 described the 2020s as the 'decade of delivery', decarbonising Scotland's infrastructure remains a challenging space. Operational models and finance structures continue to develop, technological advancements proceed apace and the extent of published advice is constantly expanding. Decision-making in such a complex and fluid environment is challenging.

ICE members have been at the heart of delivering world-leading sustainable infrastructure projects, across Scotland and around the globe. Innovation, insights and good practice are abundant.

At ICE Scotland we wanted to collate learnings and observations from the wide array of practitioners delivering the projects that are driving infrastructure towards net zero. Drawing from this deep expertise we sought to understand what, in reality, helps projects to succeed and what barriers were faced – all to help identify 'quick-win actions' that decision-makers across our infrastructure landscape can take forward with confidence.

Put simply, based on the experience of those at the forefront of this transition, we wanted to understand what interventions from government and industry alike will get us to net zero faster.

To help us conduct this research, and to lend their own expertise, we were delighted to appoint Mott MacDonald. Over the last few months an expert team has conducted a desktop review of relevant publications, held interviews and workshops with over 50 stakeholders, engaged the ICE Scotland membership, and applied their in-house knowledge to distil wide-ranging topics into five key themes that will help drive infrastructure decarbonisation:

- Procurement
- Place-based approach
- Planning and regulation
- Systems-thinking
- National infrastructure net zero coalition

The work presented in this report is that of Mott MacDonald but their findings and, most importantly, recommendations are endorsed by ICE Scotland.

We seek to benefit society by providing relevant infrastructure insights. I have no doubt that this report will provide a useful contribution, and that the recommendations presented can further support infrastructure decarbonisation in Scotland and our advance towards 2045.

David Cole
Chair, ICE Scotland

Cover image: Forth Ports

MOTT MACDONALD

ICE Scotland Insights Report

Accelerating the decarbonisation of Scottish infrastructure

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Executive summary

Rapid decarbonisation of Scotland's infrastructure is required to meet the country's legally binding 2045 net zero commitment. While good progress has already been made towards this goal in some sectors such as renewable energy generation, in other areas, such as transport, there is slower progress, despite a range of positive initiatives. The failure to meet Scotland's recent annual decarbonisation target for 2019 is a cause for concern. This is an issue that has been noted by a range of organisations, including the UK Climate Change Committee in their recent 'Progress in reducing emissions in Scotland: 2021 Report to Parliament'.

This report, commissioned by ICE Scotland, aims to highlight opportunities for the infrastructure sector to speed up our national journey to net zero and get Scotland back on track to meeting its targets. To identify those opportunities, we have undertaken an extensive and in-depth engagement exercise with a wide range of key stakeholders who have major roles in delivering infrastructure in Scotland. These include representatives from the Scottish Government and its agencies, innovation bodies, infrastructure providers, local authorities, academia, and the business sector. They have shared their valuable views and insights and this report reflects the common themes that arose from this engagement exercise; it is their lived experience that has generated our findings. We are not presenting a silver bullet to address all the opportunities we have identified but rather in highlighting these areas, as identified during our conversations, we are presenting opportunities for key stakeholders to get together to co-create ways to accelerate our net zero journey.

There is a lot to celebrate in Scotland with some excellent decarbonisation initiatives underway, some of which we highlight in this report, but we are still falling short of our targets. We know we need to accelerate progress and therefore we need to do more. The key message is that we must increase both the scale and pace of the decarbonisation of our infrastructure, focusing on the sectors that require greatest progress such as transport and heat, as well as working hard to support and encourage changes in behaviour that support our net zero targets. To do this will require greater collaboration between the key players who commission, design, deliver, consent and operate our infrastructure.

Undoubtedly Scotland benefits from ambitious legally binding targets, a raft of policy initiatives, as well as substantial funding and this is driving change. For example, Scottish Water, responding the Scottish Government's net zero ambition has committed to net zero emissions by 2040 and has developed a pathway to deliver net zero operational emissions by 2030. However, we note the UK Climate Change Committee's assessment that 'Scotland cannot deliver net-zero emissions by 2045 through devolved policy alone' and that decarbonisation in Scotland is contingent on UK ambition. Therefore, there is a need for a better understanding of what Scotland can achieve on its own, and what needs to be delivered on a UK-wide basis to create a coherent and transparent decarbonisation pathway.

As part of achieving this clarity we a need clear route map that outlines the necessary delivery steps required in each infrastructure sector by public and private organisations. This would enable better collaboration and would provide greater detail on the types of projects and initiatives that will be needed to support the levels of decarbonisation necessary. Currently, the exemplar projects which we have identified throughout this report demonstrate what can be achieved but are often delivered due to the determination of a small group of pioneers, as opposed to being the product of a coordinated decarbonisation strategy. If the 2020s are to become the decade of delivery, as is required, we must celebrate and learn from the success stories which exist around Scotland. But we must also move past the stage of pilot projects to a scale where decarbonisation is embedded throughout infrastructure and is supported by

leadership, funding and a planning and regulatory system that have delivering net zero at their core.

This report has been informed by over fifty interviews and workshops with key infrastructure stakeholders around Scotland in sectors as diverse as transport, energy, water and the built environment. These experts have decades of experience in engineering, consenting, procurement, innovation and skills development. Our conversations with these stakeholders have identified four cross-cutting topics which will influence Scotland's ability to decarbonise its infrastructure sectors. These are: behaviour change, training and skills, leadership, and funding.

In the context of infrastructure, behaviour change will be required by policy makers, designers, and engineers to embrace new technologies, upgrade existing assets, and develop solutions to implement low carbon infrastructure. To decarbonise infrastructure, we will require a skilled and carbon literate workforce equipped with the necessary knowledge and training. This will demand additional skills to those currently possessed and developing these will be critical in ensuring the decarbonisation transition is fair and just for workers. Effective leadership will be important to drive change and to manage risk. Finding a way to move past a focus on typical 5-year government terms will provide consistency and confidence for developers and funders over a longer timeframe. At the same time, maintaining incentives for short term delivery to meet our near-term decarbonisation objectives is also vital. Given the need for greater pace in delivery to achieve net zero, it will be critical to accept that a degree of risk will be a by-product of this. To support change, leadership will be needed to implement effective measures to mitigate this risk. The public sector, including planning, will have a crucial role to play in taking on some of these risks to leverage greater private sector investment to generate the change that is required.

To accelerate the decarbonisation of Scottish infrastructure at the pace necessary, additional funding, both private and public, focussed on achieving lower carbon outcomes will be required. There is also a need for an understanding of what the priorities for investment should be as well as improving our knowledge of the current condition of our existing national infrastructure as at present this is largely unknown. As we move forward, it is important we understand the extent of the challenge that maintaining and upgrading our current infrastructure will involve.

To make this report relevant for policy and decision-makers, we have grouped our findings into five key themes with specific recommendations identified for each. Our key themes and recommendations are shown in Table 0.1 and Table 0.2.

Table 0.1: Key themes

	Theme	Key message
1	Procurement	Procurement should have more of a focus on net zero aligned outcomes. Delivering net zero is an element of the procurement system at national and local government levels and within the private sector, but more can be done to make carbon reduction a contractual issue. This needs to be supported by better carbon literacy throughout project design, delivery and operation and be underpinned by procurement regimes and contracts which effectively consider carbon.
2	Place-based approach	Greater emphasis should be placed upon developing and supporting place-based approaches which exploit the individual opportunities of place to deliver national net zero policies.
3	Planning and regulation	The planning and regulatory system needs sufficient investment to allow it to play a progressive role in supporting net zero and not be viewed as a bottleneck.
4	Systems-thinking	A more proactive approach to integrating systems-thinking methods throughout infrastructure design, delivery and operation is required to achieve net zero, build partnerships and deliver wider sustainability benefits.
5	National infrastructure net zero coalition	There should be a Scottish infrastructure coalition created where key national infrastructure providers and stakeholders can convene to demonstrate leadership, share learnings and plan for an integrated economy wide transition to net zero aligned infrastructure.

Table 0.2: Recommendations

Theme	ID	Recommendation	Responsibility
Procurement	1	Public sector procurement should include a consistent focus on carbon reduction	Scottish Government and Local Authorities
	2	Establish consistent methods and tools to quantify the carbon impacts of procurement	Scottish Government and Local Authorities
	3	Focus the Civ-Tec model on net zero challenges and internationalise the model to source global net zero solutions	Scottish Government
	4	Changes to systems need to be supported by better carbon literacy	Infrastructure providers
Place-based approach	5	Develop a Scottish Government good practice guide on why and how place-based approaches bring advantages to net zero delivery	Scottish Government
Planning and regulation	6	The planning process requires more investment to enable the pace and scale of change required to deliver net zero infrastructure	Scottish Government and Local Authorities
	7	Some regulation is over complex and needs simplification and coordination	Scottish and UK Government
Systems-thinking	8	As well as considering the carbon impact of new and existing infrastructure, an assessment of a project's benefits should include wider environmental and sustainability aspects such as biodiversity, climate resilience and social value and be linked to the Scottish Performance Framework	Scottish and Local Government
	9	Greater use of digital tools should be used to identify interactions and efficiencies between traditionally separate sectors (e.g., using digital twins)	Industry and Government
National infrastructure net zero coalition	10	A forum should be created for key public and private infrastructure providers to demonstrate leadership, share learnings on decarbonisation best practice and drive better efficiencies in the delivery of net zero infrastructure	Industry and Government
	11	Open-source training materials to improve carbon literacy skills amongst the key Scottish infrastructure providers should be developed	Industry
	12	There should be an independent baseline audit to determine the condition of the existing infrastructure within Scotland to better prioritise the allocation of funds for decarbonisation initiatives	Government funded

1 Introduction

Within Scotland, we have legally binding carbon reduction targets and policies across a range of sectors which provide a positive national landscape in which the decarbonisation of the economy is promoted and encouraged. We have a net zero target set for 2045, with interim targets of a 75% reduction by 2030 and a 90% reduction by 2040 relative to 1990 levels. What is currently lacking is a detailed and coherent route map for infrastructure to achieve these ambitions. In addition, there is no baseline for the condition of our current infrastructure. In order to meet Scotland's targets, these issues need to be addressed. We need the 2020s to become the decade of delivery, where decarbonisation is mainstreamed into project design, implementation and operation. The outcomes of COP26 emphasise the need for urgent action and the momentum generated by this global event provides a timely focus to highlight what needs to be done in Scotland.

