NEW ZEALAND INFRASTRUCTURE COMMISSION
Te Waihanga

Infrastructure Resources Study

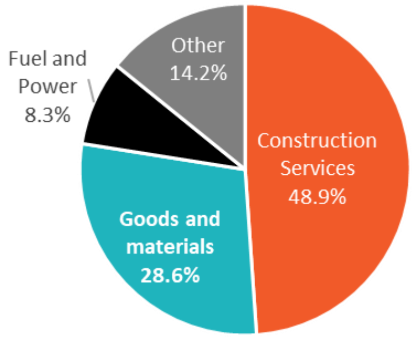
November 2021

Contents

Introduction and overview

Many traditional infrastructure projects are reliant on massive quantities of physical resources for their construction. As shown in Figure 1, Statistics New Zealand estimates that for the Heavy and Civil Engineering capital goods price index (CGPI) about 30% of the input costs come from goods and materials. These materials do not cover bitumen, a major input into roading. For those projects the costs of materials can be as high as 70%.[1]

Figure 1: Cost breakdown of the Heavy and Civil Engineering CGPI



Given their critical role in the cost and ability to undertake infrastructure projects, the Infrastructure Commission undertook this study into physical resources.

This study focusses on four key resources: aggregate, cement/concrete, steel, and timber.[2] We have focussed on these materials as they make up most input costs for most infrastructure projects. Detailed chapters on each of these resources follow this introductory chapter.[3]

Te Waihanga's focus has been on testing if there are any issues with:

- Access (whether there are any impediments to gaining access to supply)
- Price (whether there is certainty that the price estimated will be the actual price further down a project and that price itself is not creating a barrier)
- Quality (whether materials of the necessary quality will be available, and if the quality can be assured)

This overview chapter considers the wider themes of physical resource markets, including both the focus materials, but also a broader set of inputs where relevant.

This study has used three sources of information:

- Engagement across several government agencies, such as the Ministry of Business, Innovation and Employment (MBIE), Waka Kotahi, Land Information New Zealand (LINZ), the Department of Conservation (DOC), the Ministry of Primary Industries (MPI), and local councils. Where possible we have sought data held by these agencies to better understand the resources considered.
- A number of interviews with companies operating at different points of the supply chains of the focus resources. This has included both extraction companies, intermediate processing, and contracting firms that use the resources produced. Summaries of the views we heard from these companies are covered in Attachment 1: Summary of industry interviews.

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[1] Waka Kotahi estimates that the cost of physical resources can reach as high as 50-70% for roading projects, https://www.nzta.govt.nz/resources/procurement-manual/procurement-tools.html.

[2] Except for steel, these materials are all bulk commodities. They are high density, low value and high-volume goods which means that the cost of transport is disproportionately high compared to their value.

[3] Bitumen has been excluded from this study because of the work currently underway at Waka Kotahi to respond to the closure of domestic production capability. Te Waihanga has been engaging in this process directly.

- Desktop research on these materials covering both New Zealand and international research and data.

In summary, the study has highlighted five key messages:

1. Aggregates and timber struggle to increase supply to match spikes in demand.
2. Addressing the carbon impact of high emitting materials like cement and steel will have a major impact on the use of these materials in construction projects.
3. New Zealand can do more to better manage its endowment of aggregate.
4. Vertical integration[4] warrants deeper investigation.
5. Transportation costs and resource consents are major bottlenecks for the supply of many physical resources.

Te Waihanga has developed 15 recommendations to respond to these findings, which are summarised after this overview. Te Waihanga will periodically monitor and report on the extent to which the recommendations in this study are being actioned.

We see the need for a future study on physical resources that considers a Māori perspective.

This is a critical part of any assessment of this sector. The Māori world view,te ao Māori, brings a critical lense to the way we treat our natural resources that will need to be included in any future decisions. Māori are a significant land-holder and owner of key resources, anda key part of the workforce.

[4] That is integration between different parts of a supply chain, for example owning a quarry, and owning a civil construction firm that uses aggregate as an input.

Aggregates and timber often do not have sufficient excess capacity to meet spikes in demand

The ability to increase supply to meet demand varies across the industries we considered. This is summarized in Figure 2.

Figure 2: Ability to adjust to short term changes in demand across focus materials

Aggregates	Cement & concrete	Steel	Timber
– Quarries have a long lead-in time and long life. Short-term demand increases are unlikely to trigger investment decisions. – Existing quarries can increase output by adding mobile equipment and increasing labour, but this is limited by consent conditions affecting operating hours and the number of trucks allowed in and out of the site.	– Cement supply is a mix of domestic production and imports. – In normal times imports can increase to meet increases in demand. – However current shipping and container rates mean this is not viable. We expect this to return to normal levels following COVID-19, but it is unclear how long that will take.	– Domestic supply can adjust to changes in demand by: ▪ NZ steel reducing exports ▪ Increasing imports (very flexible in normal times) ▪ Increasing production (e.g., labour) at fabrication facilities. – In some areas domestic fabrication facilities can be a bottleneck. But it is possible to transport or import fabricated steel.	– Increasing supply of logs must be negotiated well in advance. – Mills can increase output by increasing operating hours. But finding labour is difficult. – Production of engineered timbers such as CLT and glulam is still maturing, current supply chains can be slow.

Aggregates and timber are a particular concern.

We have seen examples of major projects causing significant disruption to aggregate supply, such as Transmission Gully in Wellington. Local quarries are limited in how much they can increase production, causing shortages for other projects and even for 'business as usual' services.

For timber we are currently experiencing a peak of demand, largely due to spikes in small scale and domestic projects. This has resulted in a shortage, that has caused prices to increase, and some supply constraints, such as Carter Holt Harvey cutting supply to some merchants.

Both of these materials are critical for the future of infrastructure. Increased demand transparency, such as Te Waihanga's pipeline, are critical to ensure sufficient material is available and there are not wider impacts on the rest of the market.

Addressing the carbon costs of physical resources will have a large impact on the market

Many physical resources have a very high carbon impact. For example, the production of cement and steel are among the largest carbon emitting processes on earth. Per tonne produced, steel emits roughly 1.9 tonnes of greenhouse gasses,[5] and globally it is estimated that cement emits 900kg of greenhouse gasses.[6]

These materials will continue to have a critical role in infrastructure and other construction, but to meet our commitment to net zero carbon emissions by 2050,[7] significant changes will be required.[8] Applying the estimated carbon prices from the Climate Change Commission's draft report would result in an approximately 40% increase in the price of imported steel at the port, and 85% increase for cement.[9]

In part, this is likely to be addressed by new processes or technologies that lower the carbon impact of these materials. For example, research is underway across the globe on using hydrogen to convert iron to steel.[10] These processes use a large amount of electricity, but the only by-product of the process is water, significantly reducing the carbon impact. These technologies are also being investigated in in New Zealand, and there is some evidence that our unique ironsand resources may be well suited to this process.[11]

We, therefore, agree with the recommendation from the Climate Change Commission for government support for innovation to decarbonise hard to abate industries.[12] But these interventions are likely many years away from being commercially viable.

New Zealand's response to the carbon challenge of steel and cement may also be addressed by using more alternative materials that have a smaller carbon impact.[13] However we recommend more research is undertaken to better understand the marginal cost of abatement for these alternative materials. It is important that government interventions focus on emissions reduction policies that gain the best bang for buck.

Two key examples of alternative materials are:

- Blending cement with pozzolans, which can reduce the carbon impact of concrete by 25-35%. New Zealand has substantial natural deposits of pozzolans in the form of volcanic ash/pumice, which has in the past been used in infrastructure such as the Waikato Dams. HR Cement has re-introduced a product with natural pozzolans under the brand eco-cem. However, we consider that more can be done to improve the incentives for concrete mixing facilities to introduce pozzolans. Currently they receive no cost savings or carbon credits as a result of this activity, so alternative incentives may be appropriate.

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[5] https://www.worldsteel.org/en/dam/jcr:c3acc5fd-e3c2-458c-a2cc-8c4880b9334c/Steel%2527s+contribution+to+a+low+carbon+future.pdf

[6] Mahasenan, N., Smith, S., Humphreys, K., 2003, 'The Cement Industry and Global Climate Change: Current and Potential Future Cement Industry CO2 Emissions', proceedings of the 6th International Conference on Greenhouse Gas Control Technologies 1-4 October 2002, Kyoto, Japan, Volume ii, pp995-1000.

[7] Climate Response Act 2002, 5Q

[8] We are assuming that over the 30-year horizon of this strategy carbon leakage will be addressed, either by the entire world pricing carbon appropriately, or domestic measures incorporating the carbon costs of imported materials.

[9] Steel price assumed at $1,300 based on Statistics New Zealand importation data. Cement price assumed at $253, based on the only available price data (bulk imports from Holcim, and domestic production at Golden Bay are likely much lower cost, increasing the size of the % change). Price of Carbon is assumed at $250 by 2050 as estimated by the Climate Change Commission in their Draft Report.

[10] https://www.mckinsey.com/industries/metals-and-mining/our-insights/decarbonization-challenge-for-steel

[11] https://www.rnz.co.nz/national/programmes/afternoons/audio/2018793157/how-to-eliminate-c02-emissions-from-industrial-materials

[12] Climate Change Commission, 31 May 2021, 'Inaia tonu nei: a low emissions future for Aotearoa', Recommendation 21, p 307.

[13] Internationally we expect advances in technology in process heating and using hydrogen to produce steel will also bring down the carbon impact.

- Substituting some steel and cement in vertical construction with 'engineered timber' technologies such as laminated veneer lumber (LVL), glue-laminated timber (glulam), cross-laminated timber (CLT) and finger jointed timber. This technology is now being used for large-scale buildings, such as Mjøstårnet tower, an 18-story building completed in 2019 in the small town of Brumenddal in Norway. This building uses engineered timber for all structural elements, right down to the lift shaft.[14] In New Zealand, companies such as Naylor Love have demonstrated the value of engineered timber in structures such as Nelson Airport.

Use of timber for structural elements at Nelson Airport

Courtesy of Naylor Love

We also support initiatives by both the cement and steel industries in New Zealand to seek out more sustainable sources of fuel for process heat. For example, Golden Bay Cement have begun using waste tyres as a fuel. This will mean up to 50% of the 6.3 million tonnes of waste tyres will be used for process heat rather than going to landfill.[15] While we support the changes to the waste levy as the best way to reduce waste and build a circular economy,[16] we consider that innovative uses of any residual waste are a practical way to reduce reliance on fossil fuels.

More can be done to manage New Zealand's aggregate endowment

Aggregate is unique amongst the resources we considered as it is the only one that it is not viable to import due to its high weight and low value. There is a fixed resource endowment within New Zealand that we must work within. It is also a resource that has few practical substitutes and is critical to many infrastructure works as an input into roading, concrete, and ground stabilisation.

At a national level there is sufficient aggregate resource for centuries to come, however, the relatively high cost of transport[17] means there are some pockets of scarcity. In some cases, the shortages may be caused by major projects, like Transmission Gully in Wellington. However, in other areas like Auckland and the Horizons region there are more chronic shortages that require more active management of the resource if costs are to be kept under control.

The Ōpōtiki Harbour Development presents a good example. This is a high value project that will improve the harbour as a base for the fast-growing aquaculture industry. The project requires a significant amount of aggregate to build up the riverbanks to allow larger vessels into the harbour and help flush out sediment.

[14] https://www.dezeen.com/2019/03/19/mjostarne-worlds-tallest-timber-tower-voll-arkitekter-norway/
[15] https://fletcherbuilding.com/news/golden-bay-cement-sustainable-disposal-solution-for-waste-tyres-a-new-zealand-first/
[16] https://environment.govt.nz/what-government-is-doing/areas-of-work/waste/waste-disposal-levy/about-levy/#:~:text=The%20levy%20is%20currently%20set,per%20tonne%20in%20July%202021.
[17] A common industry short-hand estimate is that the cost of aggregate doubles after the first 30km it is transported.

Despite clear economic benefits, the project was initially considered uneconomic by the Provincial Growth Fund, in large part because of the high costs of transporting aggregate, which would have had to be trucked from existing sources more than 100km away. The Ōpōtiki District Council, GNS Science and the Aggregate and Quarry Association (AQA) were subsequently able to identify suitable rock locally. Development of this resource became part of a new business case, which has now been accepted.

Ōpōtiki Harbour Development

Photo courtesy of Ōpōtiki District Council

A number of government policies are making it harder for industry to increase aggregate production to meet demand. For example, the National Policy Statement on Freshwater Management, has restricted quarry development in any areas with a natural wetland, putting the brakes on a number of potential developments.

In locations where there is an on-going resource scarcity, we support measures to identify high value aggregate resource and protect it from competing uses. The challenges with getting consents make market-based solutions unlikely, so we support a larger role for government where there is scarcity. We have therefore engaged GNS Science to undertake an opportunity model of aggregate across New Zealand. This has been released on our website and is free to use.

We also note that some recent changes in roading specifications, such as Hi-Lab have had an impact on resource availability. Hi-Lab requires high quality aggregate to be used in base course where marginal aggregate has traditionally been used. Only some quarries can efficiently produce aggregate to the highly prescriptive standards. This means that, in some locations, aggregate is being transported at higher environmental and economic costs while local resources remain underused. A more detailed overview of Hi-Lab pavement is provided in Box 2

Vertical integration warrants a deeper investigation

The significant amount of vertical integration in physical resource markets may be distorting outcomes. Vertical integration exists in all materials we considered, for example between aggregates and civil construction firms and the Downers, Fletcher Building, Fulton Hogan, and Carter Holt Harvey supply chains. This likely makes the market less optimal because a downstream firm may gain an advantage in a procurement process if they have access to the best sources of materials, such as aggregate. For example, we anecdotally heard that some quarries may charge competitors a higher price than they charge their own downstream business units.

We recommend the Commerce Commission assess the impact of vertical integration on the physical resources markets as part of its upcoming market study into building materials.[18] For example, it may be appropriate to consider the profitability of firms with demonstrable vertical integration to assess if there are any wider market impacts.

If it is shown that vertical integration is allowing excessive profits, then we would encourage infrastructure funders to have a second envelope for bids that specifically relate to physical materials only. This would allow for the best supplier of the resources to be chosen independent of the choice of construction firm. The materials contracts could be set at a fixed price (with inflation adjustments) to minimise cost uncertainty.

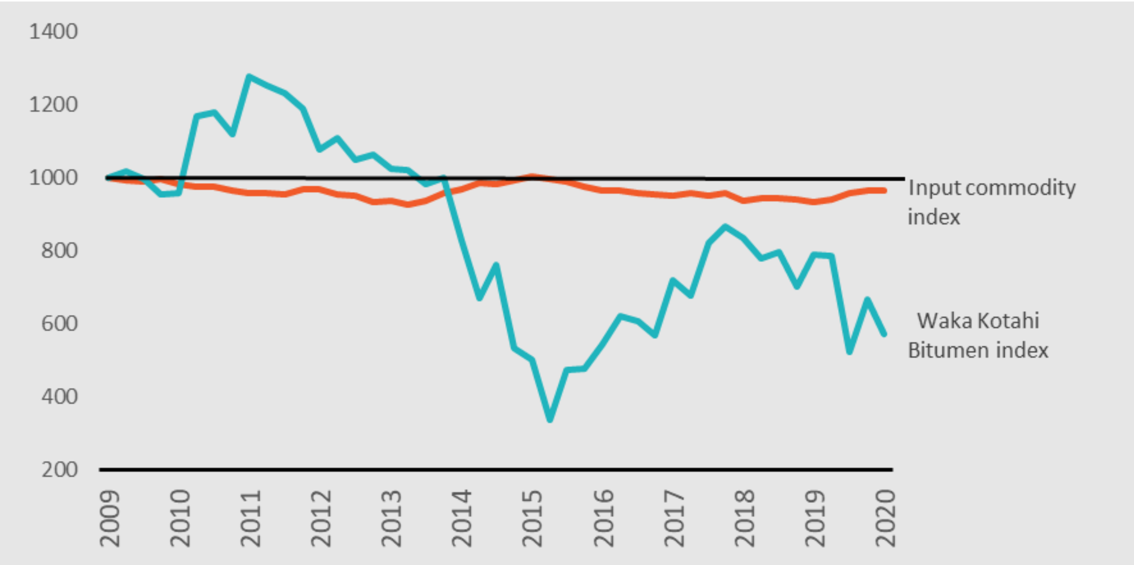
[18] This analysis was not possible as part of this study because it would require access to detailed financial information, and the legislative powers to compel the provision of this information.

We have also assessed horizontal market concentration. While there are parts of the market that are highly concentrated, there does not appear to be any evidence of a major price, access, or quality impact. For example, we found that for aggregates in the Auckland region most major quarries will only have one or two major competitors in close proximity. But we still see aggregate prices lower than in many other major centres. Steel and cement manufacturing also appear to be highly concentrated but are kept honest by open importation markets.

This finding is supported by Figure 3 which shows prices for physical materials have tended to track below inflation. Many of the products considered track closely to international prices, for example, cement, steel, and timber. These products can be vulnerable to shortages and price spikes during economic downturns, but there is no evidence of any excessive pricing in New Zealand.

Figure 3 does not include the costs of transport, which can add significantly to the cost of some resources like aggregate. The bitumen index is specifically shown as this cost is not covered in the input commodity index used by Statistics New Zealand and has been very volatile over the last 11 years.

Figure 3 Real price changes for physical resources[19]



The industry has identified significant concerns with transportation infrastructure and resource consents

Transportation issues include the limitations of New Zealand roads, which can increase trucking times, and limit the size of trucks. It is likely that this increases the cost of cartage for physical materials in New Zealand compared to other countries.

[19] The input commodity index is based on the 2020 weightings for the 'Heavy and Civil Engineering' CGPI. It comprises of: fabricated metal products, excluding machinery and equipment (34%), aggregates (22%), articles of concrete, cement, and plaster (21%), gypsum, limestone, minerals, salt, precious metals and stones (12%), plastic in primary forms (6%) and wood and timber (4%).
We note that the bitumen index tracks very closely to the price of crude oil, reflecting that this price is largely determined by international markets.

As part of this study we have attempted to estimate some ball-park scenarios of the cost of transporting aggregate into the Auckland region. This shows the additional cost of transporting from outside the region, compared to transporting from quarries within the region is likely between $37m and $163m per year. This represents up to 1% of the total cost of construction in Auckland.

Industry also highlights that ports can create a bottleneck for both imports and exports. However, we understand these issues are already front of mind for debates about port upgrades.[20]

Resource consent issues are particularly challenging for establishing and expanding quarries and sawmills. Not only do these issues limit entry into these markets, the conditions on consents often limit the volume of material that can be produced by limiting hours of operation or the number of trucks that can come in and out of a facility each day. This in turn reduces the ability to increase supply for peaks in demand. We hold significant concerns about the over-use of these restrictions. We have addressed this issue directly in the Draft New Zealand Infrastructure Strategy.

[20] See for example https://www.portstrategy.com/news101/world/australasia/berthing-window-issues-in-nz

Full list of Recommendations

Aggregate

Recommendation One - Aggregate recycling: We recommend territorial local authorities consider adopting the Auckland Transport Series 0800 Specifications for the supply of aggregates which includes specific standards relating to the use of recycled crushed concrete. Adopting this specification will help give industry confidence of the quality of the aggregates available.

Recommendation Two- Performance specifications: We recommend that the aggregate specifications set by Waka Kotahi, councils and others should apply a performance-based approach to make it easier to use local materials so long as they meet the required level of performance noting the environmental and cost implications.

Recommendation Three - Commerce Commission market study into building supplies: We recommend that as part of the Commerce Commission's upcoming market study they further investigate the role of vertically integrated construction firms.

Recommendation Four – Improved information: We recommend that MBIE consider how to improve the response rate for the Annual Return of Industrial Rocks and Mineral Output Survey, so that it captures all aggregate quarries that sell to other parties or use the aggregate for commercial projects. The survey should also be extended to include information such as peak production potential, and total remaining resource available at the quarry.

Recommendation Five - Improving understanding of long-term demand: We recommend the Ministry for Business, Innovation and Employment should consider how it can use the various long-term demand publications to derive demand for aggregate on behalf of its industry.

Relevant publications include Te Waihanga's Infrastructure long term pipeline, MBIE's National Construction Pipeline or long-term plans and 30-year infrastructure strategies produced by local authorities.

This would provide better signals to both the quarrying industry and government about where shortages could occur and how they could be avoided.

Recommendation Six - Protecting scarce aggregate: We recommend that local authorities undertake a resource scan as part of their long-term planning process, informed in part by the study into aggregate opportunities by GNS Science and known demand forecasts. If hard-rock resource is identified as being scarce, local authorities should ensure that sufficient land, where hard rock is present, is kept available for industrial activities to support future growth. This could be through zoning under the current Resource Management Act or proposed Spatial Planning Act.

Recommendation Seven - Re-balancing the trade-off between protecting the environment and enabling access to resources:

We recommend that the Ministry for the Environment work with support from the Aggregate and Quarry Association, local authorities and other stakeholders to develop a national direction for quarrying to remove any unjustified variations in how resource consents are assessed and conditioned. National direction should also provide for short-term exceptions to these conditions to meet peak demand.

In the short term, we recommend that the Aggregate and Quarry Association develop, in partnership with the Ministry for the Environment, a best practice quarry consent application template to ease the administrative burden on quarry operators and councils, and support data collection. The template could identify specific data that should be provided to territorial local authorities as part of the consent application process and as an ongoing requirement to build up the national database.

Steel

Recommendation Eight - Supporting domestic industries through climate change: We recommend that climate change policies such as MBIE's Building for Climate Change ensure that domestically produced steel is not put at a competitive disadvantage to imported steel due to differences in the way the costs of carbon are accounted for.

Recommendation Nine - Applying innovations to New Zealand steel production: As part of the first emissions reduction plan, the Ministry for the Environment should be considering the appropriate policy and regulatory settings so that innovations for decarbonizing steel making, can be applied in New Zealand.

Concrete/cement

Recommendation Ten – Supporting domestic industries through climate change: We recommend that climate change policies such as MBIE's Building for Climate Change ensure that domestically produced cement is not put at a competitive disadvantage to imported cement and clinker due to differences in the way the costs of carbon are accounted for.

Recommendation Eleven - Creating better incentives for the use of pozzolans: We recommend that further work is undertaken to consider if the incentives for increasing the use of pozzolans into cement and during concrete batching can be improved. In particular considering:

- whether pozzolans would be competitive against clinker based cement if the costs of carbon were accounted for; and
- whether there is any way to set incentives so that pozzolans will be introduced at concrete batching facilities where the carbon abatement costs are less than the price of a carbon credit.

Recommendation Twelve - Process change to support increased use of pozzolans: We recommend that Concrete NZ work with MBIE to provide guidance on how the use of natural pozzolans affects early compressive strength gain and how increasing the use of pozzolans in concrete can be done by demonstrating it still complies with New Zealand Standards.

Timber

Recommendation Thirteen - Improving domestic supply of sawn timber: We recommend that the Wood and Forestry Industry Transformation Plan and the Forestry Strategy should focus not only on the export benefits of growing the timber sector, but also the benefits to construction projects of having better and cheaper access to sawn timber.

Recommendation Fourteen - Importation of sawn timber: We recommend the Ministry for Primary Industries undertake a targeted study to understand the opportunities and risks of increasing importation of sawn timber and other wood products, and the barriers and what can be done to mitigate them.

