**The value of "low-carbon thinking"**

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Introduction

In New Zealand, the Climate Change Response (Zero Carbon) Amendment Act 2019 commits us to net-zero carbon emissions by 2050. It is worth noting the significance of this goal and what net-zero means relative to ‘carbon neutral’. Net-zero carbon is the reduction of carbon emissions with the goal of balancing those remaining emissions produced with those emissions removed from the earth’s atmosphere. The key difference of carbon neutrality is its allowance for ‘offsetting’ the remaining emissions through ‘carbon credits’ where net-zero requires a balance without offsets.

The transport sector has a significant role to play in achieving this target, requiring a step-change in how we design, build, and manage our transport assets. However, low carbon does not mean high cost. Carbon is a good proxy for resource use, focusing on ways to reduce it drives more efficient planning, design, construction, and management of assets, and improves bottom line performance.

This paper summarises the “low-carbon thinking” approach that has been applied across the design and delivery of more than NZ$15bn of transport projects in the UK and is currently being implemented on a single programme NZ$12bn spend on public transport infrastructure in Australia. The right combination of people, process and technology can save millions of tonnes CO2e and dollars.

Progress is being made across the infrastructure sector in terms of measuring, understanding, and reducing embodied, operational and user carbon. The most significant strides are being realised by those organisations that embrace and embed “low-carbon thinking” in their people and processes and employ technology solutions that support this new way of working.

To now, the transport sector has been slower than other sectors in implementing this approach, particularly in relation to embodied carbon. Its focus on operational and user carbon has yet to see reductions with rapid increases in carbon emissions, Ministry for Environment monitoring data shows that CO2 emissions from road transport fuel rose 102% from 1990 to 2018, which is twice the pace of population growth. However, this affords the sector an opportunity to identify the best approaches and crystallise on a standard approach to carbon management across infrastructure – an opportunity the size, makeup and maturity of outlook of the NZ infrastructure sector makes uniquely possible.

The value of “low-carbon thinking” is not merely seen in carbon or financial accounts but through realisation of real quadruple-bottom line value outcomes across public infrastructure delivery and operations.

Our current context

We are all facing a climate emergency and people are questioning what can I, my organisation, my community, or country do to tackle this existential threat?

New Zealand’s commitment to net-zero carbon emissions by 2050 as part of the Climate Change Response (Zero Carbon) Amendment Act 2019 shows a high level of ambition to drive decarbonisation. This is providing the step change in our approach and analysis of future asset portfolios across every sector. Considering the lifespan of some assets, those in planning now need to operate in a net zero emissions future and need to be designed accordingly.

While all sectors recognize the need for carbon reduction, infrastructure has lagged relative to its contribution of our total footprint with great progress being made within the energy and water sector. Progress is needed to move the industry on to a trajectory that will ensure we meet national targets. Awareness and momentum is there and steadily building with carbon management growing in New Zealand and the early adopters showing the leadership required.

Infrastructure is essential to improve the quality of lives everywhere and will inevitably expand as New Zealand continues to grow to provide a more robust and sustainable network. Although vital to economic and social development, infrastructure projects are a key source of greenhouse gas emissions. It is therefore important that infrastructure is delivered in a low-carbon way to minimise impact.

This is a global problem and New Zealand can benefit from some of the innovations realized internationally such as *PAS 2080: Carbon management in infrastructure* developed in the UK to provide the framework for organizations and this nation to meet this challenge together and really drive decarbonisation at every level.

Infrastructure will play an essential role in reaching net- zero carbon. The target to decarbonise the New Zealand electricity grid within the decade will help address a part of our national carbon footprint will only emphasize the role of infrastructure to play its role due to:

1. Our electricity grid accounts for the minority of fossil fuel energy use in New Zealand.
2. The reduction of operational carbon will place a larger focus on embodied capital carbon.

Both consequences of New Zealand’s successful decarbonisation of the electricity grid impact the transport sector primarily which currently accounts for a large portion of the energy usage in New Zealand and has an inherently large, embodied capital carbon contribution.

**The transport sector’s carbon challenge**

Transport is the single largest source of carbon dioxide emissions in New Zealand, accounting for 36.3 per cent in 2018 with most emissions coming from road transport. This story is consistent globally with UK’s transport sector according for 34% as of 2019 despite the energy sector being more dependent on fossil fuels. Trends highlighted over the past 30 years highlight the shortcomings of business-as-usual approaches to transport planning, investment and vehicle regulation to realize the necessary outcomes.