To inform this report, we have conducted upwards of fifty interviews with key stakeholders across infrastructure sectors such as water, transport, energy and the built environment. These experts have decades of experience in fields such as policy development, regulation, planning, education and innovation. We have captured their lived experience in contributing to infrastructure delivery and addressing net zero. These individual interviews have enabled us to identify four cross cutting topics and five key themes which will be central to the decarbonisation of Scottish infrastructure. Based upon these topics and themes, this report presents a series of recommendations which can be implemented by both Government and industry to accelerate the decarbonisation of Scottish infrastructure and build upon the many examples of good practice which have already been developed.

Regular scrutiny of progress towards meeting our net zero targets in Scotland will be vital. The UK's Climate Change Committee has a strong reputation for providing sound advice and appraising the work of the UK and devolved governments on climate change mitigation and adaptation. While the Climate Change Committee publishes a separate report on progress in Scotland, a physical presence in the country would be a welcome addition to driving action in Scotland. We recommend that there should be a dedicated Scottish unit of the Climate Change Committee created.

While this report captures some of the key opportunities to make progress towards net zero, the essential message is that we need to up the pace and scale of change. Therefore, accelerating our decarbonisation journey will require more funding to be targeted in key areas, a rapid updating of the systems and procedures which govern our sectors, and a new set of skills to be adopted by our workforce. To provide certainty for investors and to allow asset owners to plan effectively for the future, more clarity is required on how we will enable the transition to net zero by 2045. There are already clear examples of where these areas are being addressed through innovative new approaches, but we must go further and act faster. With infrastructure assets frequently having an operating lifespan of several decades, projects which are undertaken today will shape our future for many years to come. While there is the opportunity to embrace and deliver new technologies and ways of working for future infrastructure, much of the transition to a lower carbon economy will require the decarbonisation of existing infrastructure operations through retrofit and upgrades.

The levers of change are many and complex. As such, we have deliberately tried to deliver a concise set of recommendations that are applicable for broad parts of the Scottish infrastructure environment and which can be tailored and adapted to specific industries or sectors.

The recommendations within this report show opportunities for the ICE Scotland membership to make a significant contribution to delivering Scotland's net zero ambitions. ICE Scotland members help to create the structures and systems that sustain society – the infrastructure that enables us to live our daily lives. Civil engineers are responsible for designing, building, maintaining, and improving bridges, roads, airports, canals, docks, hospitals, schools, power stations, railways, flood defences, water supply, waste management facilities and much more. The transition to net zero will be no different in its requirement for engineers to deliver innovative solutions but these must be guided by effective and coherent policy decisions, a consistent regulatory environment, and opportunities for acquiring appropriate skills through education and training. Different infrastructure sectors are currently tackling the decarbonisation challenge in a range of alternative ways. While bespoke solutions will be required in some cases, there is far greater potential for connected thinking between sectors and the opportunity for collaborative learning. Indeed, a systems-level approach to decarbonisation within infrastructure is one of our key recommendations.

So far, many of the positive steps towards decarbonisation have been achieved through the will and determination of individuals and organisations showing leadership to effect positive change. We cannot underestimate the importance of the skills and the mindset of these leaders, and it is these behaviours that need to be replicated across the entire infrastructure landscape. But to achieve society wide decarbonisation, what these initiatives have achieved must become business-as-usual. Consideration of net zero must be embedded throughout every organisation and decision-maker supported by policy and regulation that puts decarbonisation at its core. As is recognised by the Climate Change Committee, we already have the technologies and the infrastructure solutions which are required to accelerate the decarbonisation of Scottish infrastructure and get us to net zero by 2045. The challenge now is to scale uptake and roll-out, and to increase the financing of low carbon schemes so that they can transition from being isolated pilot studies into business-as-usual activities.

2 Methodology

To understand the requirements needed to accelerate the decarbonisation of Scotland's infrastructure, it has been vital to speak to the key stakeholders involved. This has enabled us to obtain an accurate picture of what is already going well and identify areas where there is room for improvement. We have conducted over fifty interviews with key stakeholders across various infrastructure sectors including energy, water, transport, the built environment and experts with a specific focus on education, innovation and policy. The thoughts and insights of those at the face of Scottish infrastructure have been used to inform the insights presented within this report. Table 2.1 identifies the organisations interviewed as part of the process:

Table 2.1: Stakeholder organisations and individuals interviewed

SCDI	Climate Emergency Response Group
Scottish Government	Star Renewables
SHEFCA	Scottish Renewables
Censis	Scottish Engineering
Data Lab	ScottishPower
Construction Scotland Innovation Centre	CECA
Skills Development Scotland	National Grid
Scottish Water	Dundee City Council
Transport Scotland	Scottish Canals
EMEC	Former Scottish Government advisors
Scottish Enterprise	Scottish Futures Trust
Highlands and Islands Enterprise	Technology Scotland
RTPI	Arnold Clark
Glasgow School of Art	The Scottish Just Transition Commission
Oil and Gas Technology Net Zero Centre	Architecture and Design Scotland
Oil and Gas UK	Shepherd and Wedderburn LLP
Manufacturing Technology Centre	Heriot Watt University
UK Climate Change Committee	Scottish Hydrogen Fuel Cell Association
Michelin Scotland Innovation Park	Edinburgh City Council
Forth Ports	Scottish Gas Networks
Robertson Group	Sustrans
First Bus	Sweco

The insights taken from the stakeholder interviews have been developed and refined through a series of interactive FUTURES workshops which enabled cross-sectoral experiences to be shared. We have also reviewed a range of relevant reports to understand wider decarbonisation messages already being reported within Scotland and to identify areas where these could be further developed for application within the infrastructure sector specifically.

3 Cross-cutting topics

In addition to the five key themes which will be discussed in Section 4, we have identified four other cross-cutting topics which require action and are crucial to accelerating the decarbonisation of Scottish infrastructure. In reality, all of these topics plus our five themes are interlinked and are mutually supportive. For significant progress to be achieved, all need to be addressed together. Tackling these issues is not confined solely to the Scottish Government, these are areas where responsibility can and should be shared with industry.

The four cross cutting topics are:

- Behaviour change
- Training and skills
- Leadership
- Funding

3.1.1 Leadership

In observing where progress on decarbonisation and sustainability across Scotland has already been successfully demonstrated, we consistently see that it has been driven by strong leadership and by committed individuals. This does not always come from the top of organisations but is often supported and nurtured by effective leadership. We should not underestimate the challenges associated with bringing forward innovative solutions that challenge the norm. It requires focus, determination and an appetite to accept risk. There is not an obvious way to replicate these individual leadership traits more widely, but it is worth noting that effective leadership can be underpinned and supported by consistent policy, the skills to build partnerships, and access to consistent and appropriate levels of funding to develop momentum and build confidence in new approaches.

Drawing on our industry interviews we believe there is an attitude of risk aversion within the Scottish infrastructure community. There is a sense that people are concerned about what could go wrong as opposed to having structures and procedures in place which enable organisations and individuals to ‘fail forwards.’ With greater guidance, direction and support from leadership at national and local levels, the path to decarbonisation can be accelerated. Regulation and policy should be changed from the top to provide a supportive environment for the individual to enact positive change.

We have seen the Scottish Government look to review elements of the A96 dualling. The upgrade of the route will be subject to a review which will include a climate compatibility assessment. Such decisions provide strong political messaging and indicate that there is a need to change business-as-usual approaches if we are to accelerate to net zero. However, it will be important that these decisions are clearly communicated to the public to achieve widespread buy-in to the reasons behind their implementation and ensure industry is not unfairly impacted.

3.1.2 Behaviour change

Behaviour change is perhaps the biggest challenge to be addressed, as it underpins how we engage with many of the tools, policies and technologies available to us to deliver net zero solutions. What is required now, as many commentators have already observed, is action on delivery which will be reliant on people to change their behaviours and adapt how they live and work. Many net zero strategies recognise that we all need to alter our behaviours to some extent to make a positive impact on our carbon emissions and there is an acceptance that a

willingness to embrace new technologies will be required by us all. This also includes those working within infrastructure to identify opportunities to accelerate the decarbonisation of all sectors in a more integrated manner.

