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Infrastructure Consenting for Climate Targets

Estimating the ability of New Zealand's consenting system to deliver on climate-critical infrastructure needs

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Glossary

Abbreviation	Stands for
CCC	Climate Change Commission
CO_2	Carbon dioxide
DIA	Department of Internal Affairs
EECA	Energy Efficiency and Conservation Authority
ENZ	Emissions New Zealand
ERP	Emissions Reduction Plan
EV	Electric vehicle
FKT	Freight kilometres travelled
FTE	Full-time equivalent
GDP	Gross domestic product
GHGs	Greenhouse gases
GW	Gigawatts
LGWM	Let's Get Wellington Moving
MBIE	Ministry of Business, Innovation and Employment
MD	Mitchell Daysh
MfE	Ministry for the Environment
Mt	Million metric tonnes
MtCO2e	Million tonnes of carbon dioxide equivalent
MW	Megawatts
NDC	Nationally Determined Contribution
NES	National Environmental Standard
NMS	National Monitoring System
NPS	National Policy Statement
NZPI	New Zealand Planning Institute
OECD	Organisation for Economic Co-operation and Development
PKT	Passenger kilometres travelled
PT	Public transport
RMA	Resource Management Act
TWh	Terawatt hours
VKT	Vehicle kilometres travelled
WWTP	Wastewater treatment plant

Executive summary

Key findings

- Total demand on New Zealand's consenting system from all sectors is projected to increase by over 40 per cent by 2050.
- Observed trends in consenting processes imply that the ability of the consenting system to deliver on the infrastructure required to meet national climate targets is under threat. Consenting a project, particularly a complex infrastructure project, is becoming more costly, takes longer to complete and requires more resources.
- New Zealand is on track to miss between 11-15 per cent of the emission reductions required from the energy and transport sectors by 2050 due to consenting delays (even under optimistic scenarios with unconstrained consenting resources). As a result of consenting delays in these scenarios, New Zealand is on track to incur an emissions liability of between $5 billion and $7 billion by 2050.
- At some point, there is a pragmatic threshold of consent processing time, beyond which certain projects become unfeasible and are no longer pursued by investors. Applying such a threshold to New Zealand's pipeline of infrastructure projects means we project a scenario where 29–34 per cent of emissions targets are in jeopardy due to consenting constraints and delays. If this occurred, New Zealand would incur an emissions liability of between $13 billion and $16 billion by 2050.
- For New Zealand to meet its net zero by 2050 targets, we project that resource management reforms will need to be fully operational by 2028.
- From 2028 a 50 per cent reduction in projected consent processing times will be required.
- Any increase in delay beyond 2028, or ineffective reform, makes it highly unlikely that New Zealand will be able to consent the infrastructure needed to support its climate change aspirations.
- Based on identified trends, the system must become significantly more efficient through the reform or increase its capacity to meet the Government's targets

Infrastructure development is critical for New Zealand's wellbeing

Sustainable and appropriate infrastructure is critical to ensure New Zealand's economic, social, and environmental prosperity into the future. The continual. improvement and development of infrastructure has a critical role in enhancing the quality of life of New Zealanders and their access to opportunities. Mobility, essential services such as fresh water and wastewater, and the energy required to power businesses and households will all require infrastructure development to deliver to a growing population of residents and visitors. New and appropriate infrastructure is relied upon to meet New Zealand’s climate response commitments.

Infrastructure development relies on the resource consenting system to operate efficiently and effectively to enable the infrastructure projects needed

The 2020 review of the resource management system (Resource Management Review Panel, 2020) found that New Zealand has a costly, high-risk, and time-consuming planning environment with increasing complexity, costs and delays to development of infrastructure caused by the system’s processes and uncertainty in decision-making, and there is a lack of responsiveness by the system to changing circumstances and demands.

This report projects the demand on the consenting system in New Zealand to 2050 and estimates the likely ability of the system to respond

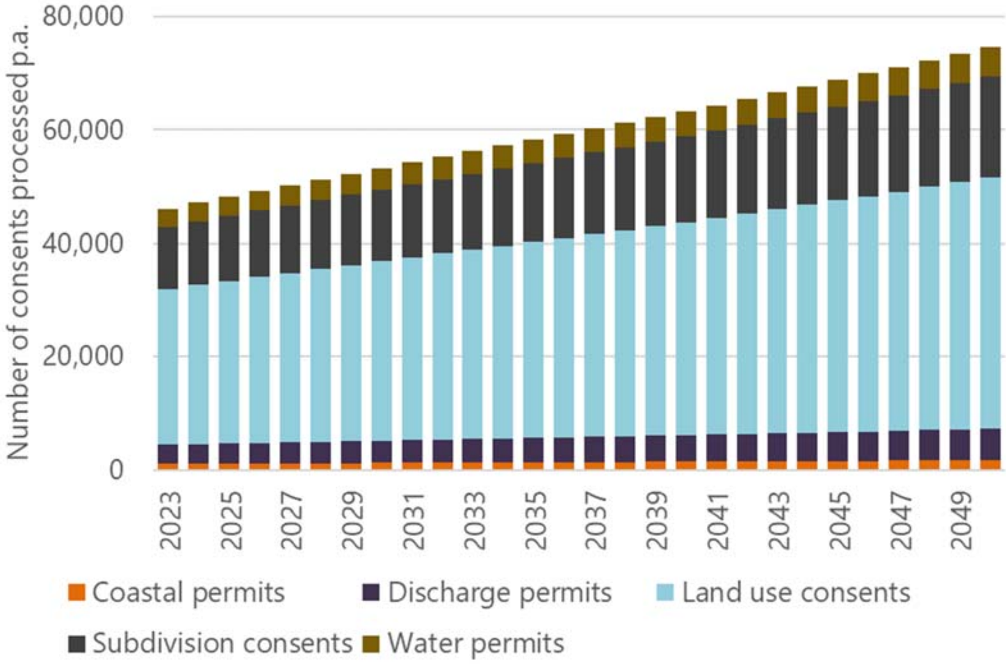
Estimations are made of the likely total demand for consenting and within that the consenting of critical infrastructure to 2050 with a focus on energy and transport infrastructure. This is achieved with the following methods:

- Build a forecast of expected consenting demand to 2050 using macro indicators and sectoral pipelines for climate-critical infrastructure within that overall forecast.
- Extrapolate the trends observed in the consenting system in the recent past (10 years) and apply these trends to the expected pipeline of projects that require consenting.
- Describe scenarios of consent delivery given observed trends and the impact this may have on the ability of the system to deliver on climate commitments.

What is the expected demand for project consents between now and 2050?

A macro projection of consenting demand has been established using our estimates of consent volumes from the bottom-up sectoral analysis. We determine that total consent demand is forecast to increase over 40 per cent in the period to 2050. This forecast is shown below in Figure 1.

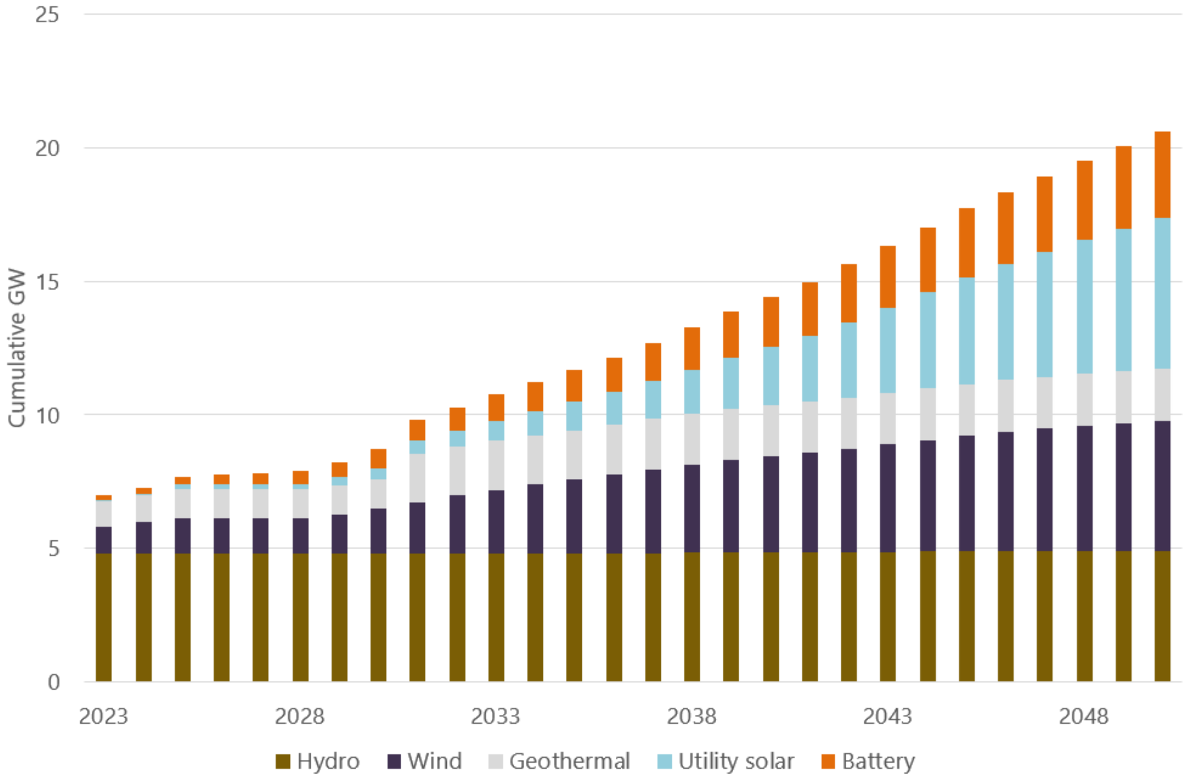
Figure 1: Projection of consents processed by type, using our estimates of projected volumes of consent applications, 2023–2050



We have not considered the impact of business cycles. Our approach is undertaking top-down aggregate expectations and bottom-up sectoral analysis of key climate critical sectors to project forward over a long timeframe. When looking forward 25 years, not all projects are known about now, and a bottom-up sectoral analysis would not account for those projects. Both methods are used here, therefore, to understand the total expectation, and to describe the (known or expected) sectoral pipelines within that expectation for the climate-critical sectors of transport and energy.

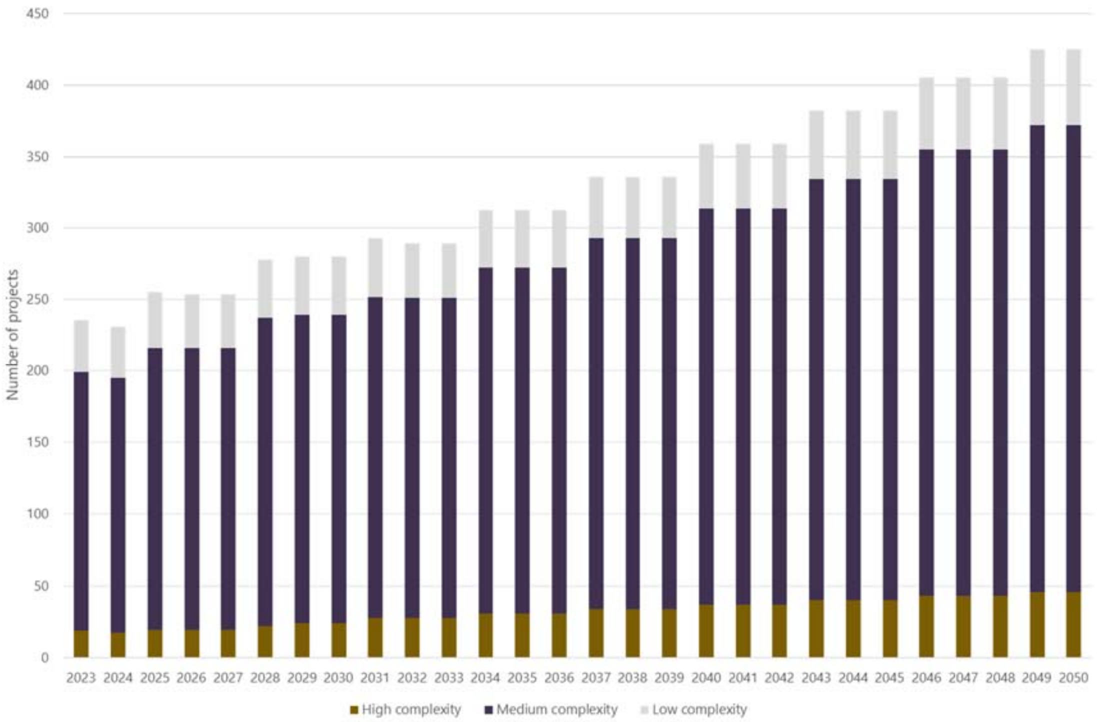
The renewable energy sector pipeline is described below.

Figure 2: Total renewable energy generation and battery storage capacity to be consented through to 2050



The transport sector pipeline is shown below in Figure 3.

Figure 3: Number of infrastructure transport projects that would need resource consent[1]

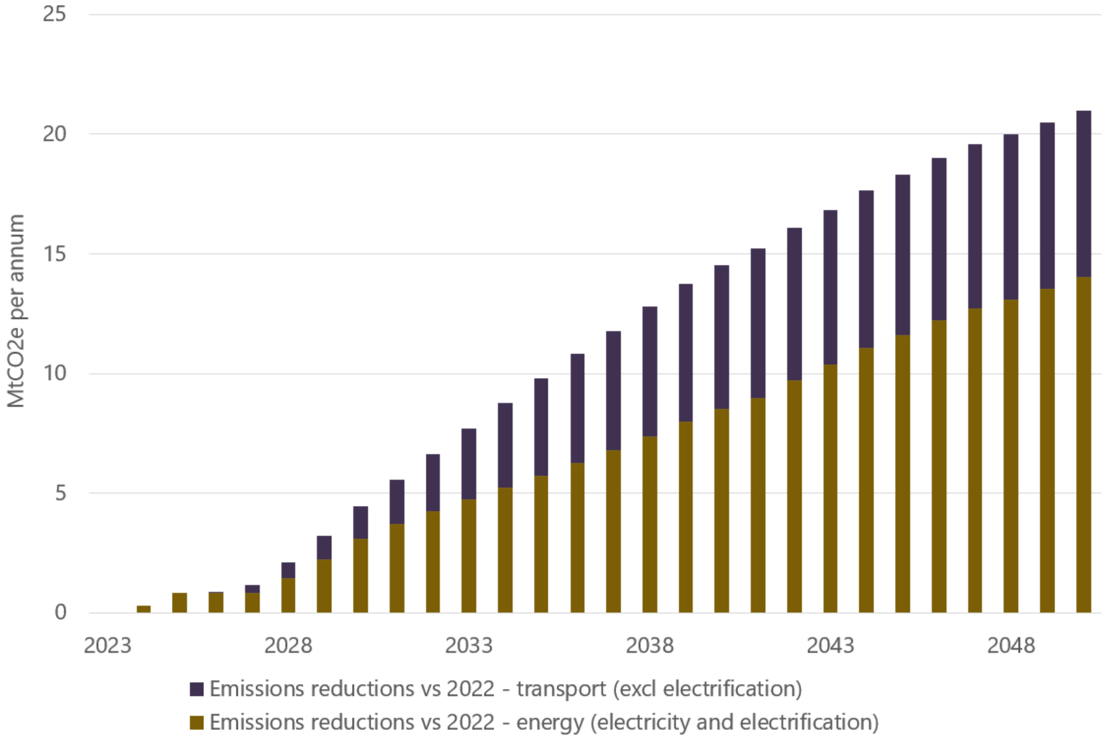


The energy and transport sectors need to deliver a combined 11 Mt of emissions reductions per annum from projects yet to be consented, for the 2050 net-zero target to be met

The emissions reductions that are generated from projects that will need to be consented are described below in Figure 4.

[1] Except EV charging infrastructure that is assumed to be low complexity. This has been removed since the number of chargers is large compared to the number of other projects.

Figure 4: Emissions reductions vs 2022 required from energy and transport projects to meet net zero by 2050



Consenting projects, particularly complex infrastructure projects, are becoming more costly, take longer to complete and require more resources

Sapere's previous report (Sapere Research Group, 2021) for Te Waihanga investigated the cost of consenting for infrastructure projects in New Zealand. A range of projects of varying size and complexity were examined to consolidate information on the consenting burden faced by infrastructure developers. Key findings from this study include:

- Consenting experiences are rarely consistent across projects and sectors. However, on average, 5.5 per cent of infrastructure projects' budgets were spent on direct consenting costs (council fees, engaging experts, hearings and appeals, internal staff time), which is considerably higher than other countries.
- Consent costs are particularly high for waste, water, and coastal infrastructure.
- Smaller projects face disproportionate consent costs given the Resource Management Act imposes a certain level of fixed cost burden on developers. Very rarely is there a low-cost consent experience for infrastructure.
- Councils appear risk-averse and require an increasing amount of in-depth information, even for very low-probability events and effects. This requires developers to use more costly expert input (technical reports, assessments, etc.).
- 37 per cent of sampled infrastructure developers reported facing material indirect costs, made up primarily of time delays, but also the holding cost of capital and necessary redesigns to be able to get consent.

- Design considerations are now part of consenting. Applicants are pre-loading design considerations into consent applications and are willing to sacrifice components or make significant compromise to get consent approval.

Observed trends in consenting processes imply that the ability of the consenting system to deliver on the needed infrastructure is under threat

Using the analysis of observed consenting trends over the past decade, we construct four scenarios that illustrate the impact (emissions volume and cost) from increasing consent processing time.

Scenarios 1 and 2 are described below.

Box 1: Description of Scenarios 1 and 2, where the consenting system has unconstrained resources

Scenario 1: Observed trend continues unabated to 2050

Scenario 1 describes the situation from 2023 to 2050 if the current trend of annual increase in effort per consent continues with no constraints on costs, time to process, workforce limits, and where there are no legislative/regulatory changes that impact the process materially.

Scenario 2: Trends halted through legislative/regulatory reform

In Scenario 2 the trends we observe are not applied all the way to the end of the period. It is assumed that some legislative/regulatory change to the resource management system halts these trends from 2034. The projection can only measure the impact if a change was successful in impacting the trends, and not how, or how likely, that is to occur.

The trends from Scenario 1 are applied through to 2033. From then on, the per-consent effort is fixed at the 2033 level. Again, it is assumed there is no constraint on costs, time to process, or the ability to call upon additional skilled resources.

Emission reductions achieved in early years are more important (cumulatively) than later years for long-lived gases. It is possible the carbon budget is not recoverable within constraints (e.g., a negative consent processing time).

The key outputs from the two scenarios are the impacts on consent processing time, in terms of annual change compared to 2022 levels. The table below summarises these estimates.

Table 1: Annual change in consent processing time in Scenario 1 and Scenario 2

Scenario ID	Scenario description	Up to 2024 (average per annum)	2025-2033	2034-2050
Scenario 1	Observed trend continues unabated to 2050	10%	3%	3%
Scenario 2	Trends halted through legislative/regulatory reform	10%	3%	-1%

The table below illustrates what Scenario 1 and Scenario 2 mean in terms of a hypothetical large-scale wind project of 100 MW capacity, for which consent applications are submitted today, 2035 or 2050. It shows the impact on consent processing time, consenting costs, and total emissions reductions gap.

Table 2: Scenarios 1 and 2 applied to a hypothetical large-scale wind farm

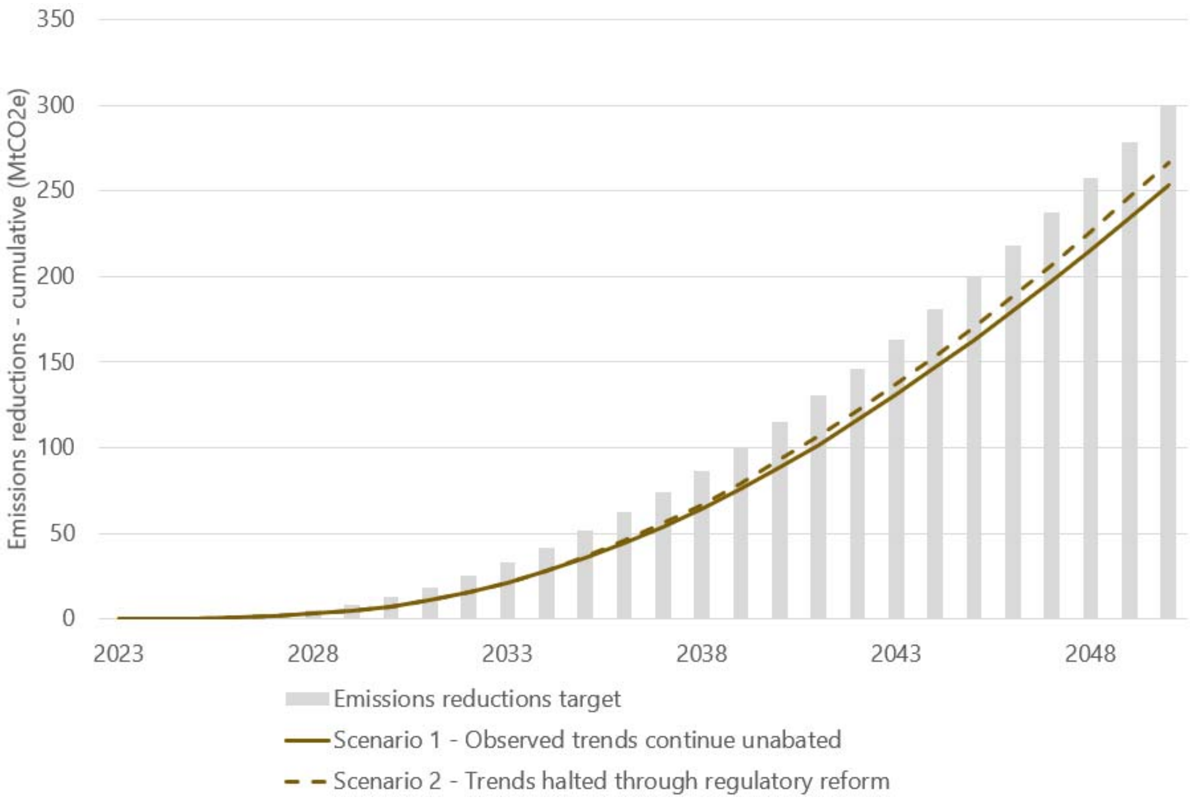
	2022	2035	2050
SCENARIO 1			
Consent processing time (years)	3.84	6.04	9.4
Consenting cost ($m)	$5.7	$8.8	$13.5
Emissions reductions gap (MtCO2e)	0	0.33	0.59
SCENARIO 2			
Consent processing time (years)	3.84	5.6	5.1
Consenting cost ($m)	$5.7	$8.2	$7.4
Emissions reductions gap (MtCO2e)	0	0.27	0.13

We are on track to miss between 11 and 15 per cent of emission reductions required from the energy and transport sectors by 2050 compared to 2022 due to consent delays, even with unconstrained resources

Scenario 1 and Scenario 2 describe a range between 11 and 15 per cent of expected emission reduction not occurring. These percentages correspond to a shortfall of 33 and 46 MtCO2e by 2050. We note that if current projects that are emissions reducing are not reconsented or are reconsented with lower operating capabilities, then the gap would be even higher.

The figure below presents the scenarios in terms of emission reductions that do take place in the scenarios with a consenting system that has unconstrained resources.

Figure 5: Annual emissions reductions in the modelled scenarios



As a result of consenting time increases in these scenarios, we are on track to incur an emissions liability of between $5 billion and $7 billion by 2050

The cost of the emissions reductions gap is estimated at between $4.8 billion and $7 billion in total through to 2050 in Scenarios 2 and 1 respectively (Figure 34). The cost of the emissions gap was estimated on the assumption that any missed abatement from the energy and transport infrastructure projects would have to be offset with emissions reductions elsewhere in the economy. The cost of these emissions reductions would need to reflect the marginal abatement costs needed to deliver on the net-zero target domestically, and as such we adopt the New Zealand Treasury's shadow price of carbon.[2]

The increasing demand for resources to undertake consenting processes may not be forthcoming

It may not be plausible to think the consenting system has unconstrained resources and can continue to source skilled people to help process consents, whether that be domestically or internationally, or allow costs and time taken to process a consent to increase indefinitely.

[2] https://www.treasury.govt.nz/sites/default/files/2020-12/cbax-guide-dec20.pdf

There could be many reasons why a constrained system is more likely a reflection of reality, including upper bounds for feasible consent costs (at which, projects would fall out of the pipeline and become economically unviable) and a tight and finite skilled labour market.

We posit two scenarios, Scenario A and Scenario B, that model a resource-constrained consenting system. The box below explains these scenarios in more detail.

Scenario A: Observed trends continue unabated to 2050, and the system is unable to call upon additional resources for consent processing

In Scenario A, the consent complexity increases as in Scenario 1, but a workforce constraint is applied. This constraint implies that the skilled labour demand is not met and is therefore represented through additional delay to consent processing times.

Consenting sector workforce is constrained to the rate of growth of population at 0.7 per cent p.a. (no effective increase in relative sector size in the economy). The expected FTE requirement for all projects limits the ability of all projects to be commissioned. This scenario could be a result of the overall market, or, a subsector of specialists, or both, but the measured effect is that as resources become scarce, the impact is realised in increased delay.

Scenario B: Trends halted through legislative/regulatory reform, but the system is still unable to call upon additional resources for consent processing

In Scenario B, Scenario A is varied by the historic annual increase in effort per consent halted from 2033.

The table below defines the key parameter, annual percentage increase in consenting time frame, of Scenario A and B.

Table 3: Annual percentage increase in consenting time frame for Scenario A and Scenario B, where resources are constrained

Scenario ID	Scenario Description	Annual % increase in consenting time frame
Scenario A	Observed trends continue unabated to 2050, and the system is unable to call upon additional resources for consent processing.	5% per annum from 2025.
Scenario B	Trends halted through legislative/regulatory reform, but the system is still unable to call upon additional resources for consent processing.	5% per annum between 2025 and 2033, 1% thereafter.

At some point, there must be a pragmatic threshold of consent processing time that becomes unfeasible and means projects are no longer pursued

It must be the case there is some pragmatic threshold of the time taken to process a consent at which point it becomes no longer viable for a developer to pursue a project. In the real world this threshold is likely different for different people and projects based on risk appetite and the economics of each project. For this analysis, however, we have assumed that the pragmatic level or threshold of the time taken to process a consent for an average project of high complexity is five years. If a consent for such a project takes longer than five years to process, then the project will not go ahead. For an average project of medium complexity, we consider a threshold of 2.5 years. On average across all sectors, these figures represent an increase of 125 per cent over the current consent processing timeframe.

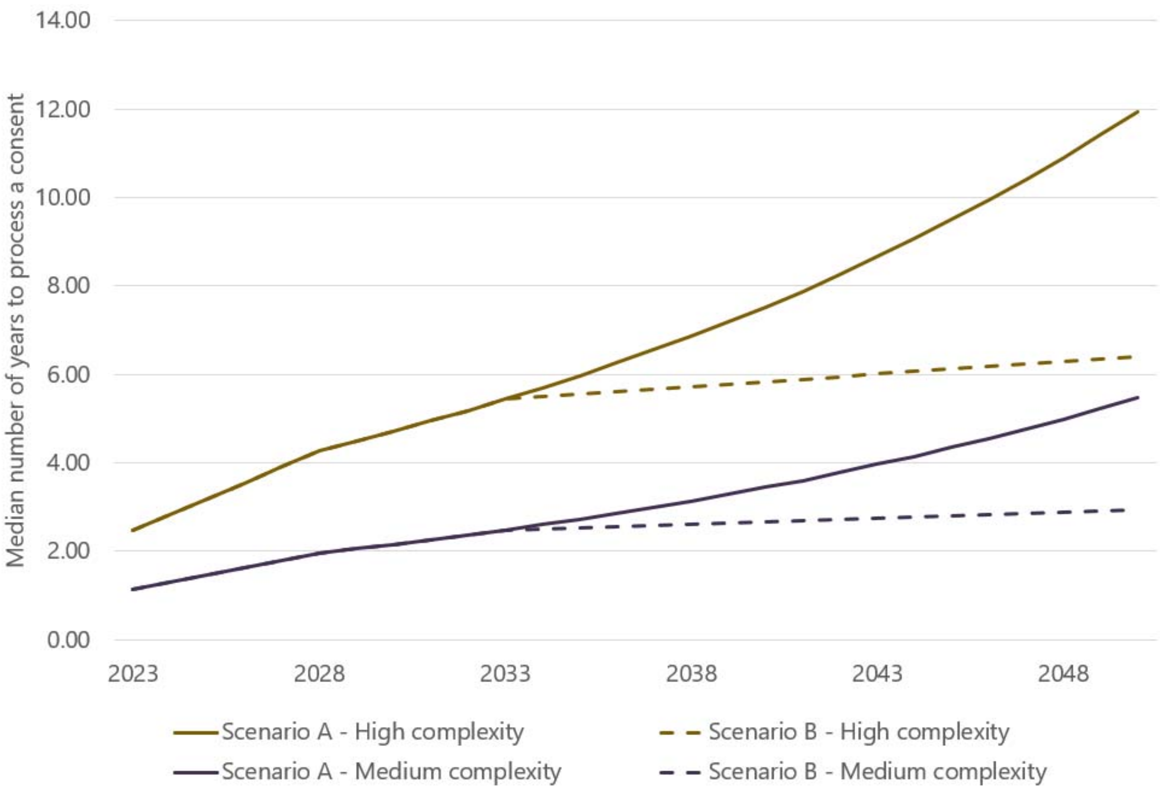
Defining these thresholds allows us to see in Scenario A and Scenario B what impact a resource-constrained consenting system has on the ability to undertake the infrastructure pipeline necessary to meet the 2050 net zero target.

In both Scenario A and Scenario B, the resource consenting system would "break" after some limits to consent processing time are reached.

Our modelling of Scenario A and Scenario B shows that the resource consenting system would "break" – projects would become unfeasible and no longer constructed – because of the exorbitant increases in the time taken to process a consent. Figure 6 shows that:

- In Scenario A, the threshold of five years is reached by 2032 for projects of high complexity. By 2050, consent applications would take 12 years to process. For projects of medium complexity, the threshold of 2.5 years is reached by 2033. By 2050, consent applications would take 5.5 years to process.
- In Scenario B, consent processing times are halved by 2050 thanks to relief from legislative/regulatory reform; however, it is still above the thresholds. To avoid the threshold being reached, the reform would need to take effect before 2030.

Figure 6: Consent processing time for high and medium complexity projects in Scenarios A and B



The table below illustrates what Scenario A and Scenario B mean in terms of a hypothetical large-scale wind project of 100 MW capacity, for which consent applications are submitted today, 2035 or 2050.

Table 4: Scenarios A and B applied to a hypothetical large-scale wind farm

	2022	2035	2050
SCENARIO A			
Consent processing time (years)	3.84	10.92	21.85
Consenting cost ($m)	$5.7	$15.6	$30.1
Emissions reductions gap (MtCO2e)		1.06	1.9
SCENARIO B			
Consent processing time (years)	3.84	10.15	11.71
Consenting cost ($m)	$5.7	$14.5	$16.7
Emissions reductions gap (MtCO2e)		0.95	0.84

Efficiency targets for resource consent processing - Consent process timeframe targets

To achieve the net-zero by 2050 target, our modelling predicts that consenting timeframes for infrastructure projects would need to be capped at current levels from 2028 at the latest. This would imply that consent complexity needs to be halved by at least 2050 compared to today.