The movement of people has been central to our progress but to address the challenges ahead we need to not only change how people travel but where they travel also. A major shift in travel habits is required to meet the decarbonisation challenge which can equally deliver social, economic and environmental outcomes by changing how and when we travel to best utilize the infrastructure within its capacity.

Accentuating Covid-19’s work-from-home trends, we have an opportunity to make a step change in our multi-modal network and urban planning that accelerates our emission reduction objective. Schemes such as revitalising local centres, plan transit-based development, and deliver place-making schemes that reduce the distance, need and type of travel while engendering local economic recovery can deliver not only environmental outcomes, but social, economic and cultural.

**Change is coming.**

They net zero targets for New Zealand as a nation require a coherent and collaborative response. To make this possible and understood by the public and private sector across every industry the Ministry of Business, Innovation and Education (MBIE) and He Pou a Rangi Climate Change Commission have released reports in recent months setting out an immediate path to realize the governments goal. The truth is that under our current policies such as the Emission Trading Scheme (NZ ETS) we will not achieve the net zero target, the decline of emissions simply needs to be steeper, something needs to change.

The most recent of these is the 2021 draft advice from He Pou a Rangi Climate Change Commission bringing the target forward to 2035 as a milestone towards 2050. They recommend an integrated national transport network to reduce travel by private car and service the growing population. To achieve this, we need to change the way we build and plan our towns and cities and the way people and products move around. Investment in good cycleways and footpaths and moving freight off the road will all contribute significantly.

There in lies a conundrum, the construction of linear assets for transport, from footpaths to railroads have a potentially significant embodied capital carbon footprints from the materials used to the construction process which equally needs addressed. We need to look at the big picture and consider the life of the asset and the balance of capital carbon to construct and maintain and the potential operational savings over the life of the asset.

In terms of operational and user carbon, the proposed path in the CCC draft advice for the transport sector sees emissions drop significantly to nearly 50% of current levels of 16.6 Mt CO2-e to 8.8 Mt CO2-e by 2035. CCC identify the electrification of vehicles as key to achieving these reductions by addressing the 91% contribution to current levels by road vehicles using fossil fuels. This is what we call a ‘hotspot’ where most of a carbon footprint lies and where the biggest reductions can be achieved.

Carbon Management

Disruptive change can be a good thing and used effectively, standards can play an important part in achieving this. For example, when the PAS 1192 series of standards on building information modelling (BIM) was introduced in 2013 it facilitated a step change in the uptake of BIM globally. The world’s first carbon management standard for infrastructure *PAS 2080* – is set to do the same for carbon, providing the framework and guidance needed to effectively manage and reduce carbon.

It is a voluntary standard which provides guidance on how to initiate and embed low carbon thinking paving the way for a consistent approach to methods, measurements and reporting making it easier to talk about carbon and cost right across the supply chain.

Until recently, businesses have had to steer their own carbon cutting agendas building upon the example of others. The BSI’s PAS 2080 standard provides much needed guidance to help all asset owners make the most of carbon management by empowering the entire value chain to identify areas of improvement. For most, complying with PAS 2080 will lead to a complete rethink of ‘business as usual’. But as always, it will be businesses at the vanguard of change which reap the rewards. It’s real value though is that it is that it is not only applicable for infrastructure asset owner operators, but the entire value chain including designers, constructors and manufacturers who can also become PAS 2080 certified.

**Calculate the baseline**

To plan any journey, you first need to understand where you are starting from. A crucial first step in low carbon thinking is establishing the carbon baseline from both an embodied capital and operational carbon perspective to understand where the hotspots lie within your organization to achieve the biggest reductions.

A baseline is a snapshot of a moment in time which evolves as technology improves to change the proportion of embodied capital carbon (CapCarb) and operational carbon (OpCarb) as the decarbonisation of the electrical network and operational emissions are reduced will place a great significance on embodied capital carbon.

A baseline should provide opportunity to make carbon reduction savings so is best utilized when calculating the capital carbon impact of a future programme of works to understand the carbon footprint if delivered traditionally. This provides the yard stick against which you can compare how it was delivered once complete.

A baseline provides a clear picture of where carbon is through the different processes and materials that constitute a project so you can make the greatest savings.

**Reduction targets**

Once you understand your starting point in your low carbon journey with a carbon baseline you can now set an audacious goal for how much reduction on that baseline you want to achieve at a project, programme or organisational level. This reduction target is the vision statement that helps focus any low carbon thinking into what the entire supply chain is trying to achieve. It should be challenging and achievable bringing the realities of a net-zero New Zealand closer to home for those planning, designing, and constructing your assets today and into the future.