Our research suggests that clear communication and the provision of incentives towards supporting behaviour change will be vital in accelerating decarbonisation. The Climate Change Committee also states that 'the role of individual behaviour change is important, and that Government has a role in guiding people to make the right choices.'[1] Behaviour change will be adopted more easily by the Scottish infrastructure workforce if it has evidence that new low carbon and sustainable ways of working have been successfully implemented elsewhere. A good example of actively addressing behaviour change is Scottish Water's Carbon Academy. The Carbon Academy is a digital learning hub set up by Scottish Water which is available across their supply chain and to their own employees. The aim of the academy is for Scottish Water's suppliers to be able to share ideas and best practice on carbon reduction and sustainability between themselves. This creates an environment which encourages knowledge sharing and, as a result, behaviour change towards lower carbon options being selected on a more regular basis (see Section 4.5.1 for further information).

3.1.3 Training and skills

To deliver against our net zero targets, we need to change how we deliver infrastructure. This will require additional skills and training which links strongly to the behaviour change topic. Skills availability has been recognised by the Scottish Government as being part of their approach to enabling a just transition to net zero. In response to this, Skills Development Scotland has produced a Climate Emergency Skills Action Plan. It recognises that "enhancing access to skills training is critical for successful decarbonisation." The skills topic has also been subject to examination by Scottish Engineering whose research concludes how "critical it is to embed sustainability and green competencies across Scottish apprenticeships". This specific focus on embedding low carbon skills within the Scottish Apprenticeship programme provides an opportunity for the Scottish Government to ensure we have the right skills and capabilities to deliver our net zero ambitions.

In terms of improving national carbon literacy, we also recognise the efforts of the Royal Scottish Geographic Society's Climate Solutions Course[2] which is being used extensively across Scotland in both the public and private sectors. This training is an example of one of the levers that could be used more extensively to support decarbonisation efforts in Scotland by making us a more carbon literate society. The infrastructure industry, and the organisations who support it such as industry and professional bodies, also have a key role to play in supporting low carbon skills development in their workforce and membership. Access to open-source training materials (see Recommendation 11) which are shared across different Scottish infrastructure sectors would help improve consistency in knowledge at a faster pace.

3.1.4 Funding

Appropriate and consistent levels of funding and new investment models will be required to deliver a rapid decarbonisation of Scottish infrastructure. There needs to be a stronger relationship between Scottish Government funds allocated to infrastructure development and the delivery of net zero aligned outcomes. This has been recognised by the Scottish Government and work is currently underway to strengthen the relationship between the allocation of funding for City Deal Projects and the implementation of carbon reduction

[1] https://www.theccc.org.uk/wp-content/uploads/2020/12/The-Sixth-Carbon-Budget-The-UKs-path-to-Net-Zero.pdf
2 https://www.rsgs.org/climate-solutions

measures using recognised carbon management standards such as PAS 2080. The embedding of carbon considerations in the procurement process is also being developed.

There are relevant examples of where a project's carbon intensity has been reduced through the procurement process. This is the case for the Cross Tay Link Road (CTLR) where the consultant for Perth and Kinross Council, Sweco, put carbon management at the heart of the project. Opportunities to reduce emissions associated with the creation of the asset during the construction phase were explored from the start (see case study in Section 4.1).

In addition to using procurement more proactively, funding needs to be allocated on a consistent and appropriate basis to deliver confidence and momentum for net zero compatible projects. Over the course of the interviews, concern was voiced that there are too many short-term funding pots which don't deliver change at scale. Government cycles of 5 years often mean that funding periods can be limited to that time frame. This acts as a barrier to effective private sector investment as organisations are not willing to invest where there is no long-term guarantee of supportive public sector funding to de-risk private sector involvement.

The Glasgow Green Print for Investment, which highlights a portfolio of investment projects that are designed to give a significant boost to the city's target to reach net zero by 2030, demonstrates the scale of investment required to meet our net zero ambitions. The Green Print envisages the need for £30bn of investment in development opportunities and is inviting international investors to support the delivery of these projects. Projects include a Glasgow Metro which will connect the city region, a housing retrofit programme to make all homes energy efficient, and more district heating schemes to provide lower carbon heating for our homes. Strategic initiatives such as the Glasgow Green Print should be replicated across Scotland to attract the private funding that is available for sustainable long-term projects.

Funding also needs to be put in place to support the regulatory and planning system that consents new infrastructure (see Section 4.3). This is currently seen as a bottleneck and to accelerate decarbonisation we need an efficient delivery system for infrastructure upgrades and new build projects.

Finally, we would note there is an opportunity, as happens in Ireland, for better alignment between the Government's capital spending and the aspirations that new development should achieve as set out in the National Planning Framework, the most recent of which, NPF4, is currently out for consultation.

4 Findings

Throughout our interviews, five key themes have emerged which provide key insights for policy and decision-makers to support the decarbonisation of our infrastructure environment. The five key themes are outlined in Table 4.1.

Table 4.1: Key themes

	Theme	Key message
1	Procurement	Procurement should have more of a focus on net zero aligned outcomes. Delivering net zero is an element of the procurement system at national and local government levels and within the private sector, but more can be done to make carbon reduction a contractual issue. This needs to be supported by better carbon literacy throughout project design, delivery and operation and be underpinned by procurement regimes and contracts which effectively consider carbon.
2	Place-based approach	Greater emphasis should be placed upon developing and supporting place-based approaches which exploit the individual opportunities of place to deliver national net zero policies.
3	Planning and regulation	The planning and regulatory system needs sufficient investment to allow it to play a progressive role in supporting net zero and not be viewed as a bottleneck.
4	Systems-thinking	A more proactive approach to integrating systems-thinking methods throughout infrastructure design, delivery and operation is required to achieve net zero, build partnerships and deliver wider sustainability benefits.
5	National infrastructure net zero coalition	There should be a Scottish infrastructure coalition created where key national infrastructure providers and stakeholders can convene to demonstrate leadership, share learnings and plan for an integrated economy wide transition to net zero aligned infrastructure.

We have outlined the key drivers for change related to each theme, as well as the potential solutions available to maximise the opportunities for accelerating decarbonisation. For each theme, we have provided concise recommendations as to how the decarbonisation of Scottish infrastructure can be accelerated which are illustrated by a range of best practice case studies.

4.1 Procurement

Key message: Procurement should have more of a focus on net zero aligned outcomes. Delivering net zero is an element of the procurement system at national and local government levels and within the private sector, but more can be done to make carbon reduction a contractual issue. This needs to be supported by better carbon literacy throughout project design, delivery and operation and be underpinned by procurement regimes and contracts which effectively consider carbon.

Table 4.2: Procurement recommendations

ID	Recommendation	Responsibility
1	Public sector procurement should include a consistent focus on carbon reduction	Scottish Government and Local Authorities
2	Establish consistent methods and tools to quantify the carbon impacts of procurement	Scottish Government and Local Authorities
3	Focus the Civ-Tec model on net zero challenges and internationalise the model to source global net zero solutions	Scottish Government
4	Changes to systems need to be supported by better carbon literacy	Infrastructure providers

Why

The Scottish Government, its agencies, and the wider public sector spends considerable capital and revenue funds on a wide range of programmes, projects and service delivery activities. We recognise the Scottish Government has made it a legally binding duty on the public sector to report their target date for achieving zero direct emissions from their own operations, targets for reducing indirect emissions, how their spending aligns with emissions reductions and their contribution to Scotland's Adaptation Programme. This duty provides a strong level of responsibility for the public sector to act but it is unclear what role procurement has in addressing this challenge.

Given that there is a clear link between reducing carbon and the associated cost saving opportunities, this needs to be built into contracts in a more consistent manner. The Green Construction Board report of 2020,[3] which marked the 7th anniversary of the original Infrastructure Carbon Review, reiterates this clear, simple message, that cutting carbon reduces cost. There is therefore strong alignment between decarbonisation and cost savings, which delivers a win-win for Government.

By changing procurement methods and making carbon reduction contractual, progress can be made. However, we recognise that this will need to be underpinned by the provision of training to support changed behaviours and to develop a better understanding of whole life carbon impacts and the options available to achieve net zero. The development of clear case studies that build understanding, confidence and capability would also be welcomed.

How

There is an opportunity to utilise procurement methods and systems to make carbon a key factor in procurement. Procurement parameters should focus on carbon as well as cost. This is currently being developed within areas of the Scottish Government but should be enhanced and implemented more broadly. Change will be driven quickest through implementation on the largest of infrastructure projects, but care should be taken not to exclude local suppliers if large framework contracts are used.

An ICE carbon working group is looking at how procurement and contracts can support net zero. It is anticipated that for certain contracts, there will be a recommendation to build specific carbon targets into the contract. This will require the contract to include a clear and robust 'method of measurement' for carbon. The group has developed a set of additional conditions to the NEC Engineering and Construction Contract to support net zero. These include the inclusion of a 'Performance Table' as is already part of the NEC Alliance Contract and the NEC Facilities Management Contract. The Performance Table will include targets for any measurable desired outcome (e.g. carbon targets) and the opportunity to include bonuses for beating the target and/or damages for not achieving that target. These additional clauses are currently being worked up into a new secondary option by NEC itself.

The use of standards such as PAS 2080, which provides a specification for managing whole-life infrastructure carbon, should be utilised more widely as a key tool to support net zero. The forthcoming update to PAS 2080 will make the standard easier to adopt by a variety of infrastructure organisations. Greater use of other sustainability standards such as CEEQUAL and BREEAM also offer opportunities to decarbonise infrastructure but these must be applied in a more consistent manner than at present.