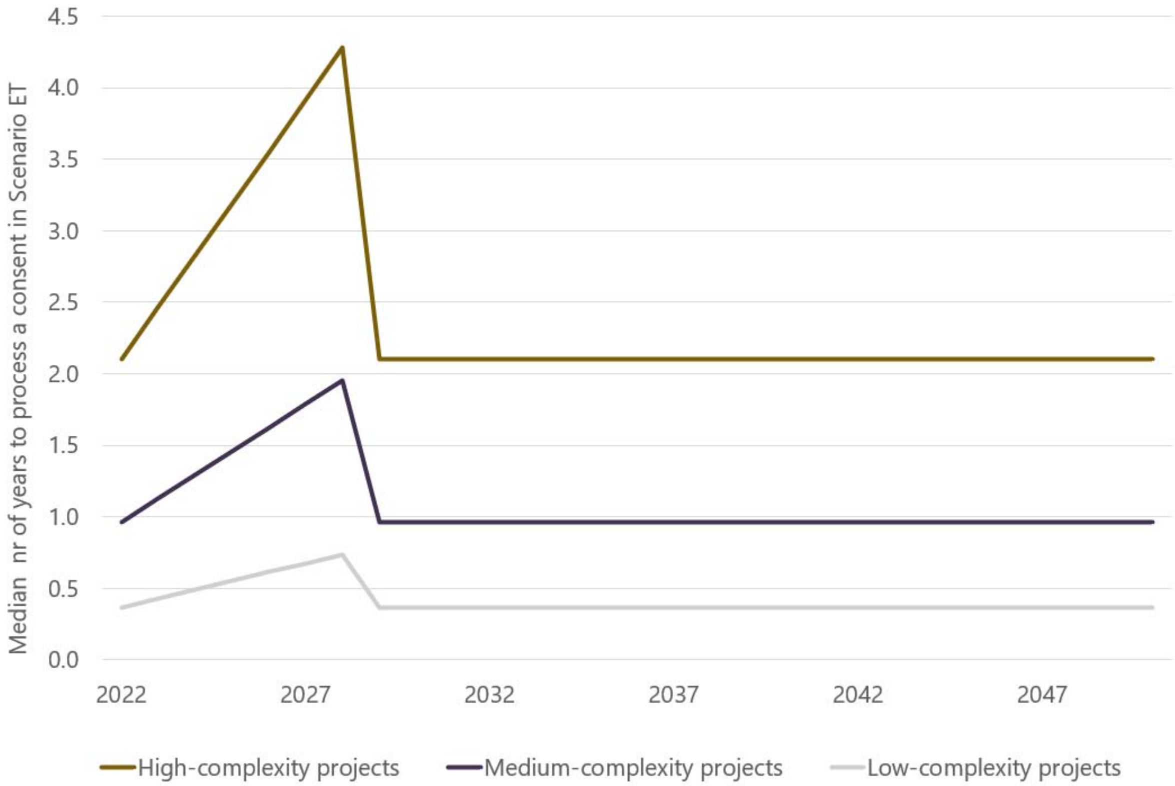
If we allow trends in effort per consent to continue for the next five years and assume there are resource constraints in the system as discussed in chapter 7.2, by 2028 consent processing time would double compared to today.

To reverse this effect, there would need to be an efficiency gain of 50 per cent in 2029 compared to 2028, such that consent processing times in 2029 revert back to 2022 levels. This is shown as Scenario ET[3] in Figure 7. Thereafter, a mix of additional resources and reduced consenting complexity would be required to ensure that the duration of a consenting process does not increase as a result of the expected rise in consent volumes.

If the resource market is constrained (as modelled in Scenarios A and B), then in order to keep the consent processing (elapsed) time capped at 2022 levels, from 2030 there would need to be a 1 per cent reduction in consenting complexity per annum[4].[5] By contrast, if historical trends continue, total effort per consent would increase by 3.7 per cent per annum. Overall, to reach net zero by 2050, total effort per consent (or consent complexity) in 2050 would need to be reduced by 48 per cent compared to today and 61 per cent compared to 2028.

[3] "ET" stands for efficiency target.
[4] Measured as total effort per consent, or number of total days required by 1 full-time FTE to process a consent
[5] FTE/consent decline because the annual growth in FTEs (0.7%, equal to population growth rate), is lower than the annual increase in the number of consents.

Figure 7: Median number of years to process consents in Scenario ET



Demand management opportunities are limited

There are limited opportunities for demand management which could be achieved in two ways:

- decreasing the demand for additional infrastructure and therefore resource consents
- decreasing the burden a consent has on the consenting system when being processed.

Managing infrastructure demand and therefore consent demand is factored into the pipelines already within the climate change modelling scenarios. There are some opportunities for system demand management however:

- limiting reconsenting requirements
- fast track processes
- bundling of consents.

Reconsenting is a significant component of the pipelines. Automatic renewals, or extensions to existing consent timeframes may have potential to remove some of the expected burden on the system. This is not seen as a long-term solution, however, as reconsenting is an important component of the system.

Fast track processes have been used in the past and have had some success. However, the same pool of resources is drawn from, and this may have the effect of reprioritising activity rather than being a systemwide solution. Bundling consents cannot address the project specific elements of a consent, which would include consenting authority specific requirements and local affected parties.

1. Infrastructure will play a key role in New Zealand's climate change efforts

Sustainable and appropriate infrastructure is critical to ensure New Zealand's economic, social, and environmental prosperity well into the future. The continual improvement and development of infrastructure has a critical role in enhancing the quality of life of New Zealanders and their access to opportunities. Simultaneously, Aotearoa New Zealand has committed to reaching net zero emissions of long-lived greenhouse gas emissions and reducing biogenic methane emissions between 24 and 47 per cent by 2050. Infrastructure will play a key role in meeting these targets.

There is therefore expected to be a step-change in infrastructure needs in virtually all industries in coming years to meet the demands of a growing national population, changes in the way society operates, and to mitigate and effectively manage the impacts of climate change (Ministry for the Environment, 2022a; New Zealand Council for Infrastructure Development, 2021; New Zealand Treasury, 2017). This means the resource management system will also likely see a step-change in the consenting and planning activity required.

The ability to develop sustainable and appropriate infrastructure to meet the wants and needs of New Zealanders relies upon the consenting system's ability to operate efficiently and effectively. The 2020 review of the resource management system (Resource Management Review Panel, 2020) found that New Zealand has a costly, high-risk, and time-consuming planning environment with increasing complexity, costs and delays to development of infrastructure caused by the system's processes and uncertainty in decision-making, and there is a lack of responsiveness by the system to changing circumstances and demands.

Sapere's previous report for Te Waihanga (Sapere Research Group, 2021) investigating the costs of consenting infrastructure in New Zealand found evidence to support the findings of the review of the resource management system. These findings will be discussed and referenced throughout this report in more detail. If the trends observed in the consenting industry continue, the process of consenting infrastructure will likely become unfeasible and unsustainable and therefore New Zealand will struggle to meet its emissions targets.

1.1 A constrained consenting system threatens New Zealand's ability to meet climate change targets

Delays or failure to implement critical climate change infrastructure at the necessary time will likely result in failing to meet the 2050 net zero target. The consequences of the consenting system being unable to meet the step-change in consent demand are likely to be large in magnitude in terms of costs to the environment and society. Details ou

The purpose of this report is to illustrate the ability of the current consenting system to meet future infrastructure demand in a range of different scenarios, informed by historic trends and planned future activity. The report can be broken down into three major components.

- First, we aim to develop a macro pipeline of resource consents out to 2050 to understand the quantum of total planned activity and demand on the system.
- Second, we aim to develop bottom-up pipelines for energy, housing-related, and transport infrastructure, as these have been identified in the consultancy services order (CSO) as climate change-specific sectors of interest. These pipelines should contain more comprehensive information on the expected quantum of projects and therefore consents required to 2050, as well as their contribution to emissions reductions.
- Third, we aim to use the pipelines to understand the required capability of the consenting system to meet planned infrastructure demand and Government objectives – particularly the net zero by 2050 target. We will use this opportunity to implement a range of different scenarios to explore the consequences of the inability of the system to meet planned infrastructure demand, such as additional costs, delayed carbon emissions reductions, and what this means for the Government in meeting its climate change commitments.

1.2 Resource consents are required for infrastructure to enable emission reductions

The subsections below describe the definitions taken in this report and what is and is not within the scope of our analysis.

For this report, the scope of the consenting system is resource consents only

The definition we have taken of the "consenting system" focuses only on the system that processes resource consents, issued under the Resource Management Act 1991 (the Act). These resource consents are issued by authorised consenting authorities such as local government.[6]

We have used a combination of Te Waihanga, New Zealand Treasury, and MBIE's definitions of "infrastructure" to guide our thinking for this project:

> "A system of inter-connected physical structures that employ capital to provide shared services to enhance wellbeing." (Te Waihanga, 2022a)

> "Infrastructure refers to the fixed, long-lived structures that facilitate the production of goods and services, including transport, water, energy, social assets, and digital infrastructure such as our broadband and mobile networks." (New Zealand Treasury, 2019)

The MBIE National Construction Pipeline reports (MBIE, 2022) make the distinction between infrastructure and other construction activities by labelling them "horizontal" and "vertical" respectively:

- "Horizontal" construction refers to structures of a non-building type, such as roads, subdivisions, and civil works. This construction does not typically require building consent, which is distinct from resource consent.

[6] That is not to say that the resource management system *only* deals with infrastructure. Other construction activities may also require resource consent(s).

- “Vertical” construction refers to structures of a building type other than residential, including hotels, offices, retail outlets, and industrial buildings. This construction would typically require a building consent.

Building consents for “vertical” construction are distinct from resource consents and are issued under the Building Act 2004. “Vertical” construction and building consents are therefore out of the scope of this work.

We are interested in long-lived gases, especially carbon dioxide

Our focus in this work is on long-lived greenhouse gases (GHGs) such as carbon dioxide (CO_2). CO_2 is responsible for the majority of human-driven global warming to date and is the most important GHG produced by human activities (Climate Change Commission, 2021). CO_2 emissions in New Zealand primarily come from transport, energy, electricity, and waste (Ministry for the Environment, 2022c).

CO_2 is a long-lived gas because, once emitted, it stays in the atmosphere for hundreds to thousands of years (Ministry for the Environment, 2021). This means CO_2 emissions increase the concentration of CO_2 in the atmosphere, and CO_2 emissions today will still be causing warming well into the future (Climate Change Commission, 2021).

We have used both Climate Change Commission (CCC) and Government (the ERP) emissions analysis to inform our work

We have used both Climate Change Commission (CCC) and Government analysis (the Emissions Reduction Plan (ERP)) to inform our thinking on the emissions reductions required by 2050, and of the relative contribution of infrastructure within our focus sectors to emissions reduction targets.

Appendix B provides a more comprehensive discussion of the emissions reduction targets.

2. The resource consent pipeline to 2050

This section describes the resource consent pipeline to 2050. The two ways employed simultaneously to understand this trajectory are:

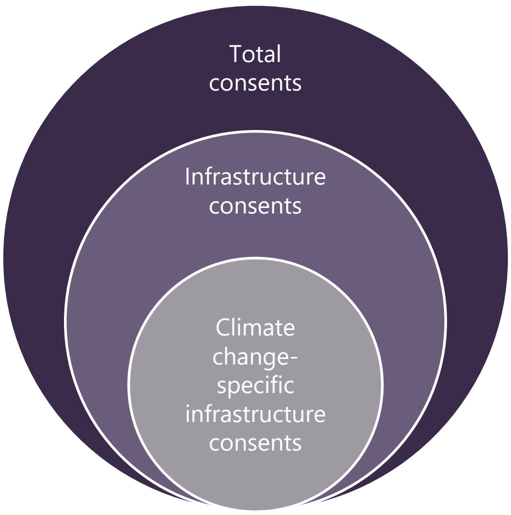
- a macro (top down) extrapolation of the trend in total resource consents, based on macro indicators and relationships
- key sectors that are associated with carbon reduction are projected forward (bottom up) within the overall expectation based on known and expected projects.

A pipeline that projects forward this far necessarily has a substantial degree of uncertainty.

2.1 We focus on total resource consents, and those for climate change-specific infrastructure in target sectors

The consenting pipeline comprises of three parts: total consents, infrastructure consents, and climate change-specific infrastructure consents. Of the total consents, a proportion are for infrastructure. As a subset of infrastructure, a proportion are for climate change-specific infrastructure. Figure 8 below shows the nested relationship.

Figure 8: Composition of the consenting pipeline



The overall relationship between total consents in the economy and macro indicators of population and GDP provides a basis to project the total task facing the consenting sector in the future.

Within this trajectory we want to look at the quantum of climate change-specific infrastructure consents projected out to 2050, both in nominal terms and as a proportion of total consents. Table 5 below shows how we have defined climate change-specific sectors based on our terms of reference, and what is considered in scope for each sector.

Table 5: Climate-change-specific sectors and the scope of our analysis

Climate-change-specific sectors	In scope components	Out of scope
Transport	State highways, arterial roads, local roads, bus lanes, rail, active modes, ports, airports, ferry.	Bespoke industry-specific transport investments.
Energy	Generation, transmission, distribution, storage, distributed energy, gas and renewable fuels.	None.
Housing-related infrastructure	Drinking water, wastewater, telecommunications, local roads, bus lanes, local rail, cycleways, and footpaths (for subdivisions).	Housing, waste.
Other sectors	Consents for the natural resources necessary such as the quarries, cement and steel production, timber plantation and harvesting/processing infrastructure and the like, which are necessary for constructing the assets outlined in transport, energy, and housing-related infrastructure.	Civic amenities and social infrastructure.

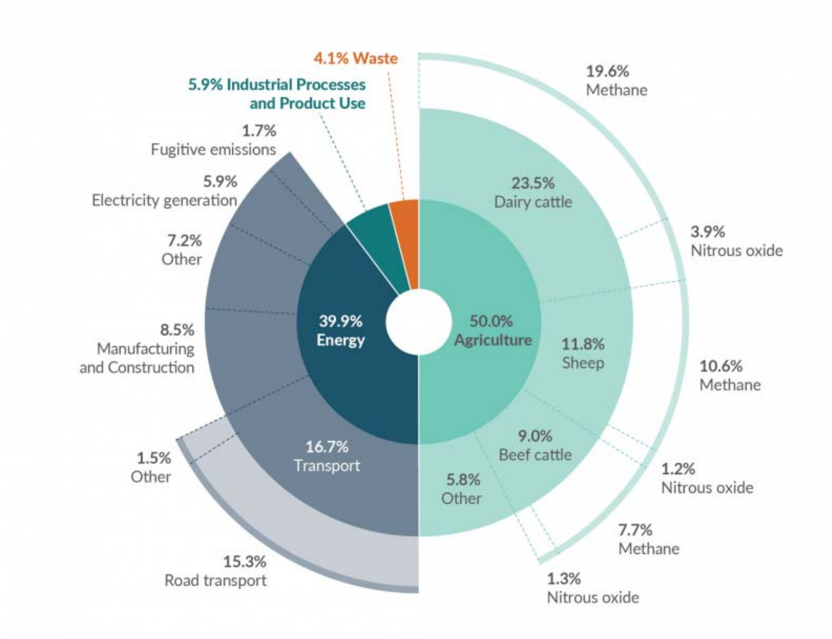
The sectors in the table above have been chosen for more detailed bottom-up estimation because infrastructure in these sectors will likely have:

- the greatest effect on mitigation of climate change impacts
- the biggest contribution toward the net zero emissions 2050 target
- measurable emissions profiles over the period in terms of long-lived gases and fugitive emissions.

This is a subset of infrastructure projects, requiring consent, that will impact emissions. In these climate change-specific sectors there will necessarily be some crossover of projected infrastructure (e.g. the roads, bus lanes, electricity generation, etc, for housing-related infrastructure will also be captured in transport and energy). To avoid double counting we have assumed projections for transport and energy (excluding transport) cover the housing-related components of these sectors, and that the most significant housing-related infrastructure category is water (wastewater, drinking water, and stormwater).

Together, our analysis covers 26 per cent of New Zealand's 2020 gross GHG emissions: transport (16.7 per cent), electricity (5.9 per cent from generation and 2 per cent fugitive emissions) and food processing (4 per cent of emission from manufacturing and construction) – see Figure 9. This represents 50 per cent of NZ emissions from gross greenhouse cases excluding biogenic methane.

Figure 9: New Zealand's Gross GHG emissions in 2020 by sector, sub-category, and gas type



Source: (Ministry for the Environment, 2022c)

2.2 Total resource consents processed could almost double by 2050

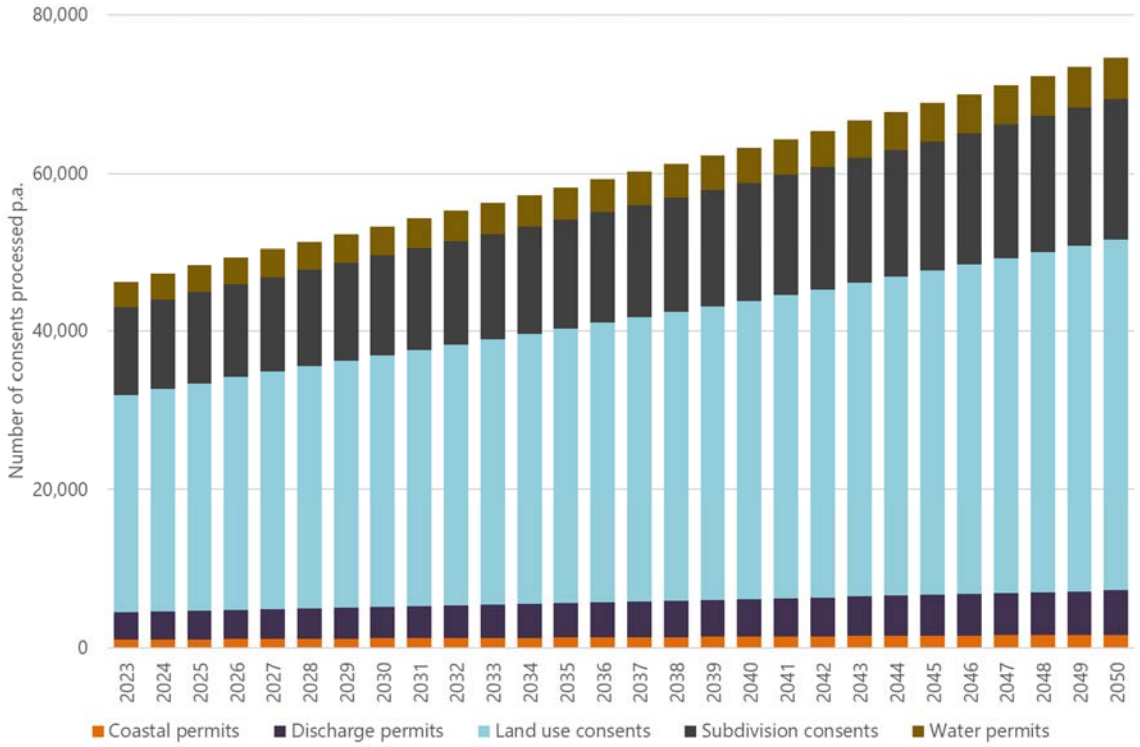
A macro projection of resource consents is undertaken to project the total "task" of the system to 2050, and to be able to place the climate change-specific sectors' projects' demands and requirements within that context. Projects within the climate change-specific sectors will be competing with projects outside of those sectors for consent processing resources at consenting authorities and in specialist support industries.[7] Forming a macro projection of resource consents allows us to understand what the consenting system may be expected to face.

Our macro view of consent activity to 2050 is informed by the MfE National Monitoring System (NMS) and sectoral estimates of consent applications that would be coming through the resource consenting system through to 2050. We note that there is a level of uncertainty in the projection. The projection is long, and as length of projection increases so does uncertainty – it is impossible to know every activity that will occur in 2050, particularly as new technologies and ways of doing things arise.

Figure 10 below shows this projection.

[7] This is assuming consenting authorities have finite capacity to be able to process resource consents (time, FTEs, etc.).

Figure 10: Projection of consents processed by type, using our estimates of projected volumes of consent applications, 2021–2050



We also note that the projection above is consistent with a projection otherwise estimated using OECD year-on-year real GDP forecasts.

While historic real GDP moves relatively closely with the number of land use consents, we do not see much variability in land use consents in our projection. This is because the OECD forecast is relatively stable and does not project future business cycles that may influence the demand for consents by type (e.g. land use, which may fluctuate with boom and recession periods).

There are some things we expect this projection to capture:

- Increasing population and GDP driving demand for consents, both for infrastructure and other construction activities that may require resource consent. This demand increase is through two channels – first, an increase in construction activity generally. Second, an increase in the quality and/or suitability of existing infrastructure and construction to meet new standards (either regulatory or imposed by society).
- A step-change in construction (and infrastructure requirements) to accommodate new technologies and ways of doing things. For example, uptake of large EV charging stations. Construction and infrastructure activities may be required within this time horizon that have not even been conceived of yet.

8.2Appendix A details our data choices and derivation of the macro pipeline.

2.3 Most projected consents are of medium complexity

Of the three sectors under consideration, transport makes up the largest proportion. Figure 11 below shows the number of consent applications by sector to 2050.

Figure 11: Number of consent applications by sector, 2023–2050

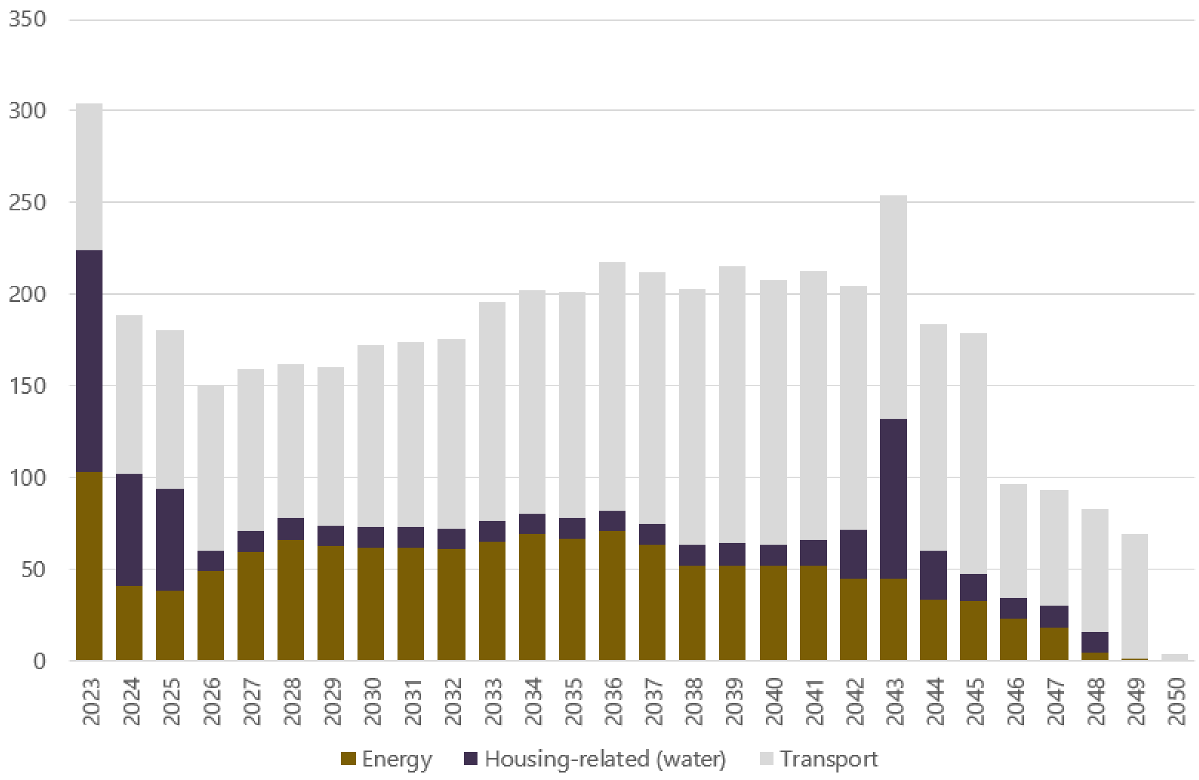
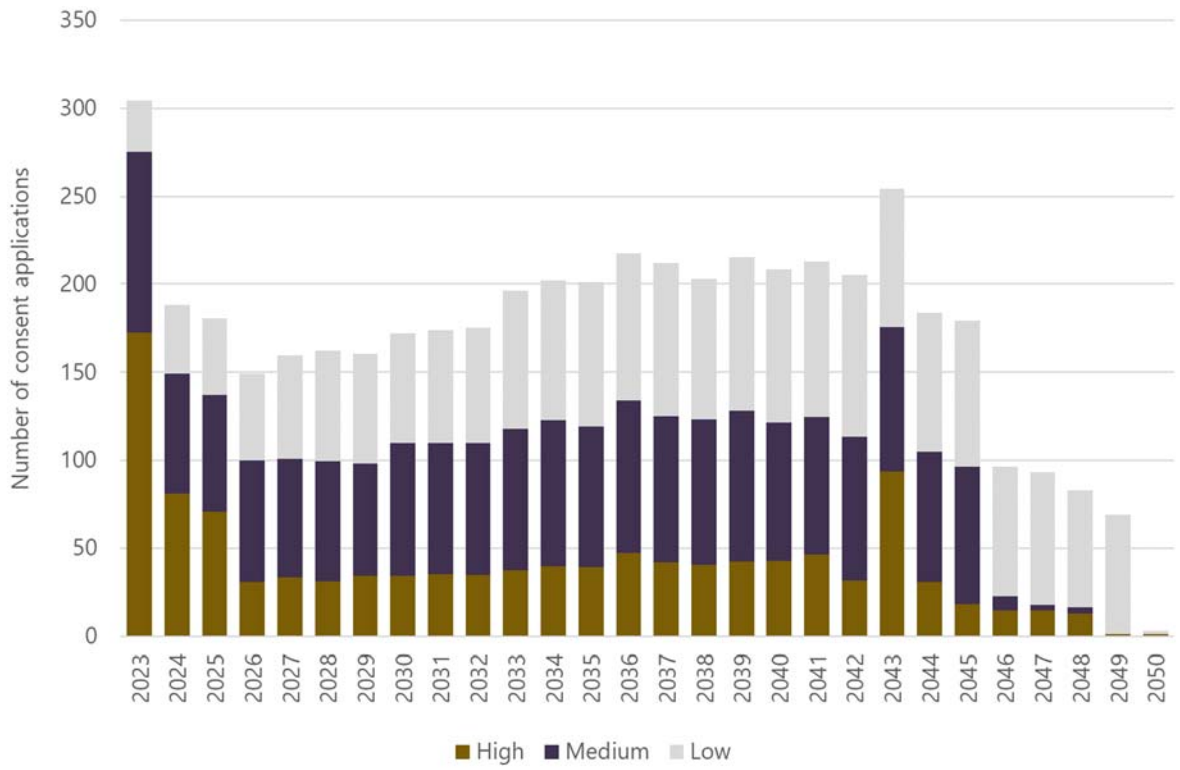


Figure 12 below shows the number of consent applications by complexity to 2050. This shows that most infrastructure projects across the three sectors in each year are assumed to be of medium complexity.

Figure 12: Number of consent applications by complexity, 2023–2050[8]



[8] The graph only shows the number of consents for infrastructure projects that are finalised by 2050, hence why there is a drop off of high and medium complexity projects in the last decade and last five years respectively. The number of consent applications drops off because of our assumption on the time taken to consent and build transport infrastructure projects of high and medium complexity – at the points at which these drop off, it would no longer be possible to consent and build in time to meet the 2050 target.

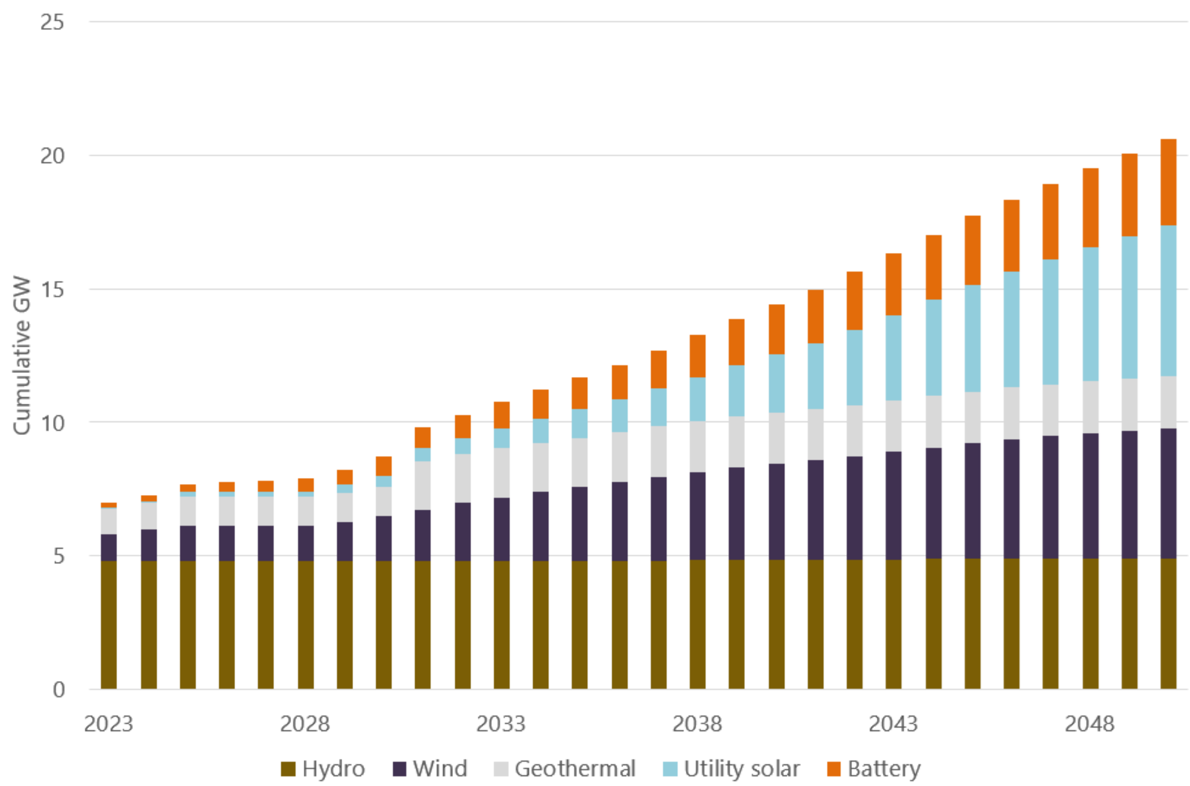
3. Energy infrastructure pipeline

The pipeline of energy infrastructure includes renewable energy generation projects, grid transmission and distribution projects, and gas pipeline infrastructure.

3.1 By 2050, renewable generation capacity and storage is expected to increase by 156 per cent

The pipeline of renewable energy generation projects is estimated based on electricity generation and capacity projections in the Climate Change Commission's Demonstration Path to meet New Zealand's target of net zero emissions by 2050. For the dry-year solution, we assume five new geothermal plants of 150 MW capacity replace the thermal alternative by 2030.[9][10] The figure below shows that generation and storage capacity is expected to increase 2.5 times from 6.81 GW in 2023 to 17.4 GW by 2050, averaging 500 MW per annum, of which 390 MW are renewable generation projects. Most of the new generation capacity will be from wind and utility-scale solar projects, with significant new battery storage capacity also expected.

Figure 13: Total renewable energy generation and battery storage capacity to be developed through to 2050



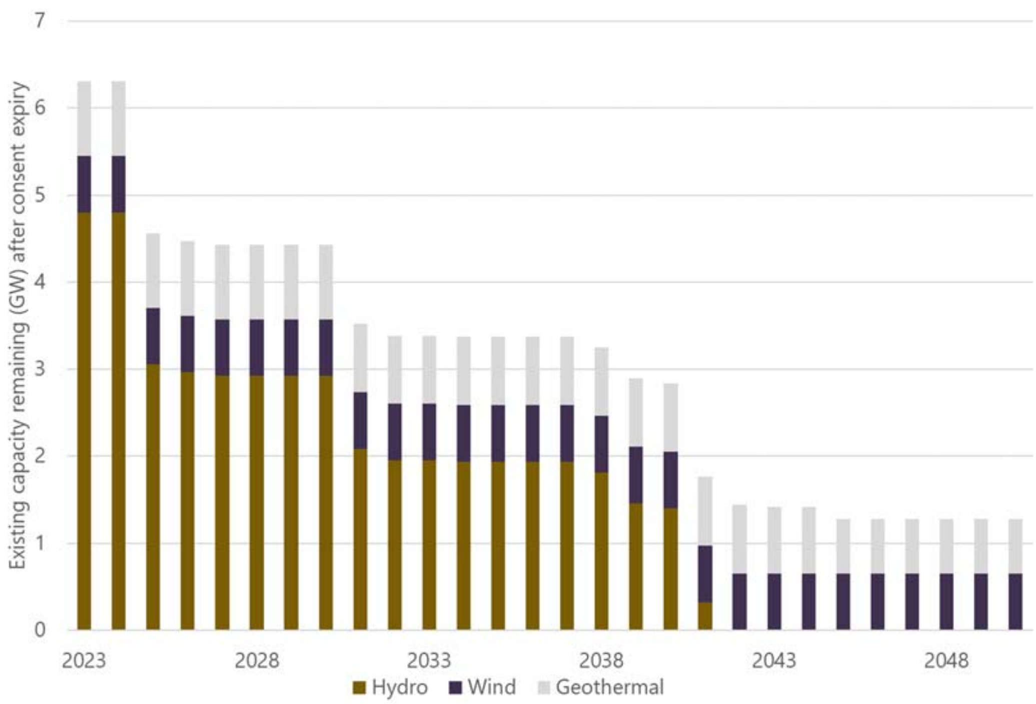
[9] Assuming the wind energy margin needs to be met over six months, the dry-year geothermal capacity is approximately 0.720 GW = ((6/12) * 3,000 GWh) / (8,760 h * 95%). The equivalent for wind plant would be 1.7 GW.