Recommendation Fifteen - Research required to justify government intervention in promoting engineered timber: We recommend that the Ministry for Primary Industries undertakes targeted research to establish whether there is a viable path for getting the marginal abatement costs of engineered timber below the costs of a carbon credit at any point in the future. This work should:

- assist with determining the true carbon impact of engineered timber buildings;
- estimate the likely carbon reduction path of traditional materials like steel and concrete. This is necessary to estimate the carbon savings that can be achieved by using timber; and
- propose if, and how the costs of engineered timber can be reduced sufficiently to make the material cost effective, taking into account its carbon impact

Focus material #1: Aggregates

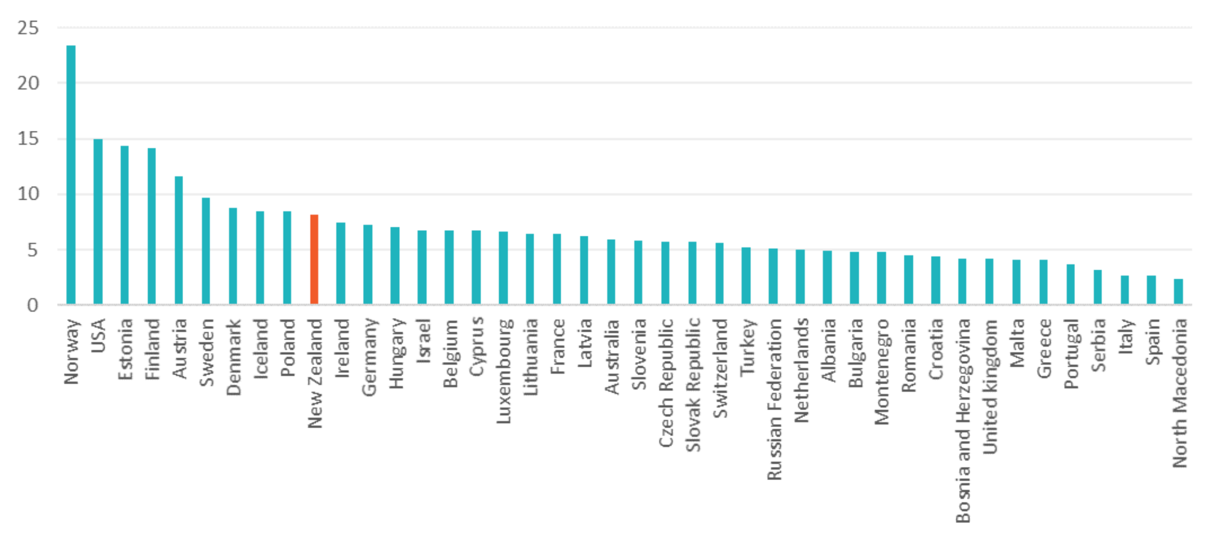
Aggregates are a significant cost of construction, particularly for infrastructure projects

Aggregates are the foundation of our roads and buildings, they are the most consumed commodity in the world after freshwater. Our need for them is set to increase and it is unclear if we have enough in the right places.

This report refers to aggregate as the rock or gravel extracted from quarries and rivers which is then crushed to various sizes for use in roading and construction. The use of aggregate for other purposes such as glass making are not considered in this report.

As a relatively sparsely populated country with challenging terrain, New Zealand has a lot of horizontal infrastructure per capita (roads, bridges etc.); this means that we use a lot of aggregates for our size. Figure 4 below shows per annum aggregate production per person for European countries, the United States of America, Australia, and New Zealand. New Zealand ranks near the top of this list, and it may be even higher if we were able to rank demand, as many of the top European producers export aggregate.

Figure 4: Aggregate production per capita in Europe, United States of America, Australia, and New Zealand (tonnes per person per annum)[21]



Independent and verified data in the aggregate industry is not readily available. However, the Aggregate and Quarry Association (AQA) has estimated that 50 million tonnes of aggregate was quarried in 2018. Roughly 65% of total aggregates is used in roading, and 35% used in construction and other end uses (glass manufacture, landscaping etc.).[22]

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[21] Europe data from https://uepg.eu/; USA data from https://www.usgs.gov/centers/nmic/crushed-stone-statistics-and-information and includes Crushed Stone, Sand and Gravel and Aggregates; Australia data from https://www.pc.gov.au/inquiries/completed/regulation-benchmarking-planning/submissions/sub054.pdf; NZ data based on https://www.nzpam.govt.nz/nz-industry/nz-minerals/minerals-statistics/industry-statistics/.
[22] https://www.aqa.org.nz/industry/fact-files/

Figure 5: Application of AQA's Statistics for 2018

		
65% of aggregate is used for roading. In 2018 this was roughly 30 Mt, which is enough for 2,321 kms of new two-lane highway, longer than the distance from Cape Reinga to Bluff along State Highway One	33,000 new houses, based on data from the number of houses consented. [23]	265 new office towers based on the amount of aggregate remaining from total production

50 million tonnes of aggregate has a value of more than $800 million per year at the average price per tonne.[24] Aggregate also makes up 5.2% of the 'Heavy and Civil Engineering' producer price index, making it one of the largest input cost categories for infrastructure works.

For roading specifically, aggregate contributes an even larger portion of input costs. Table 1 shows the contribution of aggregate across road types and the difference between construction and maintenance.

Table 1: Input percentage of road construction costs[25]

	Arterial Roads		Sealed Local Roads		Unsealed Local Roads	
	Construction	**Maintenance**	**Construction**	**Maintenance**	**Construction**	**Maintenance**
Quarry Materials	14.7%	8.1%	16.0%	7.5%	27.0%	20.3%

Are there any problems with aggregate supply?

To address the infrastructure deficit New Zealand will need a lot more aggregate in both the short term and the long term. It is likely that this will come from outside the major growth urban centers, which will increase transport costs.

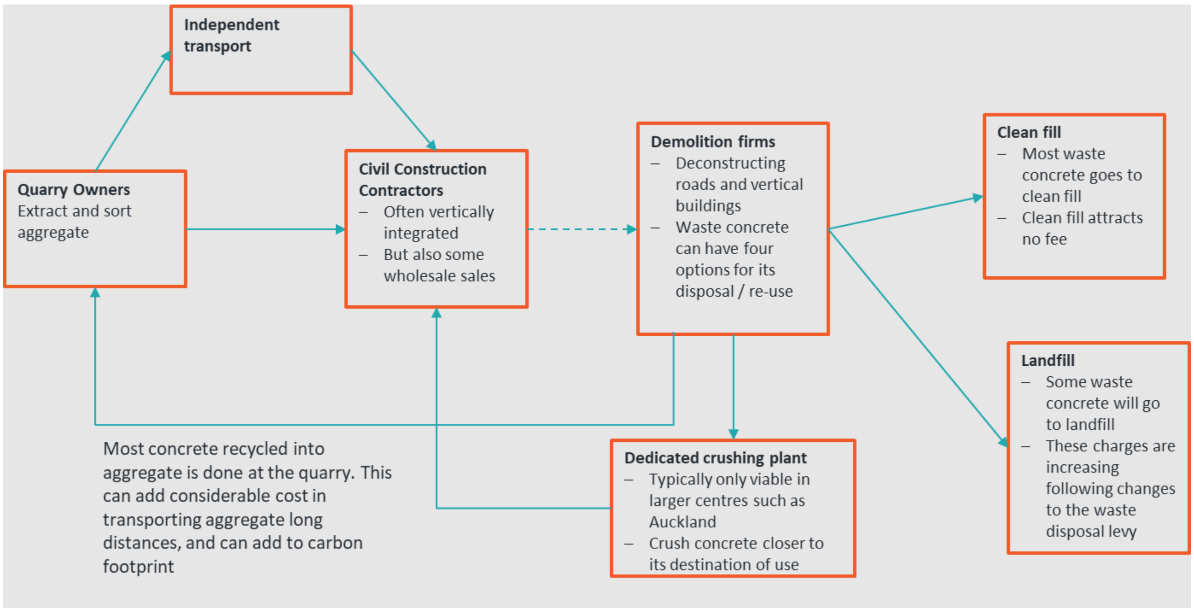
The supply chain for aggregate is shown in Figure 6.

[23] Ministry of Business Innovation and Employment (MBIE) Construction pipeline https://www.mbie.govt.nz/building-and-energy/building/supporting-a-skilled-and-productive-workforce/national-construction-pipeline-report/

[24] *Annual Return of Industrial Rocks and Mineral Output Survey* conducted by MBIE

[25] Appendix A Input mix by supplier of road works services https://www.bitre.gov.au/sites/default/files/is_049.pdf. Previous studies procured by Waka Kotahi found this Australian data is comparable to New Zealand.

Figure 6: Aggregate supply chain



Ease of access to aggregate depends on local conditions

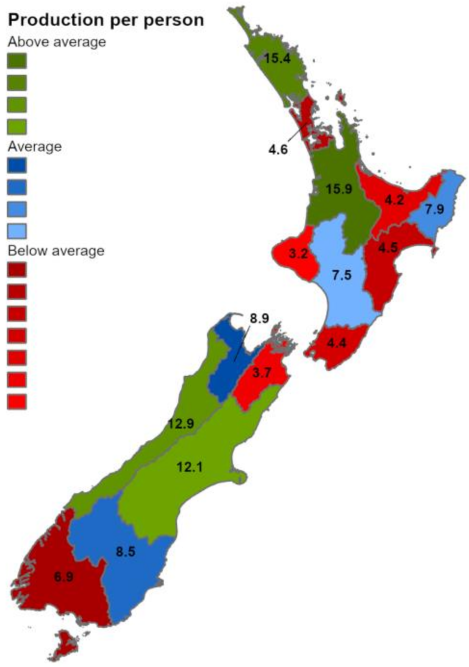
As part of our work to understand the aggregate market, we have supported GNS Science to complete a study into the aggregate opportunity in New Zealand. GNS Science has mapped the endowment of hard rock resources across the country. On top of this they have applied map filters of land use, future demand projections, supporting infrastructure and cultural sensitivity to identify the best opportunities across the country.

The GNS Science report shows no indication that we are at, or nearing, any scarcity at a national level. The maps also provide a guide for where more hard rock resources can be found and are likely to meet the conditions for quarries. This resource has been released publicly and is free to use.[26]

The report also shows that resources are not evenly distributed across the country, and neither is demand for aggregate. It is also more difficult to set up quarries in heavily populated areas because of the impact on near-by residents.

Figure 7 to the right shows aggregate production per person in each region. Those areas producing below average (in red) are likely importing aggregate from other regions often those with production above average (in green). In particular Auckland is severely constrained and is importing aggregate from Northland and Waikato.

Figure 7: Aggregate production per person in New Zealand regions



[26] https://www.tewaihanga.govt.nz/policy/reports/aggregate-mapping/

Wellington is also constrained, but does not have neighbours with excess production, so may have to import from even further away.

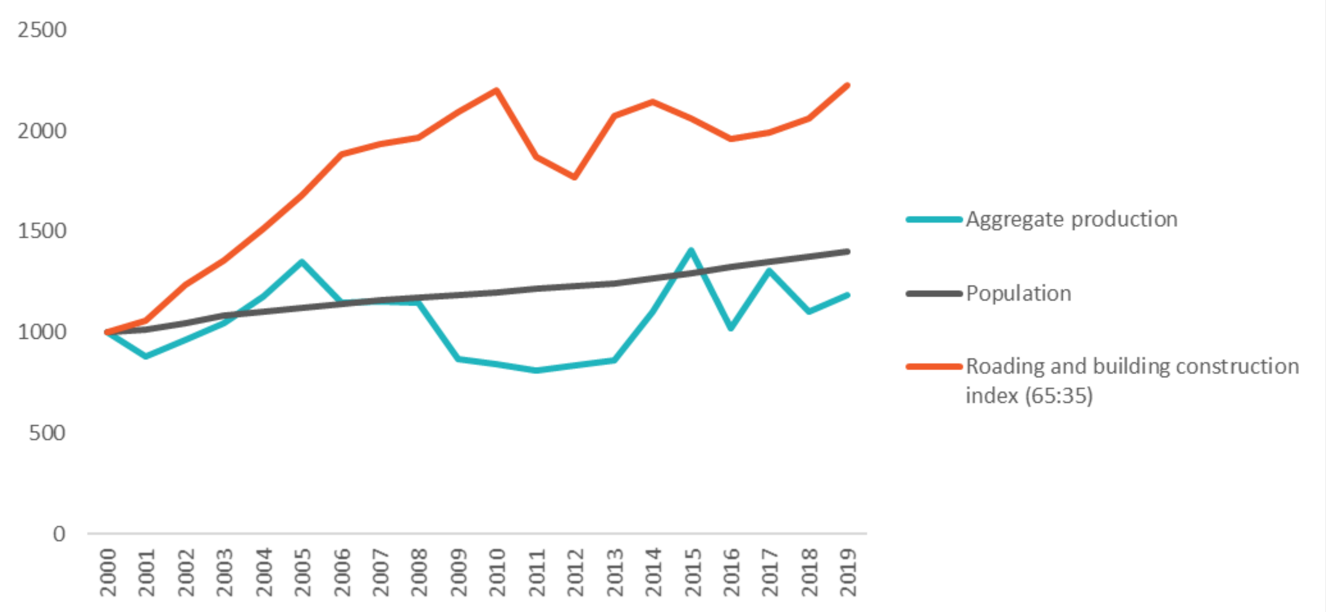
Regional supply shortages have been a feature for the last 20 years, but shortages have gotten worse in times of high demand

Supply shortages tell a different story for different regions. We have considered Auckland, Wellington, and Canterbury below to demonstrate some of the different issues faced across New Zealand.

Aggregate shortages in Auckland appear to have steadily increased over the last 20 years. Figure 8 shows aggregate production compared to population, and a composite measure of building and roading construction. While aggregate production is keeping up with population, there is a growing gap to the construction index, which we consider to be the better measure of demand.

Auckland has always imported a large amount of its aggregate to meet local demand, but Figure 8 shows that this has likely increased over the last 20 years.

Figure 8: Indices of Auckland aggregate production and demand indicators[27]



The Wellington region has had some extreme jumps in demand for aggregate since the start of the Transmission Gully project in 2014. Figure 9 shows that production has not kept up with these jumps, particularly between 2014 and 2017. This has led to supply shortages in the Wellington region, and an increased cost of importing aggregate. We also note that Figure 9 suggests that the costs of importing aggregate for Wellington are likely much higher than for many other regions,

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[27] The 'Roading and building construction index (65:35) is made up of roading data from NZTA and building consents. Both of these values were normalized for the relevant CGPI indexes to account for cost changes over time. The roading data is weighted as 65% of the index, and is based on the improvements and maintenance data, excluding administration, professional services, studies, property management, traffic management, stimulus and roading cleaning. https://www.nzta.govt.nz/planning-and-investment/learning-and-resources/transport-data/data-and-tools/. The construction data accounts for the remaining 35% of the index, and is based off the value of building consents.

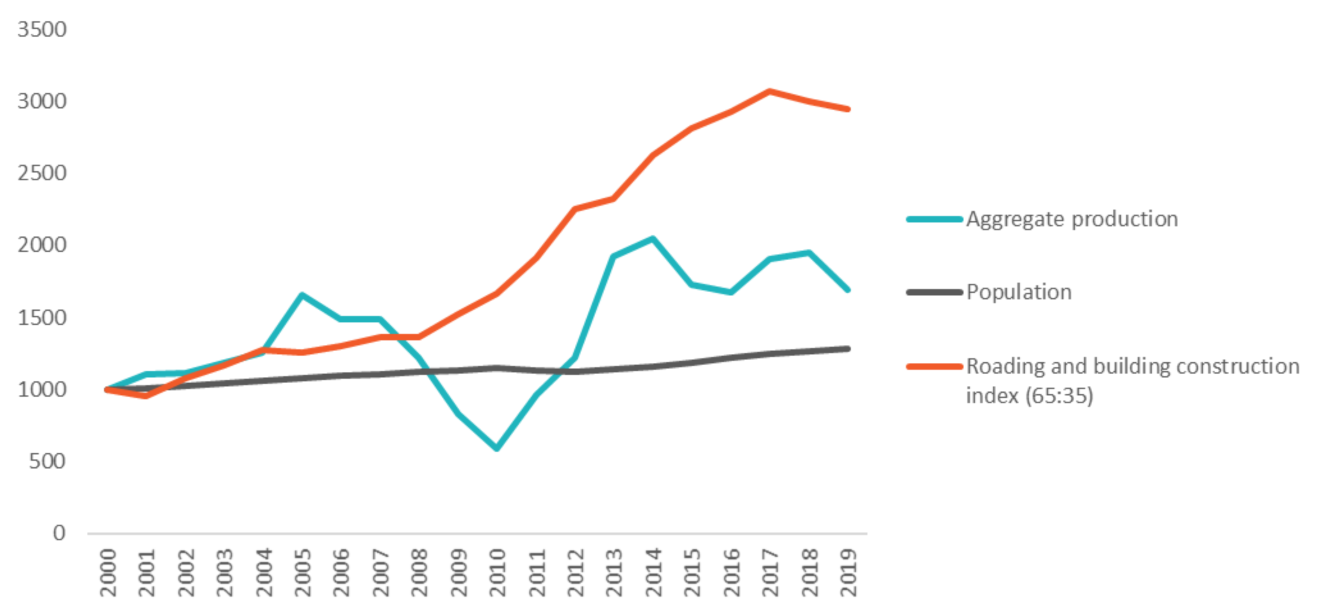
because there are no near-by regions with excess aggregate production. It appears that production in 2019 started to catch-up with demand, as the Willowbank quarry started production.

Figure 9: Indices of Wellington aggregate production and demand indicators

Canterbury has had a major increase in building consents following the Christchurch earthquakes, but a more modest increase in roading investment. Aggregate production has increased significantly but has still not quite kept pace with the composite roading and building measure. Measures to make land available for industrial purposes, like quarrying, have supported the increases in production we have seen.[28] Construction activity is expected to return to lower levels in the coming years, suggesting further increases in aggregate production may not be a good long-term decision.

[28] The Land Use Recovery Plan (effective December 2013) provides the land use framework for residential and business land use in Greater Christchurch. Around 30 years of additional land (based on pre-earthquake growth) were opened for industrial use and protected from reverse sensitivities.

Figure 10: Indices of Canterbury aggregate production and demand indicators



Box 1: Types of aggregate

Many different types of rock are used across the country, each with different qualities, like hardness, size, and abrasiveness that make them suited for different purposes. The most common forms of aggregate in New Zealand are:

- Greywacke, which is a hard, high quality rock that can either be quarried or extracted from alluvial gravel. It is commonly used in both concrete and roading. It is widespread throughout New Zealand's mountain belts.
- Volcanic rocks, such as basalt, scoria andesite, dacite, etc. Basalt is the best suited of these rocks for aggregate, and is available in Northland, Auckland, Waikato, Canterbury, and Otago. Basalt is used for roading and concrete. Scoria is used for decorative and drainage applications.
- Plutonic rocks such as Northland's dolerite (used for basecourse and concrete), granite and gneiss from Westland and Southlands (used as riprap) and Southland's dunite, which is used as a roading aggregate.
- Limestone which is largely available in the mid-North Island and Northland is used mainly for rockfill and riprap and for roading (but not sealing chips) where more suitable rock types are unavailable.
- Schist from Marlborough and Otago is sometimes used as aggregate, but it is a relatively weak rock, so has limited applications
- Sand from beach and river deposits, near shore dredging, and as a by-product of crushing rock. Sand is used in concrete, and in basecourse.

These deposits vary across the country, so in some regions certain forms of aggregate are hard to find. For example, larger rocks known as riprap, which are used for containing harbours and seas, are not easily sourced in the Wellington area because of the brittle nature of the rock. Riprap in particular is commonly imported from other regions for projects around New Zealand, substantially increasing their costs.

Recycling could be commercially viable in some urban centres, such as Auckland

In the past, the ease of access to cheap aggregate has prevented investment in alternatives to virgin rock for aggregate. Auckland is starting to invest in recycled concrete to reduce the gap between local demand and supply.

Aggregate recycling typically refers to the process of crushing concrete to use as a source of aggregate. The crushed concrete is often used as base course for roads, or foundations. It can also sometimes be used for concrete but tends to absorb more water so must be treated carefully. Recycling aggregate is very common internationally, especially in large urban and industrial areas.

There are only limited environmental benefits of aggregate recycling. Most concrete is not a hazardous waste, and recent studies indicate it can continue to absorb carbon well after it is demolished.[29] The main impact of recycling is reducing the demand on virgin aggregate; however, in most locations in New Zealand there remains abundant resource available.

In New Zealand, aggregate recycling can be considered as a simple cost trade-off compared to virgin aggregate. The cost of recycled aggregate is determined by three main factors:

- The availability of concrete to crush. In New Zealand most concrete is disposed of at clean-fills which attract no waste levy. That means demolition companies do not avoid much if any cost by sending concrete for recycling.
- The transport cost of getting the concrete to a crushing facility. In New Zealand recycled aggregates are mostly produced at quarries, which may mean very high transport costs; however, there are some dedicated crushing facilities closer to market in Auckland.
- The cost of crushing the concrete. Quarry owners have indicated that crushing concrete can increase their costs as they must have a separate run on the crushing machines, and they must be cleaned afterwards, creating downtime, and some inefficiency.

Given these costs, there will be locations where the use of crushed concrete will be less efficient than virgin aggregates (Canterbury for example). However, in places where hard rock resource is limited, concrete crushing could be an efficient way to meet the need for lower or marginal grade aggregate.

As the supply of locally produced virgin aggregates becomes more limited in Auckland (due to consent conditions and exhaustion of the resource) recycling facilities become more viable. There are at least six facilities in Auckland accepting construction waste concrete for recycling, primarily for use as base course and drainage aggregates[30], but barriers to uptake remain.

Our interviews, and recent research commissioned by Waka Kotahi,[31] have identified a perception that recycled products are inferior to virgin aggregates (reinforced by Waka Kotahi specifications

[29] https://www.engineersaustralia.org.au/News/cement-structures-significant-carbon-sink#:~:text=of%20carbon%20emissions.-,A%20new%20international%20study%20indicates%20that%20cement%20structures%20may%20be,the%20emissions%20during%20cement%20production.&text=The%20researchers%20found%20that%20the,%22sink%22%20for%20carbon%20dioxide.

[30] Auckland Council identifies the following sites as recycling concrete: Atlas Concrete, Albany; Green Gorilla, Onehunga; Kalista Ltd, Onehunga; Nikau Contractors, Onehunga; Ward Resource Recovery Ltd, Onehunga; and Western Aggregates, Glendene

[31] Recycled aggregates on New Zealand roads: barriers to uptake and drivers for change, WSP Opus

that allow only certain percentages of recycled materials), and that there may not be a consistent supply of recycled materials.

Specific quality standards and use requirements could support the development of the market. Auckland Transport has developed standards to help resolve this problem. We encourage other councils to adopt these standards to allow recycled aggregate to be used where efficient.

Recommendation One- Aggregate Recycling: We recommend local authorities consider adopting the Auckland Transport Series 0800 Specifications for the supply of aggregates which includes specific standards relating to the use of recycled crushed concrete. Adopting this specification will help give industry confidence of the quality of the aggregates available.

The price of aggregate for a particular project has as much to do with transport as quarry gate price

We do not have concerns with the gate price of aggregate. The price is similar to the USA and considerably lower than prices found in Sydney.

However, the cost of transporting aggregate can be a major factor in the cost of some infrastructure projects.

Aggregate is a bulk commodity, it has a high density, is low value and is used in large quantities. Transportation is therefore a large component of the delivered cost of aggregate. This can have a major impact on the cost of roads or other civil construction that relies heavily on aggregates.