3 https://www.constructionleadershipcouncil.co.uk/wp-content/uploads/2021/04/Infrastructure-Carbon-Review-seven-years-on_March-2021.pdf

We are also aware that the Scottish Government is assessing opportunities to ensure carbon reduction is a key element of city deal funding. We would encourage such initiatives to be used to include decarbonisation at the heart of new infrastructure development. It is important that these approaches are scaled up across Scottish infrastructure to have a more significant impact.

Another opportunity to drive lower carbon solutions is to consider greater use of challenge-based procurement techniques. The Civ-Tec procurement model[4] which involves procuring solutions to challenges, as opposed to prescribing the infrastructure outcome, offers the potential to do more to deliver innovative net zero solutions. This would enable solutions which can consider the individual opportunities of different locations and allow flexibility between different sizes of supplier organisations. It is a model that has already been used successfully within Scotland to tackle a range of issues such as peatland restoration, tourism support and rural transport and would allow the development of innovative ways to address the net zero challenge throughout the procurement process. In addition, we recognise that internationalisation of the challenge-based model offers opportunities to source net zero solutions from around the globe. The recent Civ-Tech Alliance Global Scale Up programme presented at COP26 provides a great example of developing a model to source global solutions to net zero which link back to Scotland.[5]

We recognise that the opportunities to make changes to procurement practices need to be supported by training, education and behaviour change initiatives that create a better understanding of the net zero challenge for practitioners, outline the potential solutions, show how to measure carbon and demonstrate how to design for carbon reduction. As with many of the other recommendations made in this report, this is an example of where solutions need to be joined up to effect positive change.

4.1.1 Case Study: Low Carbon Procurement in the Cross Tay Link Road (CTLR)

Project: Cross Tay Link Road

Key Organisations: Sweco; Perth and Kinross Council

Key Themes: Carbon in procurement

The Cross Tay Link Road (CTLR) will link the A9 over the River Tay to the A93 and A94 north of Scone. This will help to alleviate traffic congestion in the city centre and Bridgend, creating capacity in the city's road network that will enable a shift to greener modes of travel, and facilitating sustainable economic development of Perth and the surrounding area.

Carbon management has been at the heart of this project with opportunities to reduce emissions associated with the creation of the asset during the construction phase being explored from the start. This has been accomplished by integrating the carbon management process within PAS 2080 into design choices and decision making then further into the procurement and delivery stages.

Figure 4-1: Green Bridge as part of the CTLR (Credit: Sweco)

An initial carbon baseline was developed prior to development of the specimen design to identify carbon hotspots. Over the course of the design

[4] https://www.civtechalliance.org/civtech

[5] https://cop26.civtechalliance.org/

process, various value engineering modifications were incorporated by Sweco which resulted in associated carbon savings from earthworks, structures and pavements of some 13,000 tCO_2e.

In addition to the carbon emissions minimised during the specimen design, it was recognised that it was important to ensure that PAS 2080 would be incorporated during detailed design and construction. To achieve this, Sweco worked with Perth and Kinross Council to integrate carbon management within the procurement of the works contract. Tenderers were challenged to propose projects that would result in a minimum saving of 14,100 tCO_2e of CO_2e compared with the specimen design carbon footprint. This element of the tender was weighted at 15% of the evaluation criteria, with the maximum reduction being awarded the highest score. This ensured serious consideration was given to this element.

Figure 4-2: Sustainable drainage system included as part of the scheme (Credit: Sweco)

Through this process, a commitment was established within the tender requirements for the successful contractor to deliver its proposed carbon savings during construction. The successful supplier submitted a proposal in excess of the 14,100 tCO_2e target. The project is currently in the design phase, and the design and procurement process together are expected to result in a 26,300 tCO_2e saving of carbon compared to the baseline design.

4.2 Place-based approach

Key message: Greater emphasis should be put on developing and supporting place-based approaches which exploit the individual opportunities of that place to deliver national net zero policies.

Table 4.3: Place-based approach recommendations

ID	Recommendation	Responsibility
5	Develop a Scottish Government good practice guide on why and how place-based approaches bring advantages to net zero delivery	Scottish Government

Why

By adopting place-based approaches to delivering net zero, more systems-thinking is enabled. Scotland's varied geography allows for a range of methods to enable decarbonisation. A place-based approach encourages better partnership working, it makes the most of local opportunities and it maximises local knowledge. Through ongoing consultation and dialogue, the buy-in of local stakeholders can be maximised.

We note the recent publication by the Scottish Government of the National Planning Framework 4 (NPF4) for consultation. This Framework focuses on a place-based approach using the terms: sustainable places, liveable places, productive places and distinctive places. It also targets emissions reductions, enhancing the natural environment, improving health, delivering a wellbeing economy and maximising our key natural assets. It recognises the importance of working in partnership within the context of place, whether urban or rural, to help achieve net zero. We would also reiterate the point made earlier that there should be greater alignment between the aspirations of NPF4 and the Government's capital spending programme.

Within the city context where many place-based approaches occur, there are concentrated and complex infrastructure systems involving multiple city stakeholders. There is significant benefit in having these stakeholders look collectively at net zero opportunities. The alignment of people and organisations with the power to make change, the opportunity to share data and the ability to build effective partnerships can have a powerful impact. In rural areas, a place-based approach is also relevant such as by bringing employment in the form of new industries and to create opportunities to generate energy in more sustainable ways.

Also, within the context of a place-based approach, we should give greater consideration to the triple helix concept where the private sector, the public sector and the academic sector work in partnership to deliver innovative schemes that support net zero. In Scotland, we have an excellent academic and research resource, along with innovative companies and a supportive public sector. While this has already been implemented in some situations such as the Michelin Innovation Park in Dundee, this is undoubtedly an approach which could be further developed. In the Netherlands, Brainport is an excellent example of an innovative ecosystem where industry, the public sector and academia cooperate with a focus on manufacturing. This is a model that could be adapted to focus on our net zero challenges.

In the examples we use to illustrate how place-based approaches can help achieve net zero, we also show how such a method can deliver a range co-benefits to the people and environment of that location.

How

In developing place-based approaches, it is important to identify what makes for a coherent place. That may be focussed around a key geographical or built asset, or it may be around a city, a neighbourhood, or a new development. Within Scotland there are successful examples of all of these. Having identified the place you wish to work with, there is a need to address what the key net zero opportunities are and accordingly which players you need to involve to deliver positive change. National decarbonisation policy, as well as initiatives taken by local authorities provide a sound context for action and the opportunities to deliver these will align around the partnerships that are developed, the engagement of people and the powers that can be applied to enact change in the place. The focus on place can also enable opportunities to access a range of funding streams to maximise the delivery of a range of wider co-benefits associated with a project and encourage the use of local materials and suppliers which bring economic benefits to the local area.

The recent publication of a new place guide by Scottish Futures Trust is welcomed and provides further evidence that the concept of place as an organising principle provides a useful focus for net zero progress.[6]

To illustrate the power of taking a place-based approach, we have chosen four contrasting examples. At the strategic level we describe the work that is underway to establish a Net Zero Hub on the Firth of Forth, which brings together a wide range of partners bound by a desire to decarbonise by developing carbon capture utilisation and storage (CCUS) capacity. This project aims to support low-carbon hydrogen production, utilise offshore wind power resources and play a key role in helping the industrial sector deliver the ambitions of Scotland's Just Transition Commission.

We also want to highlight the excellent transition that has happened in Dundee with the development of the Michelin Innovation Parc initiative that has been created on the site of the former Michelin tyre factory and is now a showcase for low carbon mobility. The development

[6] https://content.yudu.com/htmlReader/A44adc/sftplaceguidenov2021/reader.html?origin=reader

was created to generate economic growth in Scotland and support a fair and just transition to a net zero economy.

An example of a successful place-based approach is the Avenues Project in Glasgow. This illustrates the benefits of making cities better places for active travel, supporting better air quality and improving the local public realm to attract investment. These projects also illustrate the benefits of partnership working, engaging with local people and organisations, using data intelligently and applying systems-thinking to developments to leverage net zero and wider benefits.

We also showcase Dundee's rollout of electric vehicles which is testament to what positive leadership and action can do when coupled with a place-based solution.

4.2.1 Case Study: Forth Ports Net Zero Hub

Project: Leith Renewables Hub

Key Organisations: Forth Ports

Key Themes: Place-based approach

The Firth of Forth has more than 250 years of international energy and trading activity and its transition to a green growth corridor will be critical to reaching net zero in Scotland. Recent reports have highlighted the Forth as the place which will have maximum impact in decarbonising Scotland – it is where the industries that need to decarbonise are located, and where much of the population is – with 70% of Scotland's population residing within an hour's journey.

Forth Ports, one of the UK's largest port operators, manages several ports along the Forth. Their land and facilities in central Scotland are home to Scotland's largest remaining industrial cluster and will play a vital role in facilitating the country's net zero and energy transition ambitions, creating new high quality green energy jobs. With access to extensive pipelines, storage, bunkering infrastructure and a highly skilled work force, Forth Ports is working with industry and stakeholders to deliver new low carbon fuels and technologies, such as hydrogen and carbon capture, across Forth Ports' portfolio of assets.

