Study Report SR490 [2024]

Climate change readiness in the construction sector

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Preface

This report outlines research from a Building Research Levy-funded project *Get Ready: preparing building and construction businesses for the transition to zero carbon*. This project was a collaboration between the University of Otago's Department of Management and BRANZ Ltd.

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Abstract

This research seeks to understand the readiness of the construction sector to address climate change, particularly in terms of business operations and products. This research aims to investigate how the building and construction industry is preparing to address climate change, the barriers and motivations for climate action/inaction within the building and construction industry and how the building and construction industry can be supported to prepare for the impacts of climate change. A qualitative case study approach was undertaken. This report outlines the barriers and opportunities identified within the sector, four case studies of businesses within the sector and a toolkit to provide guidance about how to prepared to address climate change. A climate cultures model suggests three aspects should be focused on when creating readiness to mitigate for and adapt to climate change: material culture, climate practices and norms/values/meanings. The report outlines how these aspects work together to create a sense of a climate culture that shapes the level of climate-change readiness at the organisational level.

Keywords

Transitions, zero carbon, climate change, climate cultures, readiness.

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Executive summary

The Paris Agreement on climate change outlines that we need to hold the global average temperature increase to no more than 1.5°C above pre-industrial levels to avoid a climate catastrophe. Within New Zealand, the Climate Change Response (Zero Carbon) Amendment Act 2019 sets out greenhouse gas emissions reduction targets and initiatives to help the country meet its obligations under the Paris Agreement such as reducing net emissions of all greenhouse gases (except biogenic methane) to zero by 2050.

The construction sector has a critical role to play in addressing climate change, emphasising the need for both mitigation and adaptation measures. Aotearoa New Zealand's emissions reduction plan focuses on reducing building-related emissions by targeting embodied carbon and operational emissions. The study explores how construction companies understand and prepare for climate change through conducting case studies and using interviews and secondary materials. The analysis employs the Energy Cultures framework to assess how companies embed climate change into their organisational practices and cultures.

The climate cultures model identifies material culture, climate practices and norms/values/meanings as key aspects influencing climate change readiness at the organisational level. The study reveals barriers and enablers for construction companies in preparing for climate change such as accreditations, organisational values and collaboration as enablers, while a lack of regulation, resistance to change and cost considerations act as barriers.

The key findings suggest a relationship between material culture, climate practices and values, emphasising the importance of integrating these aspects for effective climate change readiness. The report concludes with recommendations for construction companies, including developing an understanding of climate change, adapting practices and collaborating across the sector. The study positions climate change and sustainability as the next health and safety issue for businesses, advocating for the embedding of climate cultures in organisational practices to proactively address climate-related impacts and risks.

The report also provides case studies of four construction companies and explores how they have sought to address climate change and the transition to zero carbon within their operations. These case studies provide insight and also a vantage point for gauging how far along the construction sector is in the transition to zero carbon.

This report concludes by outlining a toolkit that offers guidance to construction companies who are looking to address climate change and prepare for the transition to zero-carbon construction within their operations. We see this guidance as a first step in helping companies on their journey. This report's key contribution is insight into current construction sector practices in relation to climate change and the transition to zero carbon within operations at a point of time when understanding, knowledge and action on climate change is still in its infancy but needs to urgently accelerate to meet our 2050 carbon targets.

1. Introduction

This research aims to understand the readiness of the construction sector to address climate change, particularly in terms of business operations and products.

The Climate Change Response (Zero Carbon) Amendment Act 2019 provides a framework by which Aotearoa New Zealand can develop and implement clear and stable climate change policies. Since the passing of this Act, the Ministry of Business, Innovation and Employment (MBIE) Building for Climate Change programme has sought to create regulations that will reduce greenhouse gas emissions for buildings and their operation. While the regulations and policies to help the construction sector reduce greenhouse gas emissions are still in progress, our research sought to understand what the construction sector is currently doing to address the issue and challenge of climate change.

This report outlines research undertaken with members of the building and construction industry and outlines a toolkit to assist industry with future planning and preparedness for addressing climate change within their business.

1.1 Research aims

This research was guided by three central research questions:

- How is the building and construction industry preparing to address climate change?
- What are the barriers and motivations for climate action/inaction within the building and construction industry?
- How can the building and construction industry be supported to prepare for the impacts of climate change?

1.2 Methodology

Sample

A purposeful sample of eight construction companies were used as case studies. These companies were a mix of small to medium and large enterprises from across Aotearoa New Zealand.

Method

A case study approach was undertaken informed by qualitative methods. The case studies are empirical inquiries that investigate a contemporary phenomenon within a real-life context and involve data collection from multiple sources such as document analysis to help provide context to the qualitative data.

Data analysis

All empirical data was de-identified and codes identifying participants were stored as separate electronic files.

Thematic analysis was conducted using inductive reasoning guided by Gibbs' (2007) framework, which included: (1) transcription, familiarisation and immersion into data; (2) code building; (3) dis/conformity theme development; and (4) data consolidation and interpretation. The authors discussed and reviewed the emerging coding and organisation of themes for the case studies.

Human research ethics review was undertaken and approved according to University of Otago Department of Management ethics committee and University ethics policy.

1.3 Structure of report

This report is structured as follows:

- Chapter 2 outlines an in-depth discussion of the qualitative research and addresses the barriers and opportunities companies face in relation to preparing to address climate change.
- Chapter 3 outlines four case studies that aim to provide context around how they operate within the market and how their experience is linked to their climate action.
- Chapter 4 outlines a toolkit that construction sector businesses can use to help them prepare their business to address climate change.

2. Climate cultures – embedding readiness for climate change in the construction sector

Climate change is the most pressing challenge facing global society today and requires urgent systemic transformation to both mitigate and adapt. To meet the Paris Agreement's ambitious carbon budgets, rapid decarbonisation needs to occur.

Aotearoa New Zealand's first emissions reduction plan identifies that more than 9% of domestic carbon emissions in Aotearoa New Zealand were building-related in 2018 (Ministry for the Environment, 2022a, p. 226). The plan has two focus areas for reducing emissions in construction: to reduce the embodied carbon of buildings and to reduce operational emissions. The long-term vision is that by 2050, "building-related emissions are near zero and buildings provide healthy places to work and live for present and future generations" (Ministry for the Environment, 2022a, p. 226).

In addition to decarbonisation, water efficiency is one of the aims of the draft national adaptation plan (Ministry for the Environment, 2022b). Particularly relevant to housing developments, this plan includes proposed work on the integration of nature-based solutions for the urban environment to build resilience and reduce the impact of extreme events.

The construction sector has the ability to influence future emissions by thinking about the types of buildings currently constructed and the materials used.

It is widely recognised that climate change means that a transition to a zero-carbon society is going to be needed.

The two key areas of climate action to assist the transition to zero carbon are:

- mitigation of climate change through reducing emissions in the construction of buildings and reducing waste and emissions associated with construction waste
- adaptation for climate change through constructing buildings for changing conditions, especially aspects such as sea-level rise, and increasing numbers of storms, floods and other extreme weather events.

2.1 Research

This research qualitatively explored how companies in the construction sector understand climate change. It sought to understand what steps companies are to prepare themselves for the impacts of climate change (physical, economic and political).

Eight case studies were conducted on construction companies that each had a climate change strategy or approach outlined on their website. (Only four are reproduced in this report due to privacy reasons.)

Interviews were chosen as the key research method, as having a purposeful conversation would generate useful and rich data. The interviews adopted an open questioning style.

Participants were asked about what they knew about climate change and to describe the ways in which their company was preparing for climate change.

In addition to the interviews, secondary material was collected from the participants themselves – websites, online and physical publications and media reports. This material was used in writing the case studies and analysis of a company's climate culture.

Climate cultures were developed through the analysis process. The case studies were analysed using the Energy Cultures framework as a template (Stephenson et al., 2010, 2015b) to make sense of how each company is embedding climate change into its everyday organisational practices and cultures.

The Energy Cultures framework is an interdisciplinary model that provides a way to analyse energy behaviour (Stephenson, 2018; Stephenson et al., 2015b). It focuses on three elements of culture:

- Norms and aspirations – how people/organisations think about energy
- Material culture – what people/organisations have in terms of energy-using devices.
- Energy practices – what people/organisations do that uses energy.

These three cultural elements operate in a dynamic iterative way to construct an energy culture. This framework can be found in research examining energy cultures at an individual or household level (for example, Rau et al., 2020), in transportation (for example, Stephenson et al., 2015a) and in organisational analysis (for example, Bell et al., 2014; Walton et al., 2020).

This research utilises the framework to see how each of the eight companies in the case studies has constructed their own climate culture.

The aim of the analysis is to gain an overall understanding of the organisational adaptabilities of the companies and to look for general patterns in the capacity of an organisation to adapt to the impacts of climate change (Hertin et al., 2003).

2.2 Findings

The climate cultures model (Figure 1) suggests that three aspects should be focused on when creating readiness to mitigate for and adapt to climate change: material culture, climate practices and norms/values/meanings. These aspects work together to create a sense of a climate culture that shapes the level of climate-change readiness at the organisational level.

The model depicts the main ways that the companies who took part in the study created a climate culture. Across all the studied companies, we saw a relationship operating between the material culture, climate practices in the organisation and the values, norms and meanings attributed to climate change. To embed a sense of readiness for change, a combination of factors from all three aspects need to work together.

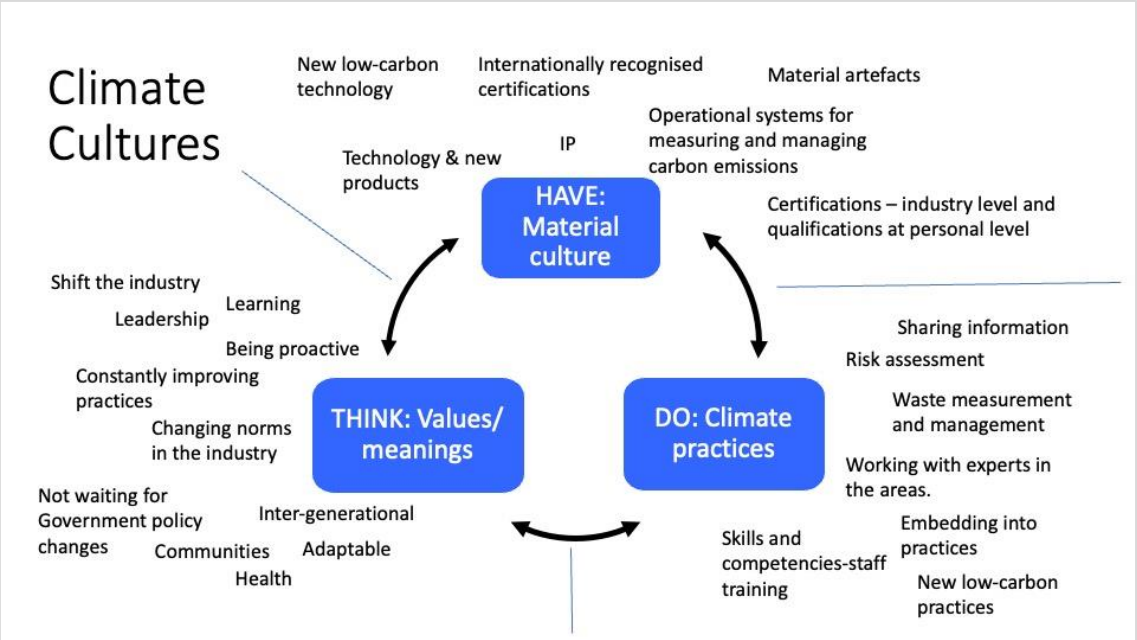

Figure 1. Climate cultures model prototype.