Aggregate is almost exclusively transported by truck. We have estimated a rough average cost of truck freight of about $4 per km.[32] An average aggregate load in Auckland will be roughly 21 tonnes,[33] and will often be empty on the return trip. That means the cost for a 50km round trip would be roughly $400, and the value of the aggregate would be roughly $350.[34]

Table 2 uses this cost estimate to provide an indication of the costs of importing aggregate into Auckland. It assumes Auckland consumes 30% of New Zealand's total aggregate,[35] or 15mt. It then

[32] This is based on confidential information we have received for this study and has been rounded to a whole number to protect commercial sensitivity. We have assumed a ratio of truck only to truck and trailers of 50:50 for the Auckland region.

[33] We assume that a truck can carry roughly 11 tonnes, and a truck and trailer can carry 31 tonnes. We have assumed a ratio of truck only to truck and trailers of 50:50 for the Auckland region. For the country overall, we understand a better ratio would be 65:35 weighted to smaller trucks, resulting in an average of 18 tonnes per load.

[34] Applying the estimated tonnage per truck for all of NZ, of 18 tonnes means that the cost of aggregate doubles every 37km, roughly equivalent to the industry shorthand that aggregate doubles in cost after the first 30km.

[35] Auckland contributes roughly 40% of construction costs in New Zealand, https://www.mbie.govt.nz/assets/national-construction-pipeline-report-2020.pdf and roughly 27% of total roading infrastructure https://www.nzta.govt.nz/planning-and-investment/learning-and-resources/transport-data/data-and-tools/. Using a composite of roading to construction of 65:35 gives about 30% of demand in Auckland.

subtracts an estimate of Auckland aggregate production of 10.5mt[36] to estimate that about 4.5mt of aggregate is imported into the region.

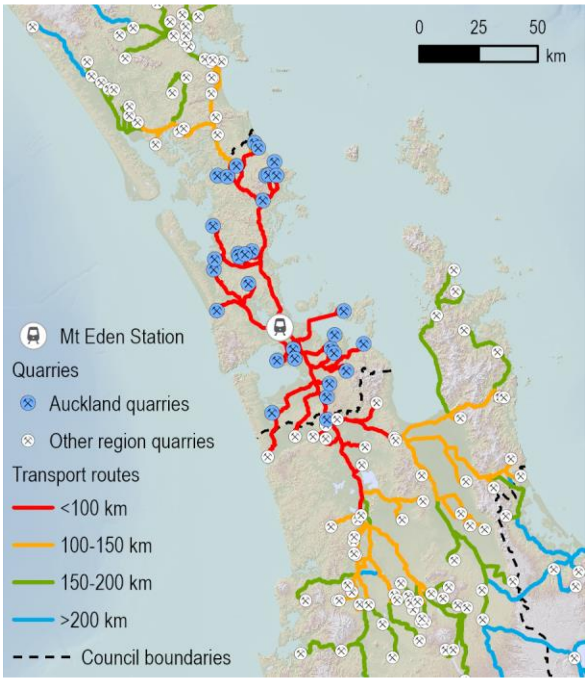
Table 2 estimates the cost to import aggregate at different distances from the Mt Eden Station development, a recent large construction project near the centre of Auckland. We have used mapping data to estimate the travel distance for trucks from quarries in surrounding regions.

The mapping data shows that on average quarries within the Auckland regional boundaries were about 50km from the Mt Eden site. This is used as the counterfactual to estimate the total landed cost of aggregate if it was all supplied within the Auckland region.

We do not know which quarries provide aggregate to the Auckland region. To get a ballpark estimate we have used three scenarios. The scenarios are three bubbles of increasing size around the Mt Eden site as shown in Figure 11. This is intended to give a range of values to show the impact if aggregate is sourced very close to Auckland, or further away. The three scenarios used are:

1. Imported aggregate travelling up to 100km from the Mt Eden site. This captures 12 quarries from outside of the Auckland region.
2. Imported aggregate travelling up to 150km from the Mt Eden site. This captures 55 quarries in total from outside the Auckland region.
3. Imported aggregate travelling up to 200km from the Mt Eden site. This captures 110 quarries in total from outside the Auckland region.

Figure 11: Distance scenarios shown on map of Auckland



Under these assumptions, if the aggregate imported into Auckland is all within a 150km bubble, then the additional transportation cost to construction projects in Auckland would be roughly $120m per year. This is about a 20% higher cost for aggregate compared to the counterfactual that all aggregate is sourced locally.

We have also considered the carbon impact of the additional travel using assumptions from the Climate Change Commission's report. Under the 150km bubble scenario the extra carbon from trucking is roughly 40,000 tonnes of CO_2 per year, or 0.1% of New Zealand's total net emissions. We calculated the impact over 30 years and found that the 150km bubble scenario would emit more than 1 million additional tonnes of CO_2.

[36] MBIE's Annual Return of Industrial Rocks and Mineral Output Survey has Auckland producing roughly 8.5mt per year. However, we understand that some quarries in the Auckland region do not contribute. AQA has estimated that including these quarries will add roughly a further 2mt to Auckland production.

Table 2: Scenarios of the cost of importing aggregate into Auckland

Inputs			
Total NZ aggregate production (Mt)[37]	50		
Auckland % of total construction costs	30%		
Estimate of Auckland aggregate demand (Mt)	15.0		
Estimate of Auckland aggregate production (Mt)	10.5		
Estimate of aggregate imported (Mt)	4.5		
Estimate of aggregate gate price (per tonne)[38]	$16.40		
Estimate of average truck load (t)[39]	21		
Estimate of cost per km[40]	$4.00		
Auckland total construction costs ($m)[41]	$17,100		
Carbon impact (g CO2/vkm, 2021)[42]	1,367		
Total net emissions Mt CO_2[43]	38.7		
Counterfactual scenario - all aggregate sourced from Auckland region, average distance to quarry = 50km			
Counterfactual aggregate gate price ($m)	$246.00		
Counterfactual travel cost (100km round trip, $m)	$285.71		
Counterfactual total cost of aggregate	$531.71		
Scenarios of additional distance travelled			
Maximum distance travelled (km)	100	150	200
Average distance travelled (round trim km)	144	238	291
Additional distance per trip cf. counterfactual (km)	44	138	191
Total additional distance travelled travel (km)	9,353,571	29,473,792	40,859,221
Cost impact of scenarios			
Extra cost for travel ($m)	$37	$118	$163
Extra cost over 30 years (6% discount rate $m)	$515	$1,623	$2,250
Extra cost as % of counterfactual costs	7%	22%	31%
Extra cost as % of Auckland construction cost	0.2%	0.7%	1.0%
Carbon impact of scenarios			
CO_2 tonnes per year from additional travel	12,783	40,280	55,839
% of yearly emissions	0.03%	0.10%	0.14%
CO_2 tonnes from additional travel over 30 years[44]	353,738	1,114,655	1,545,235

Regional variations are also reflected in quarry gate prices, but average prices are comparable with the USA and lower than Sydney

Figure 12 below shows the average gate prices across each region in New Zealand for aggregate used for roading projects as recorded in the *Annual Return of Industrial Rocks and Mineral Output Survey* (Quarry Survey) conducted by MBIE. Regions with aggregate shortages appear to have a materially higher price to other regions. This is expected. Not only is higher demand driving up price, but quarries in high demand centres appear to be able to increase their aggregate price to reflect their lower transport costs (ie, to match a similar landed price as competitor quarries with a higher transport cost).

The variations in prices between regions shows that there are some market incentives to build quarries in areas of high demand.

Figure 12: Gate prices for Rock, Sand and Gravel used for Roading by Region, 2018[45,46]

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[37] AQA estimate https://www.aqa.org.nz/industry/fact-files/

[38] MBIE, Annual minerals industry statistics and survey https://www.nzpam.govt.nz/nz-industry/nz-minerals/minerals-statistics/industry-statistics/

[39] Assumes a truck can carry 11 tonnes, and a truck and trailer can carry 31 tonnes. We assume a 50:50 split between these two vehicles.

[40] Te Waihanga's rounded estimate based on confidential information from industry.

[41] MBIE, Annual minerals industry statistics and survey https://www.nzpam.govt.nz/nz-industry/nz-minerals/minerals-statistics/industry-statistics/

[42] Climate Change Commission, '2021 draft advice scenarios dataset' https://www.climatecommission.govt.nz/get-involved/sharing-our-thinking/data-and-modelling/

[43] ibid

[44] ibid, based on 50:50 ratio of medium and heavy trucks, and assumptions of g CO_2/vkm each year, and assumptions of electric truck uptake.

[45] 2018 data was used for this graph, as the 2019 data showed a sharp dip in the average price in the Wellington region that does not seem to fit the experience in the region. Categories of aggregates are summarised by use: reclamation and protection; building; sand for industry; and rock sand and gravel for roading. We understand the latter category to be the average price across standard specifications relative to their output e.g. AP65, M/4, M/10 etc.

[46] Data for the Marlborough region has been withheld in the MBIE reporting to avoid identifying individual company production figures.

These prices are not excessive compared to the two international example we were able to identify – the USA and Sydney. The average USA price for all aggregate in 2019 was NZ$16.58.[47] This is very similar to the average New Zealand price of $16.42 in the same year. In Sydney the gate price is between $40-$50 per tonne, significantly higher than the New Zealand price.[48]

Quality

There is a tension between resource efficiency and risk-avoidance. High-specification aggregate is being used where lower-grades are appropriate and locally available.

Systemic concerns about low-quality aggregate were not raised, but we have heard about the 'overuse' of high-grade aggregates where lower-quality materials could be used. For example, we have heard anecdotes about products that meet chip-seal specification being used for footpaths, carparks, and cycleways.

In Tauranga for example, there is a shortage of high-grade virgin aggregates due to local geology. Under these conditions it is important to consider how lower-grade local resources could be used appropriately.

The overuse of high-grade virgin materials means that more aggregate is having to be imported while local materials remain under-utilised. This has three unnecessary additional costs:

a. the difference in cost between high-grade and lower grade material;

b. the additional cartage to import high-grade material; and

c. the carbon emissions associated with the additional transport.

Several stakeholders raised with us the recent trend of high-volume roads requiring the use of Hi-Lab pavements (High strength – Low fines Aggregate Base)

Horizontal infrastructure projects are particularly risk averse when considering alternative materials. Recent high-profile road surface failures (e.g., sections of the Waikato Expressway, Kapiti highway, and Transmission Gully)[49] have likely entrenched the sectors reluctance to test alternative materials where high-specification aggregate is not required e.g. bike-lanes.

These standards are driving a requirement for higher-grade aggregates. In some regions, these aggregates are not readily available and have to be transported long distances, imposing greater cost. These standards could be revisited, using a performance-based approach, allowing increased use of locally available resources that do not have a negative impact on the overall performance of the asset.

Waka Kotahi and Auckland Transport are key leaders for driving any changes in aggregate use in New Zealand. These agencies have influence through two mechanisms: 1) the widespread use of their specifications throughout other local authorities, and 2) their potential to use recycled materials in major projects that get attention from other authorities. They are also able to both

[47] https://www.usgs.gov/centers/nmic/crushed-stone-statistics-and-information and includes Crushed Stone, Sand and Gravel and Aggregates.

[48] R.W. Corkery & CO. Pty. Limited, "Supply and Demand Profile of Geological Construction Materials for the Greater Sydney Region, 16 April 2019, p96, https://search.geoscience.nsw.gov.au/report/R00055810

[49] https://www.rnz.co.nz/news/national/423149/hi-lab-nzta-s-billion-dollar-roadbuilding-method-labelled-a-looming-disaster

provide leadership through a revision of the technical specifications that promote the use of alternative materials and address industry concerns, as well as be involved in new innovations through thought leadership and the sharing of risk.[50]

Box 2: Hi-Lab

What is it?

- The key difference in Hi-Lab pavement design is the predominant use of large, dense, and machine-broken aggregate in the base course. The design is based on the principle that broken rock faces interlock and distribute the weight from traffic through direct stone to stone contact. Hi-Lab also uses a mixture of cement and finer aggregate to fill any remaining gaps.
- This design is theoretically stronger and less prone to cracking than traditional base course which can be described as large stones enclosed within a mix of finer aggregate.

Resource implications

- Hi-Lab requires greater use of high-quality aggregate (density, hardness and machine-broken faces are essential traits) produced to precise specifications.
- This has two effects:
    - Lower-grade material which is traditionally used for base course is not suitable for Hi-Lab base course and is therefore reduced to a by-product that needs to be disposed of.
    - Not all quarries will be able to efficiently produce this aggregate to specification which could therefore reduce competition and increase transportation costs. For example, the use of Hi-Lab on the Waikato Expressway led to the opening of a specialty quarry, Stevenson Construction's Huntly Hi-Lab plant.

Sources: https://www.nzta.govt.nz/assets/resources/NZ-guide-to-pavement-structural-design/New-Zealand-guide-to-pavement-structural-design-V1.1.pdf

https://contractormag.co.nz/contractor/end-in-sight-for-waikato-expressway/

Recommendation Two - Performance Specifications: We recommend that the aggregate specifications set by Waka Kotahi, councils and others should apply a performance-based approach to make it easier to use local materials so long as they meet the required level of performance noting the environmental and cost implications.

Competition assessment

There is a limited amount of competition in the aggregate market, however we do not see an impact on prices.

The main competition concern is vertical integration, which is likely leading to sub-optimal outcomes. However further research is required before any interventions can be recommended.

We have also assessed the level of competition in the aggregate industry. We have found:

a. significant amounts of vertical integration;

[50] Recycled aggregates on New Zealand roads: barriers to uptake and drivers for change, WSP Opus

b. some horizontal concentration, although likely sufficient competition for a competitive commodity market; and
c. no identifiable issues in the cost of transportation, or any other supply chain issues.

Vertical integration is very common

There is a large amount of vertical integration in the aggregate market. There are three key markets that are often integrated: aggregate extraction, aggregate transportation, and civil construction. For example, the owner of an aggregate quarry is often vertically integrated into the ready mixed concrete or concrete products business. Similarly, many producers of road aggregate are vertically integrated with roading contracting businesses.

We have seen some evidence that vertical integration may make the aggregate market less optimal. A downstream firm may gain an advantage in a procurement process if they have access to the best sources of materials, such as aggregate. For example, we anecdotally heard that some quarries may charge competitors a higher price than they charge their own downstream business units. This may mean the vertically integrated provider gets preferential access to certain projects due to the proximity and availability of aggregate within their wider company.

However, we note that identifying the specifics of this issue is complicated. A difference in internal price compared to the traded price may simply be due to eliminating double-marginalisation. It may also be due to efficiency savings by eliminating transaction costs.

Furthermore, there are also benefits from vertical integration. A vertically integrated firm will better understand their supply of resource and provide better price stability. We also continue to see independent downstream firms thriving, showing that they are not completely shut out of the market.

On balance, we consider there are sufficient concerns to justify a more detailed analysis of the impacts of vertical integration. We recommend that this is part of the Commerce Commission's market study of the building materials markets. This study can access more detailed financial information to determine if vertical integration is providing a major advantage and creating adverse outcomes for construction projects.

If it is shown that vertical integration is allowing excessive profits, then we would encourage infrastructure funders to consider a second envelope for bids to provide physical materials. This would allow for the best supplier of the resources to be chosen independent of the choice of construction firm.

Recommendation Three – Commerce Commission market study into building supplies: We recommend that as part of the Commerce Commission's upcoming market study they further investigate the role of vertically integrated construction firms.

There is likely enough competition for a commodity market

When assessing the horizontal competition in the aggregate market, there are two key factors to consider:

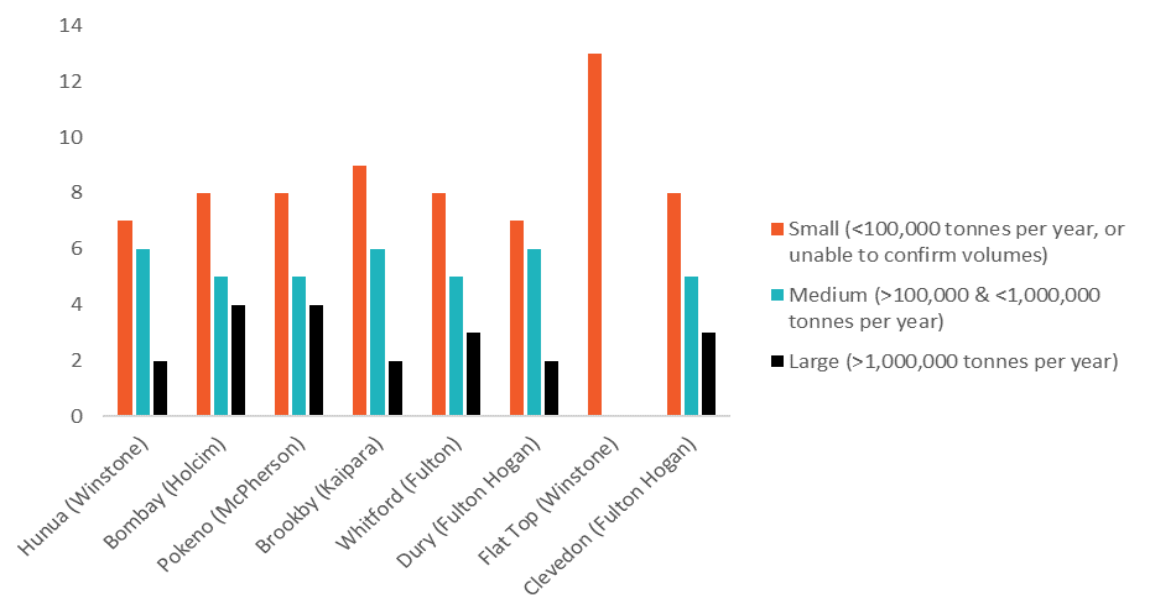
a. Given the relatively high cost of transportation, aggregate is a very regionalised market. Competition cannot be assessed at a national level.

b. Aggregate is a commodity product with little differentiation. Therefore, a small number of competitors can result in a good market outcome.

To help us assess the amount of market concentration GNS Science has done some simple mapping analysis. They placed a 50km bubble around each quarry in New Zealand and identified which ones overlapped with another quarry. This gives a rough approximation of which quarries are in competition with each other.

From this analysis we have identified the ownership and size of key quarries in the Auckland and surrounding region. Figure 13 below shows the number of competitors each of the major quarries in Auckland has within 50km. For most quarries there is at least one other large or medium competitor. The exception is Flat Top, which appears to only compete with smaller quarries.

Figure 13: Competitors for major Auckland quarries

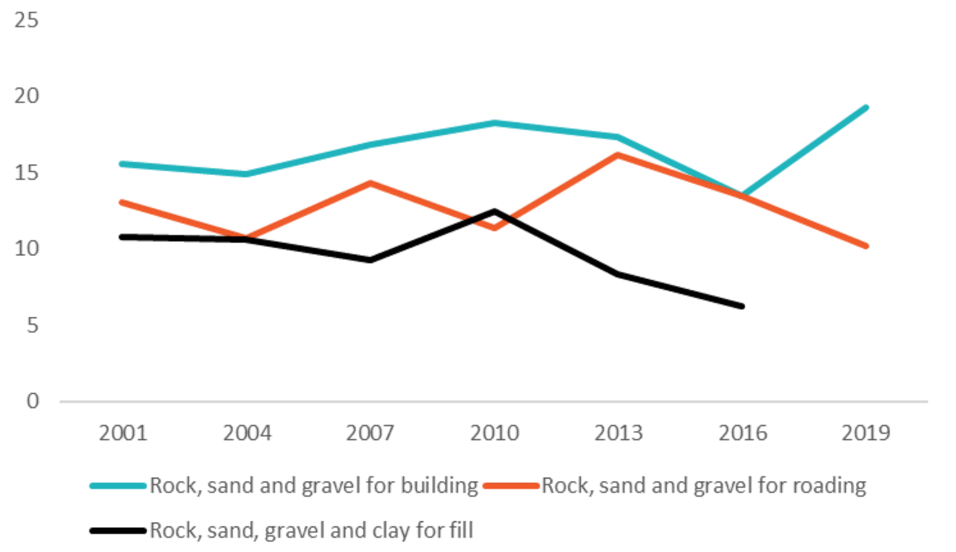


We also note that there have been several mergers in this sector over the last 10 years, including two key mergers assessed by the Commerce Commission. In 2019 clearance was granted for Fletcher Building to acquire Waikato Aggregates.[51] In 2018 an investigation into Fulton Hogan's acquisition of Stevenson's quarries was closed after the Commerce Commission's concerns were addressed (by removing the Huntly quarry from the transaction). In assessing these mergers, the Commerce Commission was still able to conclude that they had a minimal impact on competition.

Ultimately if there were problems with market concentration it would result in adverse price outcomes. However, there is no evidence this is occurring. Figure 14 below shows the average price for aggregate in the Auckland region in real terms since 2000. While there are some yearly fluctuations, overall price has remained remarkably stable, suggesting no competition concerns. The results for other regions are similar.

[51] https://comcom.govt.nz/news-and-media/media-releases/2019/commission-grants-clearance-for-fletcher-building-to-acquire-waikato-aggregates

Figure 14: Index of real aggregate prices in the Auckland region



No indication of any issues with transportation costs

Finally, we have considered if there are any issues with the market for transportation.

Vertical integration with transport appears to be having little impact. There are no barriers in place for alternative logistics companies to compete against the vertically integrated firms. It also appears that the logistics market is very competitive, leaving little room for any excess pricing or poor practices.[52]

We do not see any reason to be concerned about the transportation market for aggregates.

The future of aggregate in New Zealand

There are few substitutes for aggregate, and it will have a long future in New Zealand. To ensure we are better placed to deal with demand for aggregate this section considers both the short term, and longer-term challenges to meeting demand.

To meet both sets of challenges we consider that better information will be required. Without robust information at the regional level it is difficult to understand where and when aggregate shortages are likely to occur. This has made it very difficult for councils and contractors to manage the impact of demand they are placing on a particular region.

The Quarry Survey conducted by MBIE is not a statutory requirement and responses are voluntary. As a result, there are significant variations in response rates from year to year. For example, in 2017 the response rate was 83%, but then in 2018 the response rate fell to 64%. This means that changes in production or price from year to year may be more related to changes in survey response than actual changes in production.

[52] Productivity Commission, “International freight transport services”, 2014.

We consider that this survey should be made mandatory and expanded to include information such as peak production potential, and total remaining resource available at the quarry. This would help track where aggregate scarcity is emerging, and where opening up new resources should be considered.

Recommendation Four – Improved information: We recommend that MBIE consider how to improve the response rate for the *Annual Return of Industrial Rocks and Mineral Output Survey,* so that it captures all aggregate quarries that sell to other parties or use the aggregate for commercial projects. The survey should also be extended to include information such as peak production potential, and total remaining resource available at the quarry.

Short-term spikes in demand are challenging for the industry to respond to under current conditions

Short term supply may not be able to meet short term demand, especially when the increase in demand has not been indicated with enough certainty for investment decisions.

Short-term spikes in demand are common when there are major projects in a region. The demand for aggregate during the build phase of major projects is significantly higher than for on-going maintenance. This can result in delays in getting aggregate, or significant amounts of importation from other regions, driving up the landed cost. It can also mean that 'business as usual' aggregate supply is constrained, raising the price of building projects across the region. This is likely the scenario in Wellington between 2014 and 2017, as per Figure 9: Indices of Wellington aggregate production and demand indicators (page 18).