Figure 4-3: Leith Renewables Hub (Credit: Forth Ports)

The Port of Leith is an example of one of the facilities playing a vital role in the net zero transition and it has all the attributes to support both hydrogen and offshore wind aspirations. To enable the local content requirement and the most sustainable construction of the country's offshore wind aspirations, Forth Ports, following its £40m investment in a purpose-built offshore wind facility in Dundee, is committing a further £40m of investment towards the industrial regeneration of Leith and is working closely with the City of Edinburgh Council to deliver Scotland's largest and best located renewable energy hub. This hub will be the place to deploy offshore wind in Scottish and UK waters, with all the additional opportunities this provides to grow the decarbonisation message and agenda.

The development will include the creation of an outer berth capable of accommodating the largest offshore wind turbine installation vessels and floating turbines with 15 hectares of land adjacent to the berth for logistics and marshalling and a further 60 hectares of land available to accommodate lay down, assembly, green energy (hydrogen) manufacturing and supply chain

incubator facilities. The outer berth will be fully operational by the end of 2023, helping to secure the Firth of Forth as one of the drivers of Scotland's green energy transition.

The creation of this facility, which will be the largest of its kind in Scotland, will support up to 1,000 high quality, long term direct jobs and approximately 2,000 indirect jobs, underpinning the central belt's position as the leading area of energy and manufacturing, businesses and skills.

By utilising a place-based approach using the Firth of Forth's proximity to industry and population, Forth Ports has been able to continue to fulfil its strong purpose, which is to invest in supply chain solutions and infrastructure to support its customers and markets, and contribute to Scotland's green economy. The recent delivery of such purpose-built infrastructure in Dundee to support the deployment of Offshore Wind, and now the development of Leith Renewables Hub clearly demonstrates Forth Ports' continued commitment to supporting the energy transition, and Scotland in achieving it 2045 net-zero targets through a place-based approach.

4.2.2 Case Study: The Avenues Programme

Project: Enabling Infrastructure Integrated Public Realm - Avenues Programme

Key Organisations: Glasgow City Council

Key Themes: Place-based approach

The Avenues Programme is an excellent example of implementing a place-based approach at the city and neighbourhood level. It is an initiative to improve the quality of Glasgow City Centre by redesigning the city centre streets to become more people friendly and sustainable. The project, funded by the Glasgow City Region City Deal with additional funding from Sustrans, will transform 21 key streets in the city centre of Glasgow through the implementation of green and SMART infrastructure, reorientating traffic modes away from cars towards active, sustainable methods such as walking and cycling. The improvements aim to make Glasgow's city centre a more attractive place for pedestrians and cyclists and make Glasgow more economically competitive as a city. Key Improvements within the city centre include:

- Increased cycling and walking space
- Segregated cycle lanes
- Single surface crossing points
- Street trees and rain gardens
- Intelligent Street Lighting (ISL) and improved lighting features
- Improved street furniture

Figure 4-4: Avenues project redevelopment of Argyle Street in Glasgow City Centre (Credit: Glasgow City Council)

The ten-year project began in 2018 with the re-design of Sauchiehall Street from a traffic dominated road to a more attractive, safer and inclusive streetscape where people can sit, walk and cycle in comfort. This was achieved through the introduction of a fully segregated cycling facility; continuous footway and cycle crossings at side roads; large semi-mature trees; seats; permeable paving; improved access to buses and taxis; and a 20mph speed limit for traffic. According to data collected by Glasgow City Council in 2020, Sauchiehall street saw an 80% increase in the number of cyclists using the road to enter the city centre and a 606% increase in the number of cyclists using it to leave the city centre. This highlights its effectiveness in promoting an uptake of active transport modes. Other Avenues are being progressed in subsequent phases between now and 2028.

Figure 4-5:Avenues project redevelopment of Holland Street in Glasgow City Centre (Credit: Glasgow City Council)

The Avenues project showcases how a place-based strategy can achieve positive, sustainable results by focusing on and exploiting the local opportunities of that place. For years, Glasgow's city centre has been dominated by cars resulting in increased carbon dioxide levels, poor air quality levels and the associated health disbenefits that come with it, increased dependence on private vehicles and a decrease in city centre living. By targeting and improving key, popular streets within Glasgow's unique city centre with green and SMART infrastructure, the Avenues project has found a way to both improve the sustainability of Glasgow and increase its attractiveness as an area to walk, cycle, shop and live. The project will deliver a range of co-benefits including better air quality, better health outcomes, strong messaging towards active travel, biodiversity benefits and links to Glasgow's economic strategy highlighting what a place-based strategy can achieve.

4.2.3 Case Study: Michelin Scotland Innovation Parc

Project: Michelin Scotland Innovation Parc

Key Organisations: Michelin, Scottish Enterprise, Dundee City Council

Key Themes: Systems thinking, Place-based approach, Training and Skills

Figure 4-6: MSIP site located in Dundee (Credit: MSIP)

Michelin Scotland Innovation Parc (MSIP) is a collaboration between Michelin, Scottish Enterprise and Dundee City Council which was created to support low carbon innovation and a just transition to a net-zero economy in Scotland. MSIP is transforming the 70,000 m^2 Michelin Tyre Factory, which was closed for commercial reasons in 2020, to act as a home for innovators, manufacturers, and leaders to develop and advance sustainable mobility and decarbonisation technologies. As well as being a space designed for manufacturing businesses to locate, MSIP includes a mixture of spaces to promote innovation and collaboration including:

- Innovation Hub
- Skills Academy
- Hydrogen Production Facility and Refuelling Centre
- Green and Sustainable Energy
- Events Space
- Green Campus Space

A key focus of MSIP is collaboration, particularly between industry and academia in order to create the new ideas needed to support Scotland's journey to net-zero. As a result, MSIP has a number of strategic partnerships with Scottish universities to utilise their breadth of knowledge. This includes a partnership with St Andrew's University and the nearby Eden Campus to utilise

their expertise on battery and hydrogen technology and a partnership with Dundee University to develop new products to advance the future of sustainable mobility and low carbon energy. These collaborations use Dundee's location effectively to harness what the area and the people have to offer and implements systems-thinking by ensuring industry and academia are working together to create the best possible outcomes.

One such collaboration is effectively being utilised to deliver MSIP's Skills Academy. The Skills Academy brings skills and knowledge from colleges and universities together with industry, to deliver new skills, for the technology and industry needs of the future. It offers dedicated skills training to current and future employees of companies located at MSIP and across industry through a comprehensive range of training focused on the skills needs of companies. The curriculum is broad and flexible from entry-level to professional development with an aim to inspire new generations of engineers, technicians, and operators to design and manufacture for the sustainable mobility and decarbonisation sectors. The MSIP Skills Academy links to other facilities at MSIP including its Innovation Hub and manufacturing space allowing both industry and learners opportunities to work collaboratively, develop ideas and form knowledge transfer partnerships.

MSIP has created a space which will help to transition Scotland to a net-zero economy and is a perfect example of how a collaborative approach utilising knowledge from the public, private and academic sector can create an environment which encourages innovation and education.

4.2.4 Case Study: Dundee's Electric Vehicles

Project: Drive Dundee Electric

Key Organisations: Dundee City Council

Key Themes: Place-based approach, Systems-thinking, Leadership

Dundee City is leading the way within Scotland with the electrification of transport. Through the city's 'Drive Dundee Electric' initiative, it has promoted and supported the uptake of electric vehicles (EVs) within the city. The campaign draws on a breadth of knowledge, experience, and leadership within Dundee City Council on EVs and their supporting infrastructure. Dundee City Council has made use of its small size and high population density to successfully adopt and promote EVs; the maximum distance any vehicle has to drive within the city limits is approximately 20 minutes.

The council itself contains over 200 electric vehicles within its small vans and cars vehicle fleet which is the most of any local authority within the whole of the UK. The council also aims to increase this to 100% by the end of 2025. Alongside the electrification of its small van and vehicle fleet, the council has also invested in new electric bin lorries. At the beginning of 2021, six of the vehicles arrived in Dundee which are the first of their kind. The new electric lorries are predicted to reduce carbon dioxide emissions by 20 tonnes per year each. By 2030, all 36 bin lorries within Dundee's fleet will be electric saving 720 tonnes of CO_2 a year. To facilitate the charging of the 26 tonne vehicles, a new charging hub has been installed within a council depot which includes a 150kW, two 22kW and three 50kW chargers. These additional chargers will allow all 36 of the EVs to charge.

Figure 4-7: One of Dundee City Council's six electric bin lorries (Credit: Dundee City Council)

Alongside its own fleet, Dundee City Council has also promoted and incentivised the electrification of taxis and private hire vehicles within the city. There are now over 170 electric taxis with the city, making up 25% of the city's taxi fleet. Taxis and private hire cars are significant contributors to the carbon emissions produced within Dundee and the electrification of these transport modes has also helped to improve air quality within the city. The successful uptake was primarily down to good communication with the vehicle operators. Every three months a committee, which contains various stakeholders including members from the council taxi licencing team, fleet managers, the police, and various unions, meet to discuss current policy and any issues or challenges stakeholders are experiencing. Communication, transparency and leadership have allowed the following policies to be implemented successfully:

- all new private hire cars must be electric
- operators with a licence in their own name can apply for a corporate licence if they operate an approved EV
- low tariffs at council owned charge points
- the taxi test for EVs is £10 cheaper than a non-electric vehicle

The council has also installed charging infrastructure across the city both on street and within the city's three main multi-story car parks. The high population density within the city means many residents do not have access to on street parking. Charging infrastructure within multi-story car parks will allow residents who do not have access to on street parking to consider EVs in the future. Currently, charging hubs within Dundee are able to charge over 4,000 vehicles – which is over 7% of all cars and vans within the city, well above the UK average of 1.9%.