The two factors to consider in a reduction target to consider is firstly it size; it needs to aspirational yet achievable. Secondly, where it is applied. A project example would by the A428 by Highways England, a $1Bn 19km dual carriageway that has set the goal of being carbon negative, or at a programme level such as Transport for New South Wales AU$20Bn Sydney Metro programme which is taking a pragmatic approach setting targets such as 25% reduction in use of Portal Cement and offsetting 25% of construction electricity which is the equivalent of planting over a million trees. At an organisational level Watercares 40:20:20 targets 40% reduction of embodied carbon in construction by 2024 allowing for variance across its capital programme with the overarching goal still to be achieved.

New Zealand has several reduction targets to break down the audacious goal of net-zero by 2050 to set the trajectory and drive the change required for every industry to meet them. The carbon neutral goal of public organisations by 2025 and national emissions being 30% below 2005 levels by 2030 are two examples where decisions this year will directly influence. These will not be achieved through efficiency alone as New Zealand continues to grow but through low carbon thinking throughout the supply chain to interrogate what outcomes they are trying to achieve to maximize savings throughout the project lifecycle.

**Emission reduction pathways**

Every organisation has a role to play in bringing low carbon thinking to the forefront of every decision. Calculating the baseline and setting your reduction targets sets the direction you want to go but it can’t be left to the supply chain to achieve this goal. You can help achieve your reduction target through the formation of emissions reduction pathways. These should take into consideration the impact of different choices as well as trade-offs to get a clear understanding of how to best decarbonise.

Having a breakdown of your carbon baseline to illustrate the proportion or embodied capital and operational carbon and where the hotspots are you have clear signposts of where you are most likely to find the carbon savings will be found to help inform your emissions reduction pathway. Depending on your organisation this may be a strategic indication of where you want efforts focused or a prescriptive criterion that must be adhered to. This pathway should empower the supply chain to challenge and innovate so together the reduction targets can be achieved. Too many asset owners feel they need to steer their carbon-cutting journey themselves.

**A collaborative effort**

There is an increasing understanding that innovation comes not from clients or certain parts of the supply chain, but from the network. Instead of bringing new parties into the process when the solution has already been decided with little scope to add value through innovation, the whole team must be integrated from the beginning.

Decisions made by today’s infrastructure professionals will fundamentally determine the viability of our national and global targets. It is no longer a distant problem. We all need to ask ourselves: where does my current project fit on this roadmap to zero emissions? Are the assets I’m designing now fit to operate in a net zero nation? Any emissions not designed out now will have to be offset in future with expensive – and unproven at scale – ‘negative emissions technologies’ such as biomass energy with carbon capture and storage (BECCS).

The effective alignment of the supply chain from designers to contractors is already delivering innovations that were not previously envisaged as part of the emission reduction pathways that fostered this thinking. This is a reassuring sign that it is possible to elevate our low carbon trajectory, but it requires greater effort and collaboration from the rest of the industry.

And there is certainly a business incentive. Those who can deliver this infrastructure in accordance with the NZ’s zero carbon ambitions will be best placed to win work over the next three decades.

Manufacturers can calculate the carbon footprint of their products – considering constituent materials, the energy that goes into the manufacturing process and delivery to site using PAS 2050 methodology, the specification for assessing the greenhouse gas emissions of goods and services.

Often the products and services offered reflect common industry specifications, but is there an opportunity for them to change or challenge the design and the specification? Empowering the supply chain early in the process gives them an opportunity to find new ways of achieving outcomes through design, processes, and materials innovations.

**International success stories**

The UK’s most progressive infrastructure clients and their supply chains have tackled carbon emissions at both project and programme level such as Anglian Water, the UK’s largest water and water recycling organisation who have won awards such as the Construction Innovation Award for Low Carbon. They have driven down capital and operational carbon against a 2010 baseline and exceeded its capital and operational reduction targets of 60% and 40% by 2020, reducing average capital costs of assets by 22% in the process[[1]](#footnote-1).

A focus on cutting carbon forces consultants, contractors, asset managers and owners to challenge traditional technical management and commercial solutions. Instead of squeezing supply chain margins, savings are achieved by coming up with new ways to design, build and operate infrastructure. Cement manufacture alone accounts for 5-7% of global emissions, there are already options available for lower-carbon concrete in New Zealand with manufacturers such as Allied Concrete now demonstrating their environmental credibility through Environmental Product Declarations (EPD).

What people believe about carbon determines what they do about carbon – people need to see and know that carbon is of central importance. Carbon reduction must take its place within organisations in a similar way to ethics and health and safety, because, like those values, carbon reduction makes business sense.