Short term spikes in demand can be challenging for the industry to respond to for two reasons:

a. it can be difficult for existing quarries to increase output; and

b. short term spikes in demand generally do not trigger investment decisions.

The importance of securing a reliable supply of local aggregates was recently highlighted by the Ōpōtiki Harbour Development Project.

Box 3: Ōpōtiki Harbour Development

Ōpōtiki in the Eastern Bay of Plenty has a comparative advantage in the fast-growing aquaculture industry but lacks the supporting infrastructure, most notably a harbour and wharf.

The mouth of the Waiotahi river has degraded to the point that only small vessels in the right conditions can navigate it. Building up the riverbanks would improve the flow of the river and, along with natural tidal forces, flush sediment out of the river mouth thus making the harbour usable and further protecting the town from flooding and inundation.

Between 2017 -2019, the plans for the project were re-designed and costs significantly lowered. Sourcing local aggregate was central to lowering the costs as the original business case assumed that suitable rock was only available from more than 100km away. Subsequently, the Ōpōtiki District Council, GNS Science and AQA were able to source suitable rock locally as part of the new and accepted business case.

Source: https://www.growregions.govt.nz/assets/content/public-information/applications/Opotiki-harbour-business-case.pdf

Resource consent conditions can limit the ability for quarries to increase output

Large quarries tend to operate on a sustained production level. This allows capital to be fully employed and makes it easier to retain a sustainable level of staff. To increase output there are two options:

a. Some quarries can run for longer hours, but many quarries have conditions on their resource consents that mean they cannot operate past certain hours.

b. Most quarries can only increase output by employing more capital, such as mobile crushing and sorting machines. However, many resource consents limit the number of trucks that can enter and exit a quarry over a certain period of time. So even if more aggregate is produced there are limits on how much can leave the site.

For major projects that require aggregate well above normal production, both industry and government need to take a long ramp-up in acquiring aggregate. This means quarries can utilise their limited additional capacity to start producing more aggregate over a longer period of time. Alternatively, there may be a case for resource consent conditions to be amended in the short-term to meet the demands of major projects.

Short term spikes in demand generally do not trigger investment decisions

It is unlikely for quarries to be built or expanded to meet short term demand pressures. This is because it takes time and significant investment to establish a new quarry or extend an existing one.

We have heard from multiple sources that the process to get a new quarry through a resource consent process can take five or more years which does not include time taken to expose the quarriable rock and become operational. By this time a particular project driving up demand may well be finished, and the new quarry would have few customers. In rare cases, there may be an existing quarry that is unused or under-utilised that can be quickly invested in to start supply like the Willowbank quarry in Wellington. But this is not common in the main centres.

The decision to establish or expand is also based on the likelihood of demand for the life of the quarry. We understand that costs for a medium sized quarry can run into tens of millions of dollars. Costs include the land itself, the costs of the resource consent process, the costs of exposing the quarriable rock, capital equipment to extract, crush, and sort aggregate, and remediation at end of life. Without some certainty of on-going demand there is a high chance of these costs becoming stranded.

Given current information, the industry typically uses population projections as the best long-term measure of demand. This is likely the right decision with the information available. The costs to the economy of a stranded quarry, particularly the costs involved with closing a site, may in many cases exceed the costs of importing from other regions in the short term.

Work to increase the transparency of long-term demand will help provide better signals to the industry on where to build. For example, Te Waihanga's infrastructure Pipeline, MBIE's National Construction Pipeline or long-term plans and 30-year infrastructure strategies produced by local authorities.

Recommendation Five - Improving understanding of long-term demand: We recommend the Ministry for Business, Innovation and Employment should consider how it can use the various long-term demand publications to derive demand for aggregate on behalf of its industry.

Relevant publications include Te Waihanga's infrastructure Pipeline, MBIE's National Construction Pipeline or long-term plans and 30-year infrastructure strategies produced by local authorities.

This would provide better signals to both the quarrying industry and government about where shortages could occur and how they could be avoided.

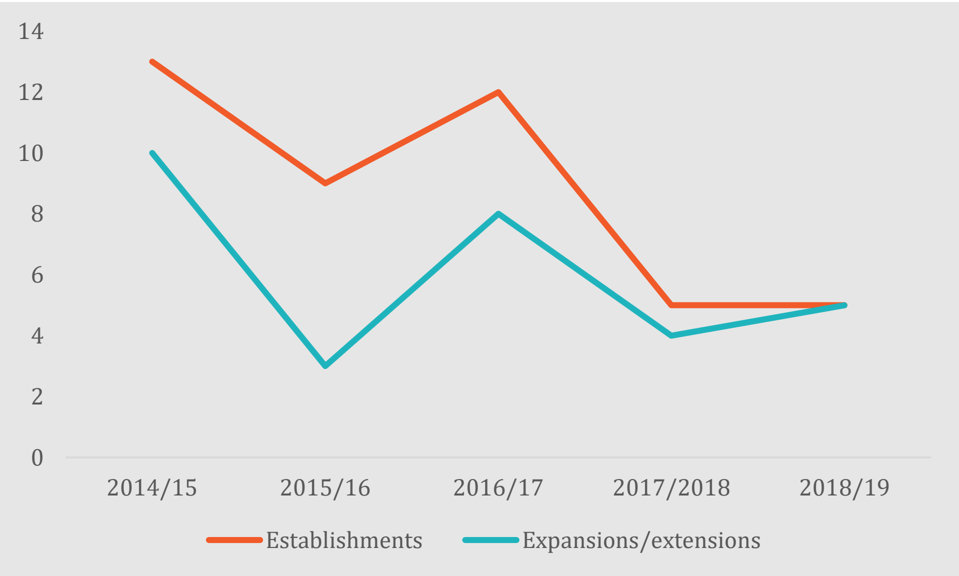
Longer-term responses to demand or supply changes may be getting harder

Government policies and local planning rules are prohibitive of the establishment of new quarries and tensions exist where pressure for housing is encroaching on peri-urban areas.

In the longer-term, production of aggregate will be determined by the trade-off between resource availability, proximity to the market, and competing land uses. This is a fine balance. In some cases, it may be economically and socially better to place a quarry further away to allow for a housing development or create recreation space in the urban fringe. However, as covered above, this can have a substantial cost, and will mean more trucks travelling longer distances.

The key long-term constraint to growing aggregate supply is the ability to gain resource consent. Figure 15 shows the number of resource consents for new quarries and expansions of existing sites granted over the last five years.

Figure 15: Resource consents for new quarries and expansions across New Zealand since 2014/15



Regional resource consent numbers can be even worse. Since 2014, there have been no new quarries established within the boundaries of Auckland Council and only three expansions of regional significance.

During this time, there were no rejected applications for expansions or establishments. Industry have explained that quarry operators will only engage in the resource consent process when they are certain of a positive outcome. The low number of applications therefore highlights the low confidence the industry has in the process, which is another barrier to investment in the industry.

The low and decreasing number of quarries gaining resource consent is a worrying trend. This is also reflected in concerns we heard from industry that other land uses are being favoured over quarries. We have identified two key factors that are limiting resource consents for quarries:

a. increasing pressure on transport networks and their inability to accommodate extra traffic from quarries; and

b. environmental policies.

At the end of this section we also discuss scale challenges in some smaller regions that can also lead to a long-term supply shortage.

Pressure on transport networks

The markets with the highest demand for aggregate are also the most sensitive to the traffic, noise, and dust inherent to its transportation. Traffic, noise, and dust are regulated at the local and regional level and constraints on any of the three effectively limit the output of a quarry. This is exemplified by the Clevedon Quarry expansion. Box 4 provides a summary.

Box 4: Clevedon Quarry Expansion, Local Opposition to Truck Movements:

Clevedon is a small settlement (population 1,515 in 2018) 40km from Auckland Central. The Clevedon Quarry has operated since 1963 and is identified in the Auckland Unitary Plan as a significant resource for the Auckland region. It contains a large amount of high-quality greywacke rock which is used as aggregate for construction and roading.

In 2017 the quarry was sold to Fulton Hogan who sought resource consent to expand operations from 201,152 tonnes to 3,000,000 tonnes per year (15 times the 2017 output). This is a regionally significant amount of aggregate. This proposal was met with local backlash due to concerns about truck movements, noise, and vibration.

In 2018, after months of negotiations, Fulton Hogan, and the Clevedon Protection Society (CPS) were able to reach a mutually acceptable agreement about conditions relating to the quarry's future operations. The negotiations were mediated by the Environment Court, but agreement meant parties were able to avoid the time and expense of a full Environment Court hearing.

A select summary of some the key restrictions includes (but not limited to):

- Fulton Hogan must fund an independent consultant providing compliance reports to the community liaison group and council on a quarterly basis;
- No quarry truck movements after 6pm each night, except for a maximum of 60 nights; per year on Monday to Thursday nights only;
- No loadout of trucks from the quarry prior to 7am (Monday to Saturday);
- Maximum average of 900 quarry truck movements per day (calculated as a rolling average across a calendar year), reduced from 1300 per day;
- No truck movements are allowed on Friday nights or Saturday afternoons;
- Fulton Hogan must undertake visual mitigation for the quarry; and
- Auckland Council can review the conditions annually.

Source: https://www.pctimes.co.nz/blog/793076

The Clevedon case study demonstrates the challenges quarries face when local costs are compared to regional/national benefits

Expanding the quarry would support the growth of the wider Auckland region and the negative impacts would be borne by a relatively small number of people. A trade-off must be made but the current decision-making framework is not functioning effectively:

a. There is no consistency in how this common conflict is resolved. The result is significant uncertainty and lack of confidence in the resource management system, highlighted in figure 15 by the low number of consent applications.

b. A protracted negotiation period was seen by all parties to be faster, more cost effective and result in better outcomes than the Environment Court; the sole purpose of which is to resolve such conflicts.

c. Local planning has allowed these diametrically opposed activities to be within proximity of each other. This should be avoided through longer-term spatial planning i.e., separate zones for housing and heavy industrial activities in anticipation of future need.

Recommendation Six - Protecting scarce aggregate: We recommend that local authorities undertake a resource scan as part of their long-term planning process, informed in part by the study into aggregate opportunities by GNS Science and known demand forecasts. If hard-rock resource is identified as being scarce, local authorities should ensure that sufficient land, where hard rock is present, is kept available for industrial activities to support future growth. This could be through zoning under the current Resource Management Act or proposed Spatial Planning Act.

Government policies and proposals are restricting quarry development

The Resource Management (National Environmental Standards for Freshwater) Regulations 2020 (NES-F) are prohibitive of both developing new quarries and expanding existing sites. The NES-F signals a paradigm shift that makes all wetlands worthy of protection due to the scarcity of remaining wetlands. Under the NPS-F regulations, earthworks are a prohibited activity on land and near land captured by the broad definition of a natural wetland.[53] Problems are arising because land, particularly in the peri-urban area, is being captured by these regulations limiting expansions to protect often very small wetland areas (one example is of an area the size of a dining table), or areas of wet grass.

For example, Auckland Council recently rejected a resource consent application by Winstone Aggregates to expand its operations at Flat Top Quarry in Kaukapakapa, north of Auckland, on the basis that the relevant land fell within the NPS-F definition of a natural wetland. The relevant land is a paddock used for cattle grazing but has a small area deemed to meet the conditions as a wetland.[54]

As a result of concerns expressed from several quarters, the Government is now amending the NES-F to provide a consenting pathway for earthworks in or near natural wetlands beyond specified infrastructure to include quarries, mines, landfills, managed fills, clean fills, and urban development. Te Waihanga has submitted as part of public consultation on proposed amendments to the NES-F,

[53] Clause 3.21 of the NPS-FM https://environment.govt.nz/assets/Publications/Files/national-policy-statement-for-freshwater-management-2020.pdf
[54] https://rmla.org.nz/2021/01/21/fresh-problems-for-freshwater-practical-issues-with-freshwater-nps-and-nes/

proposing among other things an expansion of scope for infrastructure eligible to access the consent pathway.

The AQA outlines several other policies it considers to be detrimental to the sector in its June 2020 Briefing on the Aggregate Sector and Aggregate Supply. Attachment 2: Te Waihanga's Assessment of Environmental Policies and Proposals affecting quarries provides an assessment of the relevant policies based on discussions with both industry and the relevant officials.

On balance, we consider that government policies and proposals could justifiably be perceived as being prohibitive to quarrying. Any regulatory uncertainty would have a negative impact on investment in establishing or expanding quarries.

Consistent and transparent environmental policies relating to the quarrying sector would help provide certainty to the sector. National direction (either a national policy statement or national environmental standards) would remove the variation in local decision-making while still providing appropriate environmental checks and balances.

Recommendation Seven - Re-balancing the trade-off between protecting the environment and enabling access to resources:

We recommend that the Ministry for the Environment work with the AQA to develop a national direction for quarrying to remove any unjustified variations in how resource consents are assessed and conditioned. National direction should also provide for short-term exceptions to these conditions to meet peak demand.

In the short term, we recommend that the AQA develops, in partnership with the Ministry for the Environment, a best practice quarry consent application template to ease the administrative burden on quarry operators and councils, and support data collection. The template could identify specific data that should be provided to territorial authorities as part of the consent application process and as an ongoing requirement to build up the national database.

Scale can also create a long-term supply shortage

For smaller and isolated communities, of which New Zealand has many, a local supply gap could exist due to a lack of economies of scale.

For example, the Eastern Bay of Plenty uses between 37,000 and 67,000 tonnes per annum of armour rock for stop bank construction and repair, flood protection and highway strengthening work. Until recently, it has not been economically viable to run a local quarry for such a small volume and resource has been transported from over 100km away.[55] The recent development of the Ōpōtiki harbour has provided economies of scale through the increased demand for aggregate in both the short-term (for construction) and the long term (for maintenance).

[55] : https://www.growregions.govt.nz/assets/content/public-information/applications/Opotiki-harbour-business-case.pdf

Focus material #2: Steel

Steel is critical for providing strength to New Zealand buildings

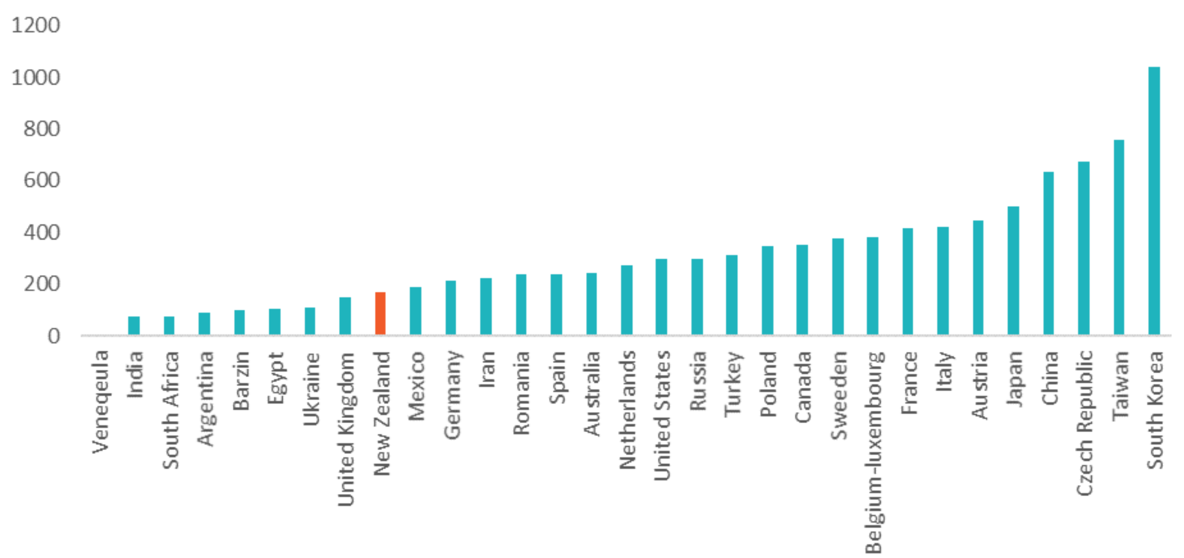
For this study we have considered all types of steel, but focussed particularly on structural steel, including beams, hollow sections, and pipes.

Structural steel is critical for providing the seismic capabilities needed in New Zealand. This was demonstrated during the Christchurch rebuild, where a majority of the buildings were constructed using steel to meet the strength demanded by residents.[56] At present no other material can match this capability.

Steel is also a critical input, particularly for water infrastructure. Stainless steel is commonly used in water treatment plants, and in some cases for underground infrastructure. All stainless steel used in New Zealand is imported. Ductile iron pipes are also used in steel infrastructure, which are also an imported product, but the connections, valves, hydrants and pumps are local made.

Steel is also the largest commodity input into Statistics New Zealand's CGPI for 'Heavy and Civil Engineering'. However, compared to other developed countries New Zealand uses a relatively small amount of steel.

Figure 16: Finished steel apparent use per capita (2020, kilograms)[57]



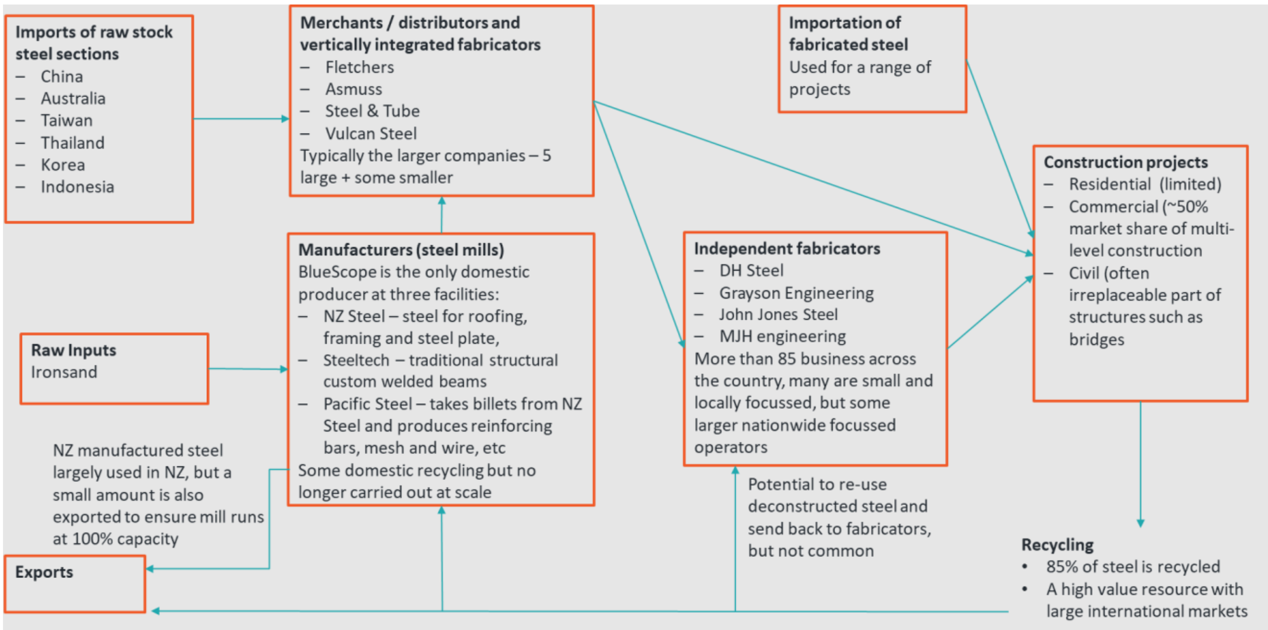
[56] http://resources.quakecentre.co.nz/wp-content/uploads/2017/11/DISTRIBUTION-COPY-of-Reconstruction-of-Christchurch-in-Steel-Nov-2017-2.pdf
[57] https://www.worldsteel.org/en/dam/jcr:f7982217-cfde-4fdc-8ba0-795ed807f513/

Are there any issues with supply?

> New Zealand competes for steel supply on a global market. There are few opportunities for domestic firms to make excessive profit. However, steel can be subject to spikes in demand globally which reduces supply into New Zealand and increases prices.
>
> Industry has developed robust processes for monitoring and providing assurance of the quality of steel.

Figure 17 below summarises the supply chain for steel in New Zealand.

Figure 17: overview of steel supply chain



There are many competitors at all levels

About half of the steel consumed in New Zealand is produced domestically by the New Zealand Steel mill at Glenbrook, however, it contributes a much smaller percentage of structural steel, which is the most common input into infrastructure. This mill produces steel directly from ironsands, a unique process which reduces the amount of processing required and has kept the mill viable against very strong import competition. New Zealand Steel is owned by a global steel manufacturing company BlueScope. Bluescope also owns the Pacific Steel facility, which uses raw billets from New Zealand steel to further produce reinforcing bars, steel wire, mesh, and other products.

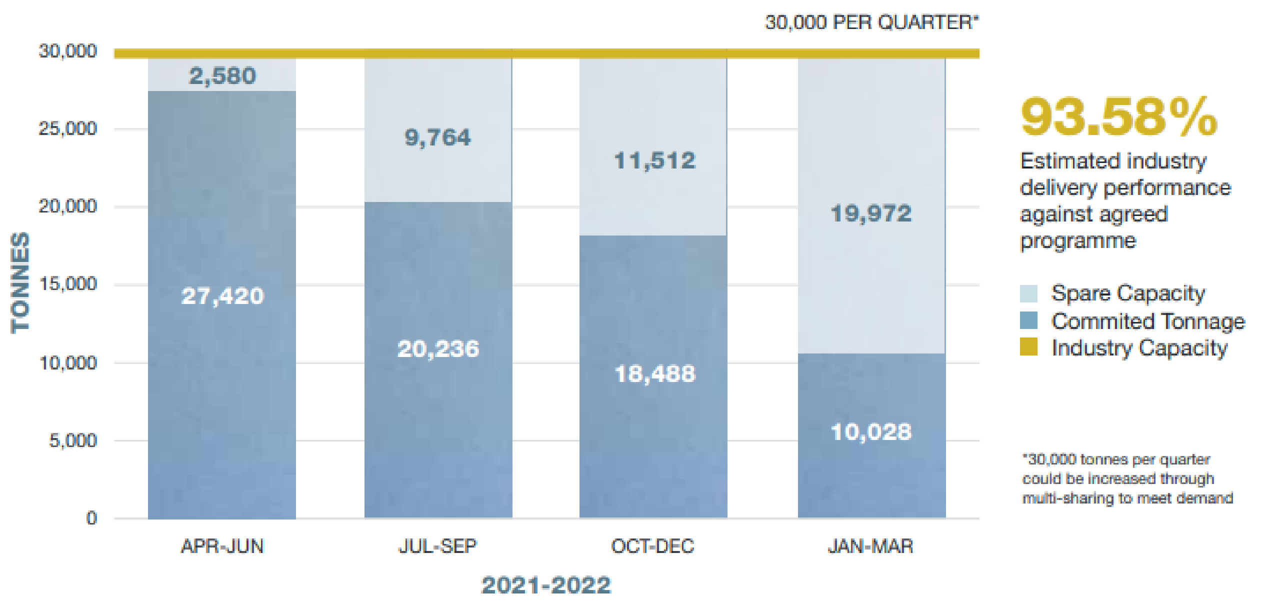
There are also several steel merchants, importing from global markets. There are five key players: Fletcher Steel, HJ Asmuss, Steel & Tube, Tasman PFV and United Steel Limited. The most common sources of these imports are from Australia, China, Indonesia, Japan, and Korea.

BlueScope and the merchants compete over a number of products such as hollow sections and reinforcing bar. However, most of New Zealand's structural beams are imported.

The next step in the supply chain is the steel fabricators. These are typically smaller local companies that take standard sized steel and process it ready for a construction project. Typical activities are to cut the steel to a specific length, shape the steel, add mounting points, and painting. There are a very large number of these companies, but they typically focus on a specific region.