[10] Geothermal is one of the non-hydro options being investigated to solve the dry-year problem (MBIE NZ Battery Project: Possible alternative approaches to the dry year problem)

3.2 Over 40 per cent of the current renewable energy generation will require reconsenting in the next 10 years

We estimate that 27 per cent of today's renewable generation (35 TWh) is subject to reconsenting in the next five years (by 2027), and 42 per cent in the next 10 years (by 2032).[11] This is shown in the figure below. For the purpose of our emissions estimates, we assume that all of this generation is reconsented without impacting output. However, we note that consent renewals could reduce plant operating capabilities, in which case additional development will be required to stay on the net-zero pathway. We also assume that land-use consents are given in perpetuity; on this basis, only hydro and geothermal projects would require renewal for water take permits and for discharges to water or land.[12]

Figure 14: Renewable generation capacity based on existing consents



Source: Sapere analysis based on data from MBIE generation stacks, https://www.windenergy.org.nz/, Energy News, and assumptions in Appendix C.

[11] These estimates are for hydro and geothermal generation that will need to be reconsented over the next decade, based on publicly available information on plant reconsenting year (e.g. MBIE generation stack updates), or information on commissioning date and assumptions on consent validity period from Appendix C.

[12] Most land-use consents for wind farms contain conditions pertaining to compliance with set noise standards, which are incorporated into the land use consent. Generally, there is no need to revisit these, unless there is an exceedance of these limits, which might trigger enforcement action or a review of the land-use consent.

3.3 In our pipeline, over 1,800 energy projects will require consenting or reconsenting by 2050 (approx. 68 per annum)

As well as renewable generation and storage, our energy pipeline includes transmission and distribution projects, gas pipeline infrastructure and the commissioning of a biogas plant. The pipeline for gas and biogas projects is based on the Infrastructure Commission's published pipeline of projects.[13] The pipeline for transmission and distribution projects combines information from the Infrastructure Commission and estimates of network investments by 2050 in BCG's recent report on New Zealand's electric future (Boston Consulting Group, 2022). We adjust down BCG's estimates of network investment to be consistent with the CCC's lower assumptions on renewable capacity required for the net-zero pathway. We note that gas pipeline projects are only reflected up to 2031.

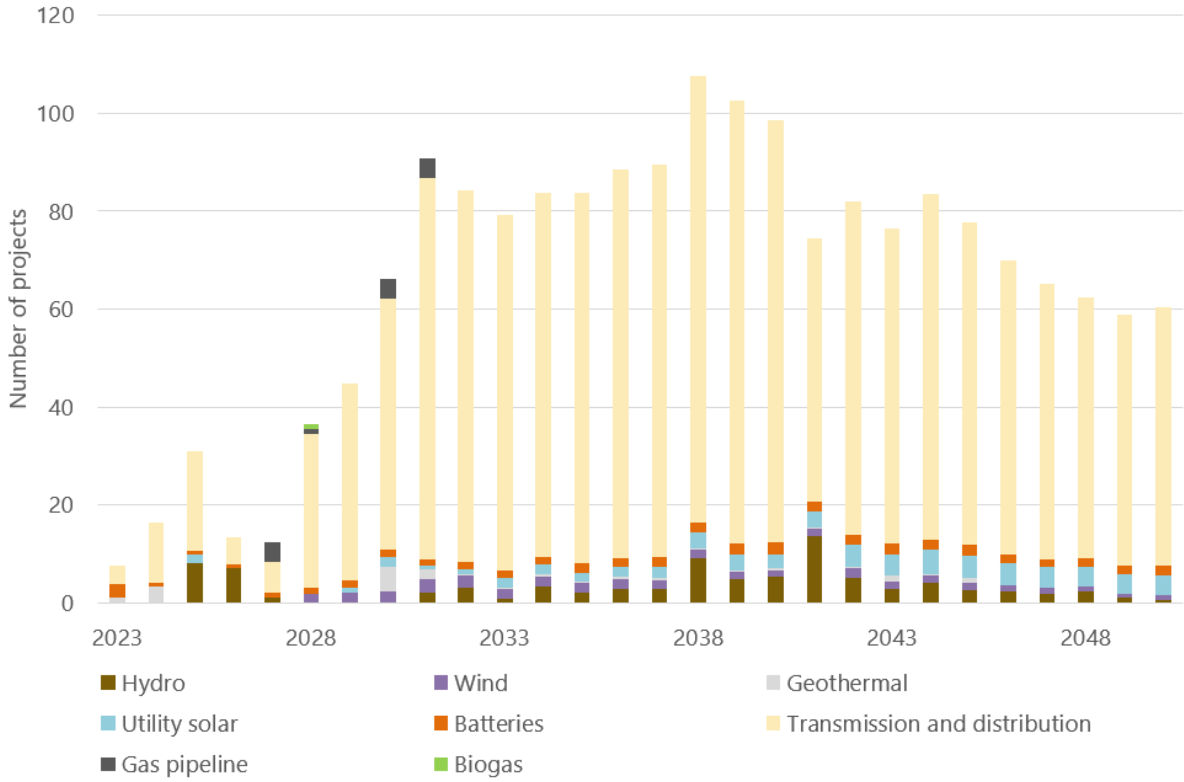
We determine the number of projects that require consents using assumptions on the average size of a renewable generation project (MW), or known capital spend per project. These assumptions are grouped by complexity (low, medium, high), as per Appendix C. We exclude some projects for which development has not been confirmed despite consents being granted. For example, we estimate that there are currently 1.9 GW of consented wind capacity that has not yet been built; however, all of the associated consents expire by 2025. For our modelling, we assume that none of these consented capacities are built before their consents expire. For other types of plant, we assume that 50 per cent of currently consented capacity that hasn't been built will go ahead.

Figure 15 below shows the number of projects that will require a new consent or a consent renewal through to 2050 on the net-zero pathway – a total of 1,845 projects over the period. Approximately 85 per cent of these consent applications will be for transmission and distribution projects.[14]

[13] https://www.tewaihanga.govt.nz/projects/

[14] This reflects the preponderance of low-complexity distribution projects.

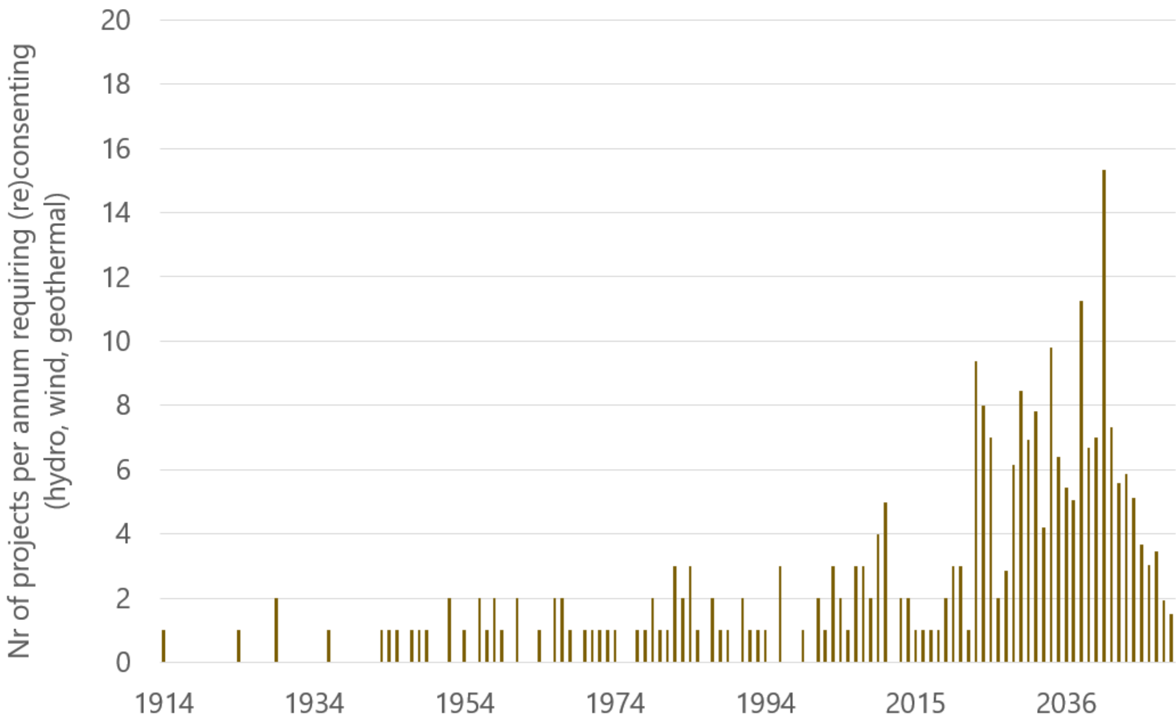
Figure 15: Number of energy projects to be (re)consented, by type of project



3.4 Our estimates indicate a three-fold increase in the number of renewable generation projects per annum compared to the last 20 years

Based on our assumptions for projects size by complexity, we determine that the annual number of hydro, wind or geothermal generation projects requiring consenting or reconsenting is expected to be significantly higher than historically (Figure 16): 5.22 projects per year over the 2020–2050 period year compared to one project over the 1914–2019 period, or 1.89 projects per annum over the 2000-2019 period.

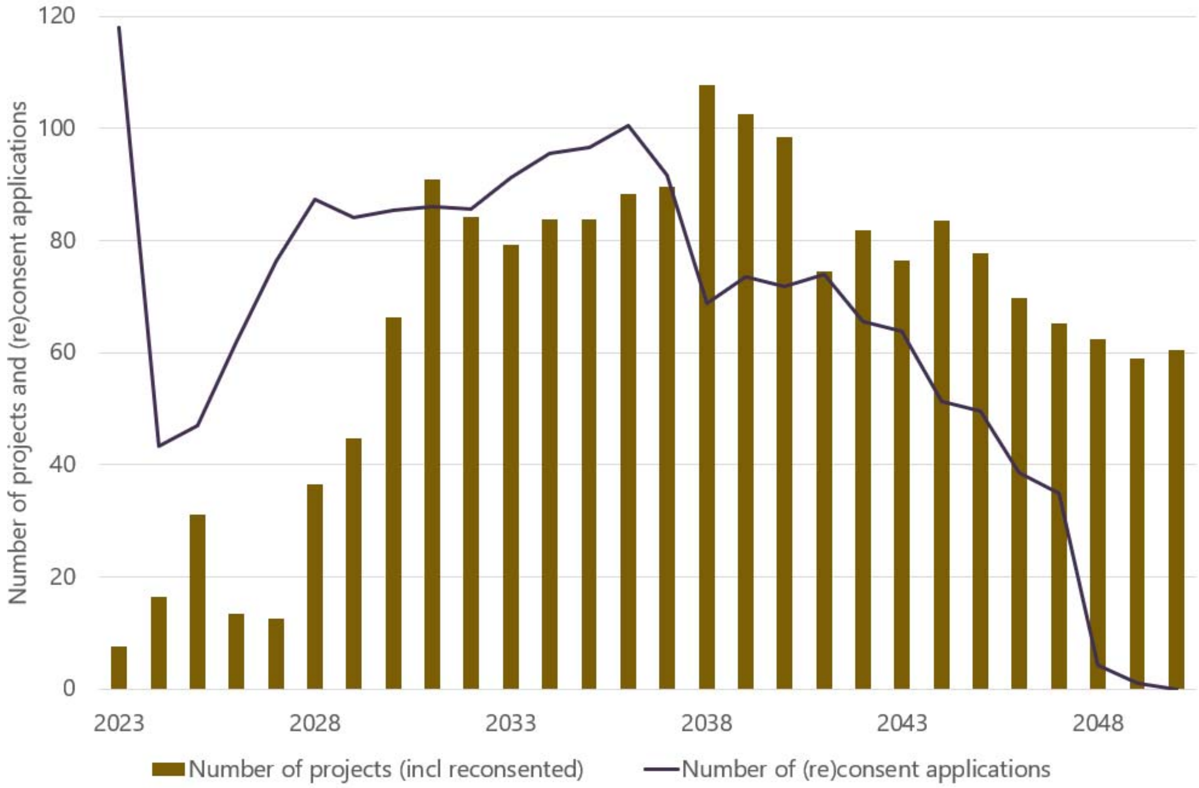
Figure 16: Number of projects requiring (re)consenting (hydro, wind and geothermal)



3.5 A third of total consent applications for new projects would need to be submitted by 2030

Energy projects vary considerably by complexity and impact on natural resources, and therefore by the number of consents they may require. In the absence of project-specific data on number of consents, we make a simplistic assumption of one consent application per project to show the timing and approximate evolution of energy consenting demand and of energy consenting costs. To determine the timing of a consent application, we work backwards from a project's commissioning date using assumptions on consent processing time and project build time as per Appendix C. Figure 17 overlays the pipeline of (re)consent applications on the pipeline of projects.

Figure 17: Number of projects and number of (re)consent applications



We determine that the vast majority (97 per cent) of consent applications (including renewals) through to 2050 would be for consenting new projects (Figure 18), and that 32 per cent of those would need to be submitted by 2030 to stay on CCC's Demonstration Path scenario of renewable generation. Seventeen per cent of consent applications through to 2030 would need to be submitted within the next year.[15] Of these projects, most would be transmission and distribution projects (Figure 19).

[15] We note that the consents applications shown for 2023 might already be going through the system. Furthermore, this timing should not be interpreted as strictly in 2023, as this year is an artefact of modelling output. A more practical interpretation of the year "2023" is "immediate future", e.g. through 2025 with most applications front-loaded over the period until then.

Figure 18: Number of consent applications by complexity

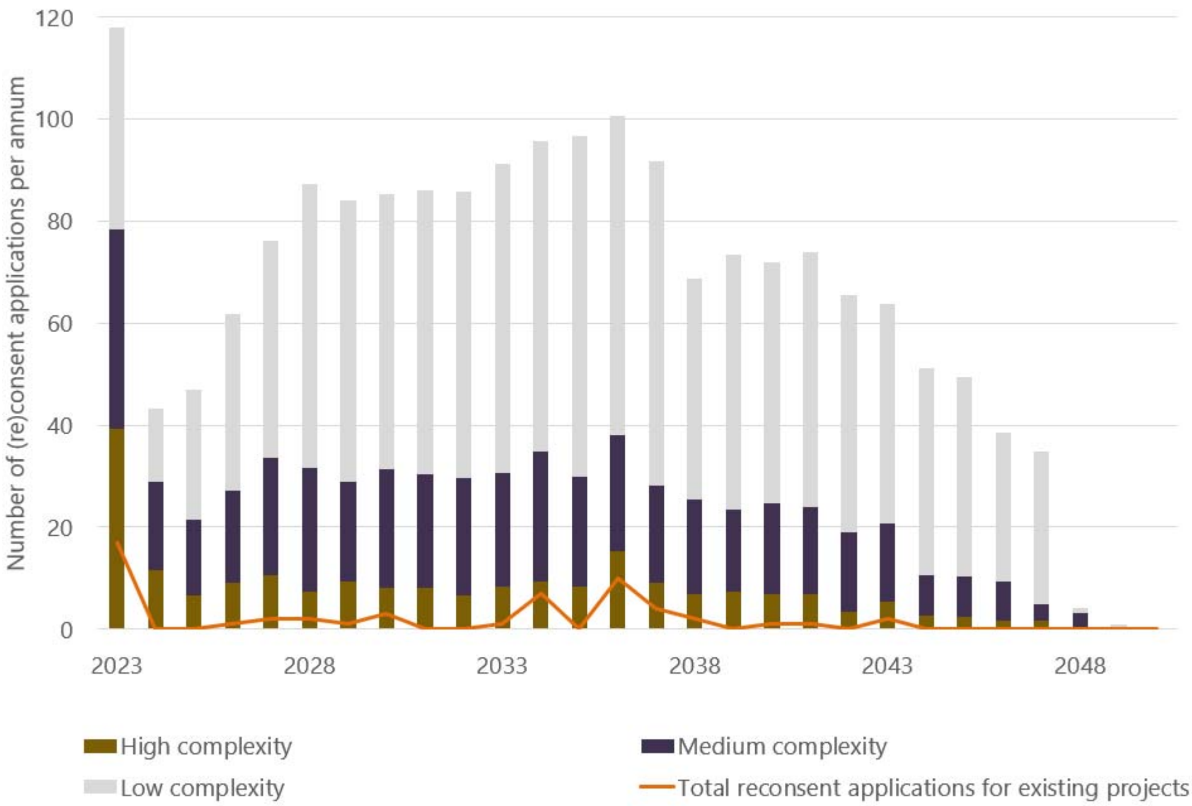
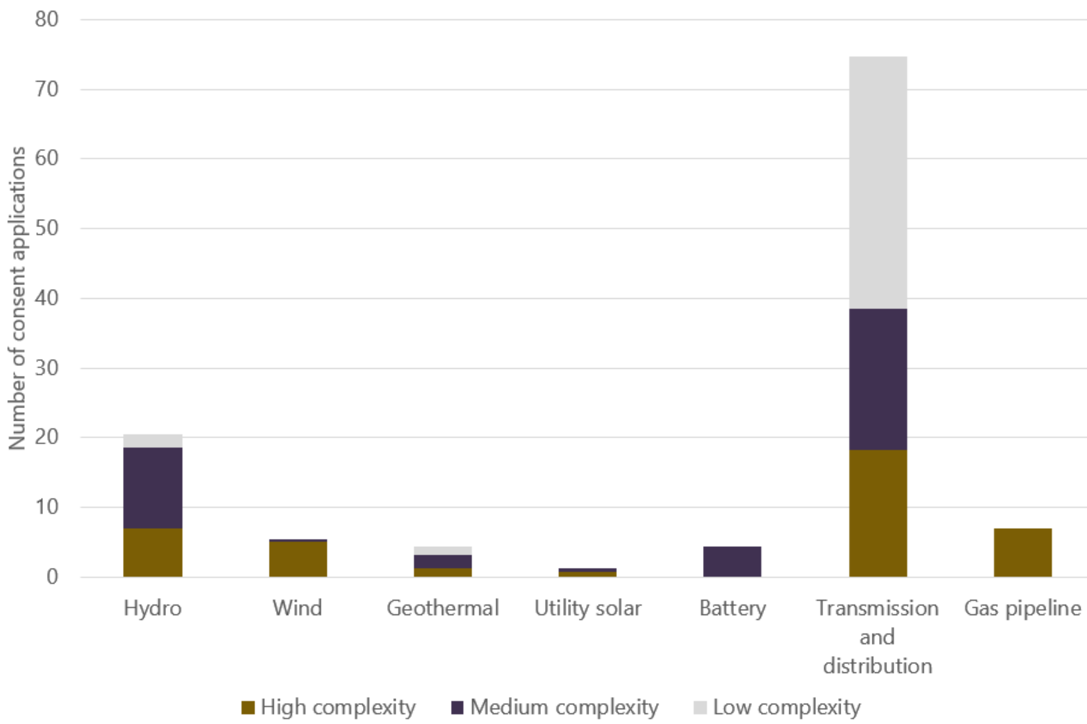


Figure 19: Break-down by project type of consent applications in 2023[16]

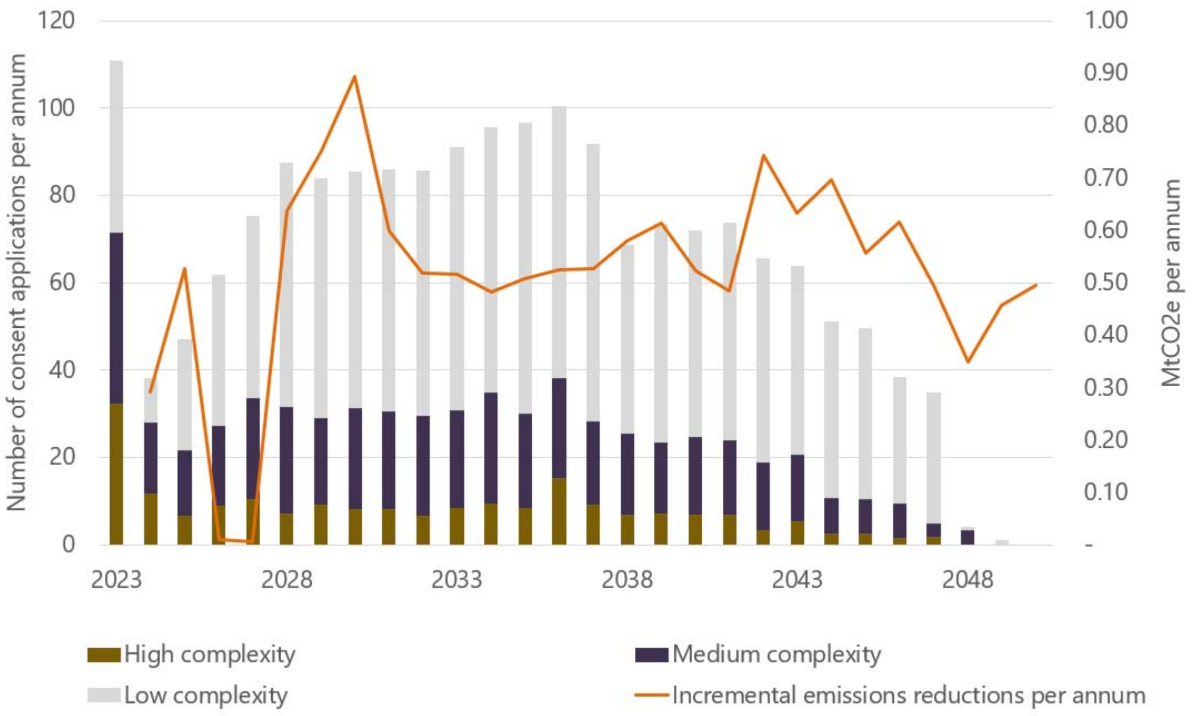


3.6 To meet net zero, the consenting process must enable the peak in incremental annual emissions reductions from renewable generation to occur by 2030

Emissions reductions from electricity generation include emissions reductions due to (i) a further reduction of the emissions intensity of electricity itself, and (ii) electrification of transport and industrial process heat (see Appendix C for method).

The figure below shows that, to stay on the net-zero pathway,[17] the peak in incremental annual emissions reduction must be delivered by 2030.[18] This annual peak, in turn, has a significant contribution to total emissions reductions from 2030 onwards when measured relative to 2022. Therefore, it is imperative that these annual emissions reductions are enabled to occur from 2030 onwards. For this, 47 generation and storage and 171 transmission and distribution projects would need to be (re)consented by 2030, with consents issued between 2025 and 2030.

Figure 20: New emissions reductions per annum



[16] In the chart, hydro refers to reconsenting of hydro projects for which consent expires by 2027 (Bay of Plenty, Waitaki).

[17] In our modelling, this pathway reflects CCC's Demonstration Path scenario.

[18] This is delivered by new wind generation installed through to 2030. Subsequently through to 2050, incremental annual emissions reductions attributable to new wind generation are on a declining trajectory (due to new annual wind capacity declining on average); by contrast, incremental annual emissions reductions attributable to utility solar are on an increasing trajectory (due to new annual utility solar capacity increasing on average).

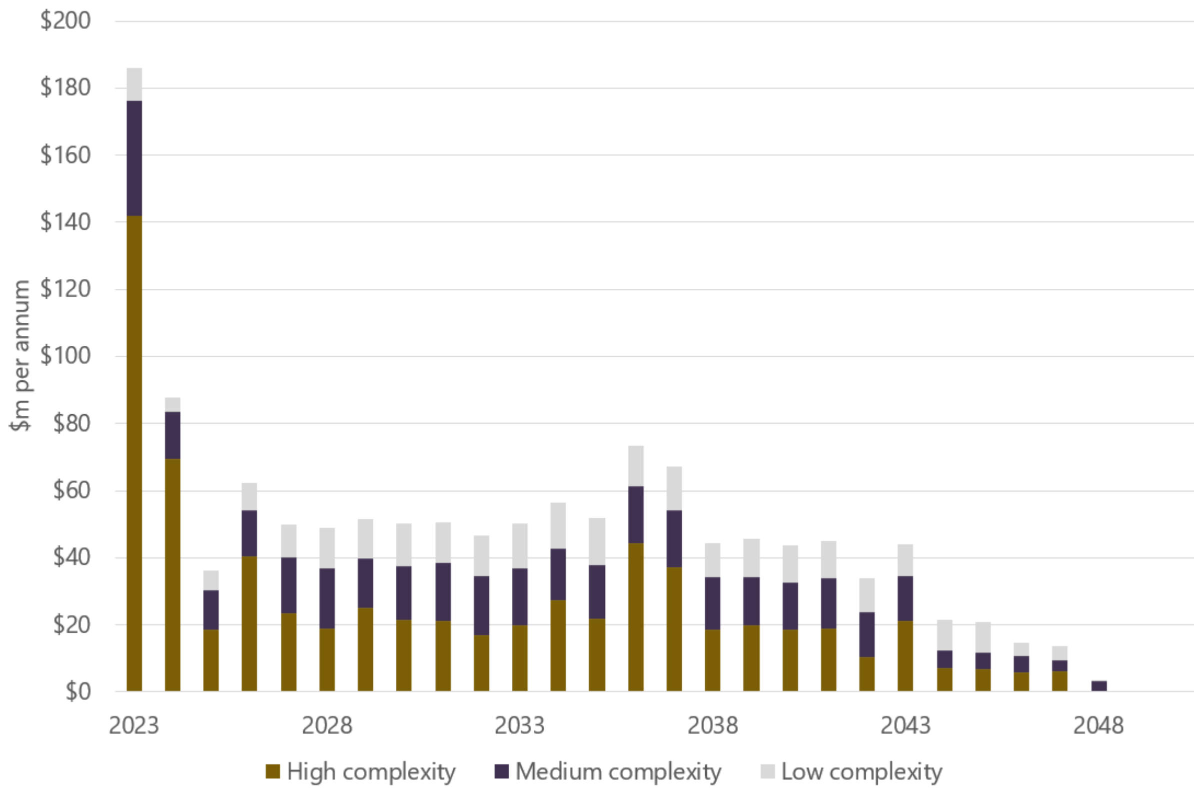
3.7 Ninety per cent of generation and storage projects are of medium and high complexity

On average through to 2050, we estimate that 12 per cent of projects requiring consenting or reconsenting will be of high complexity, 25 per cent of medium complexity and 63 per cent of low complexity. Excluding transmission and distribution (i.e. mostly renewable energy generation and storage projects), high complexity and medium complexity projects account for 35 per cent and 55 per cent respectively.

3.8 The average annual consenting cost for energy projects is $46 million

We assume that consenting costs are incurred at the time of consent application. Overall, for the 2023–2050 period, the average consenting cost for energy project is $46 million per annum (excluding 2023, this is $41.3 million). Half of these costs are for transmission and distribution projects. In the immediate future (shown as year 2023 in the figure below (Figure 21), costs include reconsenting existing renewable generation, new consents for large gas pipelines and new consents for transmission and distribution projects.

Figure 21: Annual consenting costs for energy projects[19]



[19] The bulge in 2023 is consistent with the nr of consent applications in the immediate future as described in section 3.5.

4. Transport infrastructure pipeline

In this section, transport infrastructure and the related consents pipeline are outlined. Transport sector infrastructure consists of land transport, rail networks, airports (aviation) and ports (maritime). Land transport, as the main source of GHG emissions in this sector, contributes circa 15.3 per cent of total GHG emissions in New Zealand. The ERP targets for emissions reduction by 2035 in the transport sector are:

- Reduce total vehicle kilometres travelled (VKT) by the light fleet by 20 per cent through improved urban form and providing better travel options, particularly in major cities. Infrastructure-related actions for this target include major public transport (PT) infrastructure improvements in Auckland, Wellington, and Christchurch and substantially improved infrastructure for walking and cycling.
- Increase zero-emissions vehicles (i.e. EVs) to 30 per cent of the light fleet. Improvement of electric vehicle charging infrastructure across Aotearoa is this target's required infrastructure action.
- Reduce emissions from freight transport by 35 per cent. Major investment in PT and rail infrastructure, supporting infrastructure development for green fuels, and fast charging for heavy vehicles are the main infrastructure actions required for meeting this target.
- Reduce the emissions intensity of transport fuel by 10 per cent which requires infrastructure development for green fuels and fast charging for heavy vehicles.

The transport pipeline included in this section covers the VKT reduction related actions as well as the required EV charging stations by 2050. The rest of required infrastructure actions for increased EV uptake and the reduced fuel intensity (e.g. electricity generation, fuel development infrastructure) has been covered in the energy pipeline.

4.1 Not all transport projects in future plans are contributory to emissions reduction targets

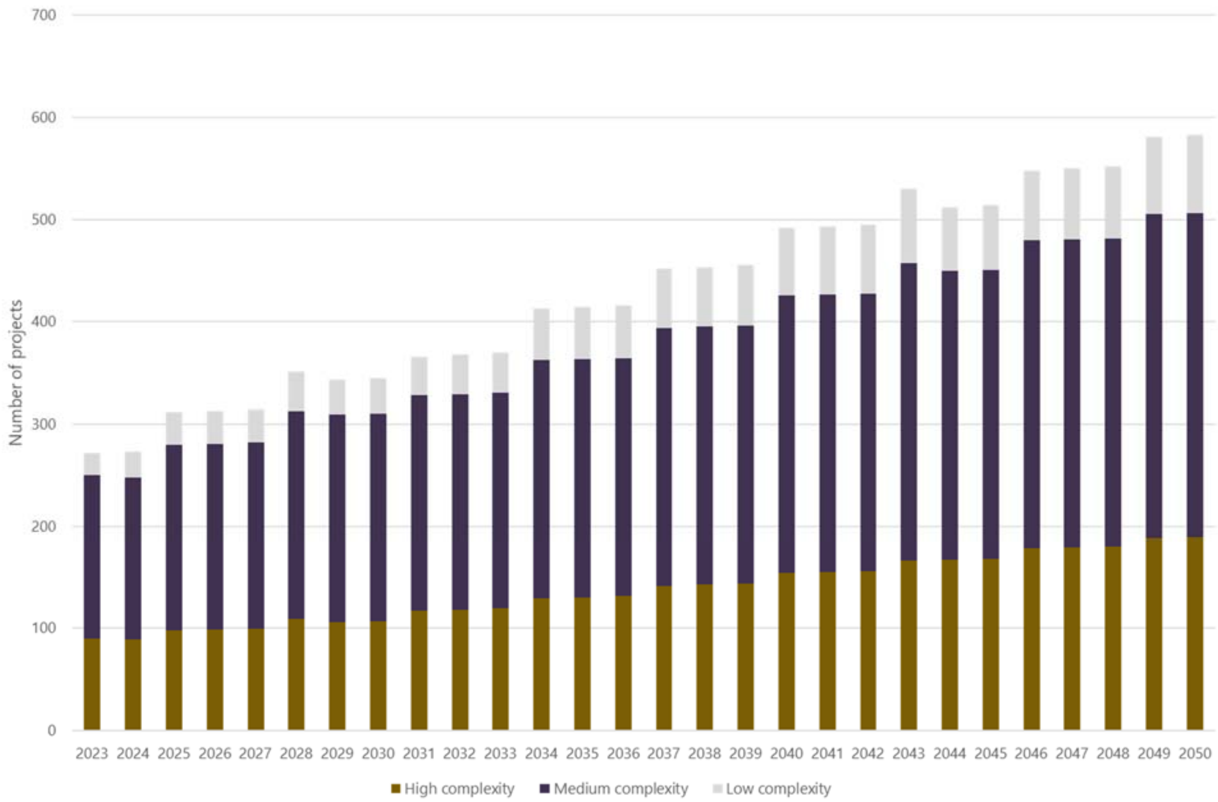
The overall transport pipeline has been estimated based on current plans in alignment with the Climate Change Commission's current policy reference and by scaling the investment in different transport activities proportionately with the difference in mode-specific passenger kilometres travelled (PKT) or freight kilometres travelled (FKT) between the current policy and the Climate Change Commission's Demonstration Path. In this section, this overall transport pipeline looks at all transport infrastructure (i.e. not just those projects that contribute to emissions reduction), to show the whole picture of transport infrastructure moving forward. The next section focuses on infrastructure that contributes to emissions reduction for the purpose of this report.

Our estimate of total number of transport infrastructure projects that would require resource consent per annum to 2050 includes both climate-positive and climate-negative (or neutral) infrastructure. The climate-positive activities are defined as transport infrastructure activities that reduce road VKT and

FKT, and include PT, rail network, walking and cycling,[20] and ports and airports infrastructure activities. Climate-negative (and neutral) activities refer to road and highway improvements.

