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March 2022	*Summary of submissions*	*MBIE*

Information redacted **NO**

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Occupational regulatory regime for engineers

Cost-benefit analysis

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November 2021

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The central or midpoint assumptions and calculations in this cost-benefit analysis (CBA) result in licensing of high-risk practice fields and registration of all engineers, delivering a monetised net benefit of $292 million over 25 years with a BCR of 1.21. If only licensing of high-risk practice fields is included, there is a $203 million net benefit with a BCR of over 7.

In addition, there are significant benefits likely to be achieved which have not been monetised, such as more lives saved and reduced environment costs from avoided incidents. Mandatory registration and licensing for high-risk fields is expected to decrease the risk to public safety from engineering failure by increasing engineering standards. This risk can be large, though unpredictable and infrequent. Although we have discussed these potential benefits in our report, a high level of uncertainty means we have not included it in our monetised net benefit. Our benefits are therefore likely to be higher than the monetised benefit.

Table 1: Net result ($ millions, 25-year PV)

Category	Registration & licensing	Licensing only
Net costs	1,391	32
Net benefits	1,683	235
Net present value	**292**	**203**
BCR	**1.21**	**7.41**

Registration result is sensitive to the value placed on engineers' time

The registration result is sensitive to the value placed on engineers' time for continuing professional development (CPD) undertaken. The result depends on assumptions used about the opportunity cost of the time engineers spend on CPD. Would an extra hour of CPD displace an hour of billable work, or would this be more likely to substitute out leisure time?

If this time is valued at what we calculate to approximate a market rate for engineers ($116 per hour) instead of the midpoint value of $51 per hour, then the monetised net benefit result becomes an approximately $800 million net cost to society. However, we feel it is unlikely that all CPD undertaken will substitute for billable time, making the central estimate of $51 an hour an appropriate balance between the cost of lost work and leisure time.

Licensing result is more robust to parameter uncertainty

The high BCR estimated for the licensing-only option is the result of a small change in net costs and the decision on allocation of benefits between the licensing and registration components of the preferred option. The small change in net costs is due to the new licensing regime replacing the current CPEng scheme. About half of the current CPEng are under the high-risk practice field so are transferred to the new licensing scheme, while the other half of current CPEng will stop paying licensing costs once the new licensing system is phased in, and will be registered instead. Some of the current CPEng outside of structural, geotechnical and fire safety practice fields may be included in licensing at a later stage, but this CBA has not accounted for that outcome. The licensing result is not sensitive to the opportunity cost of engineers' time as there is little change in the level of CPD undertaken in the status quo versus the proposed licensing scheme.

Benefit estimation and allocation decisions subject to uncertainty

The benefits calculations and allocation decisions are not precise but represent use of the best available data and a preference for conservative assumptions, which means we consider our cost estimations to be on the high side and our benefits estimations to be on the low side.

The largest of the monetised estimated benefits comes from an efficiency gain resulting from increased CPD activity. There are several ways to think about the returns from CPD which will differ depending on the type and mix of CPD undertaken. For example, if the change in CPD resulted in an engineer developing a mentor relationship that would not have occurred otherwise, this would be expected to result in better career planning and may translate into faster career and salary advancement. Other types of CPD could increase the level of interprofessional interactions or the knowledge of the consenting process that might improve site management processes and reduce delays. We expect benefits from CPD to be shared by engineers and the public and to be at least equal to the costs of undertaking CPD.

There is also a strong argument for CPD based on knowledge decay. Translating the argument into monetised benefits is a highly speculative exercise.

Sensitivity testing of key parameters results in $4.7 billion range for the net result

We conducted extensive sensitivity testing as there is uncertainty about some of the key assumptions used. As shown in the sensitivity results in Table 2, it is possible for the registration and licensing of engineers to produce a net benefit of almost $2.7 billion or a net cost of almost $2.1 billion, depending on actual assumptions adopted. The costs associated with CPD and the current level of CPD activity is the main driver of this result. However, overall we believe our core assumptions reflect a conservative CBA approach, being on the low side for benefits and the high side for costs.