Overall, this supply chain appears to be operating well. We take comfort that the industry can clearly identify its capacity limits and show there is room to meet more demand. This is shown in Figure 18 below, which is taken from the Steel Construction New Zealand website.

Figure 18: SCNZ Estimated Fabrication Tonnages (per quarter)[58]



While we are aware of pockets of constraint in particular areas, or at times of very high demand, there is no evidence that this is a systemic problem. The high value of steel also means that if there are localised constraints it can be transported around the country economically.

The economics for producing steel in New Zealand are challenging

The efficient manufacturing of steel relies on three key factors:

c. Scale.

d. The price of electricity.

e. The availability of other energy sources.

The New Zealand market is not favourable to any of these factors.

It has been estimated that the optimal size for a basic oxygen furnace steel mill is 4,500,000 tonnes per year,[59] well above the estimated 850,000 tonnes consumed in New Zealand. The simplified production process allowed from milling ironsand at Glenbrook reduces the scale requirements, but they are unlikely to be fully overcome.[60]

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[58] https://www.scnz.org/wp-content/uploads/2021/03/SCNZ-IU-MAR-2021-Web.pdf

[59] Crompton, P. & Lesourd, J.B., 2008, Economies of scale in global iron-making, Resources Policy, v33, i2, pp74-82. https://www.sciencedirect.com/science/article/abs/pii/S0301420708000160

[60] Electric Arc Furnaces can efficiently operate at a much smaller scale than blast oxygen furnaces

Electric arc furnaces can operate at a smaller scale, often in the range of 200,000 to 400,000 tonnes per year. These mills use scrap steel as their main input which is melted using electrical power. This can be a very clean way of producing steel depending on the electricity source, but it has very large electricity demands. It is currently not undertaken anywhere in New Zealand.

Basic oxygen furnace steel production also uses a large amount of electricity but less than electric arc furnaces. The Glenbrook mill uses up to 1100 gigawatt hours of electricity a year. This is approximately the same proportion of total electricity supply that Wellington City uses each year. New Zealand Steel produces up to 60% of its electricity requirements on-site by converting waste gas into electricity. However, the reliance on the electricity grid is a continuous challenge for the mill.[61]

While electricity prices have an impact on the economies of steel production, low prices do not appear to be a pre-requisite for large scale production. Japan and Germany are both within the top ten steel producers globally,[62] but both have higher industrial electricity prices than New Zealand.[63] However, we understand that the volatility of New Zealand electricity prices is particularly challenging for the Glenbrook mill.

Electricity accounts for 45-50% of the total energy needs at the Glenbrook mill. The remaining 50-55% of energy comes from natural gas, which is used as a source of process heat. The uncertainty about access to natural gas in New Zealand adds to the uncertainty of operating a mill in New Zealand. It is also likely that gas prices will begin to rise in the coming years as the resource becomes increasingly scarce, putting further price pressure on the mill.

The economic value to New Zealand of retaining the Glenbrook mill is beyond the scope of this study, but we can make two comments:

1. If the Glenbrook mill closed it would remove some security of supply of steel for construction. In times of global supply shortages (such as during and after the COVID-19 pandemic), New Zealand can experience shortages of import volumes. The Glenbrook mill can pick up some of this demand keeping domestic supply for the products it produces higher.
2. The Glenbrook mill has little impact on steel prices themselves. The mill prices based on global price trends and is far too small to have any impact on the global price.

Importation and fabrication have few barriers to entry

We have not identified any barriers to entry into the importation, distribution, or fabrication parts of the market. There are several competitors in this space, and there is no evidence of any market-based issues.

Figure 19 below shows an index of the margin between the price of imported steel at the port and fabricated steel used as an input into construction projects. This index is compared to the consumer price index. These two indices match each other closely, suggesting no issues in the margins earned by New Zealand companies.

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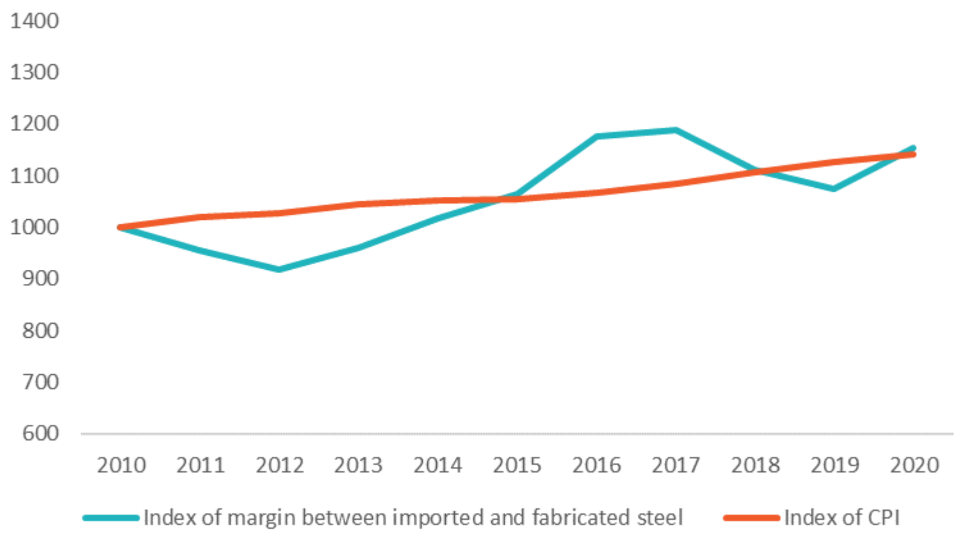
[61] https://www.rnz.co.nz/news/business/440135/manufacturing-companies-question-hike-in-power-prices
[62] https://www.worldsteel.org/
[63] https://www.mbie.govt.nz/dmsdocument/3757-first-report-electricity-price-review-pdf Figure 10

Figure 19: Index of margin between imported and fabricated steel and the consumer price index[64]



Steel prices are vulnerable to global shocks

Steel is a large global market, and New Zealand is a price-taker. During economic downturns such as the global financial crisis, or the still ongoing COVID-19 pandemic, prices can sharply rise. This is true worldwide.

In New Zealand, steel prices are also strongly related to exchange risk.[65] However, most companies in this sector appear to have adapted to this and have appropriate exchange hedging in place.

There is a thriving market for recycling steel

Steel is among the most recycled products in the world. It is estimated that about 85% of waste steel is recycled worldwide. Figures are not available for New Zealand but are likely similar. Steel can be recycled in two main ways:

1. Re-melted in an electric arc furnace and turned into a new steel product. The recycled steel is well accepted by the market and has years of testing to show its strength. In New Zealand, most steel for recycling is exported for processing in markets better suited to steel production.
2. Re-purposed. There are a small number of examples where steel is re-used. Typically, this will be when the façade of a building is damaged, but the steel frame is able to be re-used. A current example is the Civic Administration Building in Auckland.[66]

The industry has robust quality standards in place

The New Zealand industry has put in place end-to-end quality assurance. For example, Steel Construction New Zealand (SCNZ) have developed a Steel Fabricator Certification scheme and have set up the processes for smaller fabricators to become certified.

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[64] All data from Statistics New Zealand. The steel index compares the change in the series 'Fabricated metal products, excluding machinery and equipment' (which we understand is largely fabricated steel), and the change in the unit price of imported sections (the key structural steel input).
[65] https://www.mbie.govt.nz/assets/3345bf98e5/heavy-industry-energy-demand-update-report.pdf
[66] https://www.nzherald.co.nz/business/civic-administration-building-conversion-every-floor-being-removed-replaced-john-love/RVAKFTHPZL3ZWZDWDLKMFNOS5Q/

In the recent past there have been issues with imported steel not meeting the advertised standards.[67] Since these events the industry takes a much more robust approach, independently testing all imported steel. We have no concerns with steel quality in New Zealand.

The future of steel in New Zealand

Adapting to climate change will likely dominate the next 30 years of the steel market. New Zealand must be ready for this challenge.

Steel is likely to have an on-going critical role in construction and infrastructure in New Zealand. It is a well-tested material, that can be installed precisely and efficiently. It also has seismic properties that are likely to be critical well into the future for New Zealand.

However, environmental adaptation is likely to have a significant impact on the steel market over the next 30 years. The production of steel is among the highest carbon emitting processes on the planet. 1.9 tonnes of CO_2 are emitted per tonne of virgin steel produced.[68]

Currently, steel production in New Zealand is granted emission units as an emission intensive and trade exposed (EITE) industry.[69] This means they are still incentivised to reduce emissions, as this will not change the allocation they are granted, but they are protected from the full costs at this time. The number of emissions units granted to New Zealand Steel will reduce over the next 30 years to zero. At this point the emissions trading scheme will have a large impact on price. For example, Statistics New Zealand data shows the landed price of steel is about $1,300 per tonne, and the Climate Change Commission has estimated that the price of a tonne of carbon could be as high as $250 by 2050. That means the landed price of steel could increase by about 40%.

We fully support the gradual introduction of carbon pricing for steel. It is a significant emitter, and these costs must be internalised if New Zealand is to reduce its carbon impact.

However, we consider it important that incorporating carbon costs does not make New Zealand produced steel uncompetitive against imported steel. As long as it remains otherwise financially viable, the Glenbrook mill will help keep supply levels for the products it produces higher than if there were no New Zealand based production.

We therefore support policies such as MBIE's Building for Climate Change that aim to ensure we have a level playing field as we adapt to reducing emissions. Ultimately some way of ensuring that carbon costs are applied to imported steel will be required. One possibility is to impose a carbon border tax, similar to what is being considered in Europe, or putting in place restrictions to only allow importing of materials that have had the carbon tax appropriately accounted for.

Recommendation Eight–Supporting domestic industries through climate change: We recommend that climate change policies such as MBIE's Building for Climate Change ensure that domestically produced steel is not put at a competitive disadvantage to imported steel due to differences in the way carbon costs are accounted for.

[67] https://www.rnz.co.nz/news/national/305400/steel-buyers-were-told-price-'too-low'

[68] https://www.worldsteel.org/en/dam/jcr:c3acc5fd-e3c2-458c-a2cc-8c4880b9334c/Steel%2527s+contribution+to+a+low+carbon+future.pdf

[69] https://environment.govt.nz/what-government-is-doing/key-initiatives/ets/participating-in-the-nz-ets/overview-industrial-allocation/

There are two key changes likely as a response to the incorporation of carbon costs into the price of steel:

1. Increased efforts to reduce the carbon emissions from steel production.
2. Movement to alternative materials.

Reducing carbon impact of steel

Globally there are efforts to change the steel production process to reduce its carbon impact. For example, there is a technology that can use hydrogen to produce steel rather than coal that is having promising results.[70] This process uses more electricity than traditional BOF steel manufacturing, but otherwise only produces water as a by-product.

New Zealand researchers are actively engaged in developing a hydrogen based steel production process.[71] The ironsands resource used for steel making in New Zealand has some unique properties, which means we may not be able to solely rely on international research. There is also some indication that these unique properties may make our ironsands better suited to a hydrogen based approach.

We support the comments from the Climate Change Commission that there must be government support to encourage the adoption of lower carbon technologies.[72] However, we understand this technology could be decades away from becoming commercially viable.

There may also be opportunities for process efficiency improvements or the ability to use alternative sources of process heat. Currently the mill at Glenbrook uses natural gas for process heat. Seeking out renewable sources such as biofuels would help reduce the environmental impact and may reduce their exposure to carbon pricing.

Recommendation Nine– Applying innovations to New Zealand steel production: As part of the first emissions reduction plan, the Ministry for the Environment should be considering the appropriate policy and regulatory settings so that innovations for decarbonizing steel making, can be applied in New Zealand.

Alternative materials

In some cases, there are substitutes for steel that are less carbon intensive. One of the most promising is engineered timbers, which we discuss in the section on timber. While steel may be able to mitigate its carbon impact, growing capability in substitutes increases the chances that infrastructure projects will have at least one option that has a low carbon impact.

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[70] https://www.mckinsey.com/industries/metals-and-mining/our-insights/decarbonization-challenge-for-steel

[71] https://www.rnz.co.nz/national/programmes/afternoons/audio/2018793157/how-to-eliminate-c02-emissions-from-industrial-materials

[72] Climate Change Commission, 31 May 2021, ‘Inaia tonu nei: a low emissions future for Aotearoa’, p306

Focus material #3: Cement and concrete

Concrete and cement are both key ingredients to New Zealand infrastructure

As a building material, concrete is incredibly versatile. It is workable when newly mixed, and strong, durable and fire resistant when hardened. These qualities explain why, when combined with reinforcement steel, it can be used to build infrastructure, skyscrapers, bridges, houses, and dams.

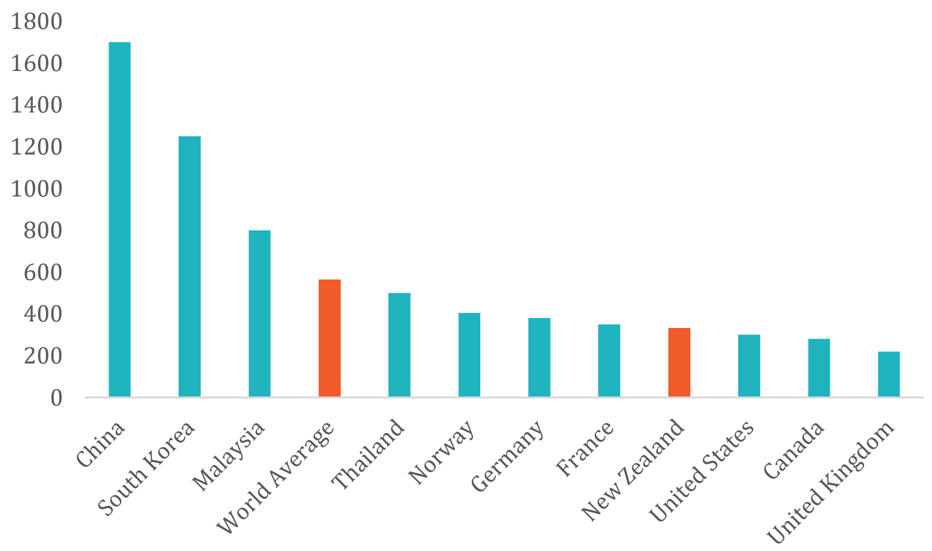
Portland cement is a key ingredient in concrete production. Concrete is formed when a paste composed of cement and water coats the surface of fine and coarse aggregates. Through the chemical process of hydration, the cement and water mix react and harden to form concrete.

Under each subheading of this section we will primarily discuss cement and then concrete where relevant.

New Zealand's per capita consumption of cement is on par with other Western countries

New Zealand's per capita domestic consumption of cement (and by extension concrete) is comparable with Western nations like France and the United States but lower than the world average. The world average is heavily skewed by the rapid urbanisation of Asian countries, especially China. Between 2011-2013, China reportedly used more cement than the United States did in the entire 20th Century.[73]

Figure 20: Cement use per capita (kilograms) in 2018[74]



[73] https://www.washingtonpost.com/news/wonk/wp/2015/03/24/how-china-used-more-cement-in-3-years-than-the-u-s-did-in-the-entire-20th-century/

[74] http://www.globbulk.com/media/news/documentos/World%20Cement%20Statistics%20Booklet%20R0.pdf

Are there any issues with supply?

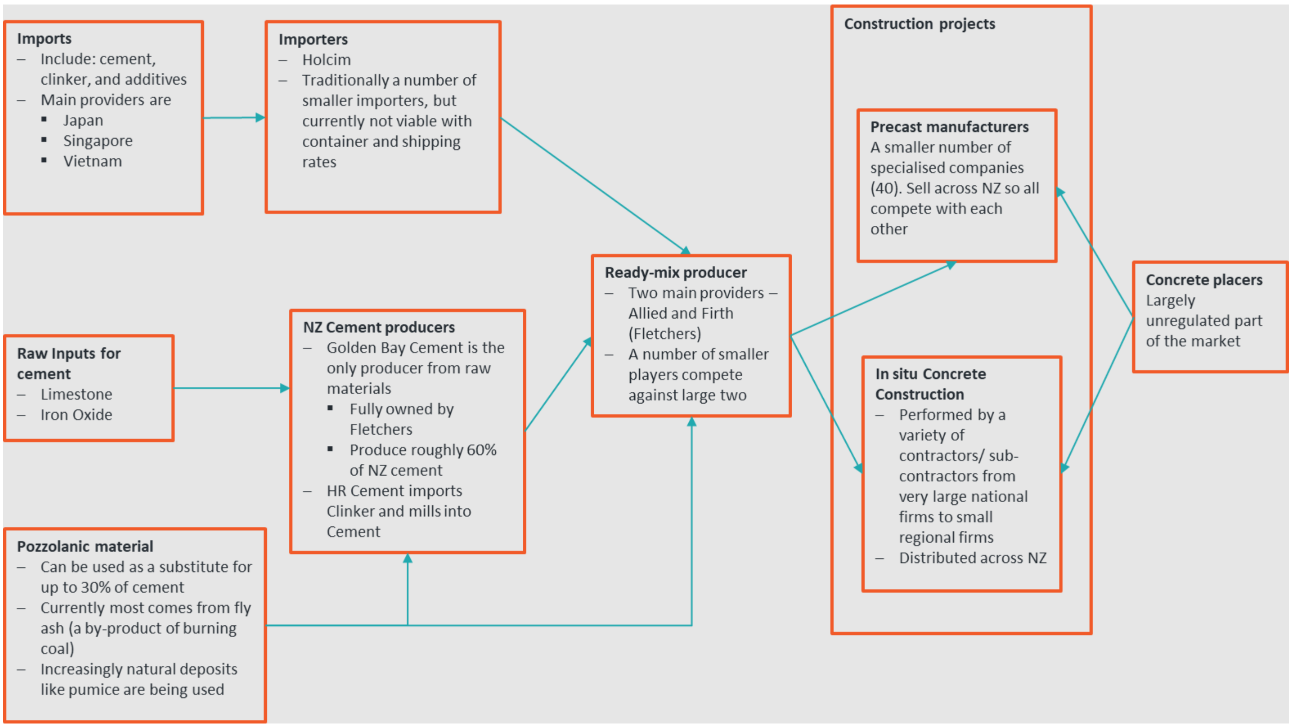
Cement in New Zealand is currently supplied by three companies. It is challenging for additional suppliers to enter the cement supply chain. The supply of concrete typically has three or more competitors in any given region.

Te Waihanga have not identified any concerns with the price of cement or concrete.

Quality of cement and concrete production is well monitored and assured across the industry. There are some issues with concrete trades, particularly around concrete placing and reinforcing fixing. The industry is working to resolve these issues.

The cement and concrete supply chains in New Zealand are shown in Figure 21 below.

Figure 21: Supply chain for cement and concrete



The New Zealand supply of cement is limited to three suppliers who each utilise a different method

Golden Bay Cement is New Zealand's only domestic producer of cement, supplying roughly one million tonnes each year. Golden Bay Cement is owned by Fletchers who also own the downstream ready-mix company Firth Concrete.[75]

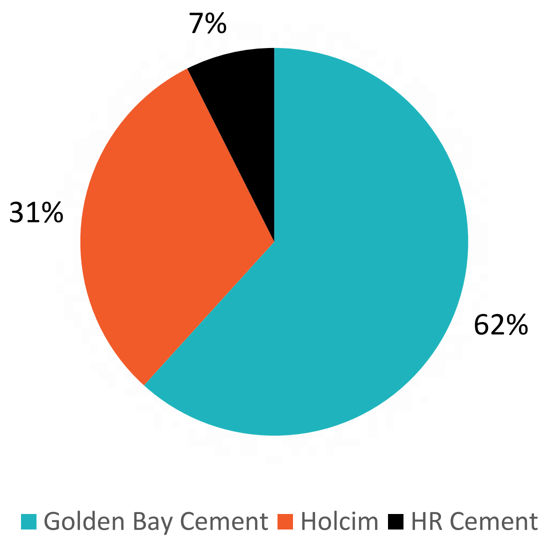
[75] https://concretenz.org.nz/page/Golden_Bay_Cement

Holcim (New Zealand) Ltd is New Zealand's only importer of cement. Holcim NZ is part of the global Lafarge Holcim group. Holcim imports approximately 500,000 tonnes of cement per year from Japan via bulk storage to its two 30,000 tonne cement storage facilities in Timaru and Auckland.

- The Timaru Cement Terminal supplies cement to the South Island and lower North Island while the Auckland Cement Terminal supplies cement to the upper North Island with most of the cement used in the Auckland market.
- A Holcim domestic ship distributes cement from Timaru to marine terminals around New Zealand including Dunedin, Lyttelton, Nelson, Wellington, New Plymouth, and Napier.[76]

HR Cement imports clinker[77] and produces around 120,000 tonnes of cement per year. It is owned by downstream independents and operates out of Tauranga.

Figure 22: New Zealand Cement Suppliers



Does having only three suppliers negatively impact the market?

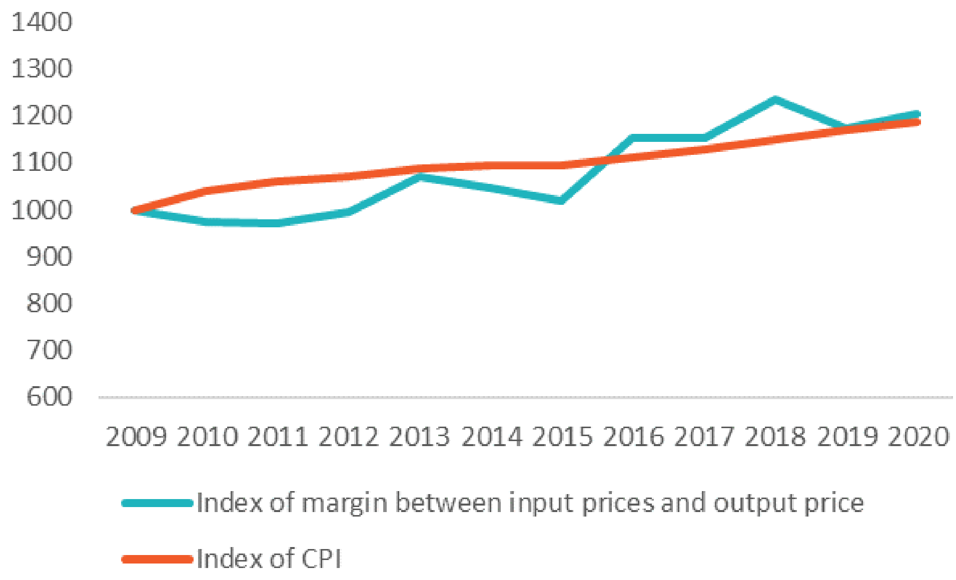
Smaller independent concrete producers have raised concerns about the market power of Golden Bay Cement and Holcim. However, Te Waihanga have not seen any evidence to suggest that there are systemic issues securing access to cement.

Containerised importing of cement has in the past been an option for companies to supply cement to the NZ market. The viability of this option is currently challenging with the current high costs of using containers, which may explain a recent closure of a containerised cement importer in the deep south.[78] In the medium-term, when shipping prices return to normal, we expect that this method will again be viable.

Figure 23 considers the margin cement and plaster operators in New Zealand have been able to earn. It shows that the margins earned have largely remained consistent with the aggregate consumer price index since 2009.