Figure 22 shows the majority of the planned transport infrastructure projects are of medium complexity. But the low complexity project group has the highest average annual growth rate (5 per cent) compared with other categories (3 per cent). This difference between medium and low complexity groups is mainly due to required substantial improvement in cycling infrastructure.

Figure 22: Total number of transport infrastructure projects[21]



4.2 The main transport infrastructure projects in transport's pipeline are the VKT reduction enablers

While we have presented the total pipeline for transport infrastructure projects above, the focus for our analysis regarding emissions is on only the number of transport infrastructure projects (i.e. a subset of the total) contributing to emissions reduction, using the CCC's demonstration path.

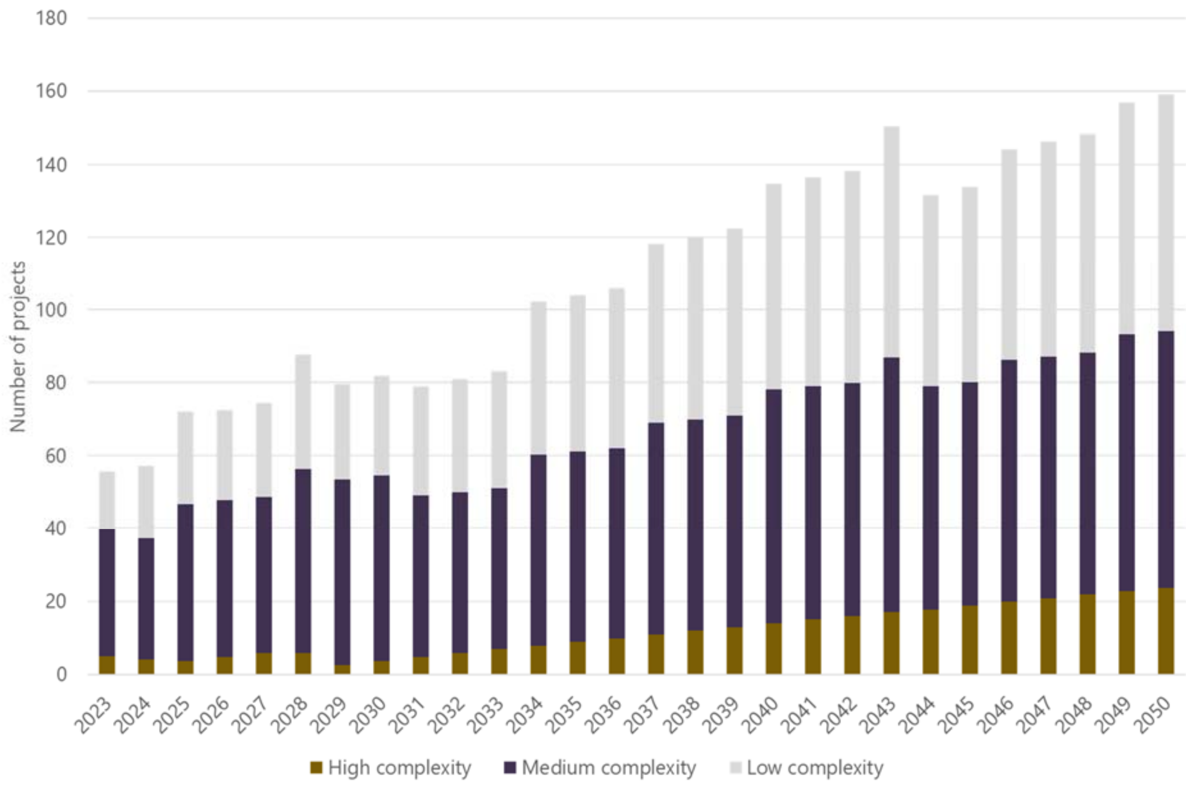
Most projects in the estimated pipeline are of low (78 per cent) to medium (22 per cent) complexity due to the large number of PT and cycling infrastructure projects. Only 9 per cent of the projected

[20] Waka Kotahi (2021). Climate Assessment Tool for Investment (CATI). Available from: https://az659834.vo.msecnd.net/eventsairaueprod/production-harding-public/708e80e6c171408bb76790414f8ddd4e

[21] Except EV charging infrastructure that is assumed to be low complexity. This has been removed since the number of chargers is large compared to the number of other projects. Section 4.3 discusses this more.

transport infrastructure projects are expected to be of high complexity. Most projects are of low to medium complexity (see Figure 23).

Figure 23: Number of climate-positive transport infrastructure projects that would require consent[22]



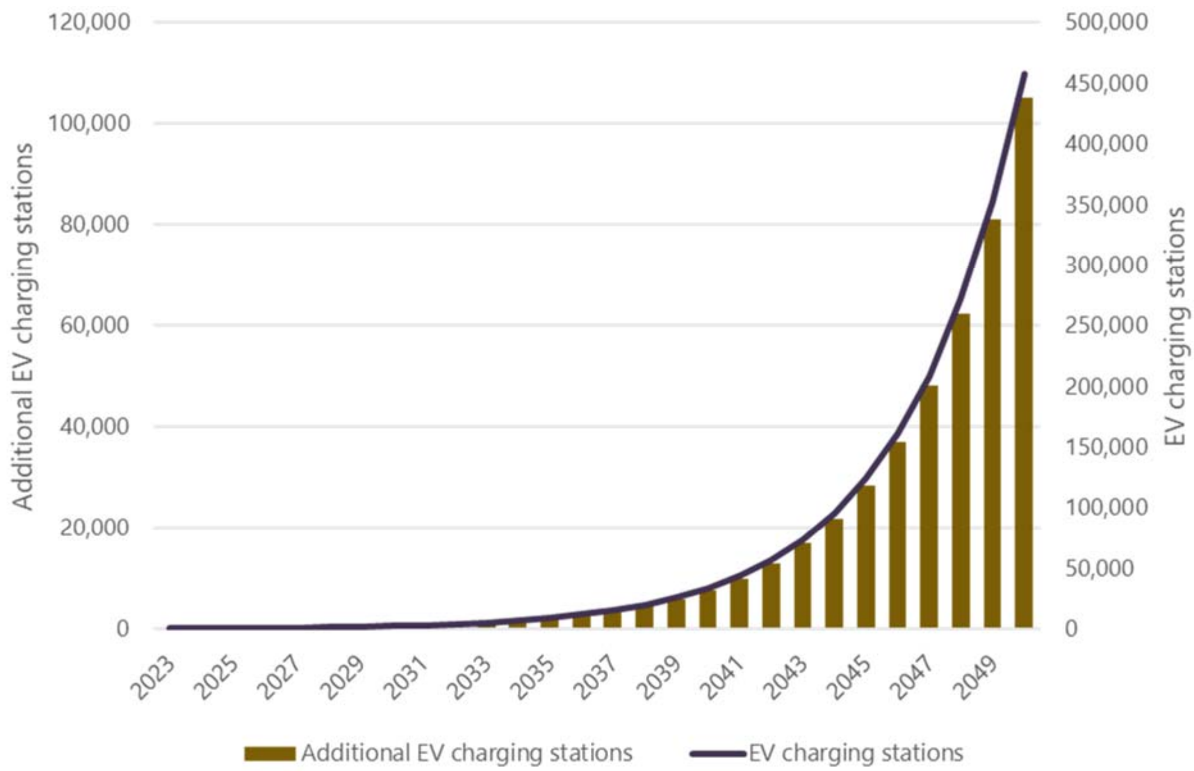
The high number of total low and medium complexity projects is due to the large number of PT and walking and cycling projects that are of low and medium complexity.

4.3 Number of EV charging stations should on average increase by 30 per cent per annum

We estimated the number of public charging stations required to meet EV uptake of 53 per cent of heavy vehicles, 81 per cent of buses, and circa 85 per cent of light vehicles in the fleet by 2050. Our estimate shows the more than 300 current charging stations (EECA, 2022) must be increased to 458,000. This estimate is based on the worldwide average in 2021 of 10 EVs per charger and 2.4 kW per EV (International Energy Agency, 2022), and two chargers per station. This means, on average, a 30 per cent increase in number of stations per annum (see Figure 24).

[22] Except EV charging infrastructure that is assumed to be low complexity. This has been removed since the number of chargers is large compared to the number of other projects. Section 4.3 discusses this more.

Figure 24: Required number of EV charging stations based on CCC's demonstration path modelled EV uptake



There are different consenting implications depending on whether an EV charging station is on-road or off-road (Waka Kotahi, 2023).

- If charging stations are on Crown land or private property (i.e. off-road), they require resource consent. Where consent is required, we see these charging stations as being low complexity infrastructure projects.
- If they are on-road within the road reserve (including in rest areas, on footpaths, etc.), they do not require resource consent.

We assume around 50 per cent of charging stations would be off-road and therefore require a consent. However, we assume those individual charging stations would be aggregated up so that one consent application could be made for 1,000 individual charging stations.

4.4 Pressure on the consenting system will be greatest in short term due to range of medium complexity projects required

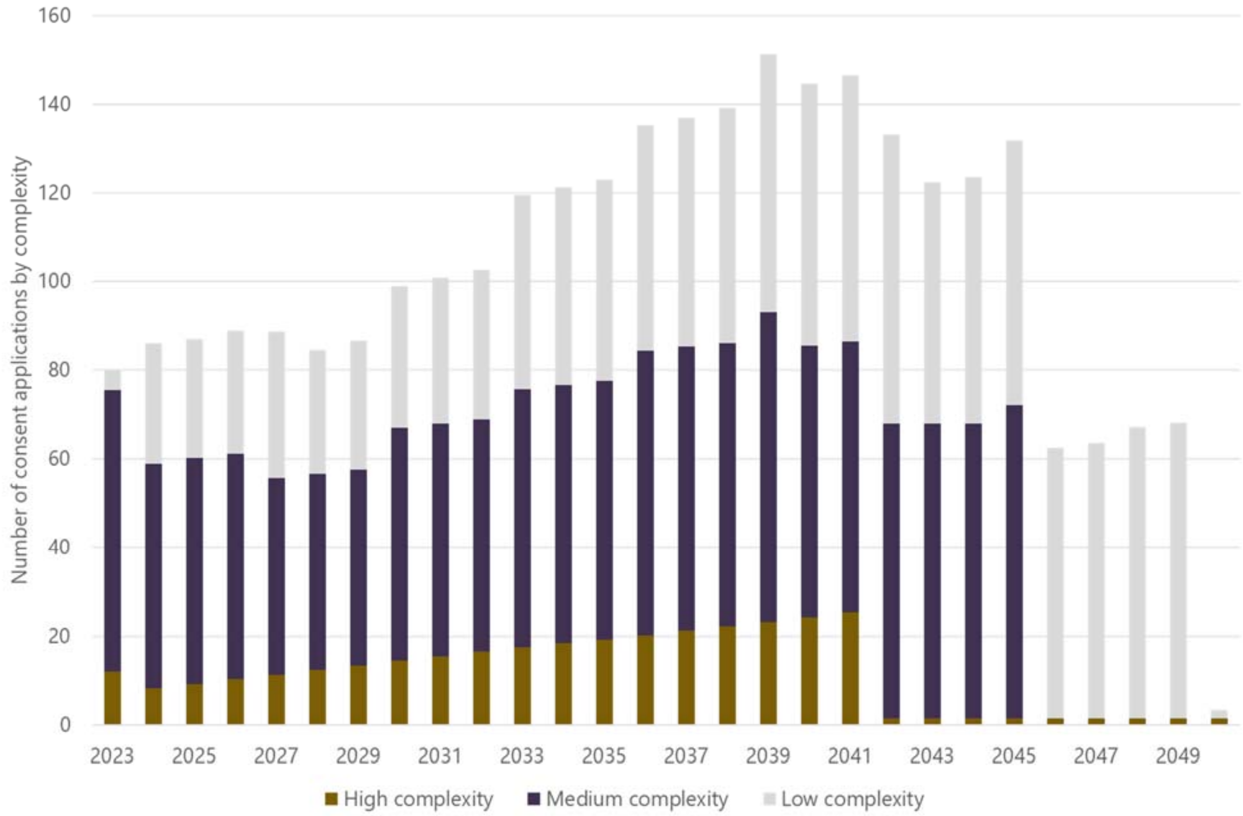
Transport projects vary by the type and complexity of impact on natural resources and consequently number of consents they may require. We estimated the number of consents for two following groups:

- New project consents. We have assumed the consent process plus construction of each project to take 10-, five- and two-years' time for high, medium, and low complexity transport projects respectively.

- Renewals of consents for existing infrastructure. We have used available data where possible for ports and airports (such as from consenting authorities' consent maps and company environmental management plans) to estimate the number of consent renewals required annually out to 2050. Our estimate shows a total of circa 93 ports and airports consent renewal applications by 2050. We did not include land transport renewals as we assumed roads and highways renewals are marginally attributable to walking and cycling and public transport activities.

Figure 25 shows the number of annual consent applications by project complexity. The annual number of consents is expected to increase over time, mostly due to the high-complexity applications by the end of next decade. The graph only shows the number of consents for infrastructure projects that are finalised by 2050, hence why there is a drop off of high and medium complexity projects in the last decade and last five years respectively. The number of consent applications drops off because of our assumption on the time taken to consent and build transport infrastructure projects of high and medium complexity – at the points at which these drop off, it would no longer be possible to consent and build in time to meet the 2050 target.

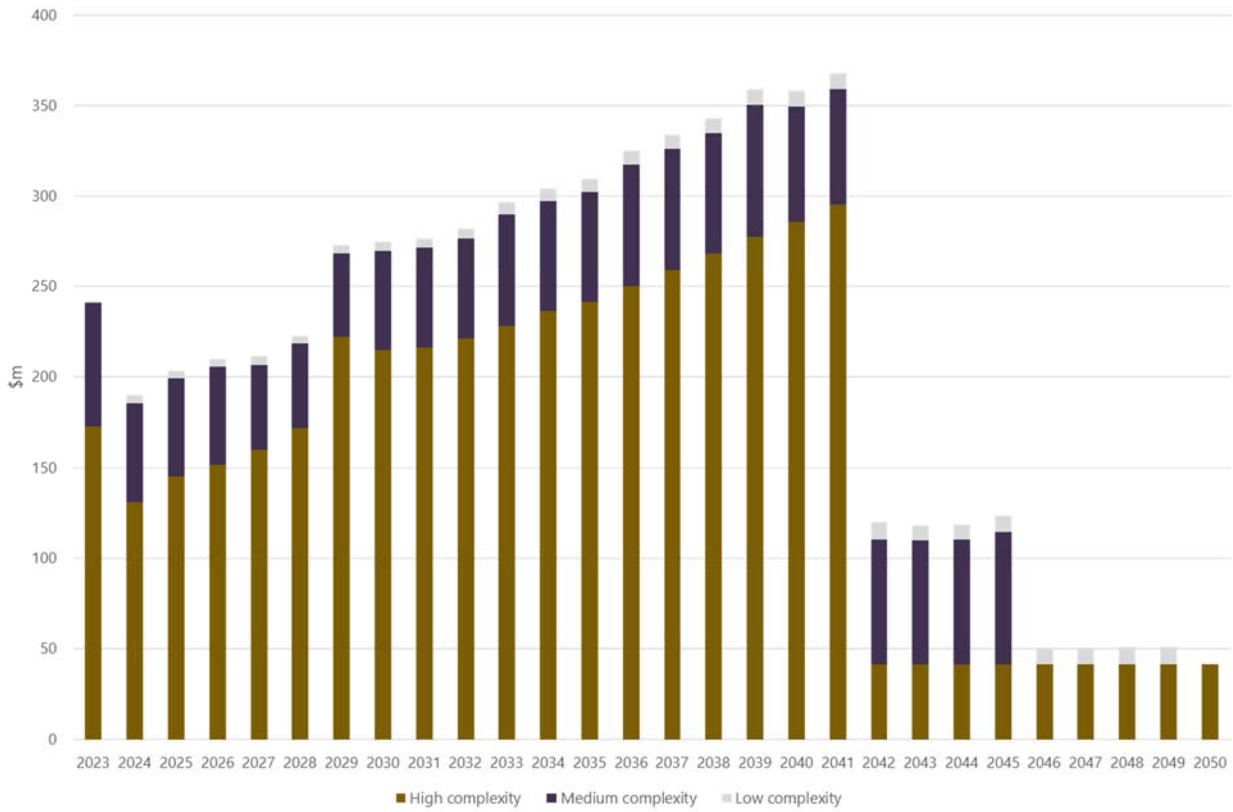
Figure 25: Number of transport infrastructure resource consent applications per annum



4.5 Annual transport infrastructure consents costs peak in 2041, then taper off to 2050

We have estimated the consent cost of a transport project as a percentage of the project's capital expenditure. Since cost information for most projects was not available, we used an expected average cost of $500 million, $50 million, and $7 million for high, medium, and low complexity projects respectively. These consent cost estimates were derived by calculating 2 per cent of total capital expenditure cost for land transport projects and 5.5 per cent, median for all groups, for ports and airports, per annum based on Sapere's previous study. Figure 26 shows an estimated increase in annual consent costs by early 2040s. There is a peak at the start of the analysis period (2023) due to many high and medium complexity applications that must go through the system soon to be able to be commissioned by the appropriate time and to get the emissions reductions at the right time.

Figure 26: Cost of total resource consent applications per annum for transport new and reconsenting



4.6 Emissions reductions in transport rely on several levers, all of which require infrastructure

Five key levers are required to deliver emissions reductions in transport, with infrastructure at the core. The other four levers (planning, regulatory, economic/pricing and information/behavioural change) are usually used prior or alongside infrastructure improvement to enable avoiding or reducing travel or the need to travel, and to shifting to more energy-efficient modes.

Infrastructure is a complementary and necessary lever and contributes to targeted emissions reduction, in combination with the other levers. Without enabling infrastructure, emissions reductions from the other levers are likely to be insignificant. On this basis, we attribute all emissions reductions in transport under CCC's demonstration path to infrastructure projects.

Table 6 shows the key transitions along the CCC demonstration path during the three upcoming emissions budgets that has all the levers included.

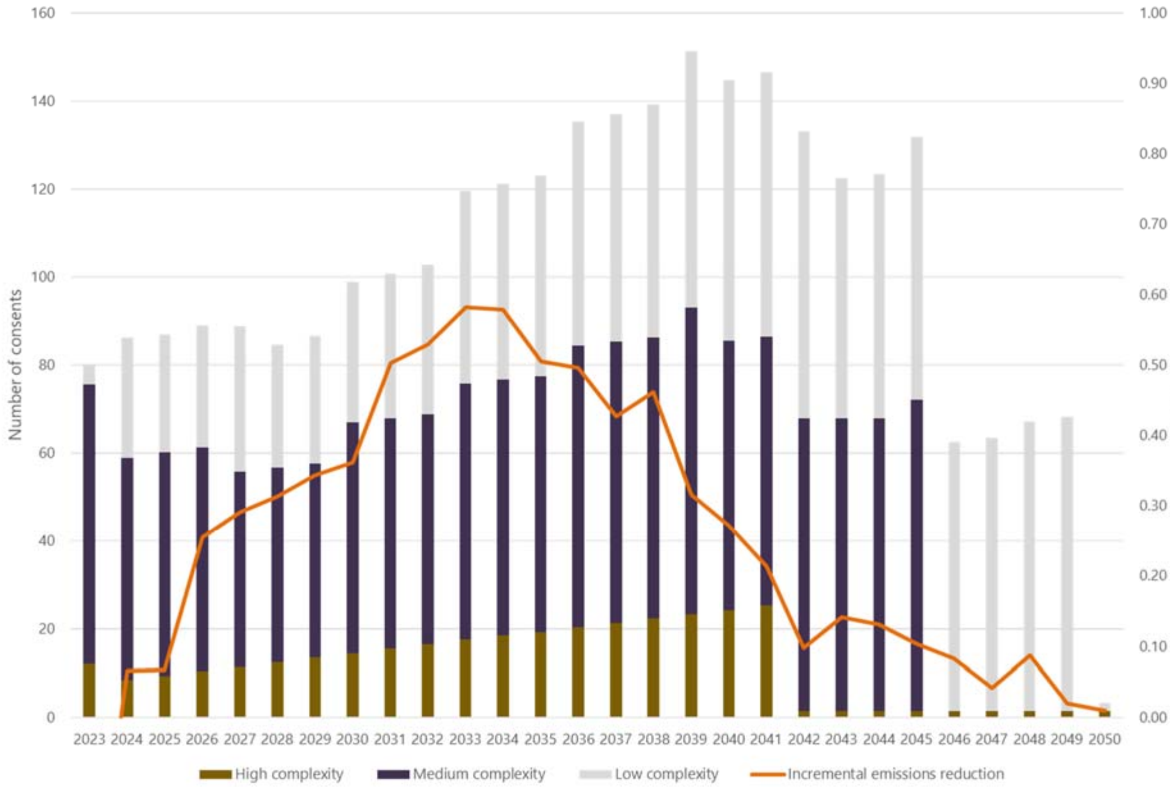
Table 6: Key transitions along CCC's demonstration path during emission budgets period

	Budget 1 **2022–25 (290 MtCO2e)**	**Budget 2** **2026–30 (305 MtCO2e)**	**Budget 3** **2031–35 (240 MtCO2e)**
Light VKT reduction	Encourage switching to walking, cycling and public transport. Planning and behavioural change: Reduce demand for travel, for example through smart urban development and increased working from home. behavioural change and infrastructure improvement: Increase use of rail and coastal shipping for freight.		
Aviation and shipping	Improve efficiency.	Start electrifying ferries and coastal shipping.	Start electrifying short-haul flights.
EV (BEV) share	Accelerate uptake of electric and zero emissions cars, buses and trucks. Improve efficiency of vehicles and freight movement.		Phase out imports of internal combustion engine light vehicles.
Reduce emissions intensity of transport fuel		Increase use of biofuels.	

Source: adapted from Climate Change Commission, 2021, table 7.1, p 103

Figure 27 below shows that most consent applications for high complexity projects must be submitted at the time we are expecting to have the highest annual emissions reductions (i.e. skewed toward the start of the period of analysis). For example, something like light rail (which is highly complex) may not be able to be used as PT for a long time yet, but the consenting application must still be underway relatively soon to enable the future emissions reductions to take place.

Figure 27: Incremental greenhouse gas emissions reduction required from transport in relation to number of consents per annum



5. Housing-related infrastructure

Housing-related infrastructure is partially captured in the energy and transport sectoral analysis. The primary additional infrastructure demand from housing development infrastructure components is generated by three waters infrastructure (wastewater, drinking water and stormwater assets). This omits other housing-related infrastructure such as telecommunications. However, we expect these infrastructure requirements to be at the margin, whereas water infrastructure appears most significant in terms of consent burden and required investment and upgrades (New Zealand Government, 2021).

Water infrastructure faces several drivers of increased consenting activity.

- Increased regulatory requirements. National Freshwater Standards have increased because of the National Policy Statement. Upgrades to wastewater treatment plants are planned across the network. Drinking water standards have increased and upgrades have been planned to meet these standards.
- Renewals. A significant pipeline of renewals are required over the forecast period as ageing pipes require renewal, particularly in city networks developed in the early part of the 20^{th} century.
- Growth. Increased urbanisation and population growth in general provides an ongoing infrastructure requirement to service these needs.

The Three Waters review currently undertaken by the Department of Internal Affairs (DIA) has prepared assessments of the upgrades needed in the sector (Beca, 2021; Controller and Auditor-General, 2021; Department of Internal Affairs, 2022; Water Industry Commission for Scotland, 2021).

5.1 Water infrastructure does not have direct emissions outcomes, but is expected to be burdensome

Water infrastructure does not have direct emission reductions outcomes and its effect on carbon emissions in New Zealand is not well documented. Water infrastructure emissions are driven primarily by industrial processes and associated energy use (ignoring construction emissions). We would expect that as technology and processes get better over time, so will the efficiency of water infrastructure and therefore its related emissions. However, the total level of processes undertaken in a growing economy will increase.

The purpose of estimating the water infrastructure requirements to 2050 in this study is not to capture direct emissions reduction activity, but instead to show the significance of the burden water infrastructure could create for the consenting system more generally. The significant demand for complex water infrastructure consents will demand time and resources from the consent system. The estimation of the water infrastructure requirements acts as a point of evidence in how we assess the plausibility of potential future scenarios, discussed further later in the report.

Baseline water infrastructure activity (excluding the upgrades to meet new standards) includes:

- network extensions for waste and drinking water as population grows (both pipes and plants)

- maintenance and renewals of infrastructure that has passed its useful life or needs emergency repair or replacement
- reconsents for smaller activities
- future climate change adaptation activities, including managed retreat of water assets and climate change-related replacement, maintenance, and/or extensions (for example, see Kool et al., 2020; White et al., 2017)
- other future water infrastructure activities that have not been conceived of.

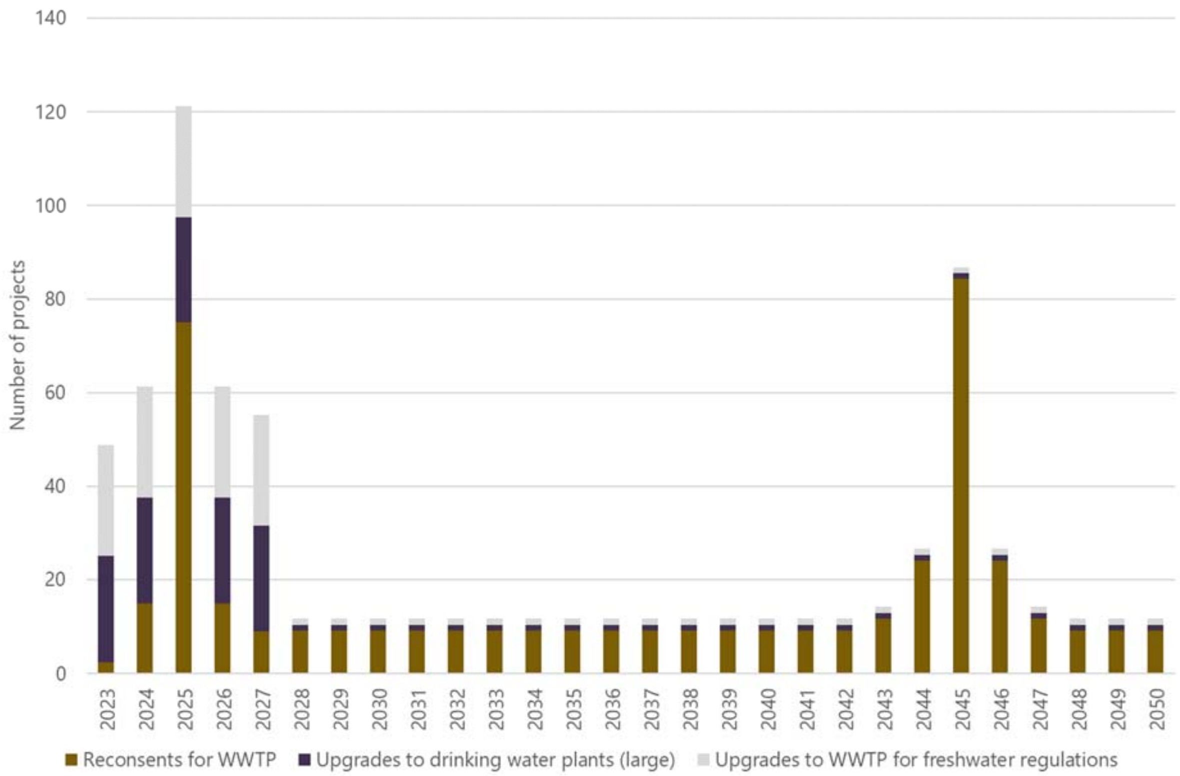
Only some proportion of the baseline must be processed by the consenting system. For example, replacing or repairing water pipes within the road reserve in Auckland does not require consent as it is permitted under the Auckland Unitary Plan. Additionally, these baseline activities may be relatively manageable and routine (i.e. not of the highest complexity, and not out of the ordinary) and therefore have a marginal impact on the resource consenting system and its capacity to process consents. We are not recording these baseline activities in our pipeline for the purpose of this report.

Based on information from the DIA Three Waters review, there are three main water infrastructure activities above the baseline which we expect to be of the highest complexity in the future:

- Reconsents for wastewater treatment plants (WWTPs). These WWTPs were set up years ago under the RMA and are due for renewal, based on statutory timeframe for reconsents. These reconsents are expected to be of the same complexity as consenting a *new* WWTP, since so much has changed and infrastructure must meet a suite of new thresholds to be able to do the same activities.
- Upgrades to drinking water plants. We are considering only medium and large ones that are likely to service towns and cities. These upgrades are necessary because of increasing drinking water standards. We have excluded small drinking water systems.
- Upgrades to WWTP to meet new Freshwater Standards. These Standards are potentially restrictive on what can be discharged, and therefore WWTP and processes must be improved and upgraded to be compliant. It is not easy to pinpoint when exactly these projects must happen, but we expect on aggregate these to happen within the next five years (and have therefore assumed normal distribution over the five-year period).

The figure below shows the quantum of these projects above the baseline, and where we would expect them to land on the timeline to 2050.

Figure 28: Estimated number of water infrastructure projects, above the baseline, 2023–2050

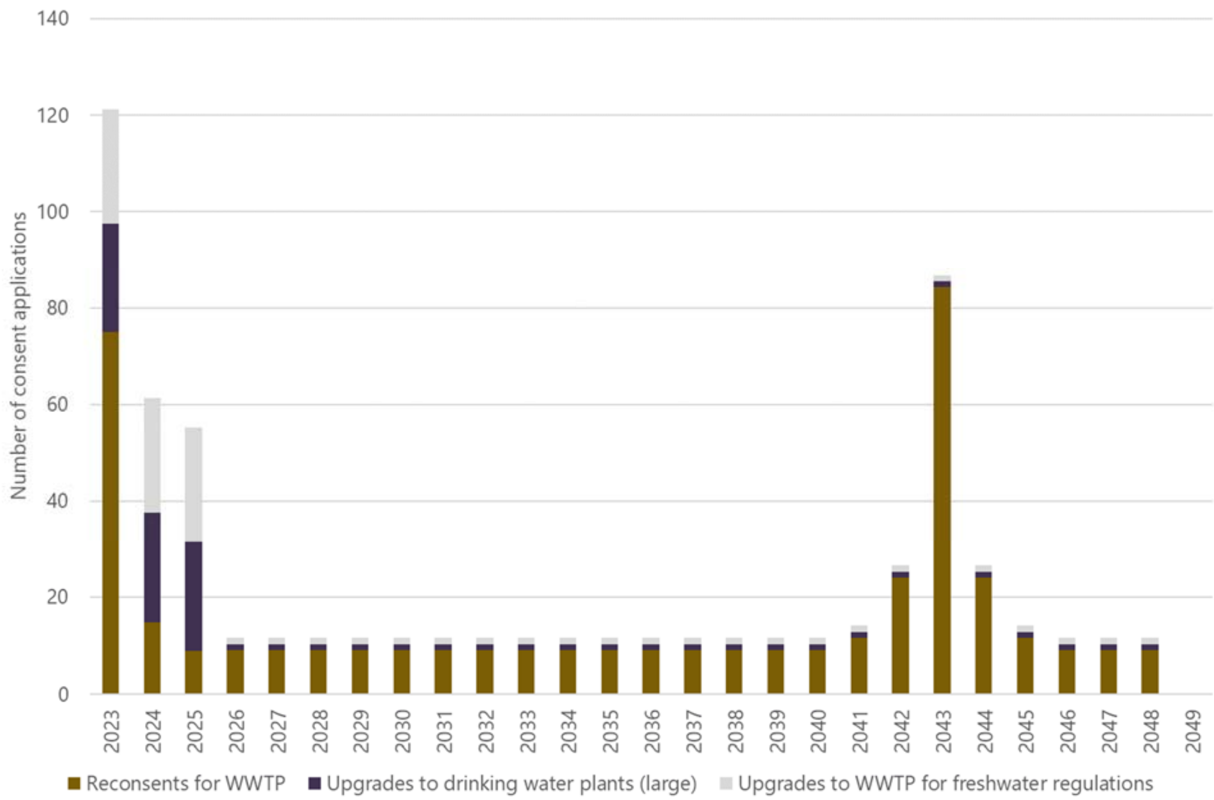


We estimate a lump of water infrastructure projects to be undertaken in the next five years, and then a relatively constant stream of these activities happening over the next 15 years. From about 2043 (i.e. almost 20 years in the future) we expect another wave of reconsenting activity to come, due to changes in how the RMA statutory reconsenting period is used.[23] It is possible that even shorter periods of water sector reconsenting may be applied in the future with a ten year period for example. This would have the effect of bringing forward and increasing the second wave of reconsenting activity by a number of years.