Table 2: Sensitivity of estimates to the primary sources of uncertainty ($ millions 25 year PV)

	Worst case	Central	Best case
Status quo costs	3,490	**2,438**	605
Forecast costs	9,120	**3,829**	1,510
Net costs	5,630	**1,391**	905
Net benefit	3,561	**1,683**	3,560
Net impact	- 2,069	**292**	2,655

Brief description of scenarios:

- The worst-case scenario uses the highest opportunity cost of time ($116), assumes no CPD outside of Engineering New Zealand (ENZ), the lowest cost of CPD activities, the upper range of registration costs, and the low discount rate of 4 per cent.

- The central scenario uses the central opportunity cost of time ($51), 20 hours of CPD outside of ENZ, the midpoint for the cost of CPD activities, and the central discount rate of 5 per cent.
- The best-case scenario uses the lowest opportunity cost of time ($10), no CPD outside of ENZ, the low cost of CPD activities, the upper range of registration costs, and the low discount rate of 4 per cent.

These scenarios result in a spread of $2.9 billion in status quo costs, $7.6 billion in forecast costs, and $4.7 billion in net costs. Interestingly, although there is a spread of $1.9 billion in net benefits, the low and high estimates are within one million of each other. This small difference arises from using the assumptions of no CPD done outside of ENZ, low cost of CPD activities, and the 4 per cent discount rates across both the worst and best case scenarios – assumptions that generate the largest range in net impact. The $4.7 billion spread in net impacts is therefore primarily driven by changes in net costs, which largely reflect the uncertainty in our estimation.

1. Introduction

Occupational regulation of a profession aims to protect the public from the risks of an occupation being carried out incompetently or recklessly by addressing the failures that are present in the market for the services of the occupation. The Ministry of Business, Innovation and Employment (MBIE) has consulted on reforms to occupational regulation of engineers twice before, but due to feedback, neither time has the process resulted in the introduction of new occupational regulation for engineers.

In response to the feedback received during the 2019 consultation, MBIE has developed a new proposal for an occupational regulatory regime for engineers, with a wider scope, encompassing all professional engineers. MBIE released a discussion document for consultation in May 2021. MBIE has analysed feedback and further refined the proposal. Details of the proposal are available in the *Discussion document - A Proposed Occupational Regulatory Regime for Engineers* and the Regulatory Impact Statement for the Occupational Regulation of Engineers, summarised in section 1.2 below.

MBIE engaged Sapere to develop the regulatory impact statement (RIS) and undertake a cost-benefit analysis (CBA) on proposed licensing and registration of engineers.

This CBA provides the detailed analysis to support the development of the RIS.

1.1 Policy objectives

MBIE's primary aim when designing an occupational regulatory regime for engineers is to:

> *Give people confidence in the engineering profession and to protect the public from harm caused by negligent, reckless, or dishonest behaviour.*

This aim results in the following four primary objectives to assess MBIE's options against the status quo:

- engineers provide engineering services with reasonable care and skill,
- engineers are operating within their areas and levels of expertise,
- regulation is proportionate to the risks to public safety and wellbeing, and
- engineers can be held to account for substandard work or poor behaviour.

1.2 Options considered

MBIE's discussion document considered four options to regulate engineers in addition to the status quo option:

1. **The status quo** – retaining the current CPEng regime under the Chartered Professional Engineers of New Zealand Act 2002 (CPEng) and continuing to rely on ENZ enforcing standards with its members.
2. **Voluntary certification and licensing** – a new voluntary certification regime would act as a mark of quality for engineers. It would be complemented by a new licensing regime for engineers working in high-risk practice fields.

3. **License high-risk practice fields only** – engineers practising in specific high-risk practice fields would need to be licensed; other engineers would not. This licensing would ensure engineers working in high-risk practice fields are competent and held accountable for their work.
4. **License all practice fields** – all engineers would require a licence to work in their practice field. This could mean an engineer needs to hold several licences to practise.
5. **Mandatory registration and licensing for high-risk practice field** – all professional engineers must be registered, and high-risk practice fields would be restricted to engineers licensed in that field. This is the preferred option as it best meets our objectives.