[76] https://www.holcim.co.nz/sites/newzealand/files/atoms/files/holcimepd19082019.pdf
[77] Cement clinker is a solid material produced in the manufacture of cement as an intermediary product. Clinker requires further processing to become cement but importing it avoids the energy and capital-intensive kiln process.
[78] https://www.nzherald.co.nz/business/from-award-winner-in-la-to-receivership-asb-tips-drymix-cement-over-for-73m-debt/R42LOCW6KGESZWVOUWMTQD32DQ/

Figure 23: Margin for cement and plaster firms in New Zealand [79]



The economics for producing cement in New Zealand are challenging

As a small nation, New Zealand is a price taker and domestic producers of industrial goods compete with intentional competitors able to leverage economies of scale. The New Zealand market is too small to leverage scale, and industrial producers therefore rely on either export markets (for example Fonterra) or the availability of an abundant natural resource (for example the Glenbrook steel mill and iron-sand).

In the case of cement, Golden Bay Cement maintains competitiveness with imported cement by having an extensive source of local limestone (operated by Winstone Aggregates, also owned by Fletchers), a capital-intensive plant and distribution network, and by being an established operator that was able to build scale over time (the facility at Whangarei was established in 1901). These are unique circumstances and we do not consider that another, commercially viable, cement manufacturing facility is likely to be built in New Zealand.

Cement production is energy intensive, and both the price and volatility of New Zealand's electricity supply is seen, by a range of industries, as a significant challenge to maintain cost parity with international competitors. However, the price of New Zealand electricity is less than that of Japan from whom New Zealand imports cement.[80]

Importing cement requires specialist equipment and scale

Since the start of the COVID-19 pandemic, the price of containerised shipping has dramatically increased (we have been told by a factor of up to seven times) and the only currently viable method of importing cement is bulk shipping (in the hull of a ship). Holcim utilises this method and has a long-term supply agreement with their Japanese supplier which has likely softened the impacts of COVID supply chain issues.[81]

Bulk-shipped cement requires both scale and specialised pneumatic handling systems to both load and unload. These two factors are likely to preclude a competitor from utilising the same method.

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[79] The margin index compares the difference between the input commodity index "Gypsum, limestone, minerals, salt, precious metals, and stones" and the output index "Articles of concrete, cement and plaster"
[80] https://www.statista.com/statistics/263492/electricity-prices-in-selected-countries/
[81] https://www.holcim.co.nz/sites/newzealand/files/atoms/files/holcimepd19082019.pdf

Importation of clinker is an emerging alternative

Clinker importation is utilised by HR Cement and has been gaining popularity in Australia – in 2019, 4.1 million tonnes of clinker and 0.9 million tonnes of cement were imported into Australia.[82]

Importing clinker avoids two significant barriers to entry for cement supply; it does not require the specialised ships or handling equipment that cement does and avoids the kiln process required for clinker production. Clinker importation does, however, require a grinding plant with a storage facility of suitable size on the receiving end. This is a barrier to entry but not to the same extent as the processes and equipment required for cement production or large-scale cement importation.

The supply of ready-mix concrete is diverse but faces similar challenges to the quarrying sector

Unlike cement manufacturing, the production of concrete and concrete products is characterised by a relatively large number of regionally distributed firms. Unlike alternative building materials, ready-mix concrete, as prescribed by New Zealand standards, can only be transported for up to 90 minutes, necessitating regional operators throughout the country. From our interviews we understand that local competition is healthy across the country – Allied, Firth and typically at least one other independent operator can generally be found across the country.

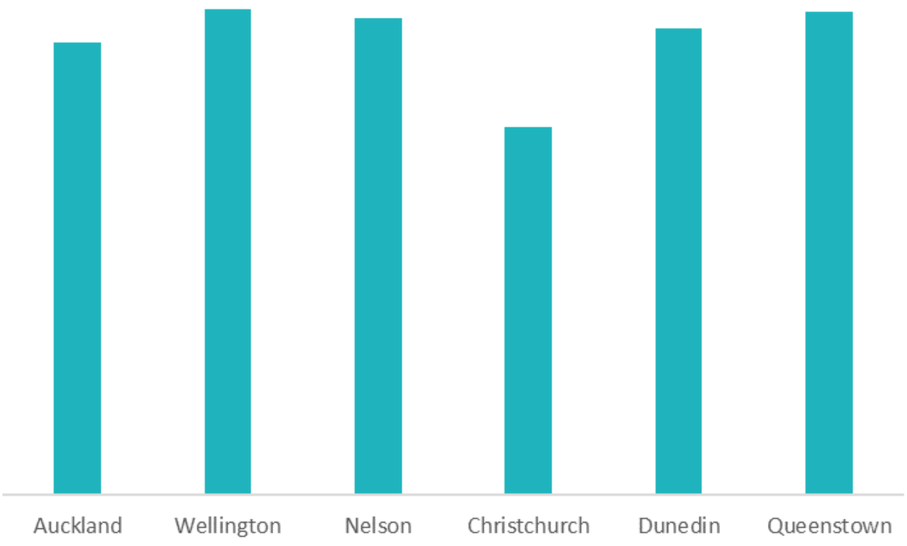
Like quarries, concrete production is an industrial activity that faces considerable constraints on where it can be located due to noise, dust and truck movements. Concrete plants are often co-located with quarries to avoid the problems of environmental sensitivities and for ready access to aggregate, a key ingredient in concrete.

Having reliable access to bulk inputs (cement and aggregate) is an advantage

In the short term, competition for aggregates (such as for use in major road projects) is driving up the cost of concrete production for some concrete manufacturers but the competitive nature of the ready mixed concrete industry means that costs are not always being passed on to consumers, especially if some firms are able to utilise low cost, local aggregate. Figure 24 shows the price of concrete across New Zealand and the difference between prices in Canterbury and Wellington likely supports this point. Canterbury has an abundant source of readily available aggregate while the Wellington aggregate market has been put under considerable pressure by roading projects.

[82] https://cement.org.au/australias-cement-industry/about-cement/australias-cement-industry/

Figure 24: Concrete Prices Across New Zealand (comparison index)[83]



The industry has robust quality standards in place

Both cement and concrete production are carried out in accordance with established New Zealand standards. We have not heard any concerns about the quality of cement or concrete.

We have heard about concerns with concrete placing and the fixing of reinforcing, typically undertaken at the construction site. Currently, these trades are not regulated or licensed and a licensing scheme has been suggested by industry.

The future of cement in New Zealand

Similar to steel, adapting to climate change will likely dominate the next 30 years of the cement market. New Zealand must be ready for this challenge.

Increased use of pozzolans is likely to be a key part of this change. The market for pozzolans can be improved by setting better incentives for concrete batching facilities to source pozzolans and introduce them during concrete production.

Cement is a major contributor to climate change. The chemical and thermal combustion processes involved in the production of cement are a large source of carbon dioxide (CO_2) emissions. Yet, overcoming New Zealand's infrastructure deficit and meeting climate change goals will rely heavily on the use of cement and concrete for the construction of wind farms and hydro-electric dams. The cement sector is therefore facing a period of higher demand at a time when its emissions need to fall.[84] The cement sector is however on a journey to decarbonise and has reduced emissions by 15% since 2005.[85]

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[83] We have been provided confidential data on concrete prices. To protect confidentiality, we have created a simple average across products, and applied it as an index where the most expensive city (Wellington) is set at 100, and other cities average prices calculated as a proportion of the most expensive city.

[84] https://www.chathamhouse.org/2018/06/making-concrete-change-innovation-low-carbon-cement-and-concrete-0/executive-summary

[85] Briefing: NZ concrete industry emissions reduction. (2020). Concrete New Zealand. https://cdn.ymaws.com/concretenz.org.nz/resource/resmgr/docs/sustain/c_sustain_briefing.pdf

Emerging research indicates that concrete structures may be a substantial but overlooked absorber of carbon emissions. A recent Intergovernmental Panel on Climate Change (IPCC) report indicates that around half of the carbon emissions from cement production are reabsorbed by the material when used in buildings and infrastructure.[86] The IPCC guidelines are important as New Zealand is an active participant in their development and they heavily influence New Zealand's domestic climate change policies.

Currently, cement production in New Zealand is granted emission units as an Emission-Intensive and Trade-Exposed (EITE) industry.[87] This means cement producers are still incentivised to reduce emissions, as this will not change the allocation they are granted, and any excess credits can be sold, but they are protected from the full costs at this time. The number of emissions units granted to Golden Bay Cement will reduce over the next 30 years to zero. At this point the emissions trading scheme will have a large impact on price.

The Climate Change Commission has estimated that the price of a tonne of carbon could be as high as $250 by 2050. This would add 85% to the cost of cement.[88] Similar to our comments on the steel sector, Te Waihanga fully support the gradual introduction of carbon pricing for cement. It is a significant emitter, and these costs must be internalised if New Zealand is to reduce its carbon impact.

However, we consider it important that incorporating carbon costs does not make New Zealand produced cement uncompetitive against imported cement and clinker. Shifting the carbon emissions overseas will not reduce the global climate impact of cement but could harm the security of supply of cement in New Zealand.

Te Waihanga therefore support policies, such as MBIE's Building for Climate Change Programme, that aim to ensure we have a level playing field as New Zealand moves to reducing emissions. Ultimately some way of ensuring that carbon costs are applied to imported cement will be required. One possibility is to impose a carbon boarder tax, similar to what is being considered in Europe, or putting in place restrictions to only allow importation of materials that have had the carbon cost appropriately accounted for.

Recommendation Ten - Supporting domestic industries through climate change: We recommend that climate change policies, such as MBIE's Building for Climate Change Programme, ensure that domestically produced cement is not put at a competitive disadvantage to imported cement and clinker due to differences in the way the costs of carbon are accounted for.

Almost all of cement's carbon emissions can be attributed to the production of clinker. Approximately two thirds of the carbon emissions are released by the raw materials as they are heated in the kiln. Thirty percent of carbon emissions come from the fuels used to heat the cement kiln to the very high temperatures needed for this process.[89]

There are two main ways that these emissions can be reduced:

1. operational efficiencies; and

[86] Climate Change 2021 The Physical Science Basis (page 1172). Intergovernmental Panel on Climate Change (IPCC). https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Full_Report_smaller.pdf
[87] https://environment.govt.nz/what-government-is-doing/key-initiatives/ets/participating-in-the-nz-ets/overview-industrial-allocation/
[88] Cement price assumed at $253, based on the only available price data (bulk imports from Holcim, and domestic production at Golden Bay are likely much lower cost, increasing the size of the % change).
[89] https://fletcherbuilding.com/assets/5-news/pdfs/golden-bay-cement-provides-sustainable-disposal-solution-for-waste-tyres-20200330.pdf

2. substituting some clinker with increased use of materials such as pozzolans.

Reducing emissions through operational efficiencies

The Golden Bay Cement facility has in recent years invested in a plant upgrade which will utilise waste tyres as an alternative energy source. This will reduce coal use by 15%, iron sands use by 5000 tonnes a year and carbon emissions by about 13,000 tonnes a year.[90] The Ministry for the Environment part funded the $25 million project with a grant of $16 million awarded through its Waste Minimisation Fund.[91]

While operational efficiencies like this example offer scope to reduce process heat-related emissions and should be applauded, they can only address a fraction of the emissions produced in the production of cement.[92]

Reducing emissions by increasing use of pozzolans

Pozzolanic material is a wide category of material, that can replace some of the clinker in the production of cement. Including more pozzolans in the cement is one of the most material ways to reduce the carbon impact of cement.

There are two categories of pozzolans:

1. industrial by-products, such as slag which is produced when smelting certain metals like steel, and fly ash produced when burning coal; and
2. natural pozzolans such as volcanic ash/pumice.

New Zealand has an abundance natural pozzolans, particularly in the central North Island. However, some of these pozzolans tend to hold a lot of moisture, so must be dried. This usually involves a large heat source like natural gas, or biofuels. Because of this, natural pozzolans tend to be more expensive to process, and domestic cement manufacturers prefer to use fly ash or slag. However, these by-products may be harder to come by as coal use reduces.

We are encouraged by the potential for pozzolans to reduce the carbon impact of cement, particularly in the near-term while more radical options, such as the introduction of novel and carbon-negative cements are still under development. There is some market activity to drive this pozzolan uptake, but there may be an opportunity to create better incentives to improve uptake.

The incentives to use pozzolans are different depending on where it is introduced into the process. In the following sub-sections we discuss two possible approaches:

1. pozzolans are bundled into the production of cement
2. introducing pozzolans at a concrete batching facility

We also consider that the current low understanding of the impact of pozzolans on concrete performance may be creating a barrier to uptake, despite evidence that pozzolans can make highly durable concrete.

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[90] https://www.nzherald.co.nz/northern-advocate/news/3-million-tyres-a-year-used-to-fuel-whangareis-golden-bay-cement-works/7OYAUZBX5FWTPFPCDPXQFBFKE4/

[91] Golden Bay Cement sustainable disposal solution for waste tyres a New Zealand first. Fletcher building. https://fletcherbuilding.com/news/golden-bay-cement-sustainable-disposal-solution-for-waste-tyres-a-new-zealand-first/

[92] Low-emissions economy; Productivity Commission of New Zealand https://www.productivity.govt.nz/assets/Documents/4e01d69a83/Productivity-Commission_Low-emissions-economy_Final-Report.pdf

Box 5 Pozzolanic material used in Waterview Tunnel

Use of pozzolans in concrete is not new (the term comes from the ancient Roman town of Pozzuoli where pumice was mined for ancient cement production) and has been used in New Zealand for both its performance features and availability. Most recently, pozzolans from Tikitere Quarry on the central volcanic plateau were used in the Waterview Tunnel which opened in 2017.

Roughly 24,000 precast concrete ring-shaped segments made from concrete containing pozzolans line the 2.4 km tunnel. Pozzolans were sourced from the silica quarry at Tikitere, providing both a reduced carbon impact, and improved smoothness and increased durability - the concrete needs to withstand 100 years of traffic use. A smooth surface was needed as the segments were gripped and placed using suction cups by Alice, the tunnelling machine. Alice would excavate 2m of tunnel then instal 2m worth of concrete segments which were then used for Alice to 'push off' of and excavate a further 2m.

Waterview Tunnel lined with pozzolanic concrete segments.

The incentives appear to be working for the inclusion of pozzolans during cement production

In New Zealand the most common way for pozzolans to be included in concrete is by combining them into the manufacturing of cement. For example, Golden Bay Cement has EverPlus fly ash,[93] and HR Cement has its Eco-cem product.[94]

This part of the market appears to be functioning well. If the introduction of pozzolans into cement reduces emissions, then the manufacturer will either be able to buy less carbon credits or be able to sell some of their industrial allocation of credits. Therefore, if the costs of adding pozzolans is less than the cost of a carbon credit, it is a good business decision.

The key costs associated with introducing pozzolans during cement production are listed below.

- Some natural pozzolans need to be dried before they are ground, this requires a furnace, and a heat source like natural gas or biofuel

[93] https://www.goldenbay.co.nz/cement-products/everplus-cement-class-c/
[94] http://hrcl.co.nz/eco-cem.html

- Fly ash has typically been the most common pozzolan in New Zealand, but as New Zealand moves away from buring coal, this will be in shorter local supply.[95]
- There are limited metal processing facilities in New Zealand limiting the amount of slag available domestically. It can be imported, but at a higher cost.
- Transportation costs of moving either imported pozzolans from the port to the cement facility, or from natural pozzolan quarries.
- We understand that grinding pozzolans must be done in a separate batch from grinding clinker, slowing down production.

That both of the manfacturers of cement in New Zealand (Golden Bay Cement and HR Cement) have introduced products including pozzolans suggests that these incentives are operating appropriately. As the cost of a carbon credit increases, the incentives to add more pozzolans will increase.

Incentives to introduce pozzolans at the concrete facility could be improved

The second way pozzolans can be introduced into concrete is at the concrete batching facility. A ready-mix producer would buy cement and pozzolans separately then add them together at the concrete batching plant at the same time as they mix together aggregates, water and additives.

There are three potential benefits of this approach compared to mixing pozzolans during cement production.

1. This approach would reduce the use of imported clinker-based cement, as well as domestically produced cement.
2. It may reduce the transport costs if the source of the pozzolans is closer to the concrete facility than the cement production facility.
3. The amount of pozzolans added can be adjusted to meet the needs of particular projects.

Despite these benefits, we are not aware of any concrete batching facility that is currently mixing pozzolans with other materials during concrete production. This may be because the cabon saving of this approach does not provide any cost benefit to the concrete batching facility.

Adding pozzolans at the concrete batching facility adds costs. For example, it would require new silos, and it has to be handled differently, which in some cases will alter the process used at the facility. The cost of pozzolans itself may also be higher than clinker-based cement. However, we note that if pozzolans can be economically incorporated during cement production, then the costs of the material itself should not be an insurmountable barrier.

Te Waihanga believe the main barrier to this type of approach emerging is that the benefits of reducing emissions are not captured by the concrete batching facility. This is because the carbon impact of cement is not included in its prices. Cement is priced by international markets, which do not account for the cost of carbon to produce clinker-based cement. If the cost of carbon were included in the price of clinker-based cement, then it may make using more pozzolans cost competitive. However, this would need to apply to all clinker-based cement. If this requirement were only placed on New Zealand based cement producers, it would make them uncompetitive against importers.

Te Waihanga recommend that further work is undertaken to consider if the incentives can be improved for introducing pozzolans at concrete batching facilities.

[95] Although we note that fly ash can be imported.

Recommendation Eleven– Creating better incentives for the use of pozzolans: We recommend that further work is undertaken to consider if the incentives for increasing the use of pozzolans into cement and during concrete batching can be improved. In particular considering:

- whether pozzolans would be competitive against clinker based cement if the costs of carbon were accounted for; and
- whether there is any way to set incentives so that pozzolans will be introduced at concrete batching facilities where the carbon abatement costs are less than the price of a carbon credit.

Building a better understanding of the effects of pozzolans on concrete's performance

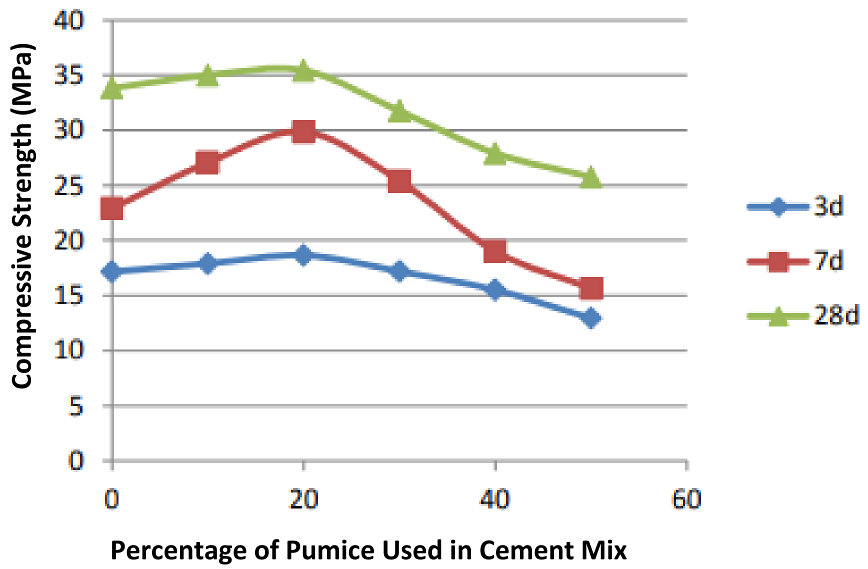
A key challenge identified by the industry in the adoption of pozzolans is the impact on concrete performance, which may be supressing customer demand. The New Zealand industry appears to have a limited understanding of how pozzolans affect the early strength gain of concrete and how it can be specified and tested in accordance with current New Zealand standards.

New Zealand based studies of the use of pumice (a naturally occurring pozzolan) as a cement substitute show that initial pozzolanic reaction is slower than that of ordinary Portland cement. This suggests that pozzolanic concrete takes longer to gain strength. However, the day 3,7,14,21 compressive strength results for pozzolanic concrete (for an 80:20 ratio of cement to pumice) are marginally better than non-pozzolanic concrete. Figure 25 below shows the comparative compressive strength of various cement/pumice mixes. [96]

Compressive strength measurements at days 7 and 28 are currently the key conformance checks stipulated by New Zealand Standards. The increased use of pozzolans in cement manufacture or during concrete batching will be encouraged by transitioning to compressive strength testing at 56 days to reflect the slower strength gain of these concretes. This will then require recalibrating 7-day strength measurements, which are typically used as indicators if there is a problem with a concrete mix. Other jurisdictions are advocating for transitioning to 56-day strength testing as means of reducing the carbon emissions from concrete production.[97]

[96] https://cdn.ymaws.com/concretenz.org.nz/resource/resmgr/docs/conf/2013/s5a_p3.pdf
[97] UK Concrete Society. Using 56-day concrete strengths. Concrete magazine (June 2021)

Figure 25: Comparative Compressive strength of various cement/pumice mixes[98]



Te Waihanga recommend that Concrete NZ work with MBIE to provide guidance on how the use of natural pozzolans affects early compressive strength gain and how increasing the use of pozzolans in concrete can be done by demonstrating it still complies with New Zealand Standards.

Recommendation Twelve - Process change to support increased use of pozzolans: We recommend that Concrete NZ work with MBIE to provide guidance on how the use of natural pozzolans affects early compressive strength gain and how increasing the use of pozzolans in concrete can be done by demonstrating it still complies with New Zealand Standards.

[98] Sourced from: https://cdn.ymaws.com/concretenz.org.nz/resource/resmgr/docs/conf/2013/s5a_p3.pdf

Focus material #4: Timber

Overview of timber in New Zealand

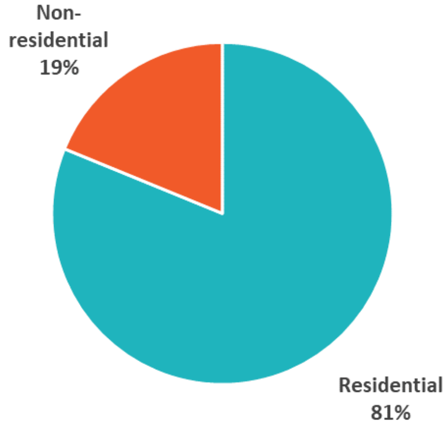
Timber is a small part of infrastructure, but has potential to grow

For this study we have focussed on structural timber, including engineered timbers such as laminated veneer lumber (LVL), glue-laminated timber (glulam), cross-laminated timber (CLT) and finger jointed timber.

Timber is not a large part of infrastructure projects. It contributes only 1% of the costs of the 'Heavy and Civil Engineering' CGPI, the lowest of all input products. This is also demonstrated in BRANZ estimates of timber use in Figure 26, which shows that the vast majority is for residential dwellings, and less than 20% is for non-residential buildings.

However, recent advances in engineered timber technology mean timber is likely to have a more important role in infrastructure (particularly vertical) in the coming years. These technologies can replace other materials like steel and timber for many parts of a building, substantially reducing the carbon cost.