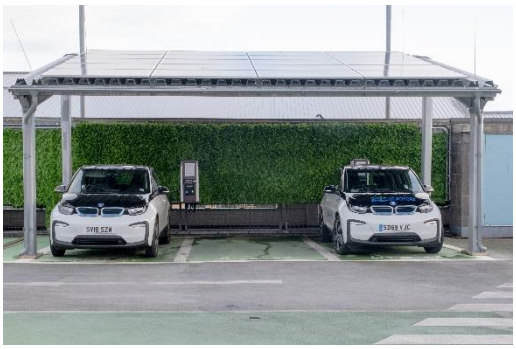

Figure 4-8: Dundee's off-street charging infrastructure (Credit: Dundee City Council)

The high uptake of EVs within Dundee, both public and private, is testament to what positive leadership and action can do when coupled with a place-based solution. Utilising Dundee's small area and high population density allowed Dundee City Council to test and implement EV infrastructure which suited their city. Communicating with key stakeholders has also ensured successful uptake across the city. Dundee, which recently held the world forum for EVs, is an international example of how to successfully implement EVs within a city and truly highlights how Scotland can be a living lab for innovative low carbon ideas.

4.3 Planning and regulation

Key message: The planning and regulatory system needs sufficient investment to allow it to play a progressive role in supporting net zero.

Table 4.4: Planning and regulation recommendations

ID	Recommendation	Responsibility
6	The planning process requires more investment to enable the pace and scale of change required to deliver net zero infrastructure	Scottish Government and Local Authorities
7	Some regulation is over complex and needs simplification and coordination	Scottish and UK Government

Why

The planning system and the marine regulatory regime will be integral in helping deliver a rapid decarbonisation of Scottish infrastructure. Strong feedback from our stakeholder interviews has indicated that without appropriate investment, the planning system and the Marine Scotland consenting system risk becoming a bottleneck to infrastructure which will help the decarbonisation of the country. It is important, given the need to increase the pace of delivery of net zero infrastructure solutions that no part of the process causes delay. For some projects, there is a short, defined window in which funding is available. If the consenting process takes too long, investment can go elsewhere. To prevent this, projects need to be evaluated in a timely manner, by appropriately qualified individuals, against a consistent and predictable regulatory landscape.

Developing net zero solutions is increasingly leading to the adoption of new technologies, particularly around energy. In order that the consenting system can deal with these applications, there will need to be appropriate training provided to ensure local authorities are able to appropriately consider such applications. Increased investment in the consenting system should be a priority for local and national government in Scotland. In addition, it has been noted that there could be lessons learnt from the Development Consent Order (DCO) process in England to better streamline the processes for major infrastructure projects.

Beyond delivering a consenting regime, the planning system has also played a key role in supporting place-based solutions. It has promoted mixed use and 20-minute neighbourhoods that minimise the need for long journeys and support sustainable travel systems that align with net zero ambitions. Effective planning also supports the delivery of smart energy infrastructure and electric vehicle charging and can ensure that new development is delivered in locations and at densities that maximises the potential for future decarbonisation.

In recent years, the planning system's ability to play a proactive role in helping deliver against the Government's net zero targets has been hampered by reductions in funding and staffing levels making the sector less attractive as an employer. Research undertaken by the Royal Town Planning Institute shows that:

- The planning service is the one of the most severely affected of all local government services in terms of budget cuts with a reduction of 42% since 2009
- Nearly a third of planning department staff have been cut since 2009
- Planning application fees do not cover the costs of processing planning applications

These issues represent a significant challenge for the planning system and need to be addressed by appropriate levels of funding. Enhancing the planning system will also support other key pieces of the net zero infrastructure jigsaw by creating place-based and systems-thinking approaches leading to effective and integrated infrastructure delivery.

We currently have a fragmented regulatory framework for consenting energy projects and this does not facilitate easy roll out of the net zero aligned infrastructure we need. To illustrate the complexity of the current system, to construct an offshore wind project requires the following steps:

- Bid to Crown Estate to win the seabed rights
- Apply for and secure a planning consent and related environmental consents
- Secure a grid connection offer that will deliver a connection on time to the right location for your project; and
- Ensure you can sell the power for a good return, which often means competing in an auction to win a government backed Contract for Difference (CfD) (or in a bid process for a corporate PPA).

Currently each of these processes is controlled by a different decision-maker and each has its own legal framework. A developer can fail at any stage which can lead to wasted investment and difficulties in obtaining finance. This also adds to challenges in developing effective supply chains due to uncertainty around which projects will succeed, where they will be located and timescales for project delivery.

Another issue which arose throughout our stakeholder engagement was the inability to invest in key energy infrastructure ahead of proven need given current Ofgem rules. This is a topic that has also been recognised by the Climate Change Committee who recommend making investments in the short-term, even at the risk of incurring short-term costs, as we need urgent action to mitigate carbon emissions. In their opinion, this will support the development of new markets which can lead to cost reductions, as has been witnessed previously with offshore wind.

The stakeholders we interviewed also believe that Ofgem's mandate should have a more devolved energy system approach thereby allowing greater governance and decision-making at a regional level as local network investment should reflect the priorities and strategies of that area.

How

The planning system should be reinvigorated through appropriate levels of funding with an increase in planning fees to reflect the required workload. There should be increased investment in the training of planners to meet the projected demands of the role including additional funding for planning apprenticeships. The digital capability of the planning system should be increased to provide efficiencies and enable closer integration between different infrastructure sectors. These actions should ensure planning has a much stronger role in the delivery of net zero ambitions and is not merely a development management system.

Improvements to regulation, particularly in respect of offshore wind, should be delivered as an outcome of the Offshore Transmission Network Review consultation which was recently undertaken by BEIS. This aims to ensure that the transmission connections for offshore wind generation are delivered in the most appropriate way to achieve net zero while balancing environmental, social and economic costs. A positive outcome of this consultation could deliver effective change to speed up the deployment of new technologies and would address the current range of regulatory issues which are a barrier to the decarbonisation of Scottish infrastructure.

Within the Scottish context we have a range of regulators who govern the delivery of infrastructure developments. These include local government, Marine Scotland, Historic Scotland, NatureScot and SEPA amongst others. All of these organisations have significant

demands on their resources which inevitably has an impact on decision-making. We would suggest that a partnership approach to assessing key infrastructure projects which support the delivery of net zero outcomes should be developed in order to enhance collective, efficient decision-making.

4.4 Systems-thinking

Key message: A more proactive approach to integrating systems-thinking methods throughout infrastructure design, delivery and operation is required to achieve net zero, build partnerships and deliver wider sustainability benefits.

Table 4.5: Systems-thinking recommendations

ID	Recommendation	Responsibility
8	As well as considering the carbon impact of new and existing infrastructure, an assessment of a project's benefits should include wider environmental and sustainability aspects such as biodiversity, climate resilience and social value and be linked to the Scottish Performance Framework	Scottish and Local Government
9	Greater use of digital tools should be used to identify interactions and efficiencies between traditionally separate sectors (e.g., using digital twins)	Industry and Government

Why

Implementing a systems-thinking approach to projects, programmes and procurement will accelerate Scotland's journey towards net zero because it delivers efficiencies and encourages better partnership working. Both outcomes have been shown to deliver tangible results towards achieving decarbonisation and delivering a range of co-benefits. On a strategic level within Scotland, a better systems-thinking approach has the potential to deliver and report against the Scottish Government's Performance Framework.[7] This framework aligns to the UN SDGs and thereby encourages projects and programmes to deliver multiple benefits that are social, economic and environmental in nature. At present, there is a lack of clarity between this performance framework and the Government's net zero targets which should be addressed.

How

Our recommendation for more systems-thinking is linked to better achieving our decarbonisation ambitions through procurement routes by requiring a wide set of outcomes from suppliers. By developing a wider set of sustainability ambitions for public spending and better defining the link between Scotland's Performance Framework and decarbonisation, the Government can use this lever to promote net zero delivery as well as co-benefits that cover social and economic considerations.

A systems-thinking approach will be critical to achieving quicker decarbonisation across Scottish infrastructure. We are increasingly seeing the boundaries between traditionally separate sectors being broken down driven by innovation and changes in demand. As outlined in the 'A Systems Approach to Infrastructure Delivery'[8] report by the ICE: "New or expanded infrastructure services such as mobility and clean energy are delivered via complex projects that bring together physical assets, technology and digital information in the form of a Building Information

7 https://nationalperformance.gov.scot/

8 https://www.ice.org.uk/getattachment/knowledge-and-resources/briefing-sheet/a-systems-approach-to-infrastructure-delivery/ICE_Systems_Report_final.pdf.aspx

Model (BIM) or a digital twin." No longer can it be said that the electricity sector is separate from our ability to provide effective transport systems or to decarbonise the heating of our homes. This change creates a challenge to understand these newly created interdependencies and interactions and enable collaboration between organisations who have their own individual procedures and are governed by different rules and regulations. To date, different infrastructure sectors have operated in silos and there has been limited interaction and sharing of knowledge between different industries. This has led to fundamentally different ways of working, different regulatory cycles, and different skills being developed by workforces.