To summarise and as a template, Figure 2 organises the aspects of material culture, practices and values into key themes.

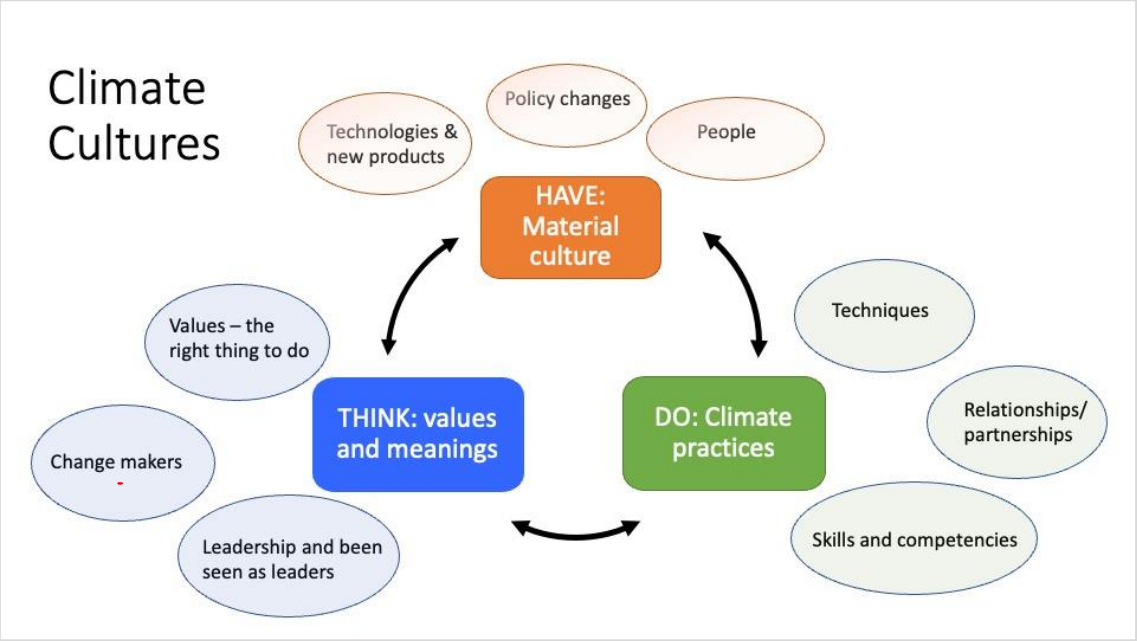

Figure 2. Climate cultures model overview.

2.2.1 Barriers and enablers to developing climate cultures

The participants were asked about what they perceived as the key barriers to change across the construction sector. Table 1 outlines the key responses to that question and an analysis of what had enabled their companies to prepare for climate change.

Table 1. Key enablers and barriers for construction companies preparing for climate change and the transition to zero carbon.

Enablers	Barriers
Accreditations and collaborations: Participants discussed the need to have more proven technologies and the benefits of working with other associations to help share information about technologies and practices.	**A lack of regulation and policy:** Participants suggested roadmaps of policy changes. They also explained the need for urgent changes to the Building Code to meet international standards and highlighted the limited poor-quality information being shared in the industry.
Organisational values: For example, having a sense of who you are as a company helped drive decision making for sustainability and climate change. Some participants saw developing a company climate culture as a key point of difference to others in the sector who might not be addressing climate change.	**Lack of (national and local) government coordination:** Many participants commented on difficulties working with government departments that might have top-level statements around sustainability and climate change but that are poorly understood at ground level. Furthermore, interpretations of the Building Code across councils caused delays, extra work and stress.
Changing attitudes: Participants were pleased to note that change is occurring. They saw this in the form of tenders (such as specifying social and environmental outcomes) and working with clients who valued sustainability. They saw a slight shift (and the potential for a greater shift) towards good quality and sustainability as being measures of success rather than a cost and consenting requirement.	**Costs:** The overriding focus on capital building costs alone needs to change to an integration of both capital and operating costs of the building. A focus on capital building costs alone means there is no business incentive to change.
Role models and leaders in the sectors: Participants perceived that having role models and leaders helps to influence change. Many saw themselves as the leaders in the climate change/sustainability space. Participants spoke about the larger companies changing first and that change trickling down. Case studies of what companies are doing were welcomed.	**Resistance to change:** Most of the participants involved in the study mentioned resistance to change in some way. This could be in the form of the market not being ready for change or unwillingness from the sector and people within the organisation.
Costs = carbon: A couple of the organisations mentioned that, if you look for the money, there is usually carbon involved – meaning that carbon is where the greater costs are in the construction process. Chasing the money means following the carbon so reducing the carbon can reduce operational costs.	**Risk perception:** Participants mentioned that companies have to change the way that they perceive risk. The sector was described as a high-risk, reactive industry, which doesn't bode well for climate change mitigation and adaptation practices. Risk also needs to include risk from not mitigating and adapting to climate change.
	Clients: Clients are a key component that drive the construction process. Participants mentioned aspects like shifting mindsets away from having large houses. Showing clients options that include sustainability and reduced carbon can encourage clients to adopt these alternative builds.

2.3 Getting ready – what can the construction sector do?

There are several key actions companies in the construction sector could take to get ready for climate change and build climate cultures within their companies:

- Develop an understanding of both climate change and sustainable practices. Learn about technologies such as materials and processes that enable a climate-ready company. Appreciate that this could be an opportunity for a company and does not always have to be a cost.
- Be able to change and adapt to situations by changing practices. Many construction companies do not have significant amounts of fixed assets so can change their practices relatively easily. Mindsets are changing quickly, and companies need to understand their market and business environment and be prepared for ongoing change in a dynamic environment.
- Collaborate across the sector. Look at who has tools to help understand carbon emissions and understand the metrics around low-carbon, high-performance buildings.

Climate change and sustainability were discussed by a few participants as being the next health and safety issue for business. For example, they saw sustainability and climate cultures becoming embedded in organisational practices and operations.

To conclude, when developing behaviour change in organisations, it is important to consider:

- the material culture – the things you have
- the practices – the things you do
- values, norms and meanings – the way that you think.

Together, all three aspects can embed a climate culture in a company that proactively creates readiness for both the impacts and risks associated with climate change.

3. Case studies

In 2023, we undertook a series of case studies into a variety of construction companies that had integrated climate change and the transition to zero-carbon construction into their operations and organisation strategies and practices. The intent is to give insight at a point in time into how Aotearoa New Zealand construction companies are currently addressing climate change and the transition to zero-carbon construction. It is hoped these case studies will provide inspiration for other companies to start and explore how zero carbon can be operationalised within their own organisation.

3.1 Craft Homes

> We've got to get moving. We need to change the Building Code and start looking at our choice of materials and construction techniques. The more homes that we build to today's Building Code, the more homes that we're going to fix later on.

Craft Homes is a family-run building company based in the upper North Island that specialises in Passive House and high-performance, energy-efficient builds. The business is niche – at the moment in New Zealand, there is only a small market that understand the principles of building this way, but this has the potential to expand over time as people realise the benefits of owning a well-designed, energy-efficient home. The owner operator is Toby Tilsley. He started Craft Homes in about 2016, continuing with building houses to the standard Building Code. Around 2018, he just got tired of the way things were done and didn't understand why New Zealand was still building differently to Europe and the UK. He decided to learn more, undertaking the NZGBC Homestar practitioner and assessor course and completing the Certified Passive House Tradesperson course not long after.

3.1.1 Craft Homes and Passive House

Drawing on his experience from living overseas and from the Passive House Tradesperson course, Toby saw that overseas house construction:

- is more focused on airtightness and energy efficiency
- has higher requirements for insulation
- has greater wall thicknesses.

He wanted to understand how you could build that way and thus find a way to improve the air inside homes to help with asthma and allergies. Although not as cold, Auckland has high humidity and therefore high CO_2 levels, and he thought that Passive House construction techniques could help. He had the 'what and why' and then found a couple of companies doing Passive House construction in Christchurch.

The ethos and values of Craft Homes is not just based around energy efficiency but the greenest aspects of building, including greywater and blackwater management systems, healthy materials, low VOC and formaldehyde. Clients are attracted to Craft Homes because of the company's values and the skills and technologies it has in green building. It has built that mentality within the business where staff are really interested in what they do as well, and clients can see that.

Toby lives by example. He has a 15 acre rural property that is off-grid with a photovoltaic (PV) system, and they are planting it out with native trees. He is building a Passive House with structural insulated panels (SIPs). He also has a natural flow

wormerator septic system to manage blackwater and greywater. He is putting in a zero-emissions pellet boiler as a back-up system. The boiler is run using the by-product from a local joinery factory and can also heat a swimming pool/spa plus provide space heating and underfloor heating if required.

3.1.2 Climate change and carbon

Craft Homes is intent on reducing its emissions, focusing on what produces carbon and also what creates embodied carbon when building homes. It recognises that simpler homes involve less concrete and less steel, which results in less carbon. Discussions with clients cover embodied carbon, reducing emissions and carbon associated with energy – for example, concrete versus timber floors, natural gas versus PV and high energy use in both the construction and operation of the home. Craft Home is trying to educate people about carbon emissions and how to reduce them.

Craft Homes is looking at processes such as prefabrication as well as actions to reduce waste on site. It is are working with Formance in Christchurch, which produces SIPs – these minimise waste and reduce construction time. Craft Homes feels it has to work with the current industry and try its best with the materials available.