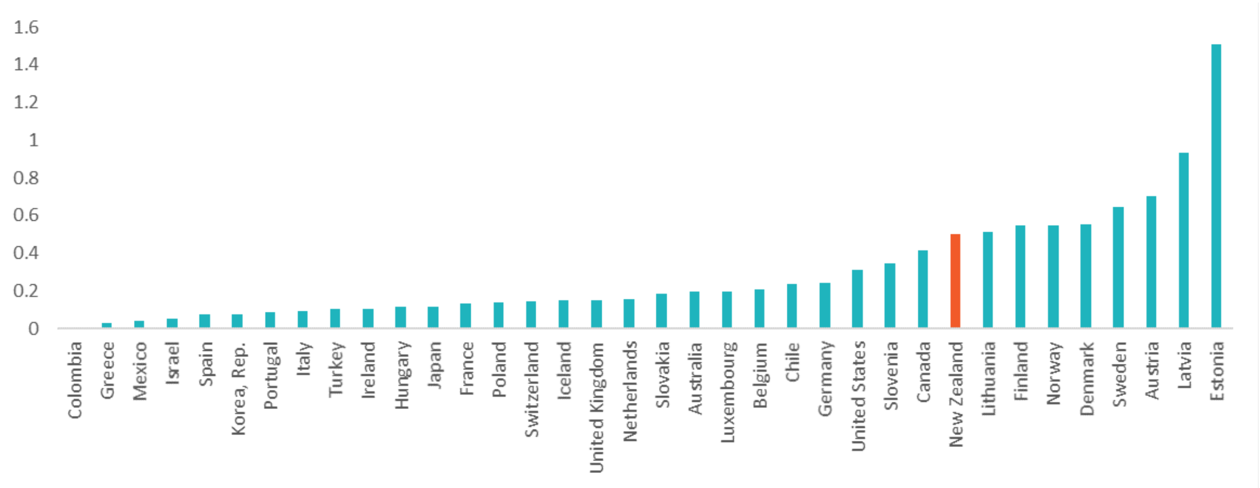
Figure 26: Timber use in New Zealand



New Zealand has a high demand for timber

New Zealand has among the highest consumption of timber per capita in the OECD. This sits in direct contrast to New Zealand's relatively low consumption of steel. These two products are substitutes in many cases, indicating that for many purposes New Zealand construction favours timber.

Figure 27: Demand for sawn timber for OECD countries (2019, m^3 per person)[99]



[99] Food and Agriculture Organization of the United Nations http://www.fao.org/faostat/en/#data/FO, figure based on total production, plus imports, minus exports.

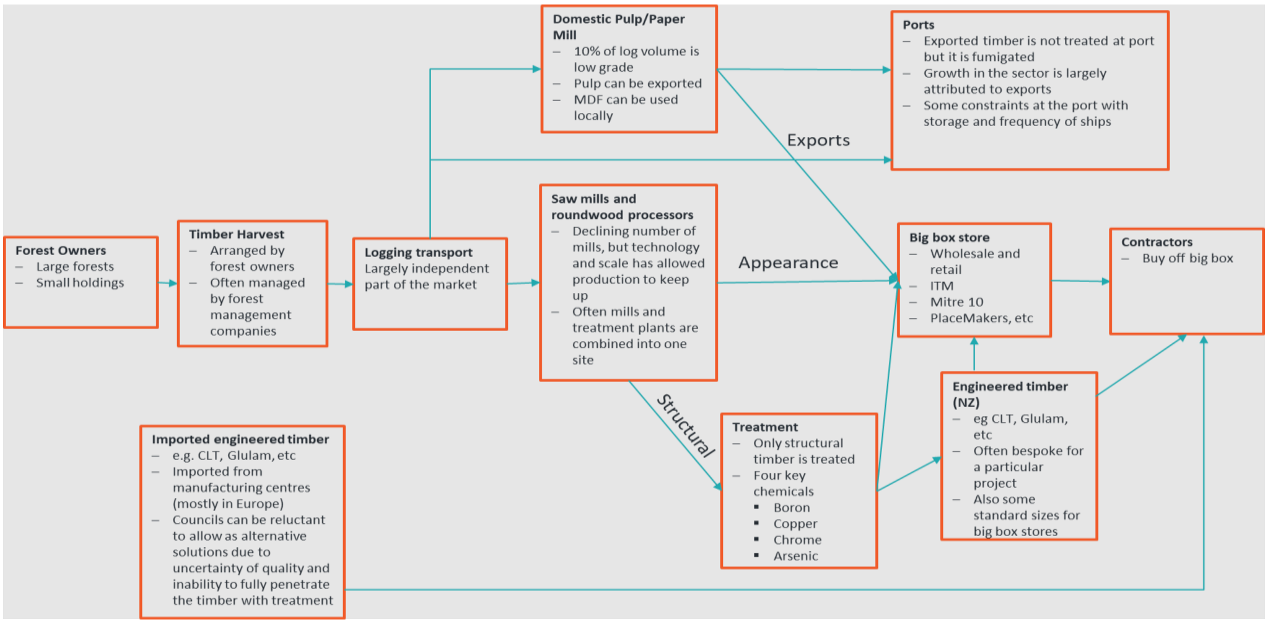
Are there any issues with supply?

Much of the timber market is export facing, putting global pressures on New Zealand firms, and minimizing the risk of any market-based issues.

Our key concern is that timber struggles to easily respond to changes in demand, creating a risk when there are sudden or unexpected changes in demand.

The supply chain for timber is showing in Figure 28 below.

Figure 28: Timber supply chain



There are four key parts to the timber market in New Zealand: Forest owners, harvesting companies, sawmills / treatment plants, and merchants. In this section we consider supply issues across each of these segments.

Forestry

New Zealand has an abundant forestry resource. Figure 29 shows the forestry stock across the country. The exotic forests in blue are the main source of timber. These are largely concentrated in the mid North Island and upper South Island.

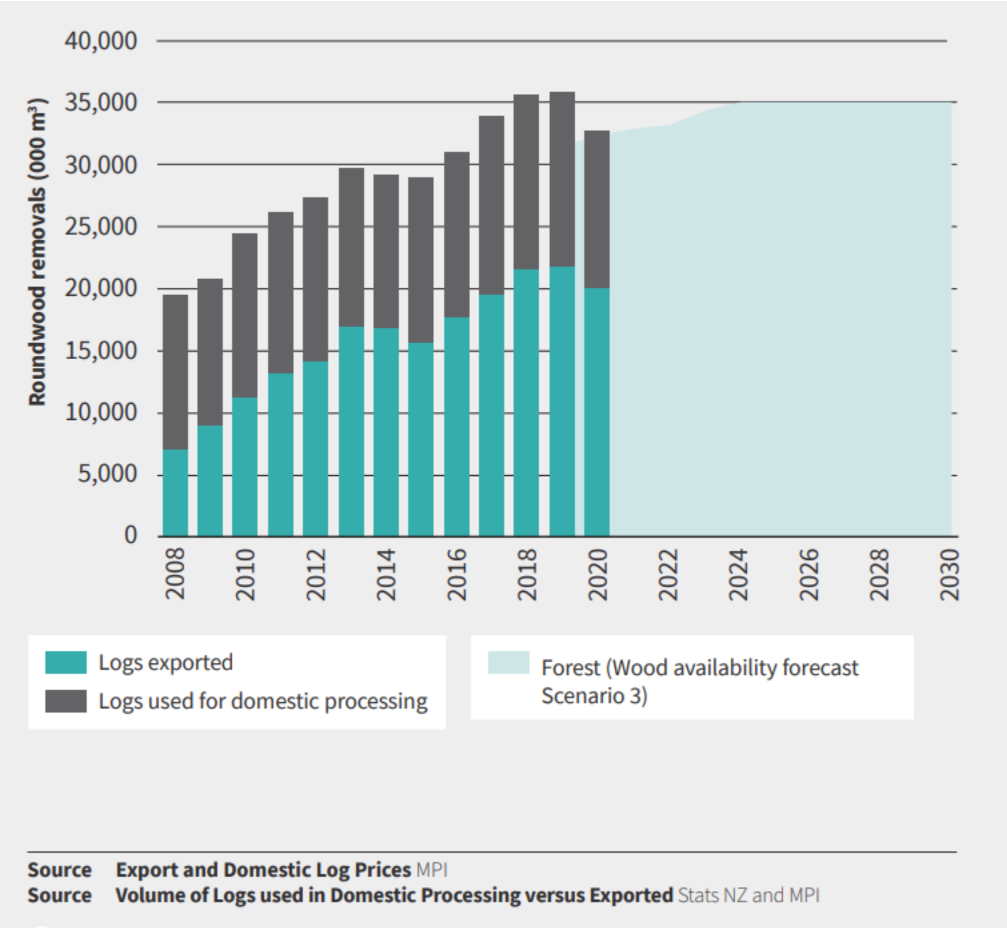
The industry is about 60:40 export and domestic supply. This is shown in Figure 30 below. Most of the growth in the industry over the last 30 years has largely been in the export market.

The increasing dependence on export markets places a strong economic discipline on the New Zealand forests. It means the international price of logs determines the New Zealand market, and there is limited risk of any one forest gaining market power.

Figure 29: Forest locations across New Zealand

The openness of the New Zealand market to exports also means that domestic demand competes freely with export demand. However, we note that shipping costs and ease of business transactions would favour domestic demand, all else equal.

Figure 30: Volume of logs used in domestic processing and exported[100]



The ability for the forestry market to adjust to changes in domestic demand is different for large forests and smaller plantations.

Larger forests are about 60% of the market.[101] Many of these organisations are run as managed funds and are focussed on providing investors with a steady rate of return. This means many of these forests aim to have a consistent level of harvesting each year, irrespective of market conditions.

Larger forests can in some circumstances increase supply domestically by reducing exports. However only a small amount of sawn timber that is currently exported is structural grade and can be redirected to meet local demand. There is some lag in changing the export/domestic balance due to changes in distribution and other parts of the supply chain. But we understand there are no prior commitments on volumes to export clearing houses, so these changes can be made with sufficient notice.

The remaining 40% of the market are smaller plantations. These tend to be more opportunistic, aiming to harvest when global prices are highest. Since the New Zealand market is too small to affect global prices,

[100] https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203660/Forestry-facts-and-figures-2017_2018.pdf
[101] https://www.nzfoa.org.nz/images/Facts_and_Figures_2018-2019_Web.pdf

increases in domestic demand are unlikely to trigger greater supply from smaller plantations. However, at times of highest global demand (and price), there is likely to be more timber available on the market.

Harvesting and log transport

Harvesting involves cutting, extracting, and processing trees into logs for export or for the domestic market. Modern harvesting involves specialised machines at all steps in the process. Transportation uses logging trucks, rail, and ships.

Many larger forest owners will have their own harvesting capability. Their size allows them to keep the machines and staff fully utilised, justifying the expense. However, transportation tends to be owned by third parties.

Smaller plantations will typically use third party harvesting companies, or in some cases hire the machines and staff from larger forest owners. Harvesting will only occur once every 30 years (or thereabouts) for smaller plantations, it makes no economic sense for them to hold the capability themselves.

Harvesting and log transport can become a bottleneck in times of high demand. There are only a certain number of trucks, machines, and trained operators throughout the country. The costs of this resource are too high for it to sit idle. At times of high demand, harvesting capability can run for longer hours to increase output, but this can only be pushed so far. It is often estimated that harvesting output can only increase by roughly 20% on top of normal production.

There has been much discussion about a “wall of wood” from the forests planted in the 1990s all coming to maturity in the coming years.[102] This is likely to place significant demand on the harvesting industry, and may result in some forests staying in the ground longer than desired.

Sawmills and treatment plants

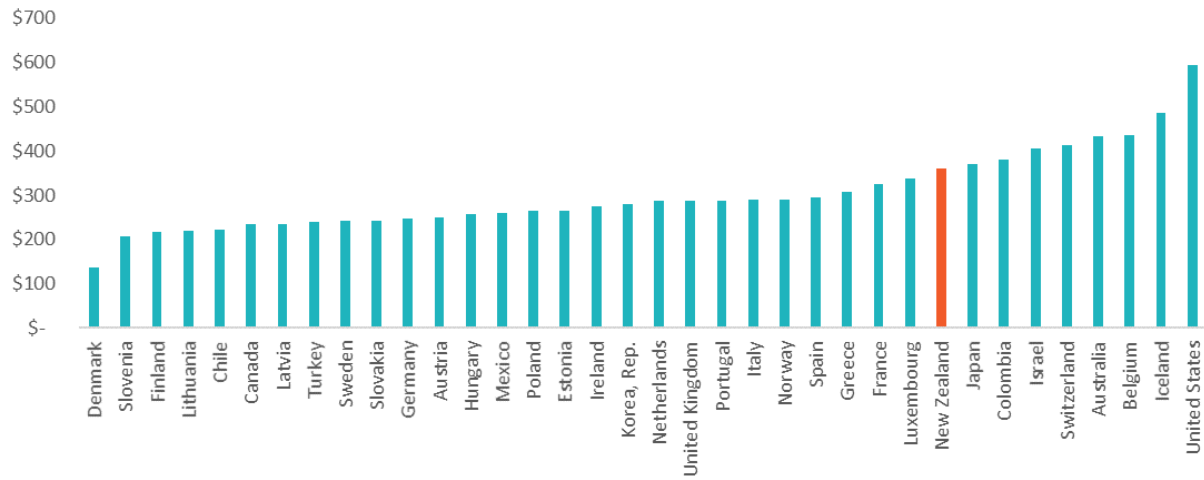
The next step for a harvested log is going to the sawmill and treatment plant. These two processes are often undertaken at the same premise, and involve cutting logs to size, testing for weaknesses, such as knots, and then finally the chemical treatment of the timber.

This market is dominated by two large operators: Carter Holt Harvey (CHH), and Red Stag. There are also many smaller mills, which have historically been dotted throughout the country.

As shown in Figure 31 below, price for timber in New Zealand is at the higher end of our OECD comparators, but is not an outlier. This figure is based on the weighted average import and export price for each country, which is likely to be a good proxy for domestically produced prices.

[102] https://nz.pfolsen.com/market-info-news/wood-matters/2015/july/the-wall-of-wood-maturing-1990s-plantings/

Figure 31: Price per m³ of sawn timber (OECD, 2019)[103]



CHH is estimated to hold about 45% market share for milling in New Zealand,[104] suggesting it may have some market power. Unlike forestry, milling is largely domestically focussed[105] and does not have the same market discipline from global competition. Many sawmills are also very small and do not have the scale or capital investment to effectively compete against the large operators.

The Commerce Commission keeps a close watch on this market. For example, in 2014 the Commerce Commission successfully prosecuted CHH for entering into restrictive trade practices.[106] Another investigation has recently begun following the announcement that CHH will stop supplying timber to some merchants.[107] This level of scrutiny dramatically reduces the ability for CHH to manipulate the market.

There are some challenges to market entry, but we consider that a determined investor could set up operations in New Zealand. Gaining resource consent for a new site for a sawmill is very difficult, and therefore generally not attempted by the industry. We are unaware of any land use consents granted for a new sawmill in the last 20 years. Instead, entry happens when an investor buys an existing small mill and uses the existing use rights to upgrade to modern equipment and processes.

There are two key barriers that need to be overcome for a new entrant:

a. The set-up costs of a scale, modern plant run into hundreds of millions of dollars. There would need to be sufficient certainty of demand to justify this investment.

b. The entrant would also need to reach agreement with local forest owners to secure supply. A new entrant would need to demonstrate they are not high risk to tempt a forest owner away from an existing supply arrangement, or the security of export earnings.

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[103] http://www.fao.org/faostat/en/#data/FO

[104] https://businessdesk.co.nz/article/infrastructure/carter-holt-harvey-boss-were-investing-but-building-is-booming#:~:text=Hughes%20said%20the%20cooperative%2C%20which,required%20to%20transact%20with%20them%22.

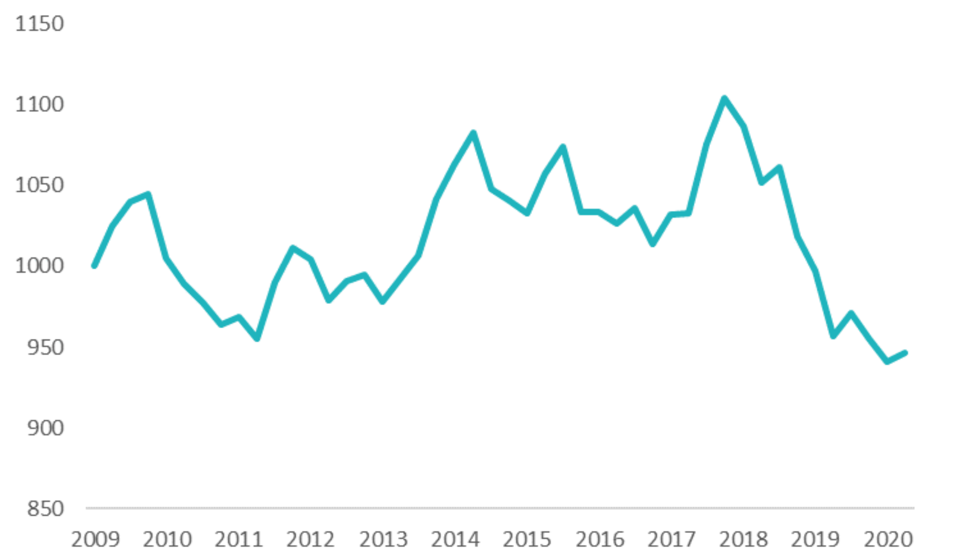
[105] There is considerable debate across government about whether there is an opportunity to grow the export potential of the milling market. We have not considered this issue in this report as it has little impact on the supply of timber for infrastructure projects.

[106] https://comcom.govt.nz/__data/assets/pdf_file/0033/67956/Commerce-Commission-v-Carter-Holt-Harvey-Ltd-Judgment-of-Venning-J-High-Court-of-New-Zealand-26-March-2014.pdf

[107] https://www.newshub.co.nz/home/rural/2021/03/commerce-commission-launches-enquiry-into-carter-holt-harvey-s-halting-of-timber-supply.html

On balance, we consider that the scrutiny of the Commerce Commission and open entry to the market is enough to place some market constraint on CHH and Red Stag. This is reflected in the data. Figure 32 below shows the timber output commodity index from Statistics New Zealand, adjusted for all industry producer price index. It shows that the price for sawn timber has remained at largely the same price level for the last ten years.

Figure 32: Timber and wood output commodity adjusted for all industries producer price index[108]



The main challenge in the supply of sawn timber is the ability to adjust to changes in demand. There are five key constraints:

1. To increase the production of sawn timber, mills need to get access to more logs. As shown in the section above, mills need to work with forest owners to gain access, and there can be several months delay.
2. Capital investments to increase production can be very expensive. These investments will only be made on the basis of sustained demand, rather than peaks with an uncertain future.
3. Using more labour can increase production at a sawmill. In practical terms this means running multiple shifts in a single day. This places a burden on staff and getting enough people who want to work unsociable hours can be difficult.
4. It is unlikely imports could meet any supply shortage. Imports of sawn timber are very small in New Zealand (<3% of domestic demand), and the price is extremely high (more than three times the price of exported sawn timber).109 It is likely that imports are constrained by New Zealand's Building Code requirements, or may be supporting bespoke requirements, driving up cost.
5. Only a small amount of sawn timber that is currently exported can be redirected to meet local demand. This is because much of the exported sawn timber is not structural grade.

The challenges in responding to short-term changes in demand are likely part of the reason CHH recently decided to stop supplying timber to Placemakers and Mitre 10. Right now, demand is unexpectedly up

[108] Data based on Statistics NZ Wood and Timber output commodities index, adjusted for the all industries producer price index.
[109] https://www.mpi.govt.nz/forestry/new-zealand-forests-forest-industry/forestry/wood-product-markets/

from previous years. This is an unexpected change, which has meant the industry has struggled to meet the demand, resulting in shortages and delays across the industry.

More international trade would help support a more agile timber industry. A more export focussed industry would have more stock that could be sold locally in times of high domestic demand. Similarly, if importation increased, international volumes would likely allow for short term increases in supply. We therefore recommend:

a. Work underway across government including the Wood and Forestry Industry Transformation Plan (ITP),[110] and the Forest Strategy should focus no only on increasing the export potential for sawn timber should also consider the domestic benefits of having greater excess supply.

b. A targeted study should be undertaken to understand the barriers to importation, and what can be done to mitigate them.

Recommendation Thirteen - Improving domestic supply of sawn timber: We recommend that the Wood and Forestry Industry Transformation Plan and the Forestry Strategy should focus not only on the export benefits of growing the timber sector, but also the benefits to construction projects of having better and cheaper access to sawn timber.

Recommendation Fourteen - Importation of sawn timber: We recommend the Ministry for Primary Industries undertake a targeted study to understand the opportunities and risks of increasing importation of sawn timber and other wood products, and the barriers and what can be done to mitigate them.

Merchants

The final market in the supply of timber are the merchants. These are big box stores such as PlaceMakers, ITM, Carters, Mitre 10, or Bunnings. They stock a large number of building supplies, and act as a one stop shop for raw materials for most residential building projects.

We have not specifically investigated this part of the market. Apart from framing timber, infrastructure projects do not frequently engage with these firms. However, we make the following observations:

a. There appears to be a healthy number of competitors, minimising the risk of any seller or buyer power issues. Although we encourage the Commerce Commission to test this assumption in their upcoming market study into the building supply sector.

b. There is a significant amount of vertical integration in this part of the market, for example:

    i. PlaceMakers is owned by Fletcher building, who supply several building products, such as GIB board, Easysteel, Golden Bay cement, and Winstone aggregates.

    ii. Carters is owned by CHH, the dominant supplier of sawn timber to the New Zealand market.

No issues identified with timber quality

Through this study we have not heard any concerns with the quality of timber. Following the leaky building problems in the early 2000s[111] most structural timber in New Zealand is now required to be

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[110] The ITP has a broader focus than this report. It will aim to address and lift productivity across the whole forestry and wood products value chain.
[111] https://www.govt.nz/browse/housing-and-property/leaky-homes/

treated under the Building Code. This process adds complexity to the supply chain but ensures the integrity of timber.

The future of Timber in New Zealand

The most significant change in the timber market is the emergence of engineered timbers. These materials can help reduce the carbon impact of some infrastructure, but questions about the appropriate carbon accounting method remain.

The costs of engineered timber are currently greater than traditional building materials, but there are encouraging signs that these costs may be able to come down.

Engineered timbers may be a key part of climate change mitigation

The emergence of engineered timbers is one of the most significant change happening in the timber construction market. These are pressure-glued beams and boards, constructed for very high strength, and can replace steel and concrete in many cases. Entire wall sections can be constructed off-site and quickly erected at a construction site.

Box 6 below provides a case study on one of the most ambitious engineered timber buildings to date. It shows that these materials can be cost effective and can improve building speed.

Box 6: Engineered timber buildings in Norway and New Zealand

Traditionally it was assumed that timber buildings could only reach up to 6 or 7 stories. This conventional wisdom has been thrown out the window in recent years, with several timber buildings in Europe and China going many stories up.

The tallest timber building to date is the 18 story Mjøstårnet tower. This building was constructed in 2019 in the small Norwegian town of Brumenddal. It is particularly impressive as it uses timber for all structural elements, right down to the lift shaft.

The tower was constructed in four story segments, which were prefabricated offsite. This greatly reduced the building time, and eliminated the need for external scaffolding, as the completed segments could be craned into place. This helped keep the building cost competitive compared to traditional materials.

Buildings like this are now starting to appear in New Zealand. For example, the recently built Nelson Airport is a fully timber building.

Engineered timbers have the potential to reduce the carbon impact of vertical construction by reducing the amount of high carbon emitting steel and concrete. We consider that this holds promise, but before the emissions impact of engineered timbers can be properly assessed, two questions must be answered.

a. What is the carbon saving of using engineered timbers compared to traditional buildings. Currently there are a number of different estimates and no agreed upon approach in New Zealand.

b. Can the costs of using engineered timbers be reduced sufficient to make them cost competitive compared to traditional buildings.