1.3 Approach to assessing options

In our RIS we undertake a high level multi-criteria analysis (MCA) of the four options plus the status quo against objectives. Based on this analysis we eliminate the lowest scoring options, which are **Voluntary certification and licensing** and **License all practice fields**. This analysis is set out in the RIS for the Occupational Regulation of Engineers.

The two remaining options are **License high-risk practice fields only** and **Mandatory registration and licensing for high-risk practice fields**.

We undertake a detailed analysis of costs and benefits of these options. The **preferred option** is **Mandatory registration and licensing for high-risk practice field**.

1.4 Mandatory registration and licensing for high-risk practice field

This section describes the preferred option -Mandatory registration and licensing for high-risk practice field.

1.4.1 Registration requirements

An engineer would need to meet a minimum standard before being registered. This is the approach taken for registered architects in New Zealand, where the regulator is responsible for setting the minimum standard for registration by way of requirements set out in rules developed in consultation with the profession and approved by the Minister for Building and Construction.

Registered engineers would be entitled to call themselves ‘professional engineer’. It would become an offence to call oneself a ‘professional engineer’ without being registered.

All registered engineers would be subject to a code of conduct, Continuing Professional Development (CPD), and a complaints and disciplinary process, with the regulator responsible for developing the code of conduct and running the complaints and disciplinary process.

Engineers registered under other regimes

The regulator will have the ability to automatically deem some engineers as being registered as part of transitional arrangements (ENZ members and CPEng).

Most heavy vehicle engineers, recreational safety engineers, design verifiers, and some electrical engineers would be able to be accommodated in the new regime. They would become registered and would continue to be assessed by the current regulator unless they are transitioned to licensing in the future.

To avoid duplication, engineers registered by the Electrical Workers Registration Board (EWRB) are likely to be recognised by the new regime as the EWRB requirements currently fulfil most of the objectives of the proposal.

Overseas engineers would need to be registered to practise unsupervised in New Zealand

To recognise Trans-Tasman Mutual Recognition Agreement obligations, engineers registered in Queensland, New South Wales, and Victoria in Australia would be entitled to register in New Zealand without needing to demonstrate their qualifications. New Zealand would also recognise engineers registered in other Australian states and territories if registration schemes are established there.

1.4.2 Minimum standards

At a minimum, MBIE anticipates that a registered engineer would have an engineering qualification and be a fit and proper person. There is likely some level of experience or assessment of competency required which would increase compliance costs for engineers and the regulator.

Code of conduct

A code of conduct sets the minimum standards of professional behaviour. A code of conduct can build the public's trust in a profession and establish a common understanding within the profession of what behaviour is acceptable and what is not. Engineers that are CPEng or members of ENZ are already subject to a code of conduct.[1]

Continuing Professional Development

Registered engineers would be expected to undertake CPD to maintain and improve their skills and knowledge.

Many professional engineers are already committed to CPD, with ENZ members committing to 40 hours a year. The regulator would be able to recognise professional development schemes from appropriate organisations and membership bodies to prevent unnecessary cost and effort for regulated persons.

Qualifications check assessment

This will be an assessment of level of experience or/and qualifications.

[1] See https://www.engineeringnz.org/engineer-tools/ethics-rules-standards/code-ethical-conduct/

1.4.3 Licensing

The proposal is to set up a framework to restrict certain engineering practice fields to engineers licensed in that field. The regulator will be responsible for determining eligibility requirements for each licensing class. It is expected requirements will vary by licence class.

The regulator will have a range of tools to check a licensed engineer's ongoing competency. These tools could include audits of an engineer's work, both randomly selected and in response to complaints, or requiring an engineer to re-sit exams. The tools used to check competency would reflect the licensing class and the level of risk involved.

1.4.4 Implementation

Legislation will establish a regulator and set a requirement for all engineers to be registered, with engineers in high-risk fields also requiring licensing. MBIE propose licensing will be phased in over a transitory period of up to six years, with registration taking priority over licensing in the near term.

The legislation will detail:

- the minimum requirements for registration,
- the practice areas that will require a licence and minimum requirements to be met to be eligible to obtain a licence, and
- continuing professional development requirements.

The detail of the legislation will influence the costs and benefits of the regime e.g. the greater CPD requirements, the greater the costs and benefits from CPD. However, the specific requirements are