We assume a two-year timeframe for the processing of consents across all these activities, since they are complex and will involve a lot of expert input, consultation, and review from local authorities, with the potential for further work through hearings and rescoping activities. For example, for a project to be able to start in 2023, this assumes the consent would have been applied for in 2021 (two years prior).

[23] We have heard that 20 years is now the typical period for reconsenting, despite the allowed length under the RMA being 35 years. This is because of a cultural shift in people not wanting to speak for future generations.

Figure 29: Number of consent applications for the projects, above baseline, 2021–2050



6. Trends in the consenting sector influence the system's ability to process consents

This section of the report highlights trends in the consenting sector, informed by:

- Sapere's previous report (Sapere Research Group, 2021) for Te Waihanga New Zealand Infrastructure Commission that investigated the cost of consenting for infrastructure projects in New Zealand[24]
- Ministry for the Environment's (MfE) National Monitoring System (NMS), which compiles local authorities' annual consenting activities and staff levels over time
- data from Mitchell Daysh (MD), a resource management and planning specialist firm involved with a variety of infrastructure projects across the country.

The historic trends form the basis for our analysis of the consenting system's task to process the pipeline of consents and its capacity to enable the required infrastructure development to meet the Government's 2050 net zero target.

Sapere's previous report (Sapere Research Group, 2021) for Te Waihanga investigated the cost of consenting for infrastructure projects in New Zealand. A range of projects of varying size and complexity were examined to consolidate information on the consenting burden faced by infrastructure developers. Key findings from this study include:

Consent costs are high and increasing

Data from Sapere's last report showed direct consent costs as a proportion of project budgets increased by 70 per cent for consents lodged since 2014. Analysis of the MfE dataset for the purpose of the previous project also showed:

- council fees for all non-notified consents have increased by 66 per cent over the five years from 2014/15 to 2018/19, and
- council fees for notified consents with a hearing have increased by 124 per cent over the same five-year period.

[24] This report looked at a range of projects of varying size and complexity to create a picture of consenting burden in New Zealand. Analysis of both qualitative and quantitative project-level data revealed some key trends in the consenting sector that are relevant in our analysis of the consenting system's ability to manage the pipeline of consenting activity.

6.1 Applicants face significant direct costs to consent infrastructure projects

An average infrastructure project historically requires 5.5 per cent of a project's budget on direct resource consenting costs.[25]

Spending on resource consenting varies considerably based on a range of factors, including:

- different pathways for obtaining consent for an infrastructure project
- different regional and local sensitivities to manage dependent on the nature and location of the infrastructure activity
- a wide range of project types with naturally different impacts on the environment and societal significance
- whether the consenting authority believes the public should be notified of the consent, or if it is taken to a hearing in the Environment Court.

Smaller infrastructure projects face disproportionate consenting costs since the RMA processes impose an element of fixed costs on infrastructure developers (Sapere Research Group, 2021). From the sample of projects in Sapere's report:

- projects with capital budgets under $200,000 incurred an average of 15.9 per cent direct consenting costs (as a proportion of the total project cost)
- projects with capital budgets between $200,000–$1 million on average incurred direct consenting costs of 13.9 per cent.

Indirect consenting costs are also material

Infrastructure developers often face material indirect costs imposed through the consenting process that are separate from direct costs. These indirect costs include holding costs of capital (i.e. if capital is pre-allocated to this project, then it cannot be earning returns elsewhere) because of delay, costs created by the uncertainty of the Resource Management Act consenting process, and design and redesign costs to improve the odds of a favourable consent decision.

Over a third of the sample of infrastructure developers reported material indirect costs in consent applications. On average, these indirect costs represented 1.4 per cent of total project budgets. Compared to projects without indirect costs, projects in the sample with indirect consenting costs had three times larger capital expenditures, took twice as long to get a consent decision from councils, and had twice as many public hearings.

Project design is now considered by infrastructure developers as a consenting issue and final designs often reflect significant compromise between applicants and councils. Projects are either more expensive from the outset since designers know what is required to secure a consent (i.e. putting in

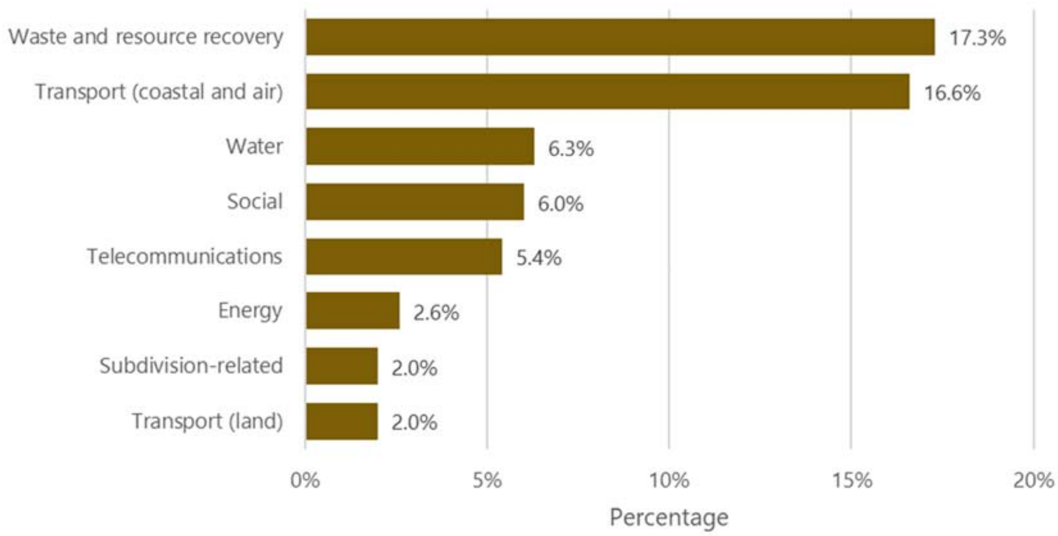
[25] Direct consenting costs includes the cost of council fees (application for the consent), engaging external experts (including to conduct impact assessments of projects and legal advice), engaging in hearings and appeals if necessary, and the internal staff time spent on consenting.

place additional things to manage expected scrutiny), or incur greater cost because of changes to the project over time and design concessions to get a favourable consent decision.

6.2 Consenting costs vary considerably by sector and are particularly high for waste, water, and coastal infrastructure

Sapere's last report found clear variation in direct consenting costs by infrastructure sector – noting any infrastructure that is near the coast or includes water take or discharge requirements is immediately more complex and requires a considerable amount more expert advice, consultation, and engagement with the community. Figure 30 below reflects this.

Figure 30: Median direct consenting cost as proportion of project budgets, by sector



Source: Sapere Research Group, 2021

6.3 Consenting is becoming more complex and therefore taking longer

Table 7 below shows the difference in time taken by local authorities to decide on a resource consent application, by complexity of project. Both the Sapere and Mitchell Daysh datasets from Sapere's previous report show the more complex the project, on average, the longer it took to reach a decision.

Table 7: Comparison of time taken to make decision across data sources

Project complexity	Average days to consent (Sapere sample)	Average days to consent (Mitchell Daysh dataset)
Typical	91	63
Some complexities	214	167
Complex / unusual	425	365

Source: Sapere Research Group, 2021

MfE's National Monitoring System shows the median time taken by local authorities to reach a decision on a consent application has increased by 50 per cent from 2014/15 to 2018/19. This is for all resource consents, not just infrastructure, but the qualitative information received from stakeholders suggests the impact may have been worse for infrastructure consents.

Analysis of a Mitchell Daysh dataset showed the time taken by local authorities to reach a decision on consent applications for infrastructure projects had increased by 150 per cent for consents issued between 2010–14 compared to 2015–19. Further, planning experts are increasingly being relied upon by both councils and infrastructure developers to be able to process resource consents and deal with demand.

Three themes were identified in Sapere's last report as to why there could be an increase in consenting complexity:

- Councils are considering a wider range of potential impacts from infrastructure projects.
- Councils are requiring more evidence about those impacts.
- Communities have less tolerance of impacts.

Applicants are expected to provide greater levels of evidence and consider more impacts

Consenting complexity has particularly increased in the marine and coastal space. As an example, consent applications for marine dredging must now have supporting analysis (and potentially mitigation steps) on the impact of noise on marine life. This is not an impact previously considered or well understood.

Similarly, public interest and the recognition of cultural values in the coastal environment mean there is a lot more focus on the potential impacts of activity than ever before. This can affect, for example, the extraction of sand from the marine environment, where sand dunes are considered of cultural significance.

Regulatory requirements are one driver of complexity

Regulatory requirements add a layer of complexity to resource consent applications and will likely continue to do so. Three key drivers are the:

- 2020 National Policy Statement (NPS) for Freshwater Management, which provides direction to local authorities on how to manage freshwater.

- 2020 National Environmental Standards (NES) for Freshwater, which set the standards to be met by anyone carrying out activities that pose risk to freshwater and associated ecosystems.
- Draft NPS for Indigenous Biodiversity, which, while not finalised or in effect, aims to protect, maintain, and restore indigenous biodiversity in New Zealand.

Both freshwater policies can be difficult to interpret in unison. For example, the new NES can be enforced as a backstop by council and the NPS can streamline the process, but nowhere is a hierarchy established.[26]

Infrastructure developers are therefore having to navigate council plans and the NES alongside the NPS for Freshwater Management and are exposed to regulatory uncertainty. This uncertainty may have unintended consequences, including regional variation in how the policies are interpreted and applied. Additionally, the NES introduced a new definition for wetlands that is stricter and much more likely to capture wetland areas than the Resource Management Act / plan definition.

The combination of the NES and NPS for freshwater has meant it is much harder to consent certain activities, particularly if the activities unintentionally create or impact wetlands. Quarries appear to be affected under the new policies because they leak some water, so they may be considered wetlands. Renewable electricity generation projects can also be affected when the associated land is seen to include wetlands under the new definition.

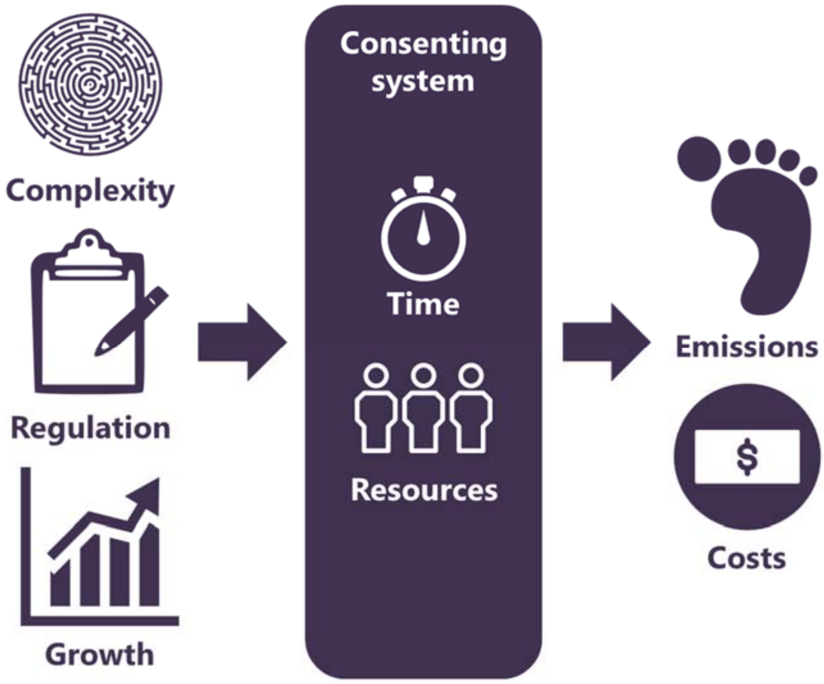
When the NPS for Indigenous Biodiversity is introduced and in effect, infrastructure developers may have to consider and explicitly manage and report on a wider range of impacts of their projects and may become accountable for other unintended consequences of their developments.

6.4 If the observed trends in consenting continue, emission reductions and costs are impacted as it takes longer to consent a project

The trends in increasing consent complexity, and growth in consenting demand, lead to higher demand on the consenting system in terms of time and resources, which will lead to impacts on the ability to commission projects that reduce emissions and the cost of consenting for those projects. Figure 31 Figure 31 below illustrates this relationship.

[26] The lack of a hierarchy was also raised in relation to having competing National Policy Statements. National rules have created complexity where they overlap – for example, the National Policy Statement on Electricity Transmission has streamlined consenting for transmission projects, but the most frequently mentioned example was the change in rules around wetlands.

Figure 31: Inputs and outputs of the consenting system, based on identified trends



The combination of increasing complexity of consent applications, regulations, standards, expectations to meet them, and natural growth in projects seeking consent impact the consenting system and its ability to process consent applications in a timely manner.

The impacts of these inputs materialise through the time taken and resources required (including FTEs and other expenses) to process a consent. If resources are constrained (at least in the short term) within the consenting system, the time taken to process a consent increases (i.e. it will manifest in delays).

Increases in the time taken to process a consent may materialise in a number of ways. Of relevance to this work are costs and emissions.

- Delays in consent processing necessarily mean the start dates of projects are pushed into the future. For climate change-related infrastructure, this means that the emissions reductions associated with the project are also pushed into the future.
- Costs appear in two ways. First, there is the additional cost to the applicant because of delays. These arise through holding costs of capital and uncertainty. Second, there is the cost to society because of the delay in emissions reductions. New Zealand must still meet its emissions reductions targets, which means finding other methods of abatement if the infrastructure cannot deliver in time. This cost can be measured through the carbon price and the amount of carbon offset that needs to be purchased.

The baseline measurement of increases in the time taken to consent a project is 150 per cent over a five-year period based on the previous Sapere report for Te Waihanga. In the next section we consider what increasing delays might mean for meeting our emission targets through the development of scenarios applied to the consenting pipeline.

7. Scenarios of emissions reduction from consenting delays

Our analysis of emissions reductions covers production-based emissions (i.e., excludes embedded emissions), consistent with how New Zealand's net-zero target has been determined. We present reductions in emissions from long-lived gases and fugitive emissions in the energy and transport sector because our approach focuses on sources of emissions. We note, however, that from an end-use perspective, these emissions would also be attributed to other sectors, e.g., buildings or industrial processing. We estimate that our pipeline of energy and transport projects requiring consents can avoid a total of 299 MtCO2e over the 2023-2050 period, compared to a scenario where annual emissions stay at their 2022 levels. This corresponds to 10.7 MtCO2e per annum on average.

The scenarios we have developed are based on observed trends in the sector over 2010–2020, the extent to which these trends continue, and the consequences of that. The key input data we used are:

- Time taken to process a consent depending on project complexity. This was estimated based on data from Mitchell Daysh.
- Increase in time to process a consent. Data from MfE's National Monitoring System (NMS) suggests that this processing time increased by 50 per cent between 2014/15 and 2018/19.
- The number of FTEs required to process a consent, both council staff and external resources. This was estimated based on MfE NMS data and NZPI Salary Survey Reports.

The main outcome of each scenario is an annual estimate of percentage increase in the time it takes to process a consent. This is then applied to determine the potential delay in the commissioning of energy and transport infrastructure projects that can deliver emissions reductions.

7.1 Two scenarios where the consenting system has unconstrained resources

Our analysis firstly looks at two scenarios (Scenario 1 and Scenario 2), where we assume unconstrained resources in the consenting system. That is, the consenting system can call upon additional skilled resources (either domestically or internationally) to help process consents and meet the increasing demand and burden on the system, and there is no constraint in doing so, and costs and time taken to process a consent do not have an upper threshold.[27] The box below provides a description of Scenario 1 and Scenario 2, and Table 8 shows a summary of key output parameters for each of these two scenarios.

[27] In other words, consents can still get processed, they just take longer, cost more, and use up more skilled resources without any upper bound on these variables.

Box 2: Description of Scenarios 1 and 2, where the consenting system has unconstrained resources

Scenario 1: Observed trend continues unabated to 2050

Scenario 1 describes the situation from 2023 to 2050 if the current trend of annual increase in effort per consent continues with no constraints on costs, time to process, workforce limits, and where there are no legislative/regulatory changes that impact the process materially.

We assume that the number of FTE per consent grows at the same rate as NZ population – 0.7 per cent.

Based on data from MfE's National Monitoring System, we also determine that consent processing time increase by approximately 50 per cent between 2015 and 2019, or 10.7 per cent per annum. The number of FTEs per consent is determined to grow by 6.6 per cent per annum, based on data from MfE NMS and NZPI. This corresponded to a 17.9 per cent increase in effort per consent, where effort is measured as number of years it would take a full-time FTE to process a consent.

We assume that consent processing time increases by 10.7 per cent on average per annum until 2024. From them on, we linearise the trends in consent processing effort, such that it increases by 17.9 per cent every five years from 2025, with an annual average of 3.7 per cent. This results in a 3 per cent annual increase of consent processing time from 2025.

Scenario 2: Trends halted through legislative/regulatory reform

In Scenario 2 the trends we observe are not applied all the way to the end of the period. It is assumed that some legislative/regulatory change to the resource management system halts these trends from 2034. The projection can only measure the impact if a change was successful in impacting the trends, and not how, or how likely, that is to occur.

The trends from Scenario 1 are applied through to 2033. From then on, the per-consent effort is fixed at the 2033 level. Again, it is assumed there is no constraint on costs, time to process, or the ability to call upon additional skilled resources.

Emission reductions achieved in early years are more important (cumulatively) than later years for long-lived gases. It is possible the carbon budget is not recoverable within constraints (e.g. a negative consent processing time).

The key outputs from the two scenarios are the impacts on consent processing time, in terms of annual change compared to 2022 levels. The table below summarises these estimates.

Table 8: Annual change in consent processing time in Scenario 1 and Scenario 2

Scenario ID	Scenario description	Up to 2024 (average per annum)	2025-2033	2034-2050
Scenario 1	Observed trend continues unabated to 2050	10%	3%	3%
Scenario 2	Trends halted through legislative/regulatory reform	10.%	3%	-1%

The table below illustrates what Scenario 1 and Scenario 2 mean in terms of a hypothetical large-scale wind project of 100 MW capacity, for which consent applications are submitted today, in 2035 or in 2050. It shows the impact on consent processing time, consenting costs, and total emissions reductions that would be missed due to consenting delays.

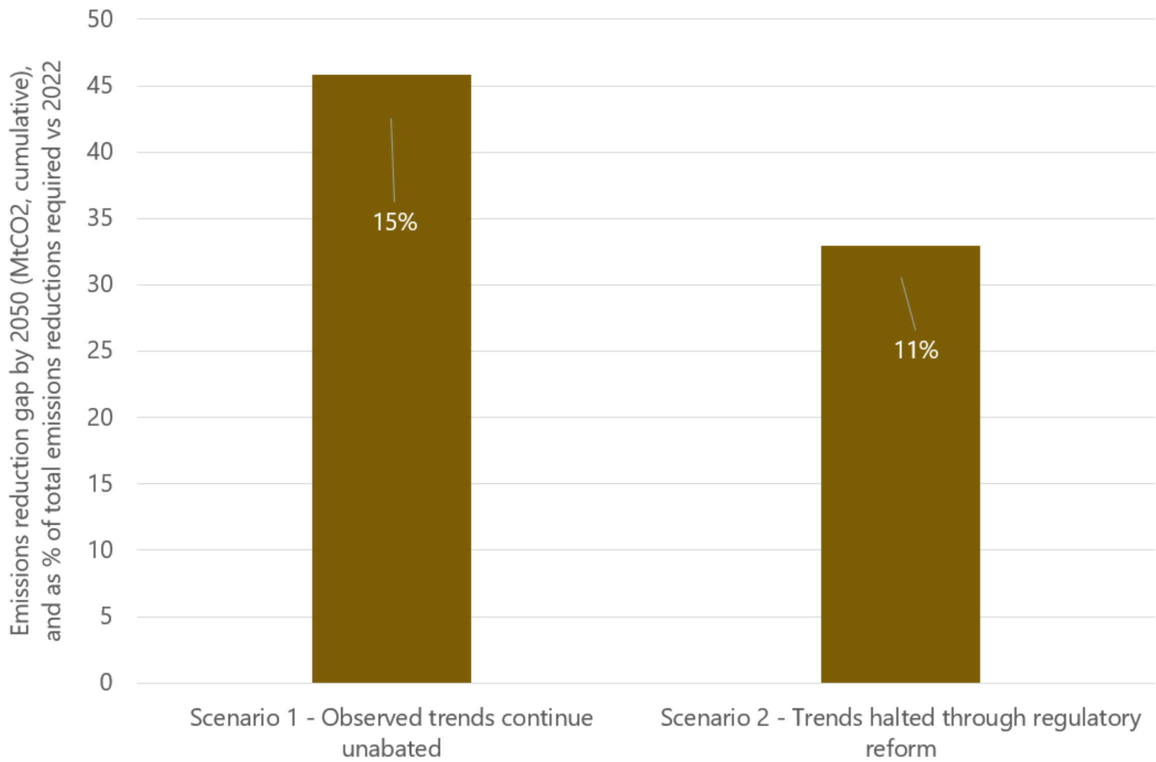
Table 9: Scenarios 1 and 2 applied to a hypothetical large-scale wind farm

	2022	2035	2050
SCENARIO 1			
Consent processing time (years)	3.84	6.04	9.4
Consenting cost ($m)	$5.7	$8.8	$13.5
Emissions reductions gap (MtCO2e)	0	0.33	0.59
SCENARIO 2			
Consent processing time (years)	3.84	5.6	5.1
Consenting cost ($m)	$5.7	$8.2	$7.4
Emissions reductions gap (MtCO2e)	0	0.27	0.13

7.1.1 We are on track to miss between 11 and 15 per cent of emission reductions required from the energy and transport sectors by 2050 compared to 2022 due to consent delays, even with unconstrained resources

Scenario 1 and Scenario 2 describe a range between 11 and 15 per cent of expected emissions reductions not occurring. These percentages correspond to a total shortfall of 33 and 46 MtCO2e over the period to 2050 respectively. This is shown in the figure below. We note that if current projects that are emissions reducing are not reconsented or are reconsented with lower operating capabilities, then the gap would be even higher.

Figure 32: Emissions reduction gap in the modelled scenarios



The figure below presents the scenarios in terms of emission reductions that do take place in the scenarios with a consenting system that has unconstrained resources.

Figure 33: Annual emissions reductions in the modelled scenarios

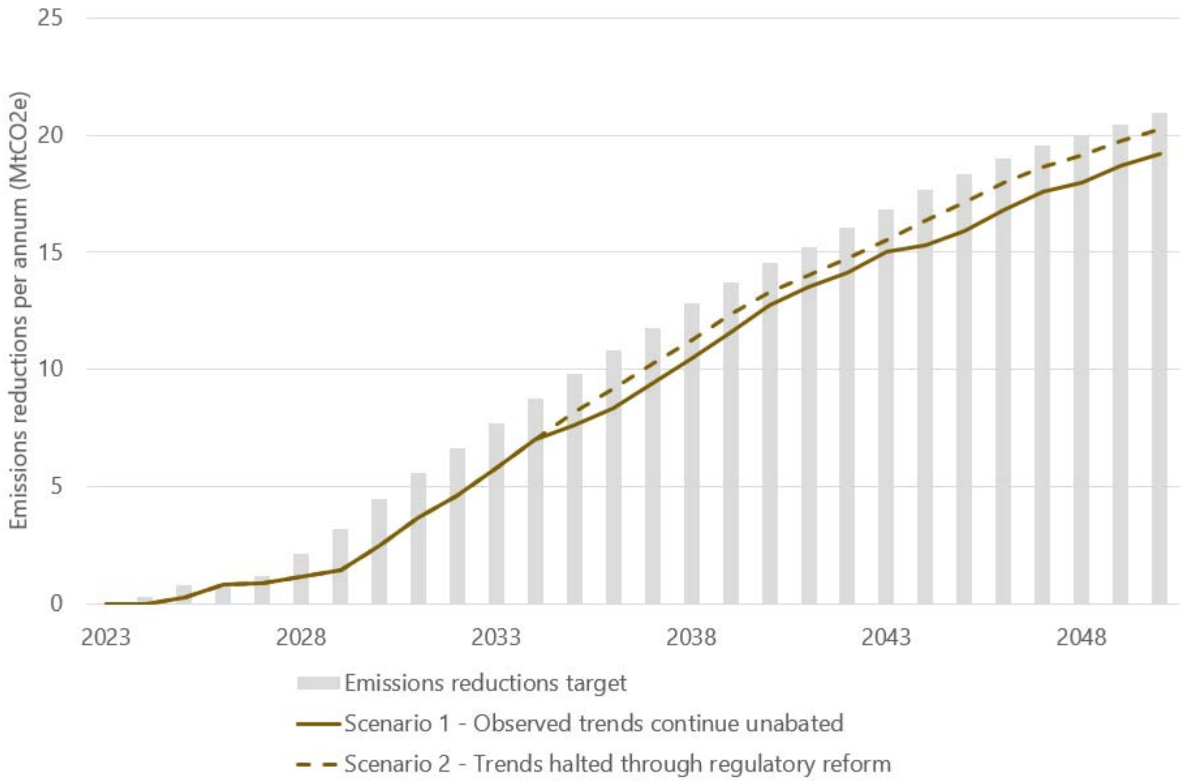
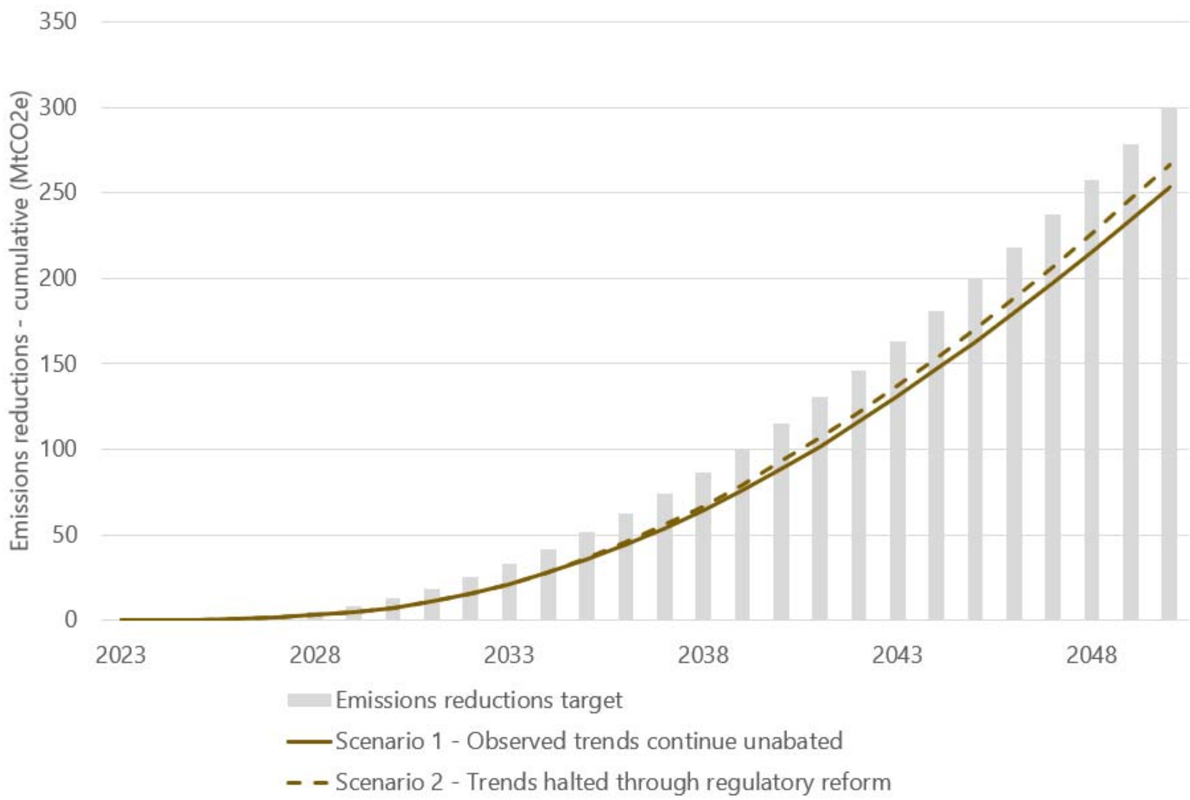


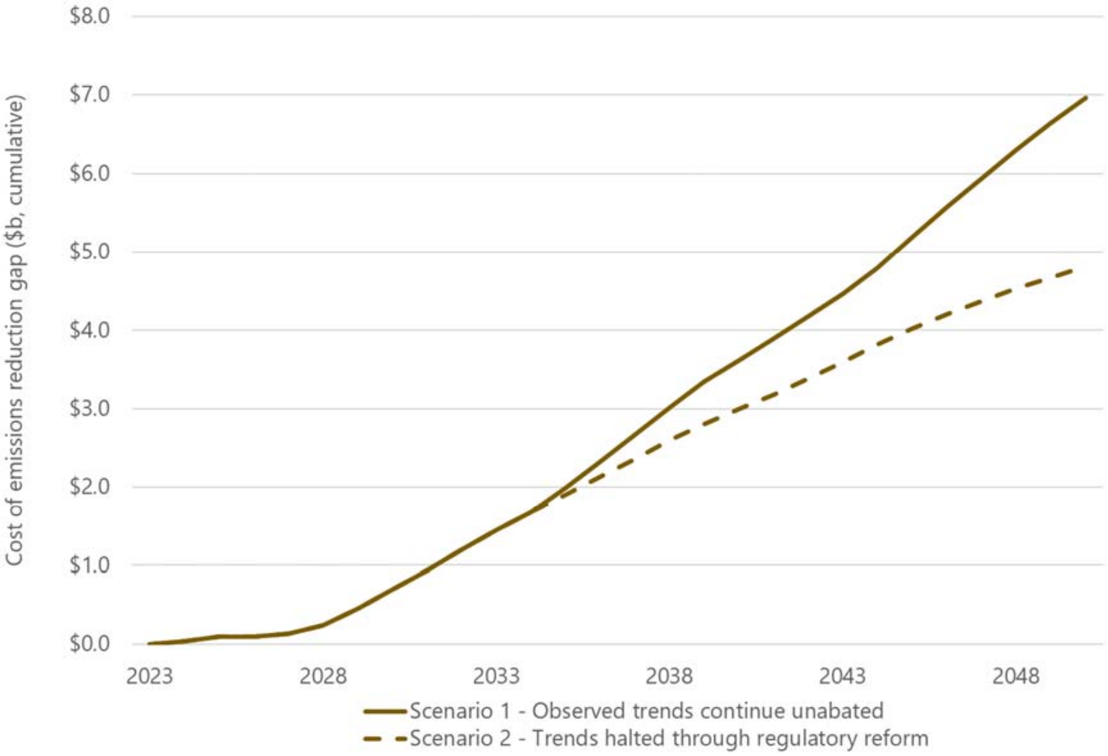
Figure 33a: Annual emissions reductions in the modelled scenarios – cumulative



7.1.2 As a result of these consenting delays, we are on track to incur an emissions liability of between $5 billion and $7 billion by 2050

The cost of the emissions reductions gap is estimated at between $4.8 billion and $7 billion in total through to 2050 in Scenario 2 and 1 respectively (Figure 34). The cost of the emissions gap was estimated on the assumption that any missed abatement from the energy and transport infrastructure projects would have to be offset with emissions reductions elsewhere in the economy. The cost of these emissions reductions would need to reflect the marginal abatement costs needed to deliver on the net-zero target domestically, and as such we adopt the New Zealand Treasury's shadow price of carbon.[28]

Figure 34: Annual cost of missed emissions reductions in the modelled scenarios



7.1.3 Halting trends in consent processing delays would not be enough to meet emissions reduction targets because of early emissions gaps caused by delays

An important observation is that emissions reduction gaps early in the period are not caught up, even when trends are halted (Figure 35).