The carbon impact of using engineered timbers is unclear

During this study we have heard several estimates of the carbon impact of engineered timbers. There are a number of factors that influence different estimates, but perhaps the most material is the carbon accounting approach chosen, and how the embodied carbon in the timber is treated. There are two main schools of thought:[112]

a. A 'cradle-to-gate' approach calculates the carbon impact based on the impact from production of the materials to the erection of the building. Under this approach, carbon stored in the timber is offset against emissions caused in the manufacture of the timber, as carbon has been removed from the atmosphere as the tree has grown.

b. Another way of calculating the carbon impact is to consider the 'cradle-to-grave', where the costs of demolishing/recycling the materials are also counted. For timber, this may include the return of carbon stored in the timber back to the atmosphere as a greenhouse gas emission. This approach has recently been adopted by the European Union under standard EN15804, where the total climate change impact is the sum of fossel fuels, embodied biogenic carbon, and land use and land use changes.

When MBIE consulted on these two options in the Building for Climate Change Whole of Life Embodied Carbon Reduction Framework in October 2020, many submissions recommended that the 'cradle-to-grave' approach be adopted, despite the additional complexities when compared to the 'cradle-to-gate' approach. Under this approach, many argue that the carbon stored in timber cannot be offset against emissions, as it may one day be released back into the atmosphere. However, others highlight that these emissions may not happen due to:

a. recycling or reuse of the timber

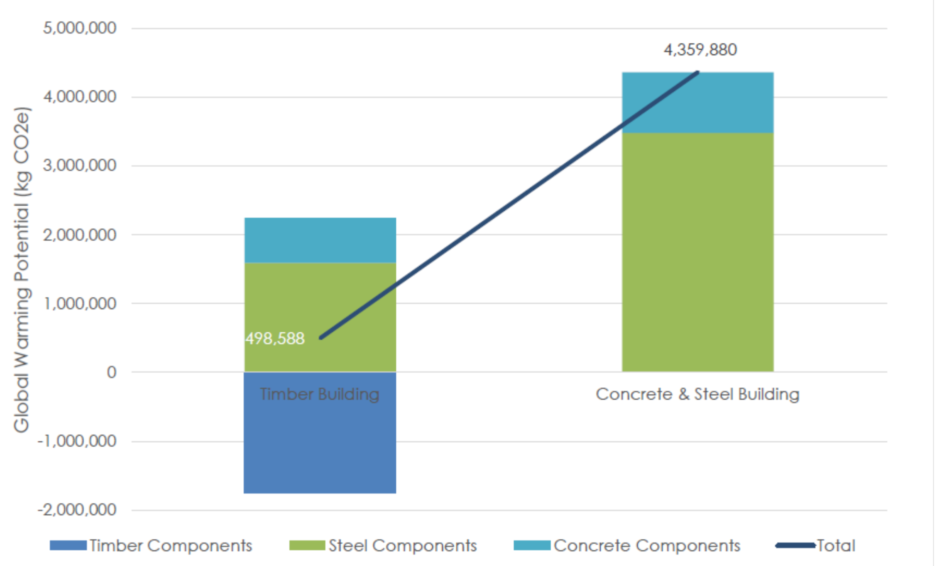
b. evidence that landfilled timber retains much of its stored carbon, and

c. technologies to capture any emissions at end of life. These technologies may be more advanced in the future when buildings constructed today are demolished.

The difference between these two approaches is demonstrated in Figure 33. This graph was developed by Naylor Love to demonstrate the carbon impact of building with engineered timbers. It is based on a composite building, using concrete for foundations, steel for lateral load (seismic), and timber for gravitational load.

[112] MBIE's Building for Climate Change report covers a fuller range of models and a more detailed explanation of each.

Figure 33: Carbon costs of different building approaches[113]



Naylor Love focusses on the 'cradle to the gate' approach and therefore nets off the embodied carbon in the timber. Under this approach timber buildings have a 90% lower carbon impact compared to a predominantly steel and timber building. However, if a 'cradle to the grave' approach is used, and it is assumed that the stored carbon in timber is released at the end of its life, then the carbon reduction of using timber is closer to 50%.

The estimates from Naylor Love are among the more optimistic we are aware of. Other estimates, particularly those for buildings with requirements to reduce vibration and liveliness, have resulted in much higher costs and less carbon savings. More research is required before a consensus view emerges.

The costs of engineered timber must be significantly reduced before they are a cost-effective way to reduce carbon emissions

For engineered timbers to be a cost-effective way to reduce carbon emissions the marginal abatement cost must be less than the cost of alternative carbon reduction methods. Taking this approach ensures that we can maximise carbon reduction efforts across the economy.

In New Zealand the target abatement cost is set in the price of a carbon credit. Currently the price per tonne of carbon sits at $64.50[114] but is predicted to rise to $250 by 2050.[115] For engineered timber to be a cost-effective approach to minimise emissions, there must be a clear path for its marginal cost compared to traditional buildings to be less than the cost of a carbon credit at some point in the future.

Identifying the marginal abatement cost of engineered timber is not possible until there is a consensus view of its carbon impact. However, we can make some rough estimates based on currently available information to put us in the ballpark.

For example, in the scenario from Naylor Love above, the marginal abatement cost is roughly $259 per tonne of CO_2. The timber building scenario uses 3,861 tonnes less CO_2 than the traditional steel and concrete building. Naylor Love estimate that the timber building would cost roughly $1m more than the

[113] Naylor Love, "Engineered Timber Buildings", Presentation, 2021.
[114] https://www.commtrade.co.nz/, visited on 21 October 2021.
[115] Climate Change Commission, 31 May 2021, 'Inaia tonu nei: a low emissions future for Aotearoa'.

traditional building.[116] That means the cost per tonne of CO_2 saved is $1m / 3,861 = $259. This cost would be substantially higher under a 'cradle to the grave' approach, where stored biogenic carbon is not counted.

We are aware of other estimates that put the cost difference between timber and traditional buildings much lower, and in some cases showing timber buildings are cheaper. These estimates rely on monetising the faster build time by estimating the reduced on-site costs, as well as the carrying cost of the developer holding land for less time. This is because engineered timber can be delivered to site in large panels, allowing much faster construction.

While time savings are possible in ideal conditions, we heard from a number of construction firms that this is not currently the case. The time to order engineered products is often equal to, or longer than the time savings they can bring. This is likely because the engineered timber sector in New Zealand is still in its early stages, and there is limited capacity, or expertise in using the material.

Government role in supporting engineered timbers

Under the current settings, the price differential between engineered timbers, and traditional materials like steel and concrete do not properly account for the carbon impacts. As covered above the prices for steel and cement in New Zealand are set by international markets, and the cost to ship to New Zealand. Currently most markets do not include the carbon cost of manufacturing these materials into their price, which means these costs cannot be included domestically either, or the local manufacturers would become uncompetitive.[117]

Because carbon pricing signals are not yet fully functioning, there may be a role for government to find other ways to promote the uptake of engineered timber. Intervention would be justified where there is a viable path for the marginal abatement costs to be below the cost of a carbon credit. Otherwise, there is a risk that engineered timber is promoted ahead of other initiatives that could have a larger emissions impact for less cost.

As above, the marginal abatement costs of using engineered timber compared to other building materials is currently unclear. Therefore, we recommend that more work is undertaken to clarify the marginal abatement cost. This may be undertaken as part of the initiatives underway across government to grow the timber sector, such as the Wood and Forestry Industry Transformation Plan, the Forestry Strategy being developed by Te Uru Rākau, the wood processing cluster in Tairāwhiti and the Mid-rise Wood Construction programme[118].

Specifically, we recommend that further work is undertaken to:

a. determine the true carbon impact of engineered timber buildings;

b. estimate the likely carbon reduction path of traditional materials like steel and concrete. This is necessary to estimate the carbon savings that can be achieved by using timber; and

c. propose if, and how the costs of engineered timber can be reduced sufficiently to make the material cost effective, taking into account its carbon impact.

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[116] This estimate was made in 2019, before the current material price inflation we are experiencing as a result of COVID-19.

[117] For this reason both steel and cement are considered trade exposed and provided industrial credits under the EITE scheme. We support this scheme as a way to protect domestic suppliers until a more comprehensive approach can be found for normalising the carbon impact of domestically produced and imported products.

[118] Mid-rise Wood Construction, Ministry for Primary Industries, 23 August 2021: https://www.mpi.govt.nz/funding-rural-support/primary-growth-partnerships-pgps/current-pgp-programmes/mid-rise-wood-construction/.

We are optimistic that this work may show a viable path for bringing the costs of using engineered timber down, potentially making it an efficient way to reduce carbon emissions.

a. The New Zealand engineered timber market is not yet mature, often operating below scale and using bespoke processes requiring a lot of labour. As demand for engineered timbers increases the industry will mature and become far more efficient, reducing time to build and time to supply, and reducing costs of using these products.

b. As the engineering community becomes more familiar with the properties of engineered timber there may be opportunities to create more efficient designs. For example a timber building will be much lower weight than a traditional concrete and steel structure. This may reduce the requirements on the foundations, reducing the overall building cost.

c. As the construction sector becomes more familiar with using engineered timber the supply chain will likely improve and the cost of construction would likely reduce.

Recommendation Fifteen - Research required to justify government intervention in promoting engineered timber We recommend that the Ministry of Primary Industries undertake targeted research to establish whether there is a viable path for getting the marginal abatement costs of engineered timber below the costs of a carbon credit at any point in the future. This work should:

- assist with determining the true carbon impact of engineered timber buildings;
- estimate the likely carbon reduction path of traditional materials like steel and concrete. This is necessary to estimate the carbon savings that can be achieved by using timber; and
- propose if, and how the costs of engineered timber can be reduced sufficiently to make the material cost effective, taking into account its carbon impact

Attachment 1: Summary of industry interviews

Summary of key messages from interviews: Aggregate

Market Entry	Supply Chain	Competition	Quality	Environmental
Significant challenges	**Significant challenges**	**Some challenges**	**Healthy**	**Some challenges**
- Resource consents are a barrier to entry – the process is becoming more time-consuming and costly - Existing use rights on brownfield sites mean they are favoured over greenfields - Alluvial gravel extraction in Canterbury does not experience resource consent conditions to the same extent as the rest of the country - Quarrying is capital intensive but machinery is readily available for hire and/or purchase - Quarries have a long lead-in time, long life, and require supporting infrastructure (like access to major roads), short-term demand increases are unlikely to trigger investment decisions.	- Conditions on consents like operating hours or number of truck entry/exit can limit the ability to adjust to changes in demand - Quarries in some regions are experiencing high demand - Additional capital and labour can increase supply but limited by consent conditions above - Third party trucking companies are common, and operate at a lower cost by utilizing back-hauls - Aggregate is travelling long distances in the Auckland and Wellington regions. This appears to be a short-term problem for Wellington but a long-term problem for Auckland	- Hard-rock resources are not evenly distributed across the country, resulting in regional price variation - There are a handful of large firms (e.g. Fulton Hogan, Winstones and Road Metals) and a long tail of smaller firms - We are unaware of any major quarries operating without a major competitor nearby - There is a lot of vertical integration, which in some cases may increase transport distances by favouring vertically supplied aggregate rather than a nearer source. But appears to have little impact on the gate price of aggregate	- Quality standards (IANZ and NZSO certifications) are well understood and generally required to get a contract, especially with councils - We have not heard evidence of systemic quality issues - Any quality issues typically relate to local resource availability	- The key environmental topic is recycling vs virgin aggregate. Most recycled aggregate is crushed concrete - Demand for recycled aggregate is low due to cost and quality concerns - Recycling often requires trucking concrete waste longer distances, making the total environmental impact unclear - Crushing concrete can be done at a quarry using standard equipment, but requires a separate run, which increases cost. Auckland also has some dedicated crushing sites - Quality standards and use requirements may improve demand for recycled aggregate.

Summary of key messages from interviews: Steel

Market Entry	Supply Chain	Competition	Quality	Environmental
Some challenges	**Some challenges**	**Healthy**	**Healthy**	**Significant challenges**
- Little to no prospect of market entry for steel production in NZ due to scale, and input costs (electricity and labour) - Healthy import and distribution market - Securing labour is a barrier to setting up a new fabrication facility - Need a factory site and some capital outlay - Competition from imported pre-fabricated steel	- Prices are currently high due to international shortages, and increases in shipping and freight rates - Most consider this is likely a short run problem - Domestic supply can adjust to changes in demand by: - NZ steel reducing exports - Increasing imports (very flexible in normal times) - Increasing production (eg labour) at fabrication facilities - International supply of material that meets NZ Standards is less accessible	- Prices in NZ are based on international steel prices - A number of players in all parts of the market, and fairly easy entry - Timber increasingly considered a serious competitor - Costs like labour, electricity and climate change mitigation could be existential to the local manufacturing of steel	- NZ produced steel and imported steel are subject to transparent quality standards - There have been quality concerns with non-compliant Chinese imports in the past. Industry is now well attuned to these risks and extensively tests on-shore	- Steel is a high carbon emitting process - Ability to minimise carbon impact by re-using steel in two ways: - Electric arc furnace to recycle steel. Can be low carbon is a sustainable energy source is used - Re-using steel sections from deconstructed buildings. (CAB building in Auckland) - Hydrogen technology is considered still in the R&D phase

Summary of key messages from interviews: Cement

Market Entry	Supply Chain	Competition	Quality	Environmental
Significant challenges	Some challenges	Some challenges	Healthy	Significant challenges
- Very unlikely for a new manufacturing facility to emerge in NZ due to scale and local input costs (labour and electricity) - Holcim currently imports cement in bulk. This is efficient, but it is not possible for a competitor to duplicate given the size of NZ market - Currently, smaller importers are not viable due to the costs of container shipping - HR Cement operates in a middle ground importing clinker. However, it doesn't appear there is any prospect of a new entrant taking this route given costs and scale	- Cement is not evenly distributed across the country. - Most domestic cement production uses local limestone but domestic production also relies on imported materials (gypsum, coal other strengthening agents + clinker for HR Cement) - Trucking and coastal shipping are the primary transportation methods. Rail is not viable due to cost and service effectiveness	- Price is dictated by the cost of imports and domestic transportation - Local production needs to maintain cost parity with international competition and costs like labour, electricity and climate change mitigation could be existential to the local manufacturing of cement. - Cement is an EITE industry and the eventual removal of industrial allocations under would have significant impacts on industry especially if international competitors are not subject to an ETS as ambitious as NZ's	- Both cement and concrete production are in accordance with established industry standards - Producers publish weekly quality certifications	- Cement has a large carbon footprint. Responding to this challenge is likely to dominate the market over the next 30 years - Industry is working to reduce its carbon impact by using more waste as a heat source - Natural pozzolans are a proven substitute for cement (current practice utilize a mix of up to 30%) and abundant in NZ – although frequently located on the conservation estate - Industrial pozzolans are another proven substitute but less available in New Zealand due to the comparative lack of heavy industry of which these material are by products

NEW ZEALAND INFRASTRUCTURE COMMISSION
Te Waihanga

Summary of key messages from interviews: Concrete

Market Entry	Supply Chain	Competition	Quality	Environmental
Some challenges	Some challenges	Healthy	Some challenges	Some challenges
- Brownfield sites have existing use rights and for this reason are often favoured over greenfield developments - Market entry is contingent on securing supply to bulk quantities of cement and aggregates. Both of which are experiencing shortages in places. - Plant and equipment are readily available (except for central mixing units which are very expensive and require more time to source and install)	- Concrete competes with roading for access to aggregates - Conditions on consents like operating hours or number of truck entry/exit can limit the ability to adjust to changes in demand - Additional capital and labour can increase supply but limited by consent conditions above - Independent trucking is rare because of the specialised nature of concrete mixers - Concrete travel times (max 90 minutes) constrain the number of practical competitors - The prohibitive cost of containerizing cement has forced the closure of a supplier in the deep south	- In the main centres, concrete is highly competitive. Increased input costs will therefore be shared by producers and consumers. - Aggregate resources are not evenly distributed across the country, and some regional price variation in concrete is to be expected as a result - Concrete appears competitive for a commodity product. There are two large firms - Allied and Firth (Fletcher Building).Both have a presence across most of the country - There is a long tail of smaller firms, but they are geographically dispersed and rare for them to compete against each other	- Quality standards are well understood and we have not heard evidence of systemic quality issues of concrete leaving the plant or truck - Concrete placers/layers are unregulated and unlicensed. - An audit programme for concrete layers has been suggested. Such a programme would require concrete placers to record data on their process and what the conditions were at the time of placing concrete	- The use of crushed concrete as concrete aggregate is rare in NZ due to price and performance perceptions - Glass has been crushed as a sand substitute but it is an expensive resource and has additional cleaning and risk of reaction of silica and alkaline cement (this risk is mitigated by reducing the particle size of the silica) - Plazrok have developed a concrete product that utilises recycled aggregate as a substitute for virgin rock aggregates. Currently, the use of plastics as aggregate is not widespread

Summary of key messages from interviews: Timber

Market Entry

Some challenges

- New sawmills are limited to the expansion of brownfields In some locations there are many options, in others like Otago and Gisborne entry is more challenging.
- Scale sawmills cost at least $200m, and require careful analysis of available forest resource which is reducing as the 1990s plantings are harvested in the 2020s
- Council behaviors (rates and water allocations) can be a barrier to logging in some areas

Supply Chain

Some challenges

- Small hold plantations are roughly 40% of the market and are responsive to price signals but export most of their production.
- The remaining 60% the market are larger forests, which harvest at a steady to age distribution of forests and to provide investor dividends
- Domestic supply of logs can to a small extent be increased by reducing exports
- Local mills can only increase production in the short term by running longer shifts – and finding labour is difficult
- To increase long-term production (e.g. to respond to climate policies) foresters and sawmills need clear signals from Government to justify investment
- The state of NZ's horizontal infrastructure is increasing the cost of logs

Competition

Healthy

- Concerns about the level of competition have not been raised
- Price is dictated internationally and NZ is a price taker
- NZ CLT is currently more expensive than European timber. This may be due to sub-scale demand resulting in current facilities running below capacity, expense of NZ logs, requirement to treat Radiata Pine and lack of competition (Red Stag CLT is about to open)

Quality

Healthy

- Timber treatment is still important and not just an overreaction to the leaky-buildings crisis
- The H1.2 treatment specification in NZS3640 is well understood, and known to demonstrate full sapwood penetration
- Structural timber has well understood standards and there are no systemic concerns
- The thermal modification specifications for LVL should be published with that standard

Environmental

Some challenges

- There is some demand for end-of-life timber for use as animal bedding (timber shavings)
- End-of-life timber can also be used as fuel source and some sawmills already utilize by-products as their primary energy source
- Timber is increasingly seen as a possible alternative to the emissions caused by steel and concrete usage.

Attachment 2: Te Waihanga's Assessment of Environmental Policies and Proposals affecting quarries

	Description	Industry Concern	Our Assessment
	**National Environmental Standards for Freshwater Management (NPS-FM) regulations**		
	There's been a narrowing of the definition of natural wetlands, and a limited scope of activities eligible to access a consenting pathway on or near them.	The quarry sector, among industries, is concerned that earthworks in or near wetlands is a prohibited activity. The Government is currently working to provide quarrying a consenting pathway in this situation, along with mining, landfills, managed fills, cleanfills, and urban development, as already available for "specified" infrastructure.	Te Waihanga has submitted on a Ministry for the Environment consultation on providing a workable consent pathway for quarries (and a broader range of infrastructure).
	**Draft National Policy Statement Indigenous Biodiversity (NPS-IB)**		
	Under the draft NPS-IB Councils must undertake district wide identification of significant indigenous vegetation / habitat which is classified as either a High or Medium Significant Natural Area (SNA). Classification as an SNA is likely to constrain or prevent almost all new development and subdivision which may have adverse effects on an SNA. That is also the case for areas not classified as SNA, however, deemed to hold significant biodiversity of high value.	The draft NPS-IB would prevent quarrying, and almost all land use and development in New Zealand outside of urban boundaries. The Government acknowledges the drat consulted on in 2019-2020 is unworkable and needs substantial revision and amendment.	The Government is aware there is a problem with the draft NPS-IB's workability, in terms of providing a consent pathway for certain activities including minerals and aggregate extraction. Te Waihanga will engage with the Ministry for the Environment to assist with practical solutions.

	Description	Industry Concern	Our Assessment
	"No new mines on conservation land" statement from the 2017 Speech from the Throne		
	The Speech from the Throne outlines an incoming Government's agenda and focus for the forthcoming term. The 2017 Speech included the statement that there would be "no new mines on conservation land".	The primary concern appears to be that areas like the West Coast, which have a high proportion of conservation land, would experience a shortage of quarriable aggregates. AQA state in their *Briefing on the Quarry Sector and Aggregate Supply* that 20-32% of the country's hard rock resources are on Department of Conservation land.	This is not government policy and it is uncertain whether it will be implemented and what it would look like. Permits, consents, and access arrangements for mining on conservation estate have been granted since 2017. We consider that there should not be a blanket prohibition of quarrying on the Conservation Estate. A pathway to consent for quarrying would provide a balance between environmental protections and enabling access to resources. In the case of the West Coast, the region has many aggrading rivers for which gravel extraction is necessary for flood protection – demonstrating the need for quarrying on the Conservation Estate.

Attachment 3: Hard Rock in Wellington is abundant but scarce

In their *Regional Demand Forecasts for Aggregates in Wellington* paper prepared for the Wellington City Council, Spire Consulting Ltd outline the factors preventing utilisation of hard rock within the jurisdiction of the Wellington City Council.[119]

The other main potential rock resources in the Wellington region are the Makara area (centred around Quartz Hill), Owhiro Bay Quarry, and the Northern Ngauranga Gorge. There would be considerable difficulties accessing each of these resources.

Makara/Quartz Hill

There is thought to be a large area of accessible hard rock resource here but there are substantial barriers:

- Transport and access would require either the use of small, narrow local roads through the heavily populated (and congested) suburbs of Karori or Johnsonville;
- Meridian's wind farm is located along the same ridgetop;
- The local community are sensitive to noise and disruption (as evidenced in their opposition to the Wind Farm construction); and
- Quartz Hill is protected under the Wellington District Plan under the ridgeline and hilltop overlay.

Northern Ngauranga Gorge

On the North Side of State Highway One across from Kiwi Point Quarry is a potential resource which is likely comparable to Kiwi Point Quarry. The barriers for this potential resource include:

- The proximity to State Highway One and the North Island Main Trunk Line would leave little space for access roads and machinery;
- Proximity to subdivisions (noise and disruption) and visual impacts from the northern Khandallah area; and
- The ridgetops and hilltops overlay in the District Plan.

Owhiro Bay

The former quarry at this site was closed in 1999 mainly in response to concerns about environmental effects. Other likely constraints include:

- The terms of the Wellington's City Council purchase means the Council cannot reopen the quarry as of right;
- Considerable public opposition to activity in the coastal area. This is an important recreation resource for the public accessing the wild south coast including walkers and mountain bikers.
- The quarry also lies within an area of special value to local iwi with cultural sites for protection.

There are several other sites around the Wellington area that could also be considered for aggregate resources. These are identified in the recent GNS Science report of national aggregate opportunityref. They include sites around Horokiwi, Belmont, Pauatahanui, and Pukerua Bay that could be evaluated for potential with detailed geological mapping and land use analysis. Locations of suitable rock material should be considered in future district plan revisions. An example of an additional resource recently commissioned in one of these areas is the Willowbank Quarry in Pauatahanui that was used to support the development of the Transmission Gully roading project.

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[119] Regional Demand Forecasts for Aggregates in Wellington