Even within sectors such as transport there have been divisions between rail, road, ports and aviation. All these sectors can have a role in moving goods yet there is the opportunity to have a more integrated discussion on the most efficient and lowest carbon way to achieve this. To enable a successful systems-thinking approach to be implemented, leadership must be open and agile to change and create procurement opportunities that enable collaboration and systems integration. One technical opportunity to improve systems-thinking is to employ a digital approach in planning and design. Digital twins which replicate an environment in a virtual way can be used to model and explore the interaction between traditionally separate sectors. There is also a need for consistent standards to enable and drive a systems-thinking approach between different organisations and sectors.

As with all the recommendations in this report, they are closely linked and interdependent. The recommendations constitute different parts of a jigsaw that, when put together, will create a picture of how to accelerate progress towards net zero in Scotland. To illustrate the tangible benefits that a systems-thinking approach can deliver, we have chosen to highlight the multi-award winning Smart Canal Project in Glasgow, led by Scottish Canals. This success story brings together many of the issues we have highlighted in this Insights Report: leadership, behaviour change, place-based solutions, funding and partnerships. From what began as a project to address flooding in an area of Glasgow, this project has grown to deliver a range of active travel, biodiversity, health, training and education benefits and also achieve carbon reductions.

We have also included a grid upgrade project initiated by ScottishPower which allowed FirstBus to make their Polmadie Bus Garage in Glasgow a centre for electrified buses. This initiative shows how the targeted application of one funding stream, the Green Recovery Fund, allowed FirstBus to invest and also access funding from Transport Scotland to deliver a fleet of electrically powered buses for Glasgow.

4.4.1 Case Study: Smart Canals

Project: North Glasgow Integrated Management System or Glasgow Smart Canal

Key Organisations: Scottish Canals, Scottish Water and Glasgow City Council

Key Themes: Systems-thinking, Place-based approach

The ‘Smart Canal’ forms part of the ‘Metropolitan Glasgow Strategic Drainage Partnership’ which aims to improve drainage infrastructure, water issues and flooding throughout the metropolitan Glasgow area and is itself a good systems-thinking approach. The canal scheme is being delivered through a partnership between Glasgow City Council, Scottish Canals and Scottish Water with capital funding coming from the Glasgow City Region Deal, the Green Infrastructure Fund, and Scotland’s ‘8th City – the Smart City’ programme.

Glasgow's Smart Canal, Europe's first ever smart canal, aims to make North Glasgow a 'sponge city', a city designed to capture and manage rainwater and reduce surface water flooding, by allowing the Forth and Clyde Canal to become a drainage route for excess water during wet weather events. This has been achieved through the use of predictive weather technology and sensors to forecast spells of heavy rainfall which automatically trigger the lowering of canal water levels (by up to 100mm) in the North Glasgow section of the canal, discharging the excess water to the River Kelvin. The project has created capacity for surface water drainage of up to 55,000 cubic metres and has unlocked 110 hectares of land across North Glasgow which was previously unusable. Approximately 3,000 new energy efficient homes, a school and other developments are being built on the previously unusable land. The project is also predicted to increase biodiversity along the canal front, improve health and wellbeing and create more desirable active travel routes, improving connectivity. This solution has helped to mitigate against the flood risk impact of climate change while creating conditions for further development and investment in Glasgow. A traditional engineering solution would have required the construction of a 2km long tunnel connecting the drainage systems to the River Clyde which was estimated to cost upwards of £45m and would have had a larger carbon footprint associated with it.

Figure 4-9: Making Glasgow a 'Sponge City' (Credit: Biomatrix Water)

The smart canal project is an excellent example of how systems-thinking can enable innovative ideas to achieve positive results. The success of the project is a result of the effective collaboration between Glasgow City Council, Scottish Canals and Scottish Water to turn the innovative idea into reality. A 60-year service agreement has been signed between the three organisations highlighting their commitment to sustainable solutions to mitigate the impacts of climate change.

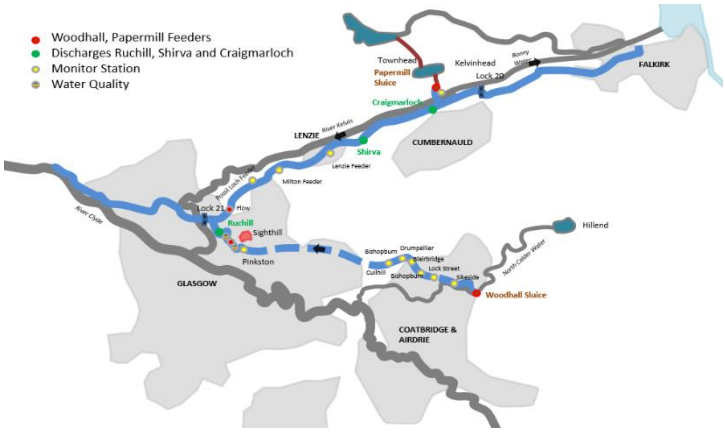

Figure 4-10: North Glasgow Canal System (Credit: Scottish Canals)

As part of the collaboration, Scottish Water has committed to maintaining all pipes which are connected to Scottish Water systems and will also maintain some of the Sustainable Drainage Systems (SUDs) being used in the project. The project also highlights how a well-designed and planned project can achieve multiple co-benefits, in this case not only improving drainage in the area but reducing carbon and improving health and wellbeing.

4.4.2 Case Study: First Bus Electric Bus Initiative

Project: Glasgow Caledonia Bus Depot Electrification Initiative Phase One

Key Organisations: First Bus Glasgow, Scottish Power

Key Themes: Systems-thinking

First Bus's Caledonia bus depot in Glasgow, the largest bus depot in the UK, has recently completed the first phase of its green transformation with the installation of 11 rapid 150kW DC charging units at the site. The new charging units, which can charge buses in just over three hours, helped to facilitate the arrival of 22 electric buses at the depot which were used during COP26 to transport delegates around the city. Further work over the next year will allow the depot to accommodate up to 300 electric buses in the future with 150 already planned to be introduced within the next 18 months. Phase two of the project will provide an additional 69 rapid chargers. Smart charging software will control each rapid charger to ensure power is used efficiently and can be spread across the majority of First Bus's fleet at one time, helping to minimise draw down from the grid at peak times. The electrification of the First Bus fleet is a significant step forward in their target to be net-zero by 2035. They are also investigating how they could further develop assets to provide flexibility services back to SP Energy Networks, to smooth charging loads and manage potential outages in the future.

SP Energy Networks, a distribution and transmission network operator, has played a key role in the implementation of the project through partnership with First Bus. The SP Energy Network Green Economy Fund has invested nearly £1.5m to help decarbonise First Bus's fleet. Initially, the fund was used to help provide two new electric buses for the First Bus fleet in December 2019 and more recently to deliver the 11 new rapid charging units at First Bus's Caledonia depot. The initial funding to enable the deployment of the first two electric buses provided First Bus with confidence in the technology which helped to them to pursue further rollout and deployment at their Caledonian depot.

The Green Economy Fund is a £20 million fund to support the Scottish Government's Energy strategy and accelerate a green economy within Scotland. First Bus were available to secure funding from the Green Economy Fund as the project contributed to the following objectives:

- Renewable and low carbon innovative solutions
- Positive environmental impacts – a reduction in carbon dioxide and improvements in air quality
- Transport – promoting the uptake and infrastructure provision of electric vehicles or other low carbon solutions
- Local energy systems – the creation of local energy solutions to match generation and demand

To handle the increased capacity because of Phase 2 of the project, SP Energy Networks is constructing a £6m substation near the Caledonia Bus Depot on land provided by First Bus which is being funded through the Green Recovery investment scheme. The Green Recovery investment scheme is a funding scheme which has been made available to distribution networks by Ofgem. The fund aims to progress actions that could facilitate a green economic recovery while accelerating the delivery of decarbonisation benefits to energy consumers.

Figure 4-11: One of the electric buses to be used in Glasgow (Credit: SP Energy Networks and First Bus)

The partnership between First Bus and SP Energy Networks to deliver low carbon infrastructure showcases what systems-thinking can achieve in Scotland by providing co-benefits to both organisations involved.

4.5 National infrastructure net zero coalition

Key message: there should be a Scottish infrastructure coalition created where key national infrastructure providers and stakeholders can convene to demonstrate leadership, share learnings and plan for an integrated economy wide transition to net zero aligned infrastructure.

Table 4.6: National infrastructure net zero coalition recommendations

ID	Recommendation	Responsibility
10	A forum should be created for key public and private infrastructure providers to demonstrate leadership, share learnings on decarbonisation best practice and drive better efficiencies in the delivery of net zero infrastructure	Industry and Government
11	Open-source training materials to improve carbon literacy skills amongst the key Scottish infrastructure providers should be developed	Industry
12	There should be an independent baseline audit to determine the condition of the existing infrastructure within Scotland to better prioritise the allocation of funds for decarbonisation initiatives	Government funded

Why

Currently, there is no one place where Scotland's major infrastructure organisations can meet and share knowledge. All are actively engaged in net zero activities at both a strategic and operational level however there is an opportunity to enhance their collective decarbonisation efforts by working in a more collaborative way. A collective approach on how to address net zero targets from such a grouping of infrastructure organisations and companies would deliver a powerful message and demonstrate to their supply chains and other key stakeholders strong leadership towards achieving net zero. Such a coalition of organisations would also present opportunities for shared learning on a wide range of aspects of decarbonisation including carbon literacy and training, circular economy activities, approaches to carbon sequestration, technical specifications and procurement amongst others. The Scottish Water Carbon Academy (see Section 4.5.1) is a good example of an initiative that all infrastructure providers could benefit from if the learnings and materials were able to be shared more widely across different infrastructure sectors.