[28] https://www.treasury.govt.nz/sites/default/files/2020-12/cbax-guide-dec20.pdf

Figure 35: Consent processing time for high and medium complexity projects in Scenarios 1 and 2

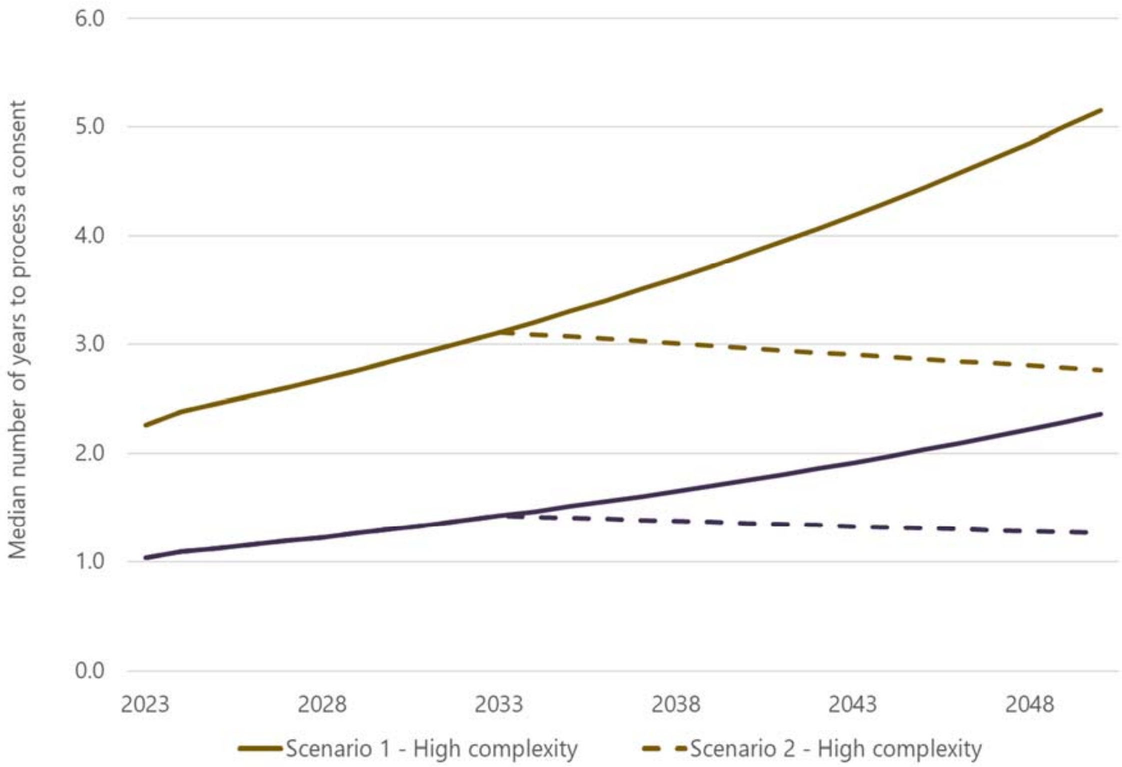
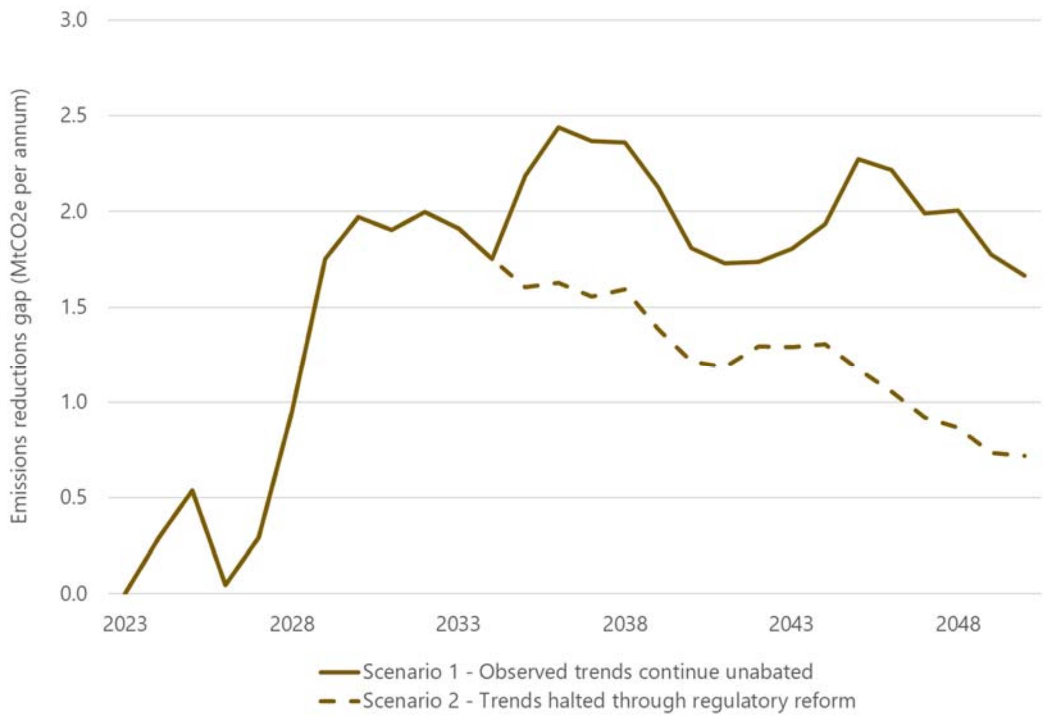


Figure 36 shows that halting the trends from 2034 can reduce the annual emissions reduction gap by 57 per cent in 2050, with the total gap being reduced by 13 MtCO2e over the 2023–2050 period.

Figure 36: Annual emissions reductions gap in the modelled scenarios



7.2 Will the resources be available?

It may not be plausible to think the consenting system has unconstrained resources and can continue to source skilled people to help process consents, whether that be domestically or internationally, or allow costs and time taken to process a consent to increase indefinitely.

There could be many reasons why a constrained system is more likely a reflection of reality, including upper bounds for feasible consenting costs (at which, projects would fall out of the pipeline and become economically unviable), and a tight and finite skilled labour market.

We posit two scenarios, Scenario A and Scenario B, that model a resource-constrained consenting system. The box below explains these scenarios in more detail.

Scenario A: Observed trends continue unabated to 2050, and the system is unable to call upon additional resources for consent processing

In Scenario A, the consent complexity increases as in Scenario 1, but a workforce constraint is applied. This constraint implies that the skilled labour demand is not met and is therefore represented through additional delay to consent processing times.

Consenting sector workforce is constrained to the rate of growth of population at 0.7 per cent p.a. (no effective increase in relative sector size in the economy). The number of consents is assumed to grow consistent with the expected growth in volumes in our pipeline analysis. On this basis, the number of FTEs per consent is declining every year (by 1 per cent per year on average).

The expected FTE requirement for all projects limits the ability of all projects to be commissioned.

This scenario could be a result of the overall market, or a subsector of specialists, or both, but the measured effect is that as resources become scarce, the impact is realised in increased delay.

Scenario B: Trends halted through legislative/regulatory reform, but the system is still unable to call upon additional resources for consent processing

In Scenario B the historic annual increase in effort per consent is removed from 2033.

The table below defines the key parameter, annual percentage increase in consenting time frame, of Scenario A and B.

Table 10: Annual percentage increase in consenting time frame for Scenario A and Scenario B, where resources are constrained

Scenario ID	Scenario Description	Annual % increase in consenting time frame
Scenario A	Observed trends continue unabated to 2050, and the system is unable to call upon additional resources for consent processing	5% per annum from 2025
Scenario B	Trends halted through legislative/regulatory reform, but the system is still unable to call upon additional resources for consent processing	5% per annum between 2025 and 2033, 1% thereafter

7.2.1 At some point, there must be a pragmatic threshold of consent processing time that becomes unfeasible and means projects are no longer pursued

It must be the case there is some pragmatic threshold of the time taken to process a consent at which point it becomes no longer viable for a developer to pursue a project. In the real world, this threshold is likely different for different agents and projects based on risk appetite and the economics of each project. For this analysis, however, we have assumed that the pragmatic level or threshold of the time taken to process a consent for an average project of high complexity is five years. If a consent for such a project takes longer than five years to process, then the project will not go ahead. For an average project of medium complexity, we consider a threshold of 2.5 years. On average across all sectors, these figures represent an increase of 125 per cent over the current consent processing timeframe.

Defining these thresholds allows us to see in Scenario A and Scenario B what impact a resource-constrained consenting system has on the ability to undertake the infrastructure pipeline necessary to meet the 2050 net zero target.

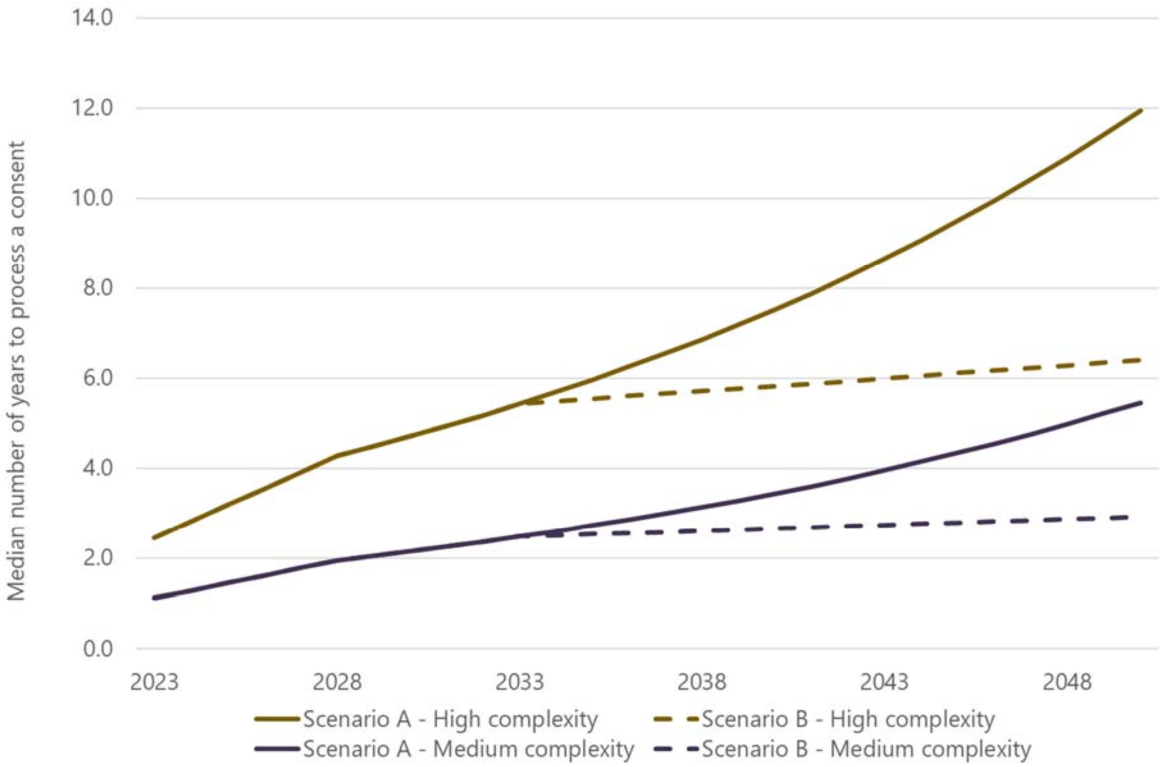
7.2.2 The resource consenting system could “break” after some limits to consent processing time are reached

Our modelling of Scenario A and Scenario B shows that the resource consenting system would “break” – projects would become unfeasible and no longer constructed – because of the exorbitant increases in the time taken to process a consent. Figure 37 shows that:

- In Scenario A, the threshold of five years is reached by 2032 for projects of high complexity. By 2050, consent applications would take 12 years to process. For projects of medium complexity, the threshold of 2.5 years is reached by 2033. By 2050, consent applications would take 5.5 years to process.
- In Scenario B, consent processing times are halved by 2050 thanks to relief from legislative/regulatory reform; however, it is still above the thresholds. To avoid the threshold being reached, the reform would need to take effect before 2030.

If developers are willing to absorb the costs of consenting delays, and if the projects do go ahead albeit with significant delay, we estimate that this would result in 29 per cent (86 MtCO2e) to 34 per cent (101 MtCO2e) of the emissions reduction target being missed by 2050 in Scenarios B and A respectively. The corresponding total emissions liability would be between $13 billion and $16 billion respectively.

Figure 37: Consent processing time for high and medium complexity projects in Scenarios A and B



8. Efficiency targets for resource consent processing

To achieve the net-zero by 2050 target, our modelling predicts that consenting timeframes for infrastructure projects would need to be capped at current levels from 2028 at the latest. This would imply that consent complexity needs to be halved by 2050 compared to today.

We model targets for consent process timeframes by focussing on median timeframes for projects of high, medium and low complexity. We then determine the annual change in these timeframes (in percentage terms), which we then apply to the specific assumptions on current processing times for projects in the energy and transport sectors.

8.1 Consent process timeframe targets

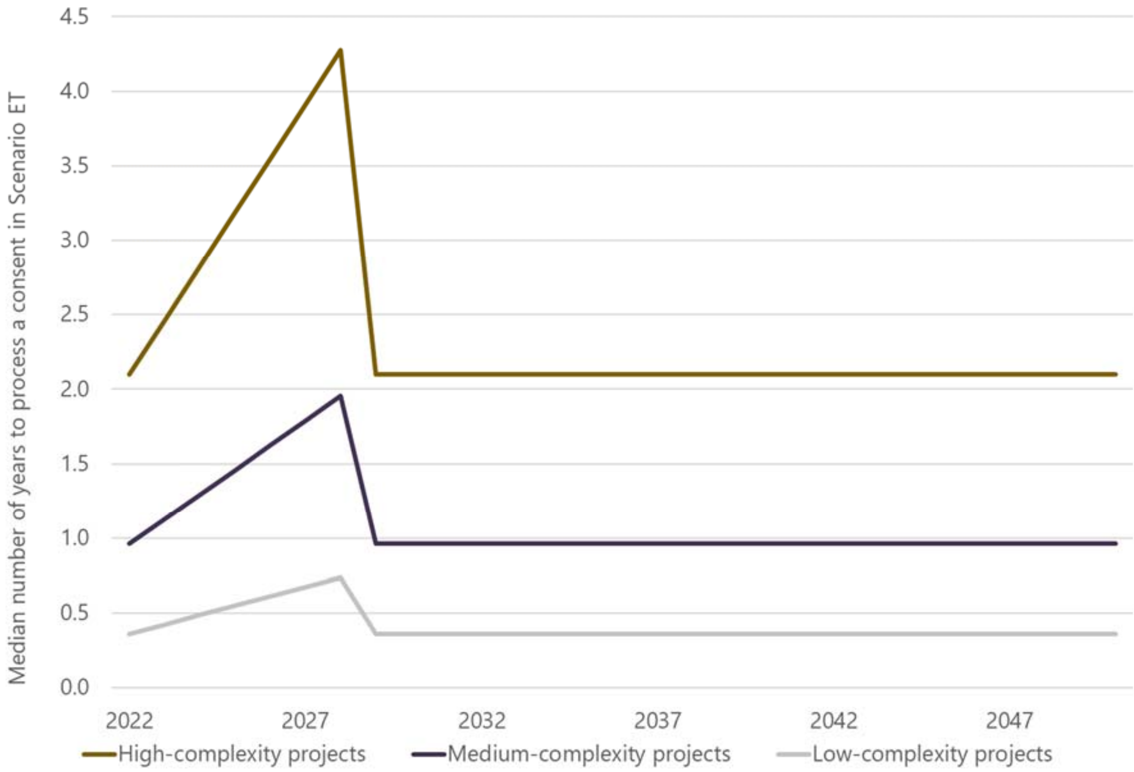
If we allow trends in effort per consent to continue for the next five years and assume there are resource constraints in the system as discussed in chapter 7.2, by 2028 consent processing time would double compared to today.

To reverse this effect, there would need to be an efficiency gain of at least 50 per cent in 2029 compared to 2028, such that consent processing times in 2029 revert back to 2022 levels. This describes a new scenario that we call "ET" (for efficiency targets). Thereafter, a mix of additional resources and reduced consenting complexity would be required to ensure that the duration of a consenting process does not increase as a result of the expected rise in consent volumes. Figure 38 illustrates the consent processing timeframes assumed in the ET scenario.

If the resource market is constrained (as modelled in Scenarios A and B), then in order to keep the consent processing (elapsed) time capped at 2022 levels, from 2030 there would need to be a 1 per cent reduction in consenting complexity per annum (measured as total effort per consent, or number of total days required by 1 full-time FTE to process a consent) to offset the 1 per cent annual decline in FTE/consent.[29] By contrast, if historical trends continue, total effort per consent would increase by 3.7 per cent per annum. Overall, to reach net zero by 2050, total effort per consent (or consent complexity) in 2050 would need to be reduced by 48 per cent compared to today and 61 per cent compared to 2028.

[29] FTE/consent decline because the annual growth in FTEs (0.7%, equal to population growth rate), is lower than the annual increase in the number of consents.

Figure 38: Median number of years to process consents in Scenario ET



We note that Scenario ET delivers 99 per cent of the required emissions reductions (Figure 39). The annual emission reduction gap is offset with a lag – in our case by 2030. Over this period, a total emissions liability of $372 million is incurred for a total gap of 2.9 MtCO2e (Figure 40).

Figure 39: Emissions reductions vs 2022 given the consenting efficiency target

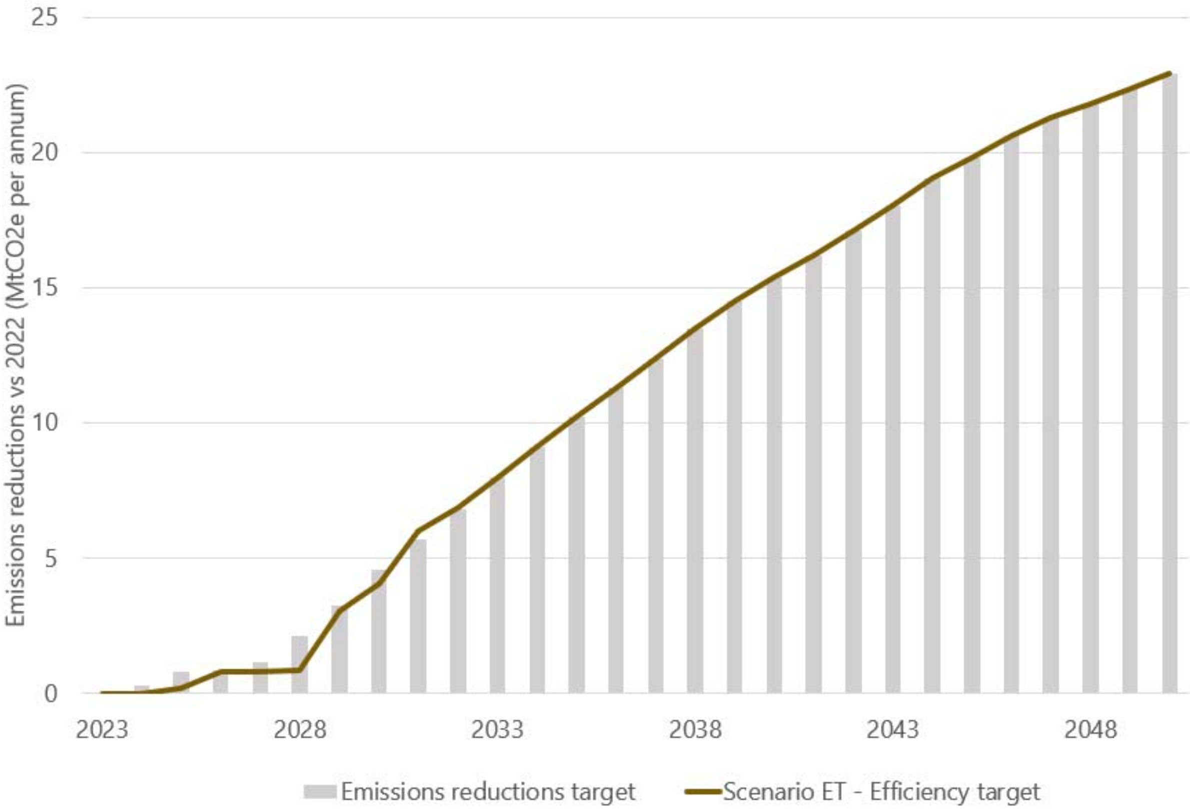
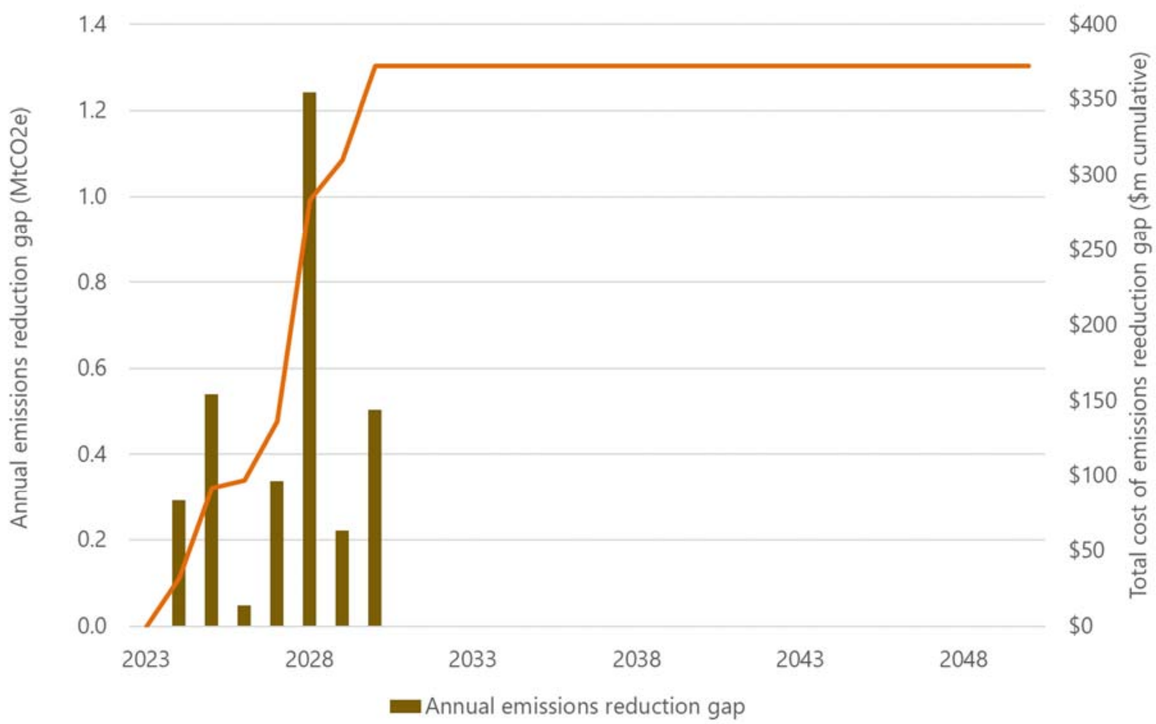


Figure 40: Emissions gap and emissions liability in the efficiency target scenario



8.2 Could demand-side tools help ease the burden on the consenting system?

Supply side initiatives can target an increase in the supply of consenting resources. Demand-side initiatives target the need for consents. The purpose of these demand-side tools would be to reduce the number (and scale) of consents that need to be processed, so that the consenting system can provide a more consistent and acceptable level of service to infrastructure developers with the resources that it has.

We can distinguish two types of demand-side tools that may help to improve the time it takes to process a consent and ease the burden on the consenting system. There are tools that reduce the demand for resources in the consent process (i.e. are less burdensome on the system, once the consent is in the system), and tools that reduce demand for additional infrastructure and therefore avoid the need for additional consents (i.e. not putting more consents into the system).

"Fast-track"-like processes that reduce demand for consenting resources may help

New Zealand has seen "fast-track" processes for consenting certain types of projects, which target processing times in the consenting system.. The COVID-19 Recovery (Fast-track Consenting) Act 2020, for example, was introduced with the purpose of:

- promoting employment and supporting New Zealand's recovery from the economic and social impacts of COVID-19
- supporting the certainty of ongoing investments across New Zealand
- continuing to promote the sustainable management of natural and physical resources.

This Act allows certain projects to be put before an expert consenting panel by the Minister for the Environment, which has the power to then grant consent based on a list of criteria (s 18) and bypass the conventional (and potentially longer) consent approval process. Subpart 2 of this Act includes specifics on the allowance of work on infrastructure to happen under the fast-track regime. Although largely untested, there is some sense this Act and the alternative consenting pathway it created have been successful In getting infrastructure projects up and running.[30]

The recently released Natural and Built Environment Bill, as part of the resource management reform, describes a specified housing and infrastructure fast-track consenting process (Part 5, Subpart 8). Use of this process would be permitted for the likes of (but not limited to):

- electricity distribution and transmission networks, plus renewal of consent for renewable energy generation, and wind and solar generation projects
- airports, ports, rail networks (including interisland ferry facilities), and the roading network (state and local) and rapid transit services
- the distribution or treatment of water, wastewater, or stormwater.

[30] For example, see https://www.russellmcveagh.com/insights/july-2022/fast-and-furious-getting-the-most-out-of-the-covid-19-recovery-fast-track-consenting-act.

Having a "fast-track"-like process, like that seen during and post the COVID-19 pandemic, and therefore prioritising and fast-tracking climate-change-related infrastructure consents, may help to ease some of the burden on the consenting system and make the emissions reduction targets more feasible. However, it is too early to say whether this particular pathway for infrastructure consenting will be successful in its aims. A 'fast track' type of process that achieved the goal of reducing consent processing times for climate related infrastructure has the potential to directly target the problem of blow outs in consenting time frames and therefore the likely failure to meet climate objectives.

Levers outside of infrastructure investment to control demand for consents

In theory, demand management could be used to control the consenting burden created by infrastructure projects by reducing the demand for infrastructure and therefore consents. The objective of demand management is to defer the need for infrastructure upgrades or construction, and therefore the need for consents (i.e. not putting more consents in the system).

In the transport sector the demand for resource consents for roads (as an example) is driven by population growth and use of vehicles. Use of other climate change mitigation levers outside of the investment on infrastructure, such as behavioural change, economic or pricing (for example congestion pricing), planning, and regulation may be able to impact the increasing demand for investment in infrastructure and consequently resource consents for roads by nudging people to shift transport modes (e.g. moving from private vehicles to existing train infrastructure).

It would be possible to use these alternative levers outside of investment on infrastructure to limit the demand for infrastructure and therefore the demand for consents. But doing so would require massive change in the way New Zealand as a society operates and to our collective choices such as how to allocate and prioritise land use and manage our work and lifestyle preferences so that we demand less infrastructure. Significant change like this may lead to fewer resource consents required for things like transport and energy distribution but may result in more resource consents being required for other critical enabling technology and infrastructure, such as fibre network extensions to allow working from home (i.e. there may be a substitution effect where the total quantum of consents required sees a relatively smaller change).

The ability to defer reconsenting for some projects may ease some of the burden on the system

The ability to defer reconsenting for infrastructure may help to ease some of the burden on the consenting system and leave consenting resources free to be applied to new infrastructure projects required to meet emissions reduction targets.

The consequence of implementing the ability to defer reconsenting is a clear trade-off between environmental effects and easing the burden on the consenting system. This is because by the time reconsenting is required (typically 20-30 years after initial consent), so much could have changed in terms of regulation, science, technology, the impacts of the infrastructure itself on the environment, and society's tolerance of these impacts.

A process of deferring a reconsent could be offered to consent holders if they are able to show no material issues have arisen since the project was initially consented. We expect this could be the case for some projects (likely smaller, non-infrastructure projects), but likely not for large infrastructure that typically has a range of complex interactions with the environment. As we have heard from planners, reconsents on significant infrastructure projects are effectively equivalent in terms of effort and evidence required to preparing a new consent for new infrastructure. The effect this process could have on easing the burden on the consenting system is ambiguous. But if the primary types of projects it applies to are small and non-infrastructure (and therefore generally less complex and burdensome in terms of time and effort), the impact this process has on easing consenting burden may be marginal.

Bundling of consents to introduce process efficiencies and streamline consent processing and approval

There may be instances where consent applications could be bundled across a suite of projects with similar characteristics. This would introduce process efficiencies and mean consents could be processed and granted in parallel.

We sense the opportunities for use of this process may be limited to relatively small or non-complex projects requiring resource consent, particularly given site-specific issues of projects varying across different projects within the suite. These site-specific issues would likely become more significant as the size and scale of a project increases, and particularly for infrastructure projects. These issues may be related to geography, and could include environmental impacts that differ by site, and the level of local and iwi consultation and their respective acceptance of the project and tolerance of its impacts. As such, the potential impact bundling of consents could have on easing the burden on the consenting system may be marginal.

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Appendix A Pipeline methodology

This appendix provides a rudimentary summary of how infrastructure is consented in New Zealand under the Resource Management Act and how we have developed the macro pipeline of resource consenting to 2050.

How infrastructure is consented in New Zealand

The Resource Management Act 1991 controls the interaction between the built and natural environment

The purpose of the Resource Management Act 1991 is to promote the sustainable management of natural and physical resources within New Zealand. As defined in section 5(2) of the Resource Management Act, sustainable management means managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural wellbeing and for their health and safety while:

- sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations
- safeguarding the life-supporting capacity of air, water, soil, and ecosystems
- avoiding, remedying, or mitigating any adverse effects of activities on the environment.

Infrastructure typically requires consent because of its activities and associated impacts on the natural environment

Infrastructure interacts with the natural environment in many ways depending on its purpose and associated activities. Infrastructure must typically be granted a consent under the Resource Management Act 1991, based on its purpose, associated activities, and the impact these have on the environment.

Infrastructure developers must apply for resource consent for infrastructure through consenting authorities (e.g. local councils). Consenting authorities then have the power under the Act to issue a resource consent for the proposed infrastructure purpose(s) and activities. Approval of consent is determined by a range of things specified within the Act, including how negative impacts of infrastructure on the environment are managed, monitored, and controlled to levels deemed acceptable through the system.

Consents are granted based on evidence base and must be revisited over time as the environment changes and evidence gets better

Approval requires:

- infrastructure to be designed to be efficient and within some determined threshold of acceptability of natural resource use and degradation, as set out in relevant standards and the Act
- the preparation and presentation of detailed and potentially complex expert evidence and thorough consideration of impacts for the consenting authority considering the application.

Only if the consenting authority is satisfied with the above will resource consent be granted. Consents can be granted for no more than 35 years as specified in section 123 of the Act. We have heard anecdotally, however, that 20 years is the more typical time frame for review and renewal of resource consents in the interest of not speaking for future generations.

Consenting authorities have the power under the Act to review consents over time to ensure activities are still aligned with society's views on natural resource use and degradation, and with local plans as they change. This is particularly important given technological advancements, improvements in evidence base, and the opportunity for infrastructure purposes, processes, and for activities to become more efficient and have less impact on the natural environment.

It is worth noting section 123(a) of the Act states coastal permits for reclamation and land use consents in respect of reclamation that would otherwise contravene section 13 can be issued in perpetuity.

Deriving the macro pipeline of consent activity to 2050

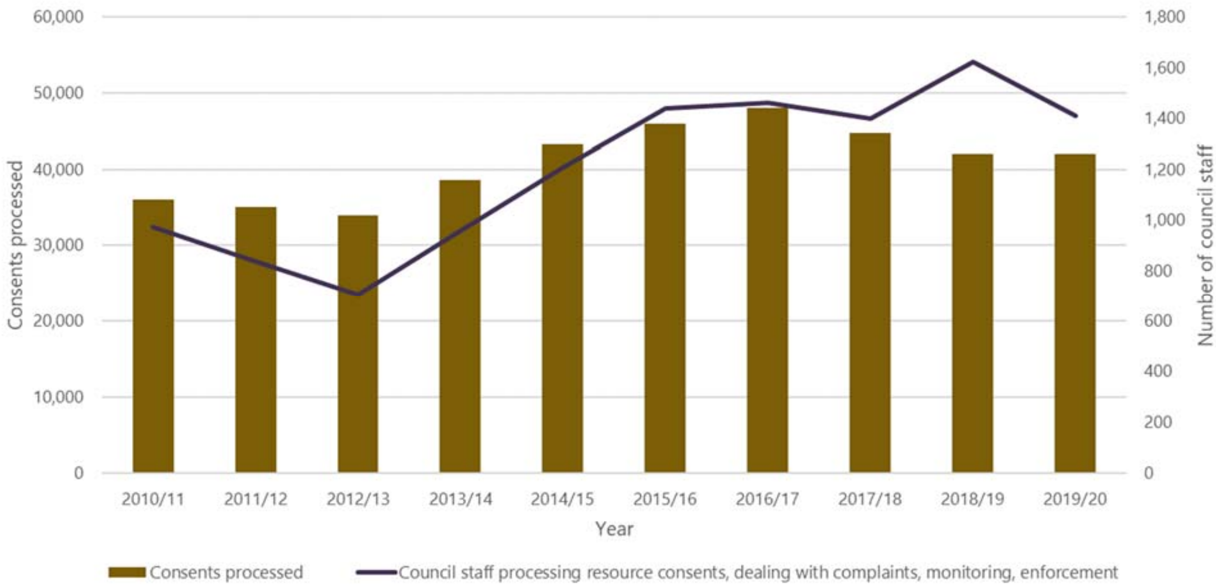
This section outlines how we arrived at a projected macro pipeline of consents, and the data sources we called upon in more detail. The basis of our projection is the MfE National Monitoring System (NMS), which is then extrapolated forward using long-term real GDP estimates from OECD.