Craft Homes started to look at doing a carbon footprint for the business right before the lockdown in 2020. It was also looking at obtaining ISO accreditation for the business at this time but was interrupted with the arrival of COVID-19. It is aiming to revisit its carbon footprint in the near future. This is likely to start with building its own Passive House and incorporate a lot of technology that has not been used in New Zealand yet. This house will then be available as a show home for people to come and understand how it works.

3.1.3 Working with clients

Most clients who engage with Toby already know about sustainability and healthy homes. One barrier he hears from clients is the cost. Building a Passive House is more expensive upfront, but clients will save a significant amount in running costs over the life cycle of the home. The primary focus is the thermal envelope and trying to make sure the inhabitants are living in an energy-efficient, healthy home.

Toby's job is now mostly talking to people: "It's a lot of education." He can have as many as three to five enquiries per week from people who are really serious about sustainability. He talks to clients about what is important to them as everyone has a different idea of sustainability – some want energy efficiency while some want healthy materials. Toby researches the alternatives for his clients so that they can make informed decisions.

To understand exactly what clients are looking for takes time – talking to them and identifying things that they would benefit from directly with a Passive House such as addressing asthma and allergies. For example, by extracting all the moisture from a home, the relative humidity decreases from 80% to 60% or even 40%.

3.1.4 A team effort

In creating healthy homes, builders are only one part of the equation, and it can't be left to them to push this. Toby believes that everyone needs to be in sync. Designers really need to be upskilled in the construction industry. As builders, they are trying to learn and educate themselves and clients are interested and want to talk about it, but all this needs to be backed up by the designers. Toby thinks that everyone needs to be

aiming higher than the current Building Code, and things are going to be really slow to move until that happens.

> It is so holistic. It's just everything about the way we build has a massive effect on climate change.

Toby says there is a learning curve to build Passive Houses – a lot of backwards and forwards before truly moving forwards. In New Zealand, there are so few builders constructing these types of homes so there is not the familiarity with airtightness, mechanical ventilation and using Passive House standard windows and doors. He thinks changing the way windows are built and installed in New Zealand is a good starting point.

3.1.5 Looking ahead

Toby believes New Zealand needs to rethink the Building Code and start looking towards the Passive House philosophies because we need tighter requirements and restrictions. For example, he thinks that the sooner airtightness and mechanical ventilation is implemented through the Building Code the better even though it will come at a cost and be a very slow process because of the housing shortage. Without these changes, it worries Toby that all the houses being built currently will need to be renovated in 10 years' time to bring them up to standard.

From a carbon perspective, Craft Homes is still learning every day. There is just so much Toby wants to learn about, so much information, it just never ends. It is good, he thinks, that people are becoming more educated about energy efficiency and reducing carbon emissions, and Toby believes that this will help shift the housing stock across the country.

3.2 Fraemohs Homes

> Back in 1968, obviously climate wasn't on the radar at all. It was more the health benefits of timber and the practicalities of timber and the people that just really liked timber … but I guess climate change presents the opportunity to make a bit of a difference.

3.2.1 History

In 1968, Denmark-born Monnie Fraemohs started Fraemohs Homes in Christchurch. After watching all the New Zealand-grown logs getting shipped overseas from Lyttelton, he saw an opportunity to use this product locally to build solid timber homes based on Danish designs and quality. Monni was ahead of his time in recognising the benefit of value-added products to New Zealand's economy.

Fraemohs Homes' founding principles, which still apply today, are: "Excellence in design, quality and most importantly helping our customers to love where they live." The company is still locally owned but now has franchises in Wānaka, Twizel, Nelson and Tauranga. It also occasionally exports to the Pacific Islands.

> It is our stated purpose to provide sustainable timber building to protect the New Zealand environment and way of life so that future generations of New Zealanders can enjoy life as we do.
>
> Our vision is to transition the New Zealand construction industry to a sustainable timber future.

> Guiding us at all times are our company values of Integrity First, People Focus and Future Thinking.

While the company started building European-style log houses, it has now diversified into more conventional homes as well. All its homes embody the strong ethos of using timber, which has many benefits. It is a renewable low-carbon product and a good insulator to help regulate indoor temperature and moisture levels, thus resulting in energy-efficient, healthier homes. Most of its homes are solid timber kitsets, although some are transportables and it also builds on site for some customers.

Back in the 1960s, kitset houses were very cost-effective as there were more people with practical skills that could put up their own homes. Now they are a more premium and specialised product as there is significantly more bureaucracy in the industry and the cost of timber is high. However, they are becoming more popular, with the business growing year on year. People like the solid timber look, the health benefits of the house and the fact that they are climate friendly.

3.2.2 Sustainability embedded in the product

Fraemohs Homes does not have a climate change or sustainability strategy as such. Instead, it believes it is fundamental to what it already does. It understands its product, which performs exceptionally well. It acknowledges there is more it could do to reduce its carbon footprint as a business. However, it is a balancing act in a very competitive industry that is currently very busy, and it is not something that is recognised by its customers presently. As much as Fraemohs Homes might want to, it needs to be realistic as there is currently no mandate from government to address zero-carbon construction, and from its perspective, no one else in the industry is doing it.

Fraemohs Homes has recognised the opportunity the company has in building with timber when it comes to carbon emissions. Timber locks up a significant amount of carbon, and as it intends its built homes to last a long time, it considers its houses to be carbon negative. Furthermore, as its homes are also energy efficient, the use of carbon through their life cycle is also reduced.

Fraemohs Homes believes that, once regulations are introduced to force traditional construction methods to acknowledge carbon, this will help level the playing field across the industry. In addition, people beginning to understand the science behind carbon in the construction industry is seen as a good thing for Fraemohs Homes, because it is already reducing carbon and has been doing so for a long time.

3.2.3 Building timber houses

Fraemohs Homes applies sustainability to all aspects of its design and build process. It designs to maximise solar gain and energy efficiency, builds with sustainably grown New Zealand pine, sources local products where possible and selects fixtures and fittings that are made to last. It aims to build quality homes with timeless designs for longevity. All these choices contribute to a more sustainable build and a lower carbon footprint over the lifetime of its homes.

When it comes to calculating a carbon footprint for a house being built, Fraemohs Homes feels there are a lack of accessible or widely used tools in New Zealand. Furthermore, its customers know the product is low carbon and are not particularly interested in the exact amount of carbon locked in. If regulations were introduced around this, it would happily do it, but presently calculating carbon for each house

would be an added cost to the company. However, it does know that around 40 tonnes of carbon is sequestered in each of its houses.

Waste minimisation is important to Fraemohs Homes. It is always trying to minimise it by separating waste and recycling. Aside from the sustainability point of view, it is expensive to take waste to landfill and waste minimisation reduces its costs. The company machines all its timber untreated so any offcuts and shavings can be on sold or provided free to other end users. It has considered using its timber waste to generate its own electricity and reduce its carbon footprint, but this would take further investment in plant and equipment and does not make commercial sense right now.

By their very nature, log houses are effectively prefabricated. The use of computerised numerical control (CNC) machines significantly reduces waste because board length is optimised and very little carpentry work is required during assembly.

Overordering in the construction industry is common as it is more cost-effective than the time involved in stopping work and driving to collect more supplies. Fraemohs Homes knows exactly what goes into its transportables it builds at its Christchurch site so doesn't need to overorder materials. However, the benefit is around sustainability rather than cost savings. The kitsets it does for conventional builds are quantified to minimise overordering and come out of the merchant branch nearest to the build site, which reduces transport distances and subsequently carbon emissions. The company uses build software when designing, and a lot more effort is put into this process so it knows exactly what is going into it and can optimise materials. By doing this, it has a far more effective feedback loop. It is a balance between waste minimisation and prudent overordering to be cost/time effective. This approach also applies to its conventional builds where the use of good technology can improve on-site practices. Standardisation for on-site builds would help. However, personalisation is very popular in New Zealand and adds significant work and cost.

Fraemohs Homes has been producing homes for more than 50 years so does a lot of extensions and modifications to its houses. The houses are built to last 50 years but more than likely will last a lot longer. Using a non-metallic treatment for the timber means any deconstruction waste timber can be used for incineration or energy reuse. A lot of its homes are built on timber floors so they can be relocated. The modular design of its transportable houses means additions are relatively straightforward. These design features and work methods all contribute to sustainability by making its homes more flexible and easily adaptable for future requirements.

Currently, from a small business perspective in a very competitive industry, Fraemohs Homes is watching this space closely and waiting for strong signals from the government so it can then proceed with confidence.

3.2.4 Key barriers

New Zealand needs innovative, alternative solutions to be able to tackle the problem of climate change. However, Fraemohs Homes finds that currently it can be extremely difficult to get alternative solutions past certain councils and council officers. There are inconsistencies across and even within councils. Each council has its own rules and each council officer has their own views. Even though the Building Code allows for Alternative Solutions, this is not what happens in practice. Even though Fraemohs Homes adheres to the compliance pathways, it has ongoing problems obtaining approval for its non-standard products. It says there is a need to update the New Zealand standards for the construction industry to embrace low carbon and it needs to

be easy. The determination process is broken as it takes 12 months. This is too long for a client to wait and is not feasible. CodeMark is the only way to deal with these inconsistencies and ensure there is a nationwide standard of what is required. However, it is expensive and should not be necessary if you can provide evidence to support a product.

> We've got 54 years of historical use of these buildings in New Zealand and no history of systematic failure.

One major barrier is the high cost of and short supply of timber – it has doubled in price in the last 4 years. Fraemohs Homes can no longer buy the boards it uses in sufficient quantities so has had to develop adjustments to its building methods with smaller-sized timber. This is because so many of New Zealand's logs are being shipped overseas. The timber mills are struggling to obtain raw material, and some are closing, making it difficult for Fraemohs Homes to source timber.

> So if timber is to be a solution to climate change, that needs to be sorted out.

3.2.5 Being ready for climate change

Fraemohs Homes supports initiatives that promote environmentally responsible building standards and building practices. It is an active member of the New Zealand Green Building Council, Future Proof Building and Homestar.

There are many sources of climate change information that Fraemohs Homes accesses, including via the government and online. For specific information related to log houses, it looks to Finland, which is well ahead of New Zealand in this space. The company is following closely what is happening overseas as an indicator of what is likely to happen in New Zealand.

Fraemohs Homes' customers tend to have an interest in sustainability and have usually done their homework before contacting the company for more details. The company does provide information around sustainability, climate change and carbon on its website.