There is also a need to better understand the current condition of infrastructure in Scotland. As noted, much of our opportunity to decarbonise will be based on the adaption of already constructed assets. Understanding what it will cost to maintain and enhance these will provide opportunities for rationalisation and carbon reductions. Accordingly, we suggest that a baseline audit be undertaken to assess the current condition of the key elements of Scottish infrastructure to understand the requirements and opportunities to upgrade existing assets, as well as to determine where new infrastructure will be required to be built.

How

Such a coalition should be convened by industry and the Scottish Government who could help set the parameters of the group. We recognise that there has been a previous suggestion for the development of a National Infrastructure Delivery Group and we fully support the reasoning behind the development of such a coalition.

We suggest that, as well as knowledge sharing, an independent infrastructure group could provide advice on the regulatory barriers which currently exist for infrastructure development and would likely include representatives from public, private and academic organisations. It presents an ideal opportunity for the Scottish Government to collectively interface with the organisations who will play a major role in helping to decarbonise Scottish infrastructure.

The increased knowledge sharing between these major infrastructure providers would enable successful initiatives and best practice to be effectively communicated such as when developing low carbon procurement systems. Currently, there are lots of positive steps being made but limited coordination or communication between different infrastructure operators. Our recommendation is similar to one made by the Infrastructure Commission for Scotland in its Phase 1: Key findings report[9] which states: “a body should be given the responsibility by the Scottish Government to provide independent, long term, evidence-based advice to Scottish Ministers on investment decisions for the social, economic and natural infrastructure needs and priorities required to deliver an inclusive net zero carbon economy.” Similar recommendations have recently been made in other UK nations.

[9] https://infrastructurecommission.scot/storage/281/Phase1_FullReport.pdf

4.5.1 Case Study: Scottish Water Carbon Literacy

Project: The Carbon Academy

Key Organisations: Scottish Water

Key Themes: National infrastructure net zero coalition

The Scottish Water Carbon Academy is an example of an initiative that has the potential to be deployed across a range of infrastructure providers. Scottish Water is committed to ensuring that their supply chain and employees become more carbon literate. They have responded to this by developing an in-house educational tool named 'The Carbon Academy'. The Carbon Academy was launched in April 2021 and continues to grow and be populated with commonly requested resources such as guidance documents, tools, data, case studies and common learnings shared through webinars and online learning events.

The idea of the Carbon Academy was formed from discussions at the Scottish Water Construction expert panel in October 2020 on potential opportunities for wider collaboration on low carbon knowledge and skills. Here, Scottish Water tried to work out how to build knowledge and change the mindset towards net zero within the company and its supply chains. Following that discussion, a subgroup was set up to support the development of the academy. Those involved included Scottish Water, Arc, M2, Morrison Construction and the Construction Scotland Innovation Centre. This led to further refinement of the idea where it was decided that an educational tool should be created to inspire, equip, grow, and empower water professionals at all levels to deliver zero carbon approaches to providing water services across Scotland. As a result, the Carbon Academy has been placed on Scottish Water's external learning hub which is also linked through the Scottish Water procurement portal enabling both Scottish Water staff and their supply chain to have access to all the same materials.

Figure 4-12: Scottish Water's Carbon Academy (Credit: Scottish Water)

The Academy is regularly promoted at presentations, highlighting the most recent materials uploaded. The materials currently included have been developed to be small 'bite-sized' pieces of information that can be utilised within team meetings and used to promote discussion. The Academy supports the collaborative ethos of Scottish Water towards its supply chain. It also provides a platform for Scottish Water's Delivery Vehicles to showcase their expertise and delivery of net zero.

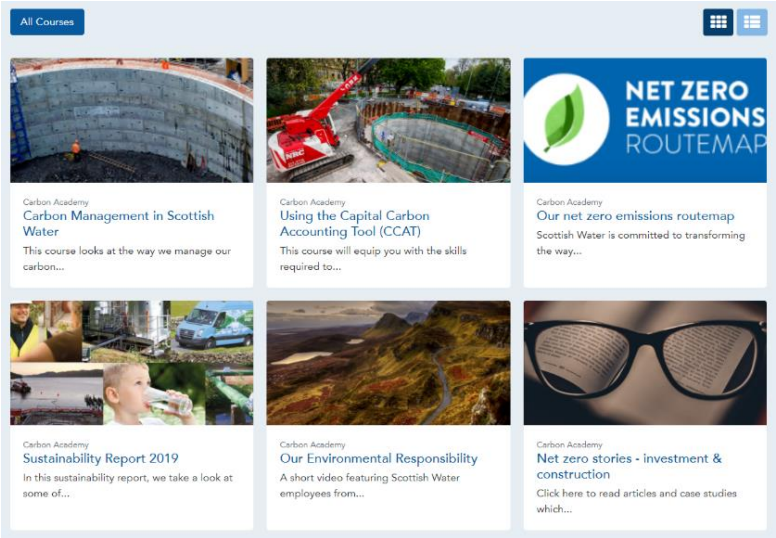

Figure 4-13: Scottish Water's Carbon Academy home page (Credit: Scottish Water)

The Carbon Academy is an excellent example of how an organisation can utilise its expertise to further improve the carbon literacy skills of both its own employees and its supply chain. There is an opportunity to further develop open-source training materials to a wider audience within Scottish infrastructure to ensure knowledge

sharing on carbon literacy and good practice on carbon reduction and sustainability is maximised throughout the infrastructure sector.

5 Summary

This report has been commissioned by ICE Scotland to highlight the opportunities for the infrastructure sector to speed up Scotland's national journey to net zero. The extensive series of stakeholder interviews that have been undertaken to inform this report emphasise that the decarbonisation of Scottish infrastructure is already well underway throughout many sectors and organisations. Yet, the scale and pace of the decarbonisation challenge ahead of us requires bolder action on a much larger scale. This will not be a surprise to those engaged in the delivery of the Government's net zero ambitions. If we are to meet our 2045 net zero target and the interim steps beforehand, we must rapidly integrate decarbonisation to be a core objective of new infrastructure projects and during the upgrade of existing assets. The 2020s must become the decade of delivery where we move past the stage of pilot projects and short-term funding to a place where decarbonisation is embedded throughout the infrastructure sector.

Achieving change must be a team effort and there are responsibilities for both Government and industry to enable quicker and more effective decarbonisation of Scottish infrastructure. Our conversations have identified four cross-cutting topics which will influence Scotland's ability to decarbonise. These are: behaviour change, training and skills, leadership and funding. Behaviour change will be required by policy makers, designers, and engineers to embrace new technologies, upgrade existing assets, and develop solutions to implement low carbon infrastructure. To decarbonise infrastructure in this way will require a skilled workforce equipped with the necessary knowledge and training. This will require additional skills to those currently possessed and developing these will be critical in ensuring the decarbonisation transition is fair and just for workers. Effective leadership will be important to manage risk. Finding a way to move past typical 5-year government terms to provide consistency for developers and funders over a longer timeframe will be required. At the same time, maintaining incentives for short term delivery to meet our interim decarbonisation objectives is vital. It will be critical to accept that risk can be a by-product of innovation and leadership will be needed to implement effective measures to mitigate the downsides where possible. The public sector will have a crucial role to play in taking on some of these risks to leverage greater private sector investment to generate the change that is required.

While progress varies between different infrastructure sectors, Scotland overall benefits from ambitious national policies and targets to encourage effective decarbonisation. What is missing is a clear route map that outlines the necessary delivery steps required in each infrastructure sector. This route map should show how collaboration can be further developed and detail the types of projects that will support the levels of decarbonisation necessary. This report has outlined five key themes where action should be focussed to enable positive change. These areas of focus are: embedding carbon throughout procurement, developing a place-based approach to infrastructure delivery, ensuring planning and regulation are adequately aligned and resourced, adopting a systems-thinking approach to integrated infrastructure delivery, and creating a national infrastructure coalition focussed on promoting decarbonisation. For each of these themes we have identified specific, attributable recommendations which will help accelerate the decarbonisation of Scottish infrastructure. Our key recommendations include:

1. Public sector procurement should include a consistent focus on carbon reduction.
2. The planning process requires more investment to enable the pace and scale of change required to deliver net zero infrastructure.
3. Greater use of digital tools should be used to identify interactions and efficiencies between traditionally separate sectors (e.g., using digital twins)

4. A forum should be created for key public and private infrastructure providers to demonstrate leadership, share learnings on decarbonisation best practice and drive better efficiencies in the delivery of net zero infrastructure

Overall, the decarbonisation of Scottish infrastructure can be accelerated through increased pace and scale in the delivery of initiatives like those that are already being implemented across the country. This acceleration will require additional funding, improved carbon literacy through training and skills development and effective leadership to provide support and consistency. There is undoubtedly a lot to celebrate in Scotland already and some world leading practice from which we can learn and take confidence. The recommendations in this report provide tangible steps that will help policy and decision-makers enable the broader decarbonisation of our infrastructure sector and help Scotland meet its net zero ambition.

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