MfE National Monitoring System (NMS) forms the basis of the pipeline

The MfE NMS (and previous RMA surveys done by MfE) collates information annually from local authorities on their implementation of the Resource Management Act. This information is publicly available on the MfE website. The NMS includes the number of consents processed by local authorities (reported at an aggregated national level) as well as the number of council staff engaged in processing of consents, dealing with complaints, monitoring consents, and enforcement activities.

The figure below shows the number of resource consents and council staff dealing with resource consents (processing, dealing with complaints, monitoring, and enforcement) from 2010/11 to 2019/20.

Figure 41: Number of resource consents and council staff dealing with resource consents, 2010/11 – 2019/20



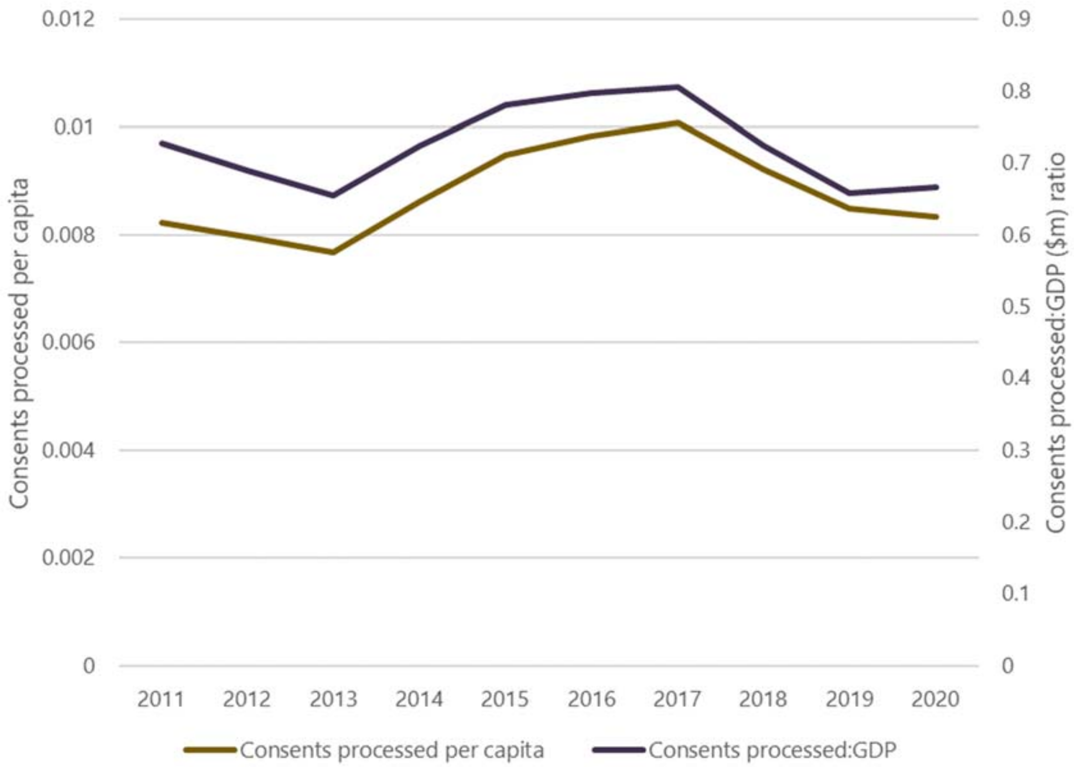
Source: MfE National Monitoring System (NMS)

These figures form the basis of our projection of consents to 2050.

The OECD real long-term New Zealand GDP forecast can inform the growth of the pipeline over time

We have used the OECD real GDP forecast to guide our projection of total consents. This choice was informed by a comparison of GDP and population growth over time and the observation that there is a stable relationship between these factors. Both GDP and population growth are assumed to be drivers of the consenting process because as society gets larger and relatively richer, we would expect there to be greater provision of infrastructure and construction development. The figure below compares consents processed per capita to the ratio of consents processed to GDP ($m) from 2011 to 2020.

Figure 42: Comparing consents processed per capita to the ratio of consents processed to GDP ($m)

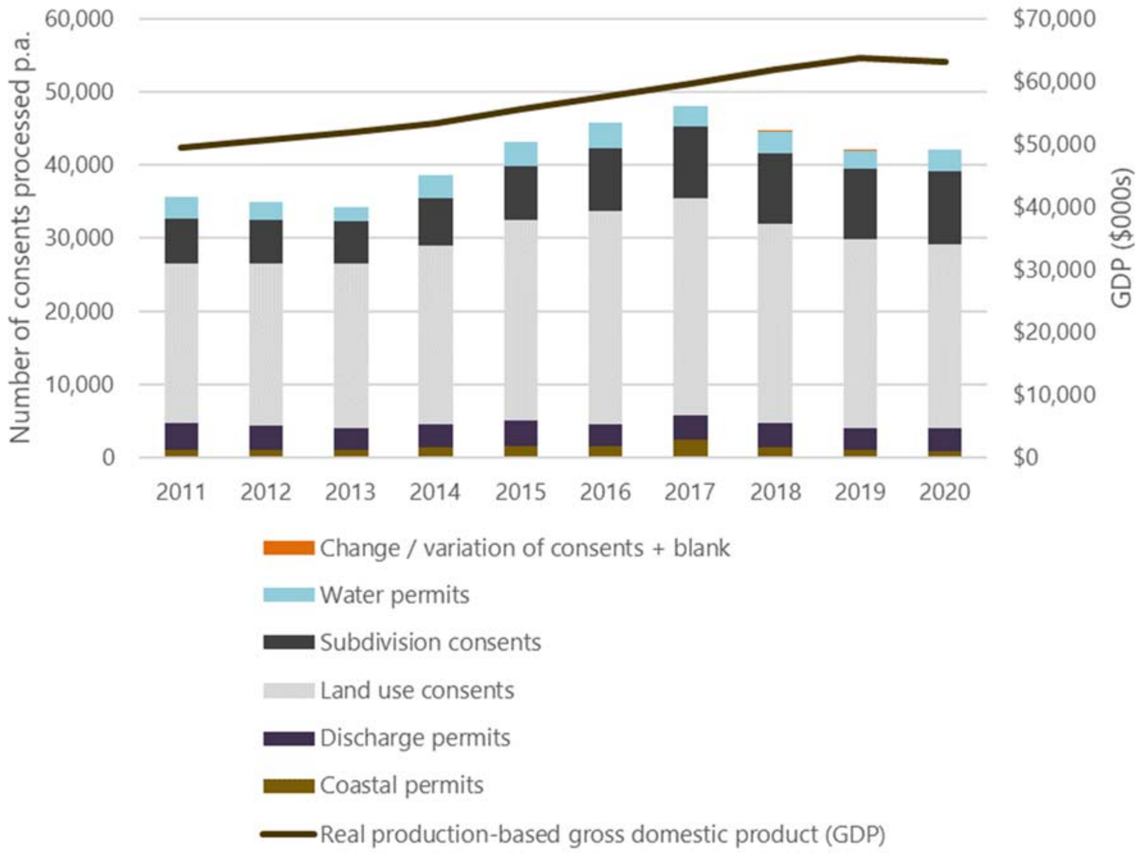


Source: Statistics New Zealand population estimates, Reserve Bank of New Zealand real production-based GDP (M5)

Consents processed per capita and the ratio of consents processed to GDP appear to move in relatively similar ways over time. The choice to use real long-term GDP forecasts rather than population projections to inform our projection of total resource consents to 2050 is based on the fact GDP over the period of 2011 to 2020 moves more closely to the changes in the number of land use consents processed, which may be reflective of business cycles and investment in development when markets are shifting.

The figure below overlays the real production-based GDP over the consents processed annually by local authorities from 2011 to 2020.

Figure 43: Consents processed, broken down by type, and real production-based GDP ($000s), annually 2011 – 2020

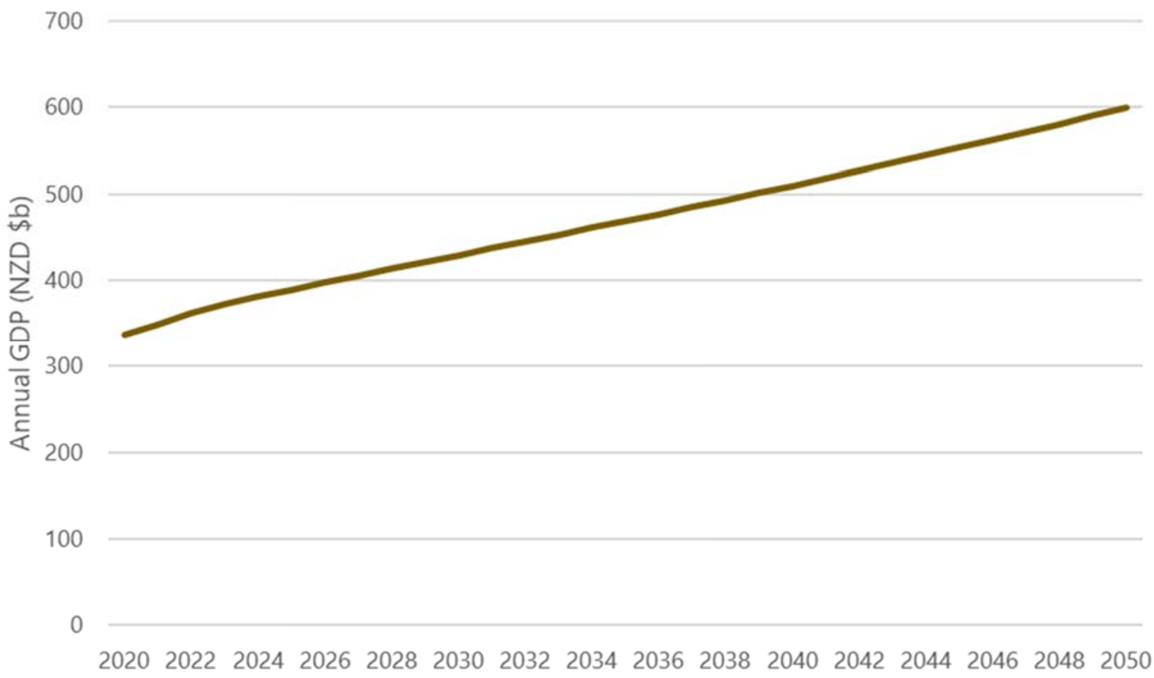


Source: MfE National Monitoring System (NMS), Reserve Bank of New Zealand real production-based GDP (M5)

OECD publishes real long-term GDP forecasts[31] for all OECD member countries out to 2060, based on an assessment of the economic climate of individual countries and the world economy. The forecast uses a combination of model-based analyses and is informed by expert judgement.

[31] The forecast can be found here: https://data.oecd.org/gdp/real-gdp-long-term-forecast.htm#indicator-chart. The 'real' GDP forecast accounts for inflation.

Figure 44: OECD real long-term GDP forecast[32]



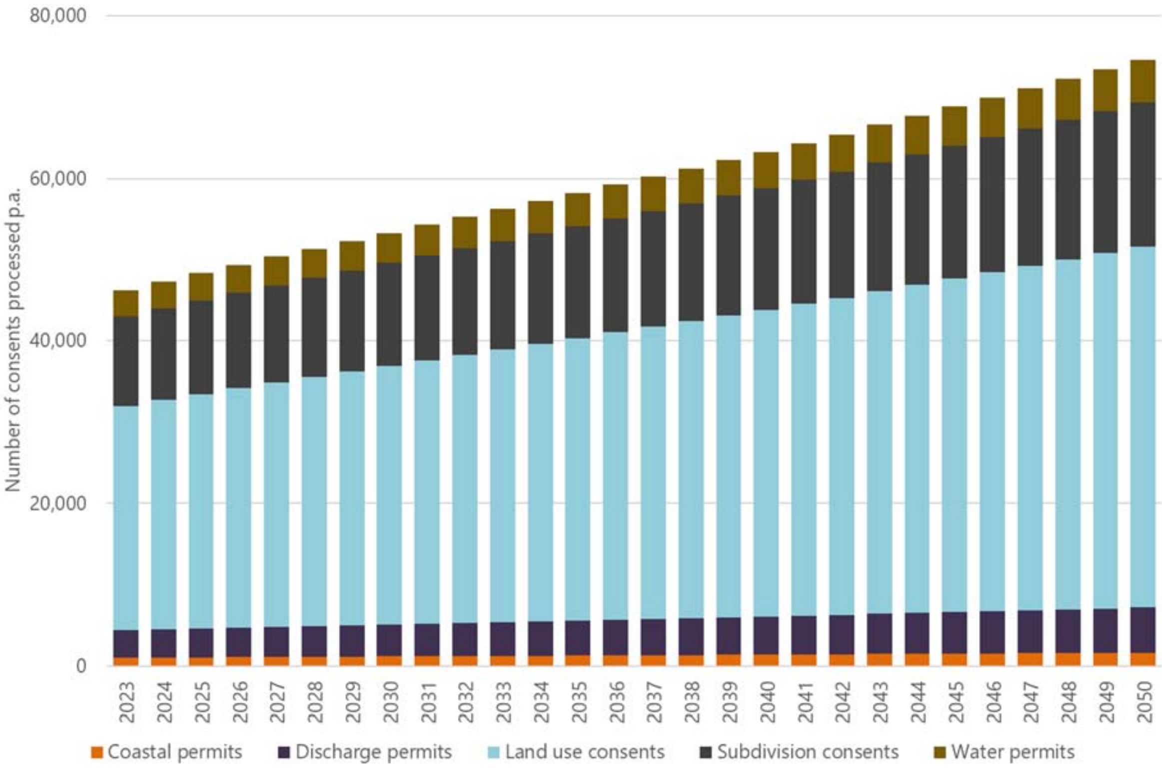
Source: (OECD, 2022)

We have taken the year-on-year percentage changes in long-term GDP to 2050 and used them in combination with the year-on-year changes in number of consent applications for the energy, transport, and housing-related infrastructure sectors to create a weighted-average year-on-year growth rate.

The figure below plots the pipeline projection using the weighted-average year-on-year growth rate.

[32] This forecast accounts for purchasing power parity and has been exchanged from USD to NZD using the rate of 1USD = 1.72NZD.

Figure 45: Projection of consents processed by type, using our estimates of projected volumes of consent applications, 2023–2050



There are some things we expect this projection to capture:

- Increasing population and GDP driving demand for consents, both for infrastructure and other construction activities that may require resource consent. This demand increase is through two channels – first, an increase in construction activity generally. Second, an increase in the quality and/or suitability of existing infrastructure and construction to meet new standards (either regulatory or imposed by society).
- A step-change in construction (and infrastructure requirements) to accommodate new technologies and ways of doing things. For example, uptake of large EV charging stations. Construction and infrastructure activities may be required within this time horizon that have not even been conceived yet.

Change in number of consent applications by sectors

To develop the pipeline for energy, transport, and housing-related infrastructure, we use our estimates of annual changes in the number of consent applications from our respective bottom-up analyses. The average year-on-year change in the number of consents is a weighted average reflecting the relative number of consent applications across the three sectors. The values are 2.3 per cent in 2023 dropping to 1.6 per cent by 2050.

Appendix B Targets for greenhouse gas mitigation and adaptation

Aotearoa New Zealand has committed to reaching net zero emissions of long-lived greenhouse gas emissions and reducing biogenic methane emissions between 24-47 per cent by 2050.

In this appendix we provide a summary of the CCC recommended paths, 2022-2025 ERP and the published regional emissions reduction plans. It provides background information on the greenhouse gas (GHG) emissions reduction targets and required activities and pathways for each sector, and more specifically each sector's infrastructure activities.

Climate Change Commission analysis

He Pou a Rangi CCC analysis shows that current Government policies do not put Aotearoa New Zealand on track to meet the 2050 targets.

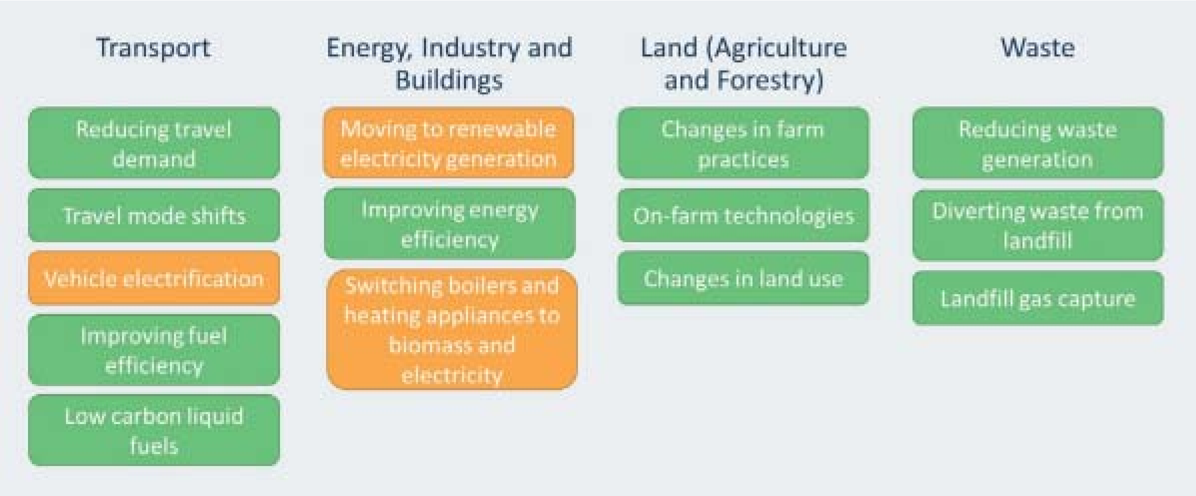
> "To achieve sustained and steady emissions reductions, Aotearoa must build a system that will support and drive these reductions." (Climate Change Commission, 2021, p. 29)

In May 2021, the CCC delivered its first advice to Government (Ināia tonu nei) on climate change action in Aotearoa New Zealand to detail the paths Aotearoa New Zealand can take to meet its 2050 climate targets. There are three parts in the CCC's advice as follows:

1. The levels of the first three emissions budgets that sets a limit on the total emissions allowed in Aotearoa for five-year periods out to 2050. The first three emissions budgets have been set for 2021-2025, 2026-2030 and 2031-2035 periods. These budgets chart a course towards meeting the 2050 targets. The CCC's modelling results show that the recommended budgets could see Aotearoa New Zealand reducing long-lived GHG emissions by 63 per cent and biogenic methane emissions by 17 per cent by 2035.
2. Direction on the policies and strategies needed in the Government's Emissions Reduction Plan (ERP) that details actions for meeting the first emissions budget. The ERP is discussed in more detail in the next section.
3. Advice on the Nationally Determined Contribution (NDC) and the eventual reduction in biogenic methane, as requested by the Minister for Climate Change.

The CCC has developed emissions reduction paths or 'scenarios' by combining a set of assumptions around technology costs, emissions values, and adoption of the various emissions reduction options across sectors. The CCC has used the Emissions New Zealand (ENZ) model to estimate the scale of the emissions reductions that are achievable in each sector when factoring in specific technologies and mitigation options. The ENZ is an economy-wide model that covers all the main emitting sectors in Aotearoa: energy, industry, transport, agriculture, forestry, product use, and waste. The model captures the major interactions within the energy system and between different sectors and chooses emissions reduction options in two ways as outlined in Figure 46.

Figure 46: Key emissions reduction options represented in the ENZ model[33]



Source: adapted from Climate Change Commission, 2021

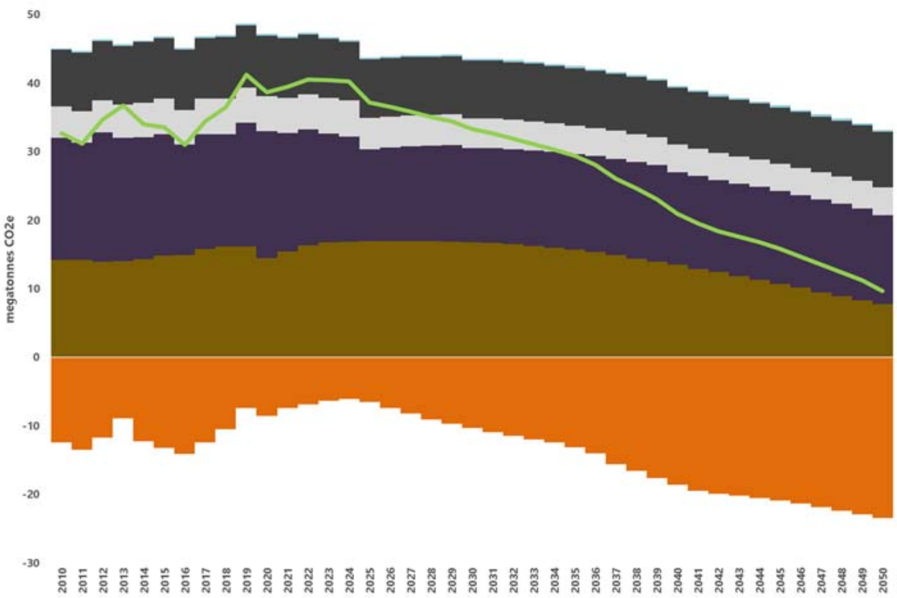
The CCC's advice comprises of six long-term scenarios to 2050 in addition to the current policy reference case. It also presents a demonstration path that includes the necessary actions over the next fifteen years to put Aotearoa New Zealand on track for the 2050 targets while delivering immediate emissions reductions and co-benefits. The demonstration path is closer to the more ambitious scenarios.

Figure 47 compares the demonstration path with the current policy reference. It shows the significant decrease in transport and non-transport energy required to meet the 2050 targets based on the CCC advice.

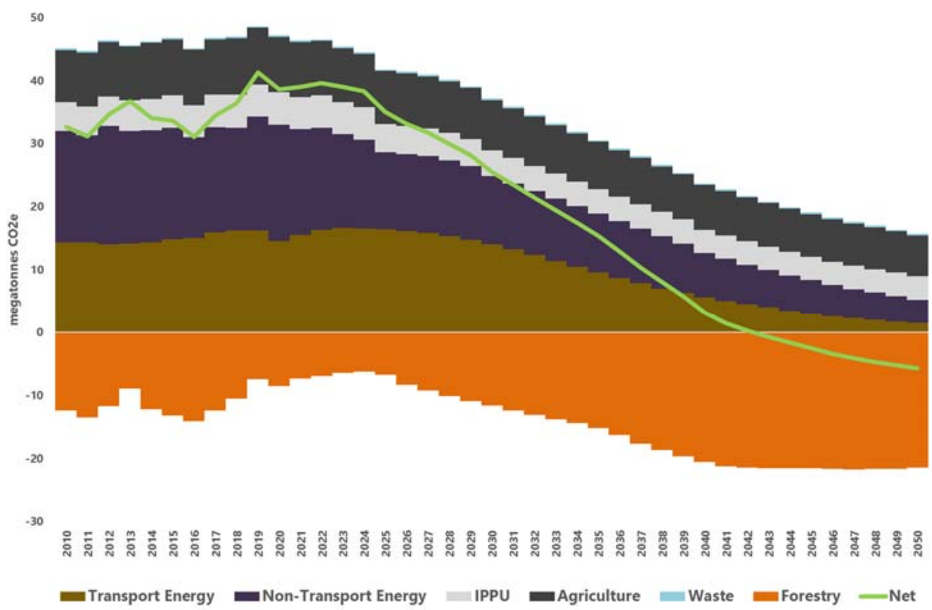
[33] For the options in orange boxes, the model simulates their uptake in each year based on costs, available resources, and other factors. For the options in green boxes, we specify their uptake as an input assumption in each scenario we run.

Figure 47: Climate change commotions demonstration path towards meeting 2050 targets compared with the current policy

Current policy



Demonstration path



Source: Climate Change Commission, Scenario's dataset 2021

The Emissions Reduction Plan (ERP)

The ERP sets out how Aotearoa New Zealand will meet its first emissions budget (2022–2025) and forge the path towards meeting our long-term climate targets. It is a key step in Aotearoa New Zealand's transition to a low emissions future. The ERP's total emissions budget is less ambitious than the CCC's advice. Table 11 compares the Government emissions budgets based on ERP and the CCC's proposed budget in 2021. It shows that the first emissions budget is the same as that recommended by the CCC, and the second and third emissions budgets are lower than the emissions budgets recommended by the CCC.

Table 11: The Government's emissions budgets ($MtCO_2e$)

ERP 2022					
Budget period	**2019 base**	**2022–25**	**2026–30**	**2031–35**	**Total**
All gases, net (AR5)		290	305	240	835
Annual average	78	72.5	61	48	
The Climate Change Commission's proposal 2021					
Budget period	**2019 base**	**2022–25**	**2026–30**	**2031–35**	**Total**
All gases, net (AR5)		290	312	253	855
Annual average	78	72.4	62.4	50.6	

Source: (Ministry for the Environment, 2022b)

Table 12 provides a summary of the ERP's targets by sector and infrastructure-related future actions.

Table 12: Summary of ERP

Sector	Percentage of total gross emissions (2019)	Long-term vision	Projected emissions without ERP (MtCO2e)	Projected average annual emissions without ERP (MtCO2e)	Projected percentage of total gross emissions without ERP	Estimated emissions reduction from ERP (MtCO2e)	Targets	Infrastructure related future actions
Transport	17% (& 39% of total domestic CO_2)	By 2035, Aotearoa New Zealand will have significantly reduced transport-related carbon emissions and have a more accessible and equitable transport system that supports wellbeing.	66.50	16.60	21%	1.7 to 1.9	Target 1 – Reduce total kilometres travelled by the light fleet by 20% by 2035 through improved urban form and providing better travel options, particularly in our largest cities. Target 2 – Increase zero-emissions vehicles to 30% of the light fleet by 2035. Target 3 – Reduce emissions from freight transport by 35% by 2035. Target 4 – Reduce the emissions intensity of transport fuel by 10% by 2035.	- Current action: major investments in public transport and rail infrastructure. - Improve electric vehicle charging infrastructure across Aotearoa to ensure that all New Zealanders can charge when they need to. - Deliver major public transport service and infrastructure improvements in Auckland, Wellington and Christchurch. - Substantially Improve infrastructure for walking and cycling. - Support infrastructure development for green fuels and fast charging for heavy vehicles.
Energy and industry	27%	By 2050, our energy system is highly renewable, sustainable and efficient, and supports a low-emissions and high-wage economy. Energy is accessible and affordable and supports the wellbeing of all New Zealanders. Energy supply is secure, reliable and resilient, including in the face of global shocks.	72.4	18.10	22%	2.7- 6.2	There are not clear targets available in this stage and setting targets for the energy system is one of the key actions. "setting a target for 50% of total final energy consumption to come from renewable sources by 2035". Transpower New Zealand estimates Aotearoa will need 70% more renewable generation to electrify process heat and transport, and decarbonise the economy.	- Accelerating the rollout of renewable electricity generation and infrastructure for electrification (such as electric vehicle chargers) will accelerate replacing fossil fuels in other sectors. - Support development and efficient use of transmission and distribution infrastructure to further electrify the economy.

Sector	Percentage of total gross emissions (2019)	Long-term vision	Projected emissions without ERP (MtCO2e)	Projected average annual emissions without ERP (MtCO2e)	Projected percentage of total gross emissions without ERP	Estimated emissions reduction from ERP (MtCO2e)	Targets	Infrastructure related future actions
Waste	4%	By 2050, Aotearoa has a circular economy that keeps materials in use for as long as possible. The waste sector has contributed to the 2030 and 2050 targets for biogenic methane and achieved a 40% reduction by 2035 (relative to 2017 levels). The sector has also met successive sub-sector targets.	14.20	3.50	4%	0.2 to 0.4	- Possible organic waste landfill limits/bans by 2030. - 40% reduction in biogenic methane by 2035.	- Strategic change: a new infrastructure plan will guide investment from 2022 – an infrastructure plan will sit alongside the Waste Strategy. This will guide investment into resource recovery and other waste minimisation infrastructure over a 10-year period. - Providing the services and infrastructure for kerbside organic collections makes it easier for households to manage their organic waste in a responsible way. - Investing in waste infrastructure and expanding landfill gas capture Invest in organic waste processing and resource recovery infrastructure. - Invest in sorting and processing infrastructure for construction and demolition materials.
Forestry		By 2050, Aotearoa New Zealand has a sustainable and diverse forest estate that provides a renewable resource to support our transition to a low-emissions economy. Forestry will contribute to global efforts to address climate change and emissions reductions beyond 2050, while building sustainable communities, resilient landscapes, and a legacy for future generations to thrive.	-24.30	-6.10	-8%	0.1: assuming permanent exotics are not restricted into the Permanent Post-1989 NZ ETS category -0.3 : assuming permanent exotics are restricted into the Permanent Post-1989 NZ ETS category.	Not specified	- Invest in expanding supply of woody biomass. - Greater investment in new and regenerating native forests to deliver a long-term carbon sink to offset emissions that are hard to reduce or remove.
Building and construction	9.4% (2018)	By 2050, Aotearoa New Zealand's building-related emissions are near zero and buildings provide healthy places to work and live for present and future generations.	32.50	8.10	10%	0.9 to 1.7	The Government is putting in place the systems and settings to facilitate a low emissions building and construction sector.	

Sector	Percentage of total gross emissions (2019)	Long-term vision	Projected emissions without ERP (MtCO2e)	Projected average annual emissions without ERP (MtCO2e)	Projected percentage of total gross emissions without ERP	Estimated emissions reduction from ERP (MtCO2e)	Targets	Infrastructure related future actions
Agriculture	50%	-	163.10	40.80	50%	0.3 to 2.7	Reducing these emissions is needed to achieve our 2050 target, including the requirement to reduce biogenic methane emissions by 24–47% by 2050.	- Improve rural digital connectivity to improve farm efficiency and access to information and online tools to reduce emissions. - Establish a new Centre for Climate Action on Agricultural Emissions to drive a step change in research, development and commercialisation of emissions reduction technologies.

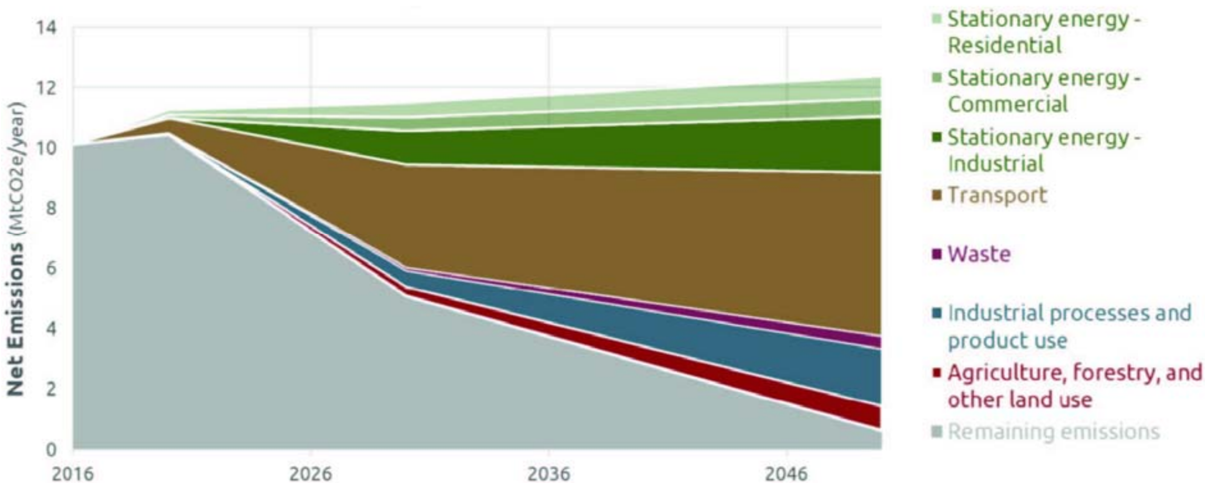
Major regional emissions reduction plans

In addition to the national targets and Government emissions budgets, main regional authorities have been working on their region's specific targets across key sectors.

Auckland has a focus on transport emissions reduction

Auckland Council adopted *Te Tāruke-ā-Tāwhiri: Auckland's Climate Plan* in July 2020, including a 64 per cent reduction in transport emissions (against 2016 levels) modelled as part of the target of halving overall emissions by 2030 and transitioning to net zero emissions by 2050. The plan (Figure 48) shows that to achieve the climate commitments, Auckland needs bold, ambitious climate action across every sector.