It is important to consider the potential financial impacts on the company as a result of climate change and associated changes in the construction industry. Fraemohs Homes is expecting a potential downturn in the market when these rules are brought in because the cost of building a house will increase and subsequently will be a short-term shock for the company. It is also preparing for an increase in insurance costs due to its location on the Waimakariri flood zone.

Fraemohs Homes thinks it is good that change is happening, but it has happened really quickly. It would have been helpful for indications some time ago. Even though this topic has been talked about in the political arena for a while, this is not monitored by small to medium-sized businesses closely. Grants are available to bring in experts in this field to help, but this is only helpful when there is a clear a direction.

> We start taking notice when documents that affect us are coming out.

3.2.6 Looking ahead

Looking ahead, Fraemohs Homes believes that the construction industry will be expected to reduce its energy use so that more electricity will be available for electric vehicles and other industries that will need more electricity to comply with impending

regulations. Exactly how the government will do this is yet to be established but is likely to include embodied carbon and airtightness as this is what is happening overseas. Without a roadmap of intentions, it is difficult to know far the new regulations will go and to make any firm investments decisions.

The construction industry in New Zealand is slow to change. There is very little clarity of what and when in relation to the Building for Climate Change proposals.

> We need to know where we're going.

The first indication of change was in late 2020 when MBIE released discussion documents with examples provided being extreme – from no change at all to increasing wall thickness to 220 mm. There is no broad 10 or 20-year roadmap laid out for the industry as in European countries, which would be very helpful. Industry players cannot begin to make change until they have a better idea of what the new rules will be. This makes it very difficult to make decisions around planning and investment. There is significant lead time if new machinery is required for an extreme change: 6 months to research, 2 years from point of order and 3 months to commission. It is hoping that the implementation timeframes for any required changes recognises this reality. However, it will be good for Fraemohs Homes' brand and product and good for New Zealand to begin moving forward.

Companies like Fraemohs Homes may have to invest in the necessary plant and equipment to meet the impending changes to the regulations. However, it is likely that when the legislation is implemented, the market will be in a downturn. Due to the cyclical nature of the industry and the reluctance of finance companies to lend in a downturn, investing could prove difficult. It does not make economic sense to invest in plant and equipment that will be underutilised or cannot be sold in a downturn.

> I'm not going to do that unless I know for certain what the outlook is going to be.

This is in contrast to other companies that invest in workers who are easily dispensed of in quiet times. Financial support for plant investment would be good and some government support to counter the cyclical nature of the industry would also be helpful, but it won't solve the problem.

Other considerations around the changes to building regulations include supply issues around windows and other various products that are currently niche but will need to become mainstream. Implementation of the changes will also require significant training, especially for designers and builders.

Phasing in the lifting of R-values under the new regulations will be a good move. However, until embodied carbon products are recognised, this will just add an extra cost to its houses and be a disadvantage to Fraemohs Homes.

The government needs to be wary of unintended consequences that any changes could bring. Europe is currently dealing with internal and interstitial moisture issues following the increase of R-values, and airtightness is missing from New Zealand's proposals. Also, changing the R-value of boards leaves the mills with more smaller offcuts of timber that are less in demand, and they will also need to mill more trees to get the same number of boards. There are ways around this problem but they need to be part of the standards.

The majority of industry players will just follow the building standards because it is the path of least resistance so clear consistent guidelines will be required for the building consent authorities (BCAs) to adhere to. Otherwise, it is very difficult to compete against standard building practices and it is expensive and soul destroying to have to provide different information to different BCAs. Furthermore, innovation is what is needed to achieve climate change goals for construction. Under the current standards, the support is not there for innovation and the best option is to buy a product from a good European company that has done the work, buy a CodeMark and get it certified.

> If you want to come up with your own unique thing here, it will be a nightmare.

There are some financial funds that are available to help with innovation and research and development, but it is difficult for small businesses not in the agricultural sector and often not that helpful. The type of grants that work for small businesses are usually around expert advice when often the applicant is the expert. Larger businesses also have more resources to handle the process.

Fraemohs Homes would like to see the government launch a public education campaign around climate change and better choices to make. More consumer understanding will result in more market pressure to instigate change in the industry. Currently, there is no benefit in going the extra mile for climate change apart from Fraemohs Homes' warranties and peace of mind. However, it is unknown to what level the government intends to go to and what will happen next. Having some indication of its intentions would give businesses some certainty and confidence to make further investment in their companies.

The construction industry is a high-risk reactive industry, and there is a lot of work to do to get ready for climate change.

> The industry is not ready – the industry is never ready.

3.3 Ngāi Tahu Holdings

> What is good for Ngāi Tahu is good for Aotearoa.

Ngāi Tahu is the largest iwi of Te Waipounamu, the South Island of Aotearoa New Zealand, where its whānui (families) have lived for over 800 years. Important traditions have included mahinga kai (customary food-gathering) sites, between which they travelled seasonally, and the trading of pounamu. These traditions remain important to current-day operations of Ngāi Tahu and it is their values that drive the operations and outcomes of this successful iwi.

3.3.1 History

Ngāi Tahu are entrepreneurial people. They were an important part of the South Island economy by the 1830s, being involved in whaling, sealing and exporting flax, potatoes and grains. Sustainability has always been embedded in Ngāi Tahu values and is part of their tikanga (traditional customs and values). It is incorporated into their mahinga kai practices. It was important to make sure there was kai available for future seasons – for example, kōura (crayfish) that had eggs were not collected and the first fish of the season was thrown back. For Ngāi Tahu, sustainability is not just about carbon – it is managing the entire ecosystem.

In 1998, Ngāi Tahu reached a settlement with the Crown to redress promises breached under te Tiriti o Waitangi | Treaty of Waitangi. The iwi was then able to move forward in preserving its identity and creating a prosperous future for its whānui.

> In the 21st century, Ngāi Tahu identity continues to evolve and adapt as it has always done. The responsibility of current generations is to honour the deeds and values of our tīpuna and to create an inheritance for future generations. Ngāi Tahu has a responsibility to be steward; to grow and use the resources we have fought to reclaim in order to achieve the culturally rich, boundless future our tīpuna dreamed we could achieve.

Te Rūnanga o Ngāi Tahu, the iwi's tribal council, is a charitable trust. Its business arm is Ngāi Tahu Holdings Corporation, which oversees five investment pillars: Ngāi Tahu Capital, Ngāi Tahu Farming, Ngāi Tahu Property, Ngāi Tahu Seafood and Ngāi Tahu Tourism. Prior to restructuring in 2020, they were run as individual companies with their own board, chair, CEO and management teams. Currently, one CEO and four executive members run all of the business operations.

Ngāi Tahu Holdings Corporation has the task of providing long-term sustainable returns to Ngāi Tahu that will in turn support iwi development and Ngāi Tahu whānui. The iwi's approach to business incorporates intergenerational investment, commitment, sustainability, diversity and long-term vision and is guided by an this whakataukī: "Mō tātou, ā, mō kā uri, ā muri ake nei | For us and our children after us." Even though the iwi works to maximise its investment returns, its philosophy and values shape its strategy. This means it also looks for cultural and community returns, which is in stark contrast to most commercial entities.

Incorporated in 1994, Ngāi Tahu Property is the property development, management and investment pillar. It started small, with its first land purchase at the Wigram Aerodrome in 1997. Today, Ngāi Tahu Property has a substantial portfolio with assets valued around $600 million. It has many residential and industrial developments and commercial investments throughout Te Waipounamu. An office was opened in Auckland in 2015, and Kerepeti at Hobsonville Point became its first North Island residential development in partnership with NZ Super Fund and New Ground Capital.

Partnerships are an important part of Ngāi Tahu's strategy. It has formed strong relationships with various organisations, businesses and individuals to provide mutual opportunities for the future. These partnerships allow the iwi to be successful in a wide range of markets and sectors. Today, Ngāi Tahu Property is continuing to build a diverse portfolio across Aotearoa New Zealand to support Ngāi Tahu whānui and future generations to come.

3.3.2 Climate change strategy

Ngāi Tahu released its first climate change strategy in 2018. This strategy supports the Climate Change Response (Zero Carbon) Amendment Act even though Ngāi Tahu has substantial investments in high-carbon-emissions industries such as transport, construction, agriculture, forestry and tourism. The iwi has taken relevant information from various sources and defined what sustainability actually means from its perspective in the modern world. Ngāi Tahu has an obligation to te Tiriti and the Crown and wants to show leadership in this space.

In late 2022, Ngāi Tahu released an implementation plan for the strategy for 2022 to 2050 with an 88-point action plan of defined deliverable and measurable targets known

as Te Kounga Paparangi. It is driven across eight kaupapa – GHG emissions, marae and whānau resilience, water, operational emissions, ecosystems, waste, renewable energy and education. At the time, Te Rūnanga o Ngāi Tahu Kaiwhakahaere Lisa Tumahai said that, over the next 9 years, the iwi would be taking major steps to cut greenhouse gas emissions, embrace renewable energy, optimise resource use, reduce water and ecosystem impacts, and create a resilient future for whānau.

The iwi recognises that significant changes are required in its commercial operations to meet targets and has action plans in place that are well under way. The aim is to develop partnership with rūnanga and others with expertise. It is also working with its 18 Papatipu Rūnanga (regional whānui groups) to produce their own climate response plans specific to their needs and creating science-informed resources for whānui. It will then be able to identify and prioritise areas that will need resources.

3.3.3 Approach to building

Ngāi Tahu's strategic plan is at the level of ecosystems. When building a development or a house, it believes that it is important to recognise that an ecosystem is disturbed. Ngāi Tahu plans to include an ecosystem rejuvenation strategy with every development it undertakes.

> The ecosystem must be better than when we left it.

The difficult part is how it is actually going to do that, which is currently a work in progress. First, it is vital to know and understand the current ecosystem – for example, is it a migratory path for birds or are there waterways? Then how do you build a development that incorporates that ecosystem into your design? Ngāi Tahu is developing a design standard to encompass its climate, sustainability and ecosystems goals.

Ngāi Tahu has recognised the need to adapt to building housing developments that meet the current and future needs of the population or it will miss an opportunity. It believes it is essential to consider the needs and wants of future house purchasers who will be more attuned to climate change – "the young kids who are currently protesting for climate emergencies". It is likely that this generation will also be interested in housing developments that have been built neutrally and where the ecosystem has been considered. This means considering what purchasers' requirements will be in 30 years time – for example, around solar, electric vehicles, rainwater use and greywater recycling. Ngāi Tahu has decided not to wait for government policy for the required standards but to incorporate these low-carbon and carbon-resilient actions into its development designs.