**What organisations need to achieve low carbon thinking?**

The success stories for instilling low carbon thinking comes from these international organisations all operating in very different environments and are on different low carbon journeys. But their headline messages are shared:

**Provide bold leadership.**

All have challenged the status quo, using the low carbon agenda to shake up thinking within their own organisations and in their supply chains. They have set goals and demanded that everyone pulls out the stops to achieve them. Failure isn’t an option.

Carbon should consistently be in the ‘top 10’ items for board meeting agendas, because those boards produce the policy-based framework within which strategic decisions about carbon can sit. However, the ability to lead is not exclusive to those at the top of an organisation, nor to those at the higher end of the value chain.

Leadership can come from anywhere, and if organisations are going to create the kind of culture shift, we need where carbon is concerned, they must encourage leadership from their junior staff and from their suppliers, because leadership flows up as well as down. Leveraging leadership from both ends of the spectrum is essential to making carbon reduction a core organisational value.

**Set yourself up for innovation.**

Delivering projects is not about the process, it’s about the outcomes. Specify the services that need to be supplied by new or improved infrastructure, and the performance it needs to achieve. The opportunity to cut carbon decreases dramatically as you move through the phases of a construction project so engage your supply chain early.

There are lots of lower carbon, lower cost options available. Examples include using novel construction techniques, LED lighting and substituting building materials, such as using 95% recycled aluminium, which has an embodied carbon footprint five times lower than that of virgin material. Continuing to do things in the same way will only get the same results.

**Flex muscle through procurement**

Procurement departments have a central role in advancing low carbon, low-cost solutions – they must be challenged to write carbon into tender and contract documents. This is where risk is allocated, innovation encouraged and performance incentivised. Simply, if carbon is not in the contract, motivating and enforcing performance is difficult if not impossible.

Set an outcome-based specification when procuring a project, not a product- or process-based specification. That enables suppliers to bring new thinking. Incentivise innovation in procurement and commercial arrangements and challenge your suppliers to compete against each other to find the lowest whole-life carbon and cost solutions.

For major infrastructure clients, an enterprise model for delivery can provide the certainty and empowerment for the wider value chain to spur innovation and reap the rewards[[2]](#footnote-2).. This combined with the use of commercial models that drive the right behaviours with the supply chain and incentivise ‘no build’, ‘less build’ and ‘smart build’ innovative solutions is a proven strategy for reducing cost and carbon.

Conclusions and recommendations

Through leadership and innovation, you can unlock potential not yet realized in the design, construction, and operation of your assets. The right combination of people, process and technology can foster a safe environment where the team is empowered to challenge the status quo and promote innovative solutions to help realize the outcomes you want to achieve.

The dissemination of carbon domain expertise into digital solutions such as Moata Carbon Portal enable the entire supply chain to understand a previously unconsidered metric and test various solutions with ease providing a first mover advantage to show leadership and be ready when policy is ratified. The pace and scale of change does not look to abate in the coming decades, organisations are looking to tools and frameworks to help guide them on a new low carbon journey.

The PAS 2080 standard and its guidance document provide this carbon management framework that aligns the entire supply chain to establish a common understanding, approach and language for whole life carbon management in the provision of economic infrastructure (defined as water, energy, transport, communications and waste). This PAS standard covers:

* The integration of GHG emission into infrastructure delivery
* Leadership and governance
* Quantification of emissions
* Target setting, baselines and monitoring
* Reporting and information management
* Continual improvement
* Responsibilities across the value chain

Ensuring reduction targets are met through emission reduction pathways necessitates commercial implications to ensure it gets the attention it deserves. However, getting the right balance of fostering a culture of innovation requires careful thought and consideration to achieve the ultimate goal of low carbon solutions to achieve social, economic, environmental and cultural outcomes rather than definitive carbon accounting.

The transport sector is service driven industry with people serving people. To build robust, sustainable infrastructure that enables the movement of people and goods. The objective of addressing climate change to ensure a better sustainable future for generations provides all the motivation needed for action today. The emerging generation are informed and empowered, aware of Earths plight and aiming to help solve todays challenges. They will not only be using the assets we are planning today but become part of the workforce that helps operate and maintain them, so we are in safe hands. Our task is to think in a multigenerational context and set New Zealand up for a net-zero future.

1. https://www.anglianwater.co.uk/about-us/our-reports/annual-integrated-report/outcome-performance-2020/ [↑](#footnote-ref-1)
2. https://www.project13.info/ [↑](#footnote-ref-2)