Figure 48: Auckland Council's modelled decarbonisation pathway



Source: Auckland Council, 2022

In June 2021, Auckland Council endorsed the *Regional Land Transport Plan (RLTP) 2021-31* subject to development of a transport emissions reduction pathway (TERP) jointly by Auckland Council and Auckland Transport. This work was deemed necessary as the RLTP investment programme only resulted in minor reductions in transport emissions by 2030, which is not in line with the requirements of *Te Tāruke-ā-Tāwhiri*. The remit of the TERP is to set out what needs to be true to achieve a 64 per cent reduction in transport emissions by 2030. The TERP document outlines:

- what the transport system needs to look like in 2030
- the systematic change that is required to archive reduction in reliance on cars and support people to walk cycle and use public transport
- the implementation of the pathway.

The main areas of change according to TERP that are relevant to infrastructure are listed below.

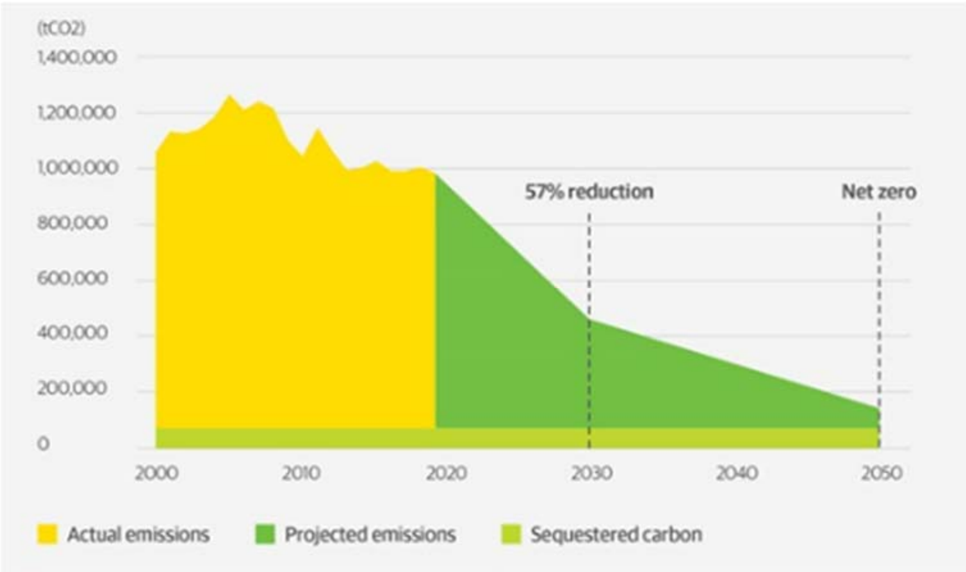
- Increased the share of walking (17 per cent) and cycling (22 per cent) trips would shift the focus from car-centric corridors infrastructure to active mode infrastructure.

- Targeted 32 per cent electric light vehicles by distance would increase the requirement for EV charging infrastructure.
- The infrastructure for public transport would increase to meet the targeted 23 per cent share of all trips.

Wellington's focus is on transport, energy, and the Council's activities

Wellington's *Te Atakura: First to Zero* climate action plan (Wellington City Council, 2020), adopted in 2020, sets out the key emissions reduction milestones and targets of the Wellington City Council. The 2021 update to the climate action plan includes a target of 57 per cent reduction in emissions by 2030, and 100 per cent by 2050.

Figure 49: Wellington City emissions and 2050 net-zero target pathway



Source: Wellington City Council, 2020

Infrastructure will be a critical component of Wellington's pathway to net zero. This is because, of Wellington city's gross emissions, transportation represents 52 per cent and stationary energy represents 34 per cent (Wellington City Council, 2021a, 2021b). Waste, industry, and agriculture represent 6, 6, and 1 per cent respectively. The wider plan is to reduce emissions to as close to zero as possible, then use forestry as carbon sinks to offset remaining emissions.

The table below shows the action areas identified by Wellington City Council in *Te Atakura: First to Zero*, and their GHG reduction potential annually at 2030.

Table 13: Action areas for Wellington city's decarbonisation journey

Action area	Examples of actions	GHG reduction potential per annum at 2030
Transportation	• Let's Get Wellington Moving • Shared mobility enhancements • Public places Electric Vehicles (EV) charger rollout	42,283 tCO2e 10% reduction in sector's emissions
Building energy & urban form	• Planning for Growth • Home Energy Saver Programme expansion • Business Energy Saver Pilot	15,116TCO2e 4% reduction in the sector's emissions
The Council itself	• Reducing the City's landfilled waste by one third by 2026 • Implementing the Energy Management Strategy & Action Plan • Converting the vehicle fleet to electric	22,644TCO2e 20% reduction in the Council's operational emissions

Source: Wellington City Council, 2020

Below breaks down the examples of actions for transportation and building energy and urban form action areas.

Transportation

Let's Get Wellington Moving (LGWM) is a joint initiative between Wellington City Council, the Greater Wellington Regional Council, and Waka Kotahi. It is focused on investment in rapid transit and improvements to public and active transport modes (such as bike networks).

Shared mobility enhancements refer to increased access to and provision of shared transport options such as car, bike, and e-scooter, so that people only use larger vehicles when needed.

Public places EV charger rollout would mean greater charging infrastructure provision around the city to make charging EVs easier, and therefore increase viability of owning and uptake of using an EV.

Other activities include accelerating the electrification of the city's vehicle fleet, incentivising flexible working arrangements, and identifying opportunities for emissions reductions in aviation and marine sectors.

Building energy and urban form

Planning for growth refers to the spatial and proposed district plans, which should consider increased migration to Wellington over the period and therefore propose high-density areas to encourage low-carbon travel.

The Home Energy Saver programme is about helping people who live in low-density and old housing stock upgrade and become more energy efficient. This plan proposes to expand the programme to ensure more households can access and benefit from the programme.

The Business Energy Saver programme proposed would be a similar process, where the Wellington City Council would conduct energy audits of businesses and provide them with personalised action plans to improve their energy efficiency.

Other actions include promoting better buildings in terms of energy efficiency, reducing construction waste, making buildings EV-ready, promoting solar community facilities, and supporting building sustainability improvements.

Christchurch has a range of planned emissions reduction activities

Christchurch City has set the target of achieving net zero GHG emissions by 2045 (excluding methane) and to halve emissions by 2030 compared to 2016/17 levels (Christchurch City Council, 2019). For 2018/19, the composition of the 2.72 million tonnes of CO2e emissions was (Christchurch City Council, 2021):

- 54 per cent transport (36 per cent from land transport)
- 19 per cent from homes, buildings, and businesses
- 15.3 per cent from agriculture
- 7.4 per cent from waste
- 4.2 per cent from industrial gases.

The *Kia tūroa te Ao*: *Ōtautahi Christchurch Climate Resilience Strategy* sets out Christchurch's climate response (Christchurch City Council, 2021). The strategy sets out multiple programmes of action, including greening infrastructure systems; carbon removal and natural restoration, development of a low-emission transport system; promotion of energy efficient homes and buildings; a zero-waste strategy; and sustainable food systems.

Below highlights the actions within transportation and energy and solid waste, two sectors of relevance for this project.

Transportation

For transportation, Christchurch City Council has two primary actions: transport and cycleway projects, and encouraging uptake of EV car sharing (Zilch) (Christchurch City Council, 2022). This includes parking; cycle networks; bus and PT infrastructure; carpool access; e-scooters and e-bike schemes.

Energy and solid waste

Energy and solid waste involves multiple actions to improve energy efficiency:

- Target Sustainability for businesses, which provides free support to Christchurch businesses to become more resource efficient and reduce waste.
- Eco-design advice for new homes.
- Healthier Homes Canterbury home renovations.
- Sustainable living education courses.
- Waste minimisation and recycling infrastructure and service provision for Christchurch residents.
- Eco-friendly packaging at Christchurch City events.
- Energy-efficient LED street light placement.
- Community food growing.

Appendix C Assumptions for the energy sector

Plant availability factors

Table 14: Generation plant availability factors

Plant type	Availability factor
Hydro	55%
Onshore wind	40%
Geothermal	95%
Utility solar	23%

Source: CCC assumptions

Built and consented generation capacities

Table 15: Built and consented generation capacities (GW)

	Total capacity built and operational	Total capacity consented but not built
Hydro	5	0.13
Wind	1.2	1.9
Geothermal	0.9	0.3
Utility solar	0	0.19
Battery storage	0	0.04

Source: Own analysis based on MBIE generation stacks, https://www.windenergy.org.nz/, Energy News.

Average size of a new generation project

Table 16: Assumption on the size of new generation and battery storage projects

		Complexity		
		High complexity	Medium complexity	Low complexity
Hydro	Distribution	0%	100%	0%
	Size (MW)	NA	3	NA
Wind	Distribution	86%	14%	0%
	Size (MW)	100	60	20

		Complexity		
		High complexity	**Medium complexity**	**Low complexity**
Geothermal	Distribution	22%	64%	13%
	Size (MW)	78	25	8
Utility solar	Distribution	75%	20%	5%
	Size (MW)	147	50	17
Battery	Distribution	0%	100%	0%
	Size (MW)	NA	67.5	NA

Source: Publicly available data on existing and announced projects, and on the authors' view on new generation.

Assumptions on capital expense by project type and complexity

Table 17: Assumptions on capital expense by type and complexity

Project type	Upper capex boundary for small projects	Upper capex boundary for medium projects
Hydro	$5,500,000	$150,000,000
Wind	$43,000,000	$115,000,000
Geothermal	$36,000,000	$107,500,000
Utility solar	$7,600,000	$48,000,000
Battery storage	NA	$72,000,000 – assume all projects are of medium complexity
Power grid – major seven inter-connection	NA	$175,000,000 – assume all projects are of high complexity
Power grid – connection	$17,500,000	$37,500,000
Power grid – distribution	$7,500,000	$17,500,000
Gas pipeline	$3,000,000	$17,500,000
Biogas plant	$7,500,000	NA

Source: Publicly available information on existing plant complemented by data from the Infrastructure Commission's pipeline https://www.tewaihanga.govt.nz/projects/. Values adjusted to be consistent with assumptions on average plant size.

Consent processing time and project build time

Table 18: Assumptions on consent processing time and project build time

Project type	Project complexity	Years to process a consent	Years to build a project
Hydro	High	5	11
	Medium	3.5	8.5
	Low	2.45	6.5
Wind	High	3.84	3
	Medium	2.69	2.1
	Low	1.88	1.5
Geothermal	High	1.95	3.9
	Medium	1.36	3
	Low	0.95	2.1
Utility solar	High	1	1.3
	Medium	0.7	1
	Low	0.1	0.7
Battery storage	High	1	1
	Medium	0.7	0.7
	Low	0.5	0.5
Power grid – transmission	High	3.75	5.1
	Medium	2.63	4
	Low	1.84	2.8
Power grid - distribution	High	0.21	4.6
	Medium	0.15	3.5
	Low	0.11	2.5
Gas pipeline	High	3	7.8
	Medium	NA	NA
	Low	1.47	1.4
Biogas plant	High	NA	NA
	Medium	NA	NA
	Low	2	1.3

Sources: (Concept Consulting, 2022), Energy News, Mitchell Daysh data, information on consents issued in 2021 by the Taranaki Regional Council, Meridian public data on assets, Infrastructure Commission pipeline (Te Waihanga, 2022). Where data was missing, an assumption was made that the variation in consent processing time between two levels of project complexity is 30%.

Assumptions to determine consenting costs in the energy sector

Table 19: Consenting costs as percentage of project capex

	Consenting cost as % project capex
Hydro	0.91%
Wind	2.8%
Geothermal	1.53%
Utility solar	2.8%
Battery storage	2.8%
Power grid – transmission	3.03%
Power grid - distribution	1.72%
Gas pipeline	6.48%
Biogas plant	2.8%

Sources: Mitchell Daysh data, (Moore, et al., 2021).

Approach to determining emissions reductions in the energy sector

Emissions reductions from renewable sources of energy are estimated on the assumptions that relative to 2022, hydro, wind and utility solar generation replace

- current thermal gas and coal generation for electricity production
- diesel and petrol for road vehicles (transport electrification)
- gas, coal and diesel for industrial process heat (electrification of food processing).

The baseline and counterfactuals are:

- Electricity
  - Baseline: current thermal capacity does not change relative to 2022
  - Counterfactual: current thermal capacity is replaced with renewables. Impact from new capacity required to meet increase in base demand and electrification is not modelled. This is because this demand for new capacity cannot be assumed to be provided by thermal plant in the baseline as it would be facing the same consenting issues as renewables. As such, it cannot be assumed that renewables covering increase in base demand and electrification would be displacing new thermal.
- Industrial heat for food processing
  - Baseline: current fossil fuel use for industrial heat does not change relative to 2022
  - Counterfactual: industrial process heat for food processing is electrified in line with CCC's Demonstration Path scenario. Electrification is provided by new renewable generation plant.
- Transport
  - Baseline: emissions intensity of road vehicles does not change relative to 2022.

- Counterfactual: road transport is electrified in line with CCC's Demonstration Path scenario. Electrification is provided by new renewable generation plant.

Because our pipeline projections are in terms of capacity (GW), our task was to derive avoided emissions in terms of MtCO2e/GW, based on the energy content of fossil fuels; assumptions on proportion of electricity generation for base electricity, transport electrification, and food process heat electrification; and generation plant capacity factors. Furthermore, because each energy project has different consenting parameters (e.g. time to process a consent, consent validity), our task was to estimate emissions reductions separately for each type of energy project.

Emissions reductions were internally determined by the model, with some calibration of input parameters so that aggregate output values align with total emissions reductions CCC's Demonstration Path scenario (excluding emissions reductions due to rooftop solar generation, Tiwai exit and renewable capacity that had already been consented).

The proportions of total new renewable electricity used to meet base electricity demand, transport electrification demand and demand for electrifying food processing were determined based on end-use electricity demand estimates from CCC's Demonstration Path scenario.

For base electricity demand, emissions reductions vs 2022 are attributable to the replacement of thermal generation with new renewable generation. The proportion of new renewable generation that is used to replace existing thermal generation was determined based on estimates of electricity generation by source in CCC's Demonstration Path scenario.

Based on our model's estimates and subsequent calibration, the implied emissions intensity of thermal electricity generation (including fugitive emissions) for base demand is 760 tCO2e/GWh in 2022. For the electrification of food process heat, emissions avoided per GWh of energy are 777 tCO2e/GWh.

For transport electrification, we derive avoided emissions per GWh of energy (emissions intensity factors) based on outputs from CCC's Demonstration Path. We determine emissions reductions from transport electrification in CCC DP scenario by first determining emission reductions from the decline in VKT, which is then subtracted from the sector total emissions reductions to give 106 MtCO2e avoided in total over the 2023-2050 period. Emissions intensity factors are then determined by dividing emissions reductions from transport electrification by total GWh consumed to electrify transport in CCC DP scenario. We estimate an average value of 644 tCO2e/GWh over the 2023-2050 period.

Appendix D Assumptions for transport sector

This appendix sets out the assumptions, process of estimation, and sources of data used as inputs in estimation of the transport infrastructure pipeline and the subsequent emissions reductions scenarios.

Process of estimating the transport infrastructure pipeline

The number of transport infrastructure projects estimated using the reviewed data sources while controlling for double counting the projects included in multiple sources. In this process the following steps were carried out.

- Forecasting the future NLTP expenditure was done using a linear forecast of the NLTP trends 2012–2020.
- Estimating the base land transport infrastructure projects required an estimate of average cost of projects by land transport activities to convert the pipeline information and NLTP trends information, that are all based on the expenditure in each activity class per annum, to number of projects. The number of projects in the implementation and construction phases of each activity class from the current NLTP versus their relevant total expenditure were uses to estimate an average cost per project in each activity class as the basis for estimating and forecasting the number of projects on three-yearly basis consistent with NLTP periods. Only the main activities related to infrastructure improvement were included in the analysis (i.e. public transport infrastructure, roads improvement, state highways improvement and walking and cycling).
- Comparing the forecasted number of projects with the information available from other data sources for example RLTPs and infrastructure commission's national infrastructure pipeline to sense check the project numbers to 2031.
- For other transport projects, i.e. rail, airport and port related infrastructure, we used the information available in Te Waihanga's pipeline, Infometrics' infrastructure pipeline, and RNIP.
- Scaling the investment in different transport activities proportionately with the difference in mode-specific passenger kilometres travelled (PKT) or freight kilometres travelled (FKT) between the current policy and the Climate Change Commission's Demonstration Path.
- The number of consents estimated using the number of new projects plus required infrastructure consenting.

Data

The following data sources were reviewed for an estimate of the total transport infrastructure pipeline to 2031. We then projected the pipeline beyond that to 2050.

- Regional Land Transport Plans (RLTPs 2021–2031), which define the future pathways of New Zealand regions' transport networks. The main plans reviewed were Auckland RLTP (Auckland Transport, 2021), Wellington RLTP (Greater Wellington Regional Council, 2021), and Canterbury RLTP (Canterbury Regional Council, 2021).

- The Auckland Transport Alignment Project 2021-2031 (Ministry of Transport, 2021) sets the strategic direction to the Auckland RLTP and outlines $31.4 billion of investment, of which almost two thirds is planned to be spent on new infrastructure. The main ATAP infrastructure projects include City Rail Link and associated wider network improvements, Light Rail, rail electrification to Pukekohe and delivery of third main rail line (Westfield to Wiri), significant programme of safety improvements, Connected Communities programme of bus priority, cycling & safety improvements, and a walking and cycling programme.
- Let's Get Wellington Moving (LGWM) (Let's Get Wellington Moving, 2022) is an ambitious plan including three packages: the three-year programme, city streets, and the longer-term programme. The focus of the three-year programme is to improve travel time and reliability of bus trips to and from the city centre and making a better environment for walking and cycling. The city streets package is designed to prepare Wellington for future growth and help the city to meet carbon targets towards becoming net-zero by 2050. The longer-term package includes projects that would substantially change how people get around in Wellington and includes Mass Rapid Transit (MRT) and an extra Mt Victoria Tunnel.
- The National Land Transport Plan (NLTP) (Waka Kotahi, 2021), which is a three yearly programme that includes activities funded through National Land Transport Fund (NLTF). The current NLTP 2021-2024 spent by project stage and project activity class,[34] trend of the NLTP spent 2012-2021 and significant regional activities identified in RLTPs that are expected to be considered for funding in the NLTP 2024-2028 (Waka Kotahi, 2022) are the main sources we used to estimate the transport infrastructure pipeline and more specifically post 2031 (the final year of current RLTPs).
- New Zealand Infrastructure Commission's National Infrastructure Pipeline (Te Waihanga, 2022b) that records some of the planned major transport infrastructure projects.
- The Infometrics infrastructure pipeline profile (Infometrics, 2022) that provides a reference for infrastructure projects and spending to 2031 across the country. This profile uses a bottom-up approach to understand what types of infrastructure spending are likely to take place and includes roading, ports, airports, and rail.
- KiwiRail's Rail Network Investment Programme (RNIP) (Kiwirail, 2021).
- The New Zealand public electric vehicles (EV) charger map (EECA, 2022) by Te Tari Tiaki Pūngao, Energy Efficiency and Conservation Authority (EECA), which shows the number and location of EV charging stations across the country.
- A range of consenting authority maps showing consents granted (Canterbury Maps, 2022; Greater Wellington Regional Council, 2022; Hawke's Bay Regional Council, 2022; Otago Regional Council, 2022; Taranaki Regional Council, 2022; Waikato Regional Council, 2022)

[34] Activity classes and work categories are groupings of similar outputs from investments through the National Land Transport Programme (NLTP). Investment management, road to zero, walking and cycling improvements, public transport services, public transport infrastructure, local road maintenance, state highway maintenance, local road improvements, state highway improvements and rail network and coastal shipping are the activity classes included in the 2021-24 NLTP. Each activity comprises at least one work category.

and other documents (Auckland Airport, 2018; Bently and Co, 2019; Christchurch Airport, 2017; Environment Canterbury, 2018; Golder Associates, 2018).

The main assumptions and data used for the rest of the process are listed in the table:

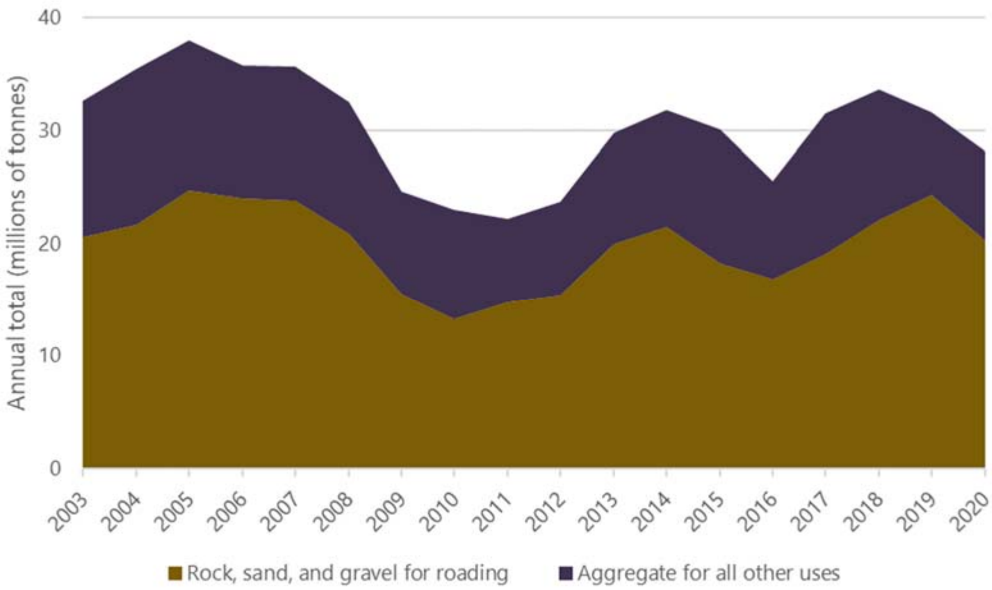
<table>
<tr><th colspan="4">Estimate of number of projects under CCC’s demonstration path</th></tr>
<tr><td>Household person-kilometres travelled by mode (million km)</td><td>Annual million km PKT 2023-2050</td><td>CCC’s demonstration path</td><td>https://www.climatecommission.govt.nz/our-work/advice-to-government-topic/inaia-tonu-nei-a-low-emissions-future-for-aotearoa/modelling/</td></tr>
<tr><td>Coastal shipping and Rail shipping freight mode share (per cent of tonne-kilometres)</td><td><table>
<tr><th></th><th></th><th>2019</th><th>2035</th><th>2050</th></tr>
<tr><td rowspan="2">Current Policy</td><td>Coastal</td><td>13.70%</td><td>12.80%</td><td>12.80%</td></tr>
<tr><td>Rail</td><td>12.40%</td><td>11.60%</td><td>11.70%</td></tr>
<tr><td rowspan="2">Demo path</td><td>Coastal</td><td>13.70%</td><td>15.9%</td><td>18.0%</td></tr>
<tr><td>Rail</td><td>12.40%</td><td>14.4%</td><td>16.4%</td></tr>
</table></td><td>CCC’s ENZ assumptions inputs 2021, final advice</td><td></td></tr>
<tr><td>Aviation PKT</td><td>Same as the current policy reference</td><td></td><td></td></tr>
<tr><th colspan="4">Estimate of required EV stations</th></tr>
<tr><td>Total number of public EV charging stations</td><td>306 (as at 07/09/2022)</td><td>306</td><td>https://www.eeca.govt.nz/insights/data-tools/new-zealand-public-ev-charger-map/</td></tr>
<tr><td>Total number of vehicles in the fleet by 2050</td><td>9155</td><td>CCC’s demonstration path</td><td>https://www.climatecommission.govt.nz/our-work/advice-to-government-topic/inaia-tonu-nei-a-low-emissions-future-for-aotearoa/modelling/</td></tr>
</table>

EVs per charger	The worldwide average in 2021 was 10 EVs per charger and 2.4 kW per EV	Global EV outlook 2022	https://iea.blob.core.windows.net/assets/ad8fb04c-4f75-42fc-973a-6e54c8a4449a/GlobalElectricVehicleOutlook2022.pdf
Number of chargers per station	2	Sapere's assumption	
Estimate of renewal consents			
Length of local road and state highways (Km)	**Highways, unsealed**: **32** **Roads, sealed**: 53936 **Highways, sealed**: 11021	Ministry of Transport 2019/2022	https://www.transport.govt.nz/statistics-and-insights/road-transport/sheet/length-of-road
Airports and ports reconsenting schedule	A range of consenting authority maps showing consents granted (Canterbury Maps, 2022; Greater Wellington Regional Council, 2022; Hawke's Bay Regional Council, 2022; Otago Regional Council, 2022; Taranaki Regional Council, 2022; Waikato Regional Council, 2022) and other documents (Auckland Airport, 2018; Bently and Co, 2019; Christchurch Airport, 2017; Environment Canterbury, 2018; Golder Associates, 2018)		
Estimate of number of new consents			
Consent application per infrastructure project	1	Sapere's assumption	
Average consent process time	**Low complexity**: 1 **Medium complexity**: 2 **High complexity**: 4	Sapere's assumption based on Sapere (2021)	
Average construction time	**Low complexity**: 1 **Medium complexity**: 3 **High complexity**: 6	Sapere's assumption	
Estimate of consenting cost			
Cost per consent application	2% of the average land transport project capex and 5,5 percent of average air and water transport projects:	Sapere's assumption based on Sapere (2021) and information on cost of transport projects	

Appendix E Input sectors for infrastructure

Constructing infrastructure requires input materials. For example, aggregate, ore, and steel are required to build roads and structures. Between 2003 and 2020, approximately two thirds of rock, sand, and gravel extraction in New Zealand annually was for the purpose of roading (New Zealand Petroleum and Minerals, 2022).

Figure 50: Aggregate production in New Zealand, for roading and total, 2003 – 2020



Source: New Zealand Petroleum and Minerals, 2022

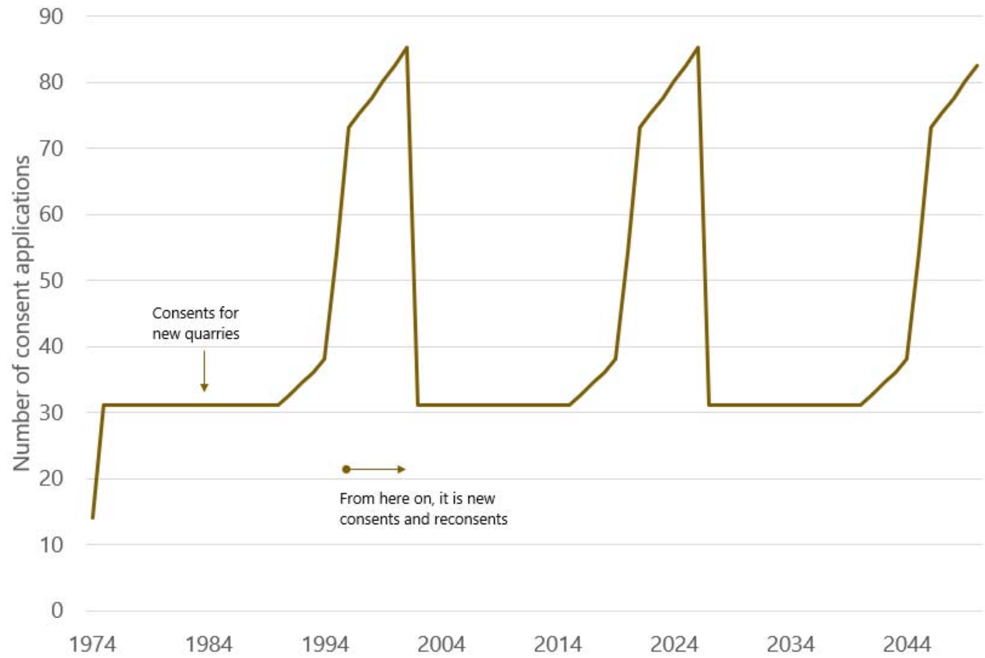
Quarries that produce and process these input materials used for infrastructure require consent for things such as water discharge, air (dust) discharge, and noise. Quarries, like other activities managed under the RMA, must be reconsented once the statutory time limit of their consent expires.

Quarries must be close to the site of the infrastructure to be efficient in terms of cost and emissions (i.e. less travel distance). This could raise issues if suitable sites for quarries, close by to infrastructure sites, are problematic in terms of consenting. We have heard it is getting harder to consent quarries. For example:

- New standards mean considerations and mitigations must be much greater – for example, new freshwater standards mean water runoff from quarries are considered wetlands.
- Sites of cultural significance e.g. taking sand from dunes of local cultural significance – concern the sand will not be replenished, or will be replenished with sand from other areas
- "Not in my backyard" (NIMBY) effect, whereby people do not want quarry activity in their surroundings.

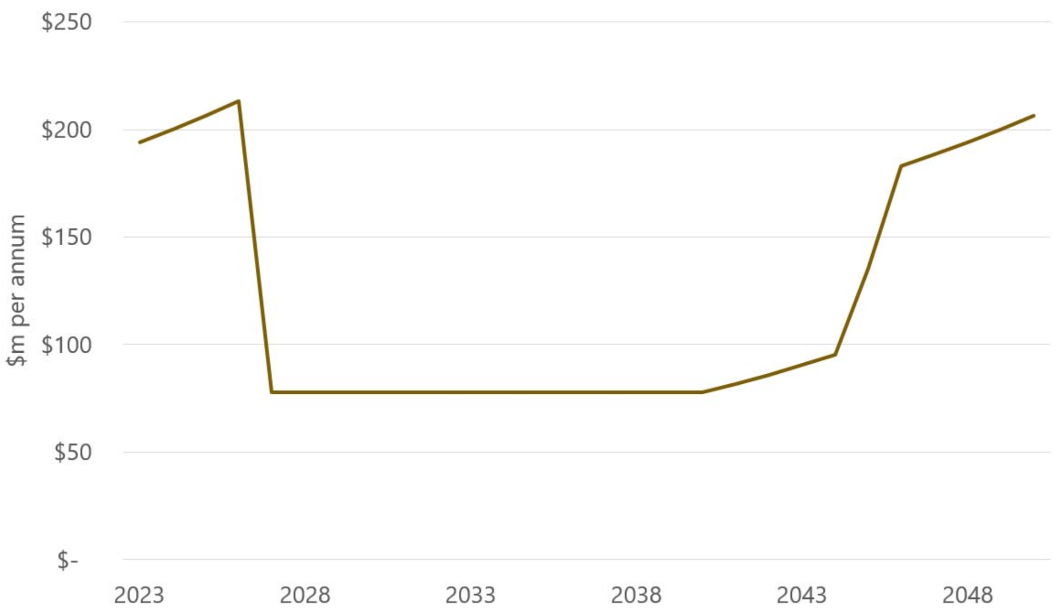
Based on minerals and coal expenditure statistics from the NZPAM, in the figure below we have estimated the number of consent applications for quarries. Information on reconsenting for quarries is not perfect. We estimate that there are 1,106 active quarries, 100 of which are complex. Evidence also suggests that reconsenting a quarry is just as complex as a new consent.

Figure 51: Number of consent applications for quarries



The figure below shows the expected cost of consenting and reconsenting quarries. Evidence suggests that a complex quarry cost approximately $2.5 million to consent.

Figure 52: Cost of quarry (re)consenting



The consequence of being unable to consent quarries can be considered in two main parts:

- Infrastructure that is reliant on inputs from quarries gets delayed. In the absence of sourcing inputs from elsewhere, this delay pushes out any associated emissions reductions and therefore increases the likelihood of failing to meet the government's emissions reductions targets.

- If the inputs are sourced from elsewhere (either existing quarries in New Zealand but further away from the site of infrastructure, or overseas), the infrastructure project may be completed on time, but there will also be potentially large emissions and costs generated from the transport.

Looking at quarries highlights that the issue of resource consenting for infrastructure is twofold – not just for the purpose of constructing the infrastructure, but also for getting the appropriate inputs.

About Sapere

Sapere is one of the largest expert consulting firms in Australasia, and a leader in the provision of independent economic, forensic accounting and public policy services. We provide independent expert testimony, strategic advisory services, data analytics and other advice to Australasia's private sector corporate clients, major law firms, government agencies, and regulatory bodies.

'Sapere' comes from Latin (to be wise) and the phrase 'sapere aude' (dare to be wise). The phrase is associated with German philosopher Immanuel Kant, who promoted the use of reason as a tool of thought; an approach that underpins all Sapere's practice groups.

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