A good example is Te Whāriki at Lincoln.[1] The subdivision includes a programme to help regenerate ecosystems native to the area. Any impact on the environment has been minimised by reducing pollution and noise, conserving resources, preserving and reinstating natural landscape features and encouraging native plants. Waterways and wetlands have been developed to help manage and treat stormwater and support a diversity of wildlife. Plants native to the area have been selected for minimum watering and the attraction of birds. There are trails to connect the subdivision with Lincoln University and the town centre to encourage walking and biking. This contributes to a reduction in noise, carbon emissions and energy requirements for residents. The development has covenants to encourage the building of healthy and energy-efficient

[1] https://tewhariki.co.nz/

homes. This approach is proving to be beneficial for the environment, with pūkeko, herons and frogs being observed in recent times.

Ngāi Tahu's Pita Te Hori Centre[2] in Ōtautahi Christchurch is one of New Zealand's most sustainable office developments. Phase one is complete and consists of two office buildings and a car park building. Further phases are planned for two more office buildings and residential apartments. The centre has a Greenstar rating of 5 and NABERSNZ energy efficiency rating of 5.5. The plantroom for Christchurch's first district energy system is located on site, which provides groundwater heating and cooling along with solar. An EV car sharing scheme has vehicles available at the centre and there are 198 secure bike parks.

In the construction industry, it is widely known that there are many high-carbon materials. However, there are not necessarily suitable replacements currently available. When it comes to research and development, Ngāi Tahu does not have the capability so it partners with other companies to produce products it requires. For example, as part of its climate change strategy, all of its packaging will be 100% biodegradable.

3.3.4 Is it succeeding?

Ngāi Tahu is very much in the public eye and there is a lot of interest in its leadership position related to sustainability and addressing climate change. Its admits it doesn't always get it right but its own people are watching and holding them to account.

Some of its commercial operations have environmental concerns, including carbon emissions, so how does it reconcile that with its values and goals? Is it better for Ngāi Tahu to own these businesses and implement sustainable and environmental practices that are in the best interests of New Zealand or sell to others who are unlikely to have these same visions with worse environmental outcomes? Ngāi Tahu is driven to invest in these areas as it wants to add value to New Zealand's primary industry. Farming has changed and will continue to change, but its sees New Zealand as still being a primary industry country in the foreseeable future.

Particular to the construction arm of Ngāi Tahu, it is challenging itself to create communities and not just housing developments. Many questions arise from this. What does a community look like? What drives a community? Sustainable developments are likely to cost more to build. Buyers may be prepared to pay more for them because they are built for the community and have considered the ecosystem. Another challenge is the consideration of the whole-of-life perspective, including the entire supply chain. How does it work with its supply chain partners? The biggest challenge is to deliver a product that is marketable and provides a return as well as achieving its environmental desires. Being a charitable trust, if it does not deliver on its commercial goals, it cannot deliver on its charitable outcomes.

A big impact on Ngāi Tahu as a business is its ability to respond to climate change.

> It's all about what you do. We can continue going as we are, right, do nothing, we will probably still sell them and it'd be fine. But we don't want to do that.

Overall, there are many uncertainties around what the future may look like, government action and how Ngāi Tahu will get there. This makes it difficult to prepare and results in financial risks to the iwi.

[2] https://ngaitahuproperty.co.nz/portfolio/pita-te-hori-centre/

3.3.5 Being ready for climate change

Being a Treaty partner affords Ngāi Tahu access to government insights on climate change as well as expert knowledge outside of New Zealand – Te Rūnanga o Ngāi Tahu Kaihwhakahaere Lisa Tumahai is also the Deputy Chair of the Climate Change Commission. It also looks at what others are doing to glean information around climate change and technological advancements. However, it does take a pragmatic approach on how to incorporate any advice into its businesses as it is a balance between sustainability and the wellbeing of the iwi.

COVID-19 has been disruptive to the globe and made Ngāi Tahu realise that anything can happen in the world. This drove it to significantly restructure its business so it could survive. COVID-19 highlighted the need to be adaptive, flexible and nimble to respond to risks that arise. This can be related to climate change – it will have an impact but exactly how is unknown.

> We have to adapt. If you don't, adapt you die.

3.3.6 Looking ahead

Ngāi Tahu thinks there are stages of innovation in the construction industry. This means going back to first principles – writing a design standard that is the best in the world that either replaces the ecosystem or builds around it. The restructure of its business will allow it to more closely incorporate iwi values into its design standard. These values are core to everything it does regardless of the project on hand.

> The good thing about the iwi is we're not tied into any particular government policy. We can pivot, change direction and move and be nimble with our own strategies. We can adapt to new scientific evidence that might come along in the next 5 to 10 years.

3.4 Cook Brothers Construction[3]

> We have to reduce carbon emissions as much as we can, and we've got to build for the effects of climate change because it is happening. We can't stop it, but we can slow it down, minimise the risks and build for the future. We have to give it our everything, and we need to work together to do it.

Cook Brothers Construction aims to adopt a proactive stance to sustainability rather than a reactive one – its vision is to be a leader. It works with clients to try and add sustainability wherever it can and is not waiting for clients to demand it from them. To create such a proactive approach, it is embedding learning for sustainability and climate change throughout the organisation so that everyone working for Cook Brothers Construction can make the company more sustainable.

3.4.1 History

In 2005, two brothers and their friends purchased the Captain Cook Tavern in Dunedin and subsequently became involved with other businesses. In that same year, the two brothers started Cook Brothers Construction and have since been aggressively growing the business to now having a presence in other regions outside of Otago. Their clients are mostly commercial along with some high-end residential projects.

[3] Information for this case study is drawn from https://www.cookbrothers.co.nz/

The introduction of sustainability into the business came about from personal and team passion and clients requesting it for their projects. Initially, a consultant was employed to assist in building a sustainability framework. With a vision to be a role model and lead sustainability in the industry, Cook Brothers employed a sustainability manager in 2020 who updated the initial framework, which is a continual process in this rapidly changing space, and is responsible for facilitating the implementation of the framework and taking a teamwork approach for training and education.

Some of the Cook Brothers' builds across New Zealand include Air New Zealand's Logistics Warehouse at Auckland Airport (5 Green Star Industrial v3 Design rating), SkyCity refurbishments, Tasti Products manufacturing plant, Northlake Village Centre Wānaka, Cardrona Ski Field, The Terrace School, Mount Aspiring College, Bauer Media, Ilam Fire Station, Otago Polytech O Block and the Matatiki Hub in Canterbury.

3.4.2 Sustainability and changing the business

Sustainability is thought of as the new health and safety and therefore seen as a disruption to the industry that will bring about change. For Cook Brothers, sustainability is about building structures for the future – building to withstand climate change and taking into consideration the whole life of a building, including maintenance across that life. Internally, sustainability is also about measuring and reducing its carbon footprint and mitigating for climate change.

A big part of Cook Brothers' philosophy is about being innovative. As Managing Director Dave Bulling states in the company newsletter, "[we have] carved out space in the industry as bold and ambitious innovators, and quality creators".

Cook Brothers sees the next strategic innovation advances for the company as being in sustainability, calling on its team to be part of the sustainability journey for the organisation by focusing sustainability on "what we do today defines our tomorrow". As such, the company has awards for staff to encourage innovation from across the organisation to promote ideas, and sustainability innovation is encouraged as part of the awards.

At Cook Brothers, success in sustainability is about people as well as the economy. It requires passion from both the company and its people and passion from its clients. People need to change habits, be committed and work together. Cook Brothers is taking a whole-organisation approach to sustainability and encouraging it across everything it does. For example, it chose Camp Glenorchy for its 2019 conference because of its outstanding sustainable design and vision, and it switched to Ecotricity, New Zealand's only provider of 100% renewable and carboNZero-certified electricity. In Auckland, Cook Brothers uses Green Gorilla, a waste collection, recycling and diversion service because it sees landfill as a last resort. The United Nations Sustainable Development Goals have been adopted as the focus for its sustainability efforts, which helps to broaden the focus to think about sustainability as not just about the natural environment but also about society and people in the economy.

Cook Brothers sees a shift in its clients who have started to request sustainability in their buildings, especially government projects. Some corporates are asking for sustainability data from the company, and some developers are recognising the added value in building green, future-proofing for the next generation. Therefore, the demand is not just driven internally as a key capability in the organisation but also externally from the customer.

3.4.3 The sustainability journey

Cook Brothers is near the beginning of its journey. In 2020, the sustainability role was created to overhaul its framework and embed sustainability into every element of the business and to make sure its strategies and policies are enacted. At the end of 2020, it undertook a climate change risk and carbon footprint assessment. The climate change risk matrix has been designed to be regionally specific (from what information it can obtain) and covers aspects such as sea-level rise, surface waters, rainfall and flooding, extreme weather, wind direction, frequency and intensity and temperature such as heat duration and spikes. The aim is to be able to consider everything that will impact on the business and even to determine which parts of the business might be worst affected by what impact.

A sustainability strategy for the company has been created drawing on the UN Sustainability Development Goals and focused around three pillars: people, place and work. Climate action is under the place pillar and states, "We understand the urgency of climate action and aim to be carbon negative by 2030." To enact the strategy, aspects such as minimising travel, zero waste, renewable energy and measuring and managing carbon emissions are planned along with forestry as a carbon removal opportunity.

To begin to implement the strategy, Cook Brothers has developed its own site-specific sustainability management plan that covers people, economics, leadership, influencing, knowledge sharing, training and environmental factors. A big part of having this plan is ensuring that the policies are implemented on site. To ensure the success of this plan, it has provided extra resources to handle project administration, freeing up time to implement the plan, as time was a key element in limiting behaviour change on the ground.

3.4.4 Key barriers

The biggest barriers to Cook Brothers being more sustainable are its clients and material costs. It prefers to work with clients that would like to build sustainably where possible and focus on quality rather than spending time trying to influence customers who have not yet switched to being more sustainable. With each client and build, Cook Brothers' aim is to present the costs of alternative products and methods and the impacts in order to build sustainability into each project. The cost of sustainability is incorporated into the design and tender stage, and any savings are passed on to the client. One of the biggest barriers is that the overall cost of building sustainably is more expensive and the rating and certification systems are also expensive. While Cook Brothers is prepared to absorb some of the costs in order to be more sustainable, it is unable to absorb all the present costs, so it is working to involve its clients in the sustainability journey. One way it has begun to deal with the costs is building business cases for sustainable products in the building and construction industry. This helps clients understand the full costs of the sustainable products, which often have a lower operating cost than non-sustainable products – making them cheaper across both infrastructure and operational costs.

Cook Brothers believes that the behaviour of people is the key to change.

> How people act, what people buy, what people want ... we need to understand what behaviours drive people's decisions in order to influence them towards a more sustainable direction.

The culture at Cook Brothers is dynamic, innovative, creative and open-minded. Its staff are all on board with climate change action. However, they don't always know what or how to do it or lack the time (such as separating waste). Time is the biggest barrier but that this is easier to fix than not having the people on board.

3.4.5 Being ready for climate change

Cook Brothers has identified the need to make climate change relevant for New Zealand in the present day – for example, selecting infographics for education resources that are real and relevant, not images of melting ice and polar bears! It obtains information on climate change from key scientific sources such as the Intergovernmental Panel on Climate Change, Environment Canterbury, local councils, Ministry for the Environment and MBIE and uses this to inform the whole organisation.

Cook Brothers sees education across the company as crucial for building sustainably and embedding climate change into its DNA. The company is building a library of knowledge and a platform for training programmes to disseminate information to its people. This is a virtual repository of mainly videos and recordings of Zoom meetings that staff can watch on demand to increase their knowledge of responding to climate change and sustainability in the workplace.

3.4.6 Looking ahead

Cook Brothers is proactive in this space. It wants to be prepared in advance for the new Building Code. It wants to be the most sustainable and make the biggest impact. It wants to influence as many people as possible to become more sustainable, including the supply chain, suppliers and its trade partners. It needs to be prepared for clients asking for sustainable buildings, and this is already increasing. The company has begun to look at more sustainable options for commonly used materials and will change suppliers if required. Their sustainability manager is also the quality manager, which means Cook Brothers can more readily include sustainability into its projects. It is committed to continuously updating its strategies, policies and systems as changes occur and new information and research becomes available.

Cook Brothers sees insufficient urgency around climate change in the construction industry and believes it will take government policy to accelerate any change. Its aim is to lead the industry in this area in anticipation of changing regulations and demand from clients and to stay at the forefront of innovation and technology changes.

4. Creating your climate culture – preparing for climate change

This section seeks to provide some guidance for construction companies who wish to begin their journey towards decarbonisation and climate action. This resource is a launching pad for creating a climate culture within your business and a resilient and robust climate change strategy. There are four key areas of action that will enable you to create a climate culture within your business:

- Increasing climate change literacy.
- Measuring your carbon footprint.
- Managing climate change risks.
- Being a climate champion.

4.1 Increasing climate change literacy

Climate change is real and is impacting our lives. Even though climate change has been around for a while, talk about climate change often comes in a scientific, technical or regulatory language. Climate change literacy is the degree to which individuals can find, understand and use information and services to inform climate change-related decisions and actions.

See section 5.1 for explanations of some key terminology and use these resources to increase your climate change literacy:

- A guide to the language of climate change (Gen Less) https://genless.govt.nz/climate-change/a-guide-to-the-language-of-climate-change/
- Reducing carbon video series (BRANZ) https://www.youtube.com/playlist?list=PLQeYTsvZ7o2yCGcolN_fuDpg33xgSwpBA

Keep up to date with any changes from government that might impact your business:

- Ministry for the Environment https://environment.govt.nz/what-you-can-do/have-your-say/
- MBIE Building for Climate Change programme https://www.building.govt.nz/getting-started/building-for-climate-change/stay-up-to-date/
- Climate Change Commission https://www.climatecommission.govt.nz/our-work/our-upcoming-work/

4.2 Measuring your carbon footprint

The carbon footprint of your company is the total amount of greenhouse gas emissions. Carbon dioxide (often shortened to carbon) is the most common greenhouse gas emitted directly and indirectly by your company's activities. There are several things to consider before calculating your emissions:

Understand why you are doing it

Think about why your business wants to measure its emissions. For example, are you measuring your emissions for internal reporting or reporting to a legislative framework?

- Managing carbon (Otago Daily Times) https://www.odt.co.nz/lifestyle/magazine/managing-carbon

Define your emissions

International standards of voluntary carbon footprinting organise emissions into scopes:

- Scope 1: The direct emissions from the impact of your organisation or emissions that are created by assets that your organisation owns.
- Scope 2: Direct emissions that your company doesn't create but consumes such as electricity usage.
- Scope 3: All other indirect emissions that occur in the company's value chain. For example, this could be the impact of employees and contractors and the carbon they create such as air travel and waste.

Measure your emissions

This Ministry for the Environment guide contains all the information you need to calculate your carbon footprint. Use the spreadsheet to enter your raw data and the emissions will be calculated. See example reports for how to structure reports to the international standards.

- Measuring emissions: A guide for organisations (Ministry for the Environment) https://environment.govt.nz/guides/measuring-and-reporting-greenhouse-gas-emissions-guide-for-organisations/

Other resources:

- Climate Action Toolbox https://www.tools.business.govt.nz/climate/
- FutureFit (for individuals) https://www.futurefit.nz/
- Carbon Neutral NZ Trust Business Calculator https://www.carbonneutraltrust.org.nz/business-entry

Once you have measured your company's carbon footprint, aim to get this verified as it will help to ensure that you have measured and accurately captured the correct the information. Some verification processes come with certifications, like CEMARS and carboNZero, ISO14:064-1, international certification and the Greenhouse Gas Protocol.

Report your emissions

Once you have measured your emissions, you should incorporate them into actions within a climate change strategy for your company. The Sustainable Business Network suggests it is important to let your stakeholders (customers, employees, suppliers, board) know about your targets and how you are tracking. You might want to do this as part of a more complete sustainability report or other relevant outputs such as an internal report on your website or in your annual report. The important thing is being transparent and open with stakeholders (employees and customers) so they can see the journey you're on and help you achieve your goals.

4.3 Managing climate change risks

Climate change brings several risks to your business from extreme weather events to other longer-term risks such as rising sea levels that might impact physical assets. It is important to identify the climate-related risks that your business might be exposed to and assess the impact those risks will have on your business or the wider construction

sector over the short, medium and long term. The two key risks that might impact your business are physical risks and transition risks.

Physical risks

Physical climate change risks are the potential negative impacts from harm, loss or disruption that can arise when your business is exposed to climate hazards. These could be short term such as extreme weather events or long term such as rising sea levels. The impact of physical climate change risk is very dependent on the geographic location of your business, which might create multiple risks for your company.

NIWA's Climate Change Adaptation Toolbox can assist you to find out what physical climate change risks might mean for your business and what you can do about it, assess your current climate resilience and plan for future change.

- NIWA Climate Change Adaptation Toolbox (NIWA) https://niwa.co.nz/climate/information-and-resources/climate-change-adaptation-toolbox

When planning action on physical climate change risks, it is important to build resiliency into company operations. The best course of action is to create continuity and contingency plans to help deal with extreme weather events and other disruptions that might occur from the impact of climate change. Business.govt.nz offers some tools and resources to assist with creating a continuity and contingency plan for your business.

- Continuity and contingency planning (business.govt.nz) https://www.business.govt.nz/risks-and-operations/planning-for-the-unexpected-bcp/continuity-and-contingency-planning/

Transition risks

Transition risks are potential negative impacts for your business from the social, economic and political risks of transitioning to a net-zero carbon economy. These risks could include policy and regulatory risks, technological risks, market risks, reputational risks and legal risks.

Examining transition risks is important to help manage potential negative risk to your business. However, transition risks might also highlight climate change-related opportunities that enable your business to take advantage of climate action with the sector.

Climate change risk liability

Companies and their directors have a duty of care and diligence to act in good faith and in the best interests of the company as well as a need to respond to regulation, litigation and liability risks. For all companies, climate change is a corporate social responsibility and should be a part of a company's environmental, social, and governance (ESG) strategies.

A report by Chapman Tripp for The Aotearoa Circle outlines that climate change is a foreseeable risk of financial harm to many companies and that directors of companies must, at a minimum, identify the risk to the company, periodically assess the nature and extent of the risk, including by seeking and critically evaluating advice as necessary, and decide whether to take action in response, taking into account the likelihood of the risk occurring and possible resulting harm.

- The Aotearoa Circle – legal opinion (Chapman Tripp) https://chapmantripp.com/media/r30jdd05/climate-change-risk-legal-opinion-2019.pdf

The Institute of Directors notes that, contrary to what many directors have long assumed, their legal duties to protect the interests of the company should not be seen as a barrier to taking action on the climate crisis. Directors' duties require them to be properly informed about climate change risks, and to make decisions accordingly. No director, if challenged in court, will reasonably be able to argue that nobody knew how serious the climate threat was or that they were not grossly negligent in failing to be informed of these risk. The standard will be that directors knew or should have known.

- Primer on climate change (Institute of Directors) https://www.iod.org.nz/resources-and-insights/research-and-analysis/primer-on-climate-change#
- Climate risk – key resources for boards (Institute of Directors) https://www.iod.org.nz/resources-and-insights/guides-and-resources/climate-risk-key-resources-for-boards/#

Some examples of processes to assist with risk management:

- ISO 31000 Risk management https://www.iso.org/iso-31000-risk-management.html
- Enterprise Risk Management Integrated Framework (Committee of Sponsoring Organizations) https://www.coso.org/guidance-erm

Climate-related financial disclosures

There is a growing international and national requirement for companies to undertake climate change-related financial and/or non-financial disclosures. Climate-related financial disclosures are about providing information to investors about a company's climate response to climate change risks in order to create greater transparency and seek to reduce risk and increase business resilience and leadership for climate action.

Toitū Envirocare outlines several benefits of climate related financial disclosures:

- Risk assessment – more effectively evaluating climate-related risks to your company, its suppliers and competitors.
- Capital allocation – to make better-informed decisions on where and when to allocate your capital.
- Strategic planning – to better evaluate risks and exposures over the short, medium and long term.

Climate-related disclosures were made mandatory for some companies with the passing of the Financial Sector (Climate-related Disclosures and Other Matters) Amendment Act 2021, with annual reporting periods beginning on or after 1 January 2023:

- Large listed companies with a market capitalisation of more than $60 million.
- Large licensed insurers, registered banks, credit unions, building societies and managers of investment schemes with more than $1 billion in assets.
- Some Crown financial institutions (via letters of expectation) such as ACC and the NZ Super Fund.

As a result, the External Reporting Board (XRB) now has a mandate to issue climate standards as part of a climate-related disclosures framework and guidance on non-financial matters. Several standards have been developed to assist businesses.

- Aotearoa New Zealand Climate Standards https://www.xrb.govt.nz/standards/climate-related-disclosures/

4.4 Being a climate champion

Being a climate champion is about showing leadership among industry peers and within your region. Being an advocate and supporting climate action will be critical to your business success in the years to come.

Being a climate champion with clients and colleagues could include:

- creating a shared understanding about climate change and what is needed to transition to zero-carbon construction and the actions you and your colleagues could make
- committing to climate action – formalising your climate actions within practice values and company goals, measuring your business carbon footprint and aiming to reduce its emissions with project targets
- discussing zero carbon and sustainability with the client and design team at the start of projects
- advocating and agreeing on best-practice carbon footprints for buildings that you construct, especially operational carbon and embodied carbon and other environmental impacts
- advocating and using life cycle assessment, including energy modelling of proposed designs
- ensuring the client and project team are aware and understand the benefits of sustainability and zero-carbon construction such as specifying higher than New Zealand Building Code to enhance performance for better environmental and health outcomes
- actively engaging with clients so they consider future proofing their design to increase resilience to climate change and extreme weather events
- if you inherit a project, taking the opportunity to improve the zero-carbon elements of the design if not already done
- ensuring clients understand the risks associated with not targeting low-carbon design from the outset such as the high penalties for retrofitting buildings within the first 10–20 years of the building's life
- partnering with other companies, organisations and stakeholders to promote sustainable development and advocate for policies that support it
- actively engaging in continuous learning and training about zero carbon and core building science.

5. Climate change knowledge bank for construction

5.1 Key terms

What are greenhouse gases?

Greenhouse gases are gases in the atmosphere that trap heat. They let sunlight reach the Earth but stop the heat that the sunlight brings from leaving the atmosphere. They act just like a greenhouse, affecting our climate. Greenhouse gases include carbon dioxide (CO_2), methane, nitrous oxide, ozone and chlorofluorocarbons.

Greenhouse gases don't all cause equal harm. Some have much higher global warming potential (GWP) than others. The GWP of a gas indicates the contribution to global warming resulting from the emissions of one unit of that gas compared to one unit of carbon dioxide, which has a value of 1. For example, R-134a (tetrafluoroethene – a traditional refrigerant used in some heat pumps) has a GWP of 1300.

What is embodied carbon?

Embodied carbon is the amount of greenhouse gases required to produce a material, expressed as a carbon dioxide equivalent (CO_2e). It is basically that material's carbon footprint.

Embodied carbon can be assessed over different periods such as:

- cradle to gate, which covers resource extraction through to the factory gate (before it is transported to site)
- cradle to site, which includes all a material's emissions up to the point it reaches a building site
- cradle to grave, which is a whole-of-life approach from manufacture and installation to demolition/disposal.

What is net-zero carbon?

Net-zero carbon is when human-caused emissions are reduced to as close to zero as possible. Any remaining greenhouse gas emissions produced would be offset with an equivalent amount of carbon removed from the atmosphere – for example, by planting forests.

What is biogenic carbon?

Biogenic carbon involves biological sources such as trees, plants and soil. In a carbon cycle, trees capture CO_2 from the atmosphere during photosynthesis and store it. The carbon that has been sequestered in this way is released at a later stage when timber is burned or rots away. Because timber stores carbon, assuming it comes from sustainable forests (replanted after harvest), it has a low carbon footprint as a house material.

What is a carbon footprint?

A carbon footprint is the amount of greenhouse gases – typically measured as carbon dioxide equivalent – released into the atmosphere by a particular human activity or good or service. A house has a carbon footprint, which is the sum of all greenhouse gas emissions produced as a result of its construction, occupation and demolition.

How is a carbon footprint calculated?

A carbon footprint is calculated by identifying and measuring all the greenhouse gases emitted as a result of an activity. For example, a building's carbon footprint would include the emissions that came from the manufacture of the building materials and the transport of materials to the site, the energy and water used in the building itself and so on. There are standards and guidelines for making these calculations.

What is a carbon budget?

A carbon budget for a New Zealand house estimates the volume of emissions that a new house can be responsible for while still moving towards New Zealand's 2050 net-zero carbon goal. Calculations show that, in carbon terms, typical new builds today are over budget – they have larger carbon footprints than they should have.

5.2 Why the need to take action?

If climate change will lift temperatures by just 1.5°C or 2°C, that doesn't seem like a problem so why are we bothering?

Temperature changes are not evenly spread around the country and around the world. Due to climate change, an average 2°C global warming will see more extreme heat waves in some locations. For example, in 2015, India and Pakistan saw deadly heat waves when temperatures remained continually high and hit 49°C. The extreme heat resulted in thousands of deaths. An increase in global warming of 2°C would likely see extreme heat waves become an annual event.

Even minor average temperature changes have a huge impact on drought. It has been estimated that, if the average global temperature increase reaches 2°C rather than 1.5°C, about 61 million more people in the Earth's urban areas would be exposed to severe drought. In New Zealand, just small average increases in temperature could result in more heat waves, droughts and water shortages in already vulnerable areas.

Is there any evidence of climate change happening in New Zealand right now?

There is considerable evidence that our climate is changing:

- Our temperatures are getting warmer – 7 of the past 9 years have been among the warmest on record. The winter of 2022 was the warmest and wettest ever recorded.
- Sea levels around New Zealand have risen by up to 220 mm in the last century and the speed of sea-level rise has increased.
- The South Island's glaciers have lost 25% of their ice in the past 4 decades.
- Many locations are seeing drier soils and changing rainfall patterns. Auckland had a record-breaking drought in 2020.

There's been talk of more flooding, more droughts, higher temperatures, higher sea levels and so on – which are going to affect us most in New Zealand?

All of these issues are going to affect us with many already having an impact.

In mid-2020, the government released the first National Climate Change Risk Assessment for New Zealand. It found that the biggest issues facing the built environment are risk to potable water supplies and risks from extreme weather events and sea-level rise.

The risk to water supplies (availability and quality) due to changes in rainfall, temperature, drought, extreme weather events and sea-level rise was rated most urgent of the 10 most significant risks that require action in the next 6 years.

Other research indicates that, by 2050, the number of hot days (>25°C) in many locations could double from the figures today. Auckland and Christchurch could see an extra month of hot weather each year.

What is New Zealand legally committed to doing around climate change?

New Zealand's biggest commitment is to reduce net emissions of greenhouse gases (except methane from plants and animals) to zero by 2050. This is set out in the Climate Change Response (Zero Carbon) Amendment Act 2019.

New Zealand is a signatory to the Paris Agreement – a United Nations initiative where countries commit to take action to reduce the threat of climate change. Under this agreement, New Zealand committed to keeping its 2030 net emissions (gross emissions less carbon sequestration from forestry) at least 50% below its 2005 gross emissions by 2030. (This was updated in 2021 from our original commitment of 30%.)

If the law doesn't require us to be net-zero carbon until 2050, why are we acting now?

BRANZ calculations show that New Zealand's current house construction methods and materials produce too many emissions to help meet climate targets. It is going to take time to educate the industry and the public about what is required. Some upskilling of industry practitioners will be required as will changes in the choice and use of building materials. It is a big project and will take many years to achieve.

Right now, there is no law requiring houses to produce fewer emissions – will that change?

Yes, over coming years laws and regulations will be brought in that require changes in the way we build. In mid-2020, the government announced the Building for Climate Change programme as part of this process. The government has said:

> To meet the goals, we'll need to make some changes to current building laws – both the Building Act and the Building Code … At first, we'll be focusing on how we can build new buildings better. In the future, we'll also likely need to look at what changes need to be made to existing buildings.

5.3 Carbon and the construction sector

Aren't farm animals the real greenhouse gas problem in New Zealand? Why does the building and construction industry need to change?

If we consider all the energy our buildings use and a building's full life cycle – manufacture of materials, building construction and demolition – the built environment accounts for approximately 16–20% of New Zealand's greenhouse gas emissions. While it is true that a large part of New Zealand's greenhouse gas emissions come from animal sources (and from transport), the built environment still makes a significant contribution as its impact is across several sectors.

Where are greenhouse gases emitted in New Zealand house construction and operation?

A large part of the greenhouse gas emissions from a new house over its whole service life come from the energy used for plug loads, water heating, space heating and so on.

Building materials also account for a significant proportion and water use for just under 10% of total emissions.

Of the building materials we commonly use in New Zealand houses, which are responsible for the most greenhouse gas emissions and which the least?

Steel and concrete have the largest carbon footprints. When steel roofing and concrete floor slabs are used in a house design, they are typically the highest contributors, by material type, of carbon. Both the steel and concrete industries are researching ways to reduce the carbon footprints of their products.

Bio-based materials such as timber and engineered wood have advantages in net-zero carbon construction because they have captured and stored atmospheric carbon dioxide as the timber was growing. It is crucial that these products are grown sustainably with forests replanted after timber is harvested. New Zealand forestry is generally considered sustainable. Sustainably grown timber may have a certificate provided by the Forest Stewardship Council (FSC) or Programme for the Endorsement of Forest Certification (PEFC).

Will the shift to building net-zero carbon houses be a big move for the Kiwi building industry or does it just require a few small changes?

Some houses being designed and built today already have much lower carbon footprints than others. We already have a lot of the information we need to be able to design and build net-zero carbon houses (although realistically, none are actually being built). In some aspects – like making our houses better insulated and appliances far more energy efficient – we are making progress.

The challenge is that all practitioners need to be brought up to speed, and all new houses will need to be designed and built to meet the 2050 goal. In large part, we know what we have to do – it is the scale and the logistics of the change that is the hard part.

What does a net-zero carbon house look like?

At first glance, a net-zero carbon house doesn't look radically different from the new houses being built today. It may be slightly smaller than many recent new homes, and there may be greater use of certain types of material such as timber. South-facing windows may be smaller than on some homes. There will be eaves or shading devices, especially on the north-facing side, to reduce summer overheating.

Many of the changes are not visible or obvious – for example, the much higher levels of thermal insulation in the walls and ceiling, the higher-performing windows and glazing and the heat pump water heater with CO_2 as a refrigerant.

5.4 For architects and designers

What reliable, New Zealand-based tools and resources can I use in designing net-zero carbon houses?

BRANZ has developed several tools to help:

- LCAQuick is a free tool that evaluates the carbon footprint and other environmental impacts of a building design.
- CO_2NSTRUCT provides values for embodied greenhouse gas and energy for some construction materials.

You can find other resources and guidance on the BRANZ website.

My clients are extremely cost-conscious. How can I persuade them that they might need to spend a few dollars more on their new home to reduce emissions?

It is very common for New Zealanders to think a great deal about the upfront cost of a new house (or significant renovations) and very little about the running costs. Part of the approach to costs should be an explanation that things such as higher levels of insulation and glazing will make their house much warmer and more comfortable to live in and reduce the costs of space heating to keep a house the same temperature.

Clients should also understand that it is almost always cheaper to install features such as a higher level of wall insulation at the construction stage than as part of a retrofit a few years later.

My new-home clients all focus on what they can see – granite benchtops and fancy tapware. How do I talk to them about climate change?

Stories about climate change are regularly a part of mainstream news media, so most clients will already know something about it. It is up to designers and builders to explain:

- how new homes need to be able to cope with the impacts of climate change such as higher temperatures, more frequent extreme weather events and so on
- how new homes must produce fewer greenhouse gas emissions.

A practical approach may be best – for example, explaining how some water heating systems and space heating systems produce far fewer emissions than others. Encourage your clients that, when they are selecting any part of the house from the wall cladding to the showerhead, this should be part of their consideration.

I am not an expert on climate change so why should I take any responsibility in this?

The simple fact is that all of us are affected by climate change and all of us need to be involved in dealing with it. As with other challenges such as COVID-19, we need to see ourselves as a team of 5 million and work together.

Over coming years, there will be regulatory changes that everyone will need to abide by, but life will be easier if we make changes as we can rather than waiting to have them imposed on us.

My client base prefers larger houses – well over 200 m². Is it just as easy to design a large net-zero carbon house as a smaller one?

In general terms, the bigger the house, the bigger the carbon footprint. This can be true even for high-specification houses with better insulation and glazing. The energy efficiency in their design may mean less energy is used for space heating, but their size alone requires more materials to build and maintain, and this means more greenhouse gas emissions. Designing a large net-zero carbon house is possible, but it is more difficult than with a smaller house.

If I want to bring net-zero carbon ideas into my work, where should I start?

A good approach would be to introduce the idea with clients very early in the design process. Help them understand the basic concepts and guide them to include a consideration of greenhouse gas emissions in their decisions. There is a huge overlap

between areas such as good passive design and energy efficiency – concepts already well known in the industry – and net-zero carbon construction.

In the broadest terms, there are two key areas designers can address: the orientation and layout of the building and the thermal envelope – the specification of cladding, windows and glazing, insulation and so on.

My wealthy clients want a house design that I know has a huge carbon footprint. Is it OK to go ahead if they pay to have trees planted somewhere to offset the carbon?

It is true that offsetting is a consideration in net-zero carbon planning, where greenhouse gas emissions produced are balanced with an equivalent amount of carbon removed from the atmosphere by planting forests. This is not seen as an equitable or acceptable long-term approach. As construction laws and regulations are introduced or amended to require new building work to be net-zero carbon, exemptions such as this for new homes with large carbon footprints are unlikely to be included.

5.5 For builders and trades

The big decisions around house design and materials are all made by clients and designers – why should builders think about this?

Builders have a key role to play in constructing net-zero carbon houses. Consider just two areas – materials installation and waste:

- The quality of construction and installation of building materials and elements can have a big impact on all areas of a house, from weathertightness to energy efficiency. Thermal insulation is a classic example if it is poorly installed or temporarily removed and not properly restored by subsequent trades.
- On-site practices can have a significant impact on the amount of building waste that goes to landfill (and the more waste, the higher the levels of emissions). There are many ways of reducing waste, from ordering the right quantities at the right time, storing materials on site so they are not damaged, reusing offcuts where possible and so on.

If I build a net-zero carbon house, what will I be doing differently to what I do today?

Most of the building techniques in today's houses are also used in net-zero carbon houses. It is the materials, building elements, fixtures and appliances that are more likely to change. Key differences are likely to be:

- an increased use of certain materials and reduced use of others because of the emissions produced during their manufacture
- significantly higher levels of thermal insulation
- higher-specification windows and glazing
- certain types of appliance used much more frequently (such as heat pump water heating rather than the common electric storage water heaters or gas instantaneous heaters).

I never learned anything about this during my apprenticeship 20 years ago – where do I find information?

There is already information available on the BRANZ website and in many issues of *Build* magazine. Local authorities are producing information – ask your local Eco Design Advisor if your council has one. The New Zealand Green Building Council also has useful information.

5.6 For homeowners

We are about to start looking for a section to build our dream home on – do we need to think about climate change?

Choosing a building site is the best time to think about climate change and net-zero carbon building. Some councils (not all) place information on a land information memorandum (LIM). The choice of a site can have a huge impact on the carbon footprint of a house and its future energy use and running costs.

Choose a site with as much all-day sun as you can get and a size/shape that lets the living spaces of your home face north, and your home can be designed so it is kept warm mostly by the sun (and has lower energy bills). A house on a site that sees little sun will typically require higher amounts of purchased energy, have a bigger carbon footprint and come with higher running costs. Rectangular sites that run east-west are generally preferable to sites running north-south.

The ideal site will also be within walking/cycling distance of shops and other services or at least on a bus or train route so you do not need to use a car every time you go out.

Is a net-zero carbon house going to cost us a whole heap more dollars than a standard new home?

First, it is important to bear in mind the two types of cost that come with home ownership – building or buying a home and running a home. Very often, people focus just on the upfront cost of getting into a house but forget the thousands of dollars a year spent in running costs. As net-zero carbon houses are very energy and water efficient, that means that their running costs (buying electricity or water) are likely to be lower. This should be borne in mind when the upfront costs are considered.

Second, remember that house size is also a crucial consideration. Bigger houses, including bigger net-zero carbon houses, are more expensive to build. You may find that, if you focus on good design rather than size, you can get a house you are very happy to live in for little more (if any) than an older style of house that does not consider carbon or climate change.

What does climate change have to do with my old house?

The move to a net-zero carbon economy by 2050 doesn't just affect the new homes we are building. A large part of our building stock today will still be around in 30 years' time and will need to contribute to the target – for example, by being much more energy efficient.

The government has hinted that we will need to upgrade our housing stock in coming years. A good approach would be to take any opportunities you see for upgrading your home. There are already grants and interest-free loans available from government programmes, some local councils and some banks for making energy efficiency improvements to existing houses.

What can I do to my house to help reduce carbon emissions?

There are many things homeowners can do to reduce the carbon emissions from their home. Some (such as adding insulation to uninsulated walls) are likely to be best done as part of a major renovation, but other steps can be taken at any time:

- Add insulation: Insulate an uninsulated roof space or add insulation to one that is poorly insulated. Fix insulation under uninsulated suspended floors.
- Choose a heat pump: When replacing an old space heating system, choose a heat pump or a log burner/pellet burner and burn wood from sustainably grown forests (or waste wood).
- Choose electric: When replacing an old water heating system, opt for a heat pump water heater (preferably with CO_2 refrigerant) or an electric-boost solar heater system designed and installed by experts.
- Reduce water use: When replacing your washing machine, choose one with a WELS rating of 4 stars or above. Replace a showerhead that uses a lot of water with one that uses 9 litres per minute or less. Fit aerators/flow restrictors to bathroom taps. Design a garden and garden irrigation so you don't need to use sprinklers.

5.7 Further information

- Climate change tools and resources (BRANZ) https://www.branz.co.nz/sustainable-building/climate-change/branz-tools-and-resources-climate-action/
- Low-carbon resources (BRANZ) https://www.branz.co.nz/low-carbon-resources/
- Building for Climate Change (MBIE) https://www.building.govt.nz/getting-started/building-for-climate-change/
- Energy efficiency first (EECA) https://www.eeca.govt.nz/strategic-focus-areas/energy-efficiency-first/
- Sustainable Business Network https://sustainable.org.nz/
- The Aotearoa Circle https://www.theaotearoacircle.nz/

References

Bell, M., Carrington, G., Lawson, R., & Stephenson, J. (2014). Socio-technical barriers to the use of energy-efficient timber drying technology in New Zealand. *Energy Policy*, *67*, 747–755. http://dx.doi.org/10.1016/j.enpol.2013.12.010

Gibbs, G. (2007) *Analyzing qualitative data*. Sage.

Hertin, J., Berkhout, F., Gann, D., & Barlow, J. (2003). Climate change and the UK house building sector: Perceptions, impacts and adaptive capacity. *Building Research & Information*, *31*(3–4), 278–290. https://doi.org/10.1080/0961321032000097683

Ministry for the Environment. (2022a). *Building and* construction. In *Te hau mārohi ki anamata | Towards a productive, sustainable and inclusive economy: Aotearoa New Zealand's first emissions reduction plan* (pp. 226–244). https://environment.govt.nz/publications/aotearoa-new-zealands-first-emissions-reduction-plan/building-and-construction/

Ministry for the Environment. (2022b). *Te mahere urutaunga ā-motu (tuhinga hukihuki): Draft national adaptation plan*. https://environment.govt.nz/assets/publications/Draft-national-adaptation-plan.pdf

Rau, H., Moran, P., Manton, R., & Goggins, J. (2020). Changing energy cultures? Household energy use before and after a building energy efficiency retrofit. *Sustainable Cities and Society*, *54*, 101983. http://dx.doi.org/10.1016/j.scs.2019.101983

Stephenson, J. (2018). Sustainability cultures and energy research: An actor-centred interpretation of cultural theory. *Energy Research & Social Science*, *44*, 242–249. http://dx.doi.org/10.1016/j.erss.2018.05.034

Stephenson, J., Barton, B., Carrington, G., Doering, A., Ford, R., Hopkins, D., Lawson, R., McCarthy, A., Rees, D., Scott, M., Thorsnes, P., Walton, S., Williams, J., & Wooliscroft, B. (2015b). The energy cultures framework: Exploring the role of norms, practices and material culture in shaping energy behaviour in New Zealand. *Energy Research & Social Science*, *7*, 117–123. http://dx.doi.org/10.1016/j.erss.2015.03.005

Stephenson, J., Barton, B., Carrington, G., Gnoth, D., Lawson, R., & Thorsnes, P. (2010). Energy cultures: A framework for understanding energy behaviours. *Energy Policy*, *38* (10), 6120–6129. https://doi.org/10.1016/j.enpol.2010.05.069

Stephenson, J., Hopkins, D., & Doering, A. (2015a). Conceptualizing transport transitions: Energy cultures as an organizing framework. *WIREs Energy and Environment*, *4* (4), 354–364. http://dx.doi.org/10.1002/wene.149

Walton, S., Zhang, A., & O'Kane, C. (2020). Energy eco-innovations for sustainable development: Exploring organizational strategic capabilities through an energy cultures framework. *Business Strategy and the Environment*, *29* (3), 812–826. http://dx.doi.org/10.1002/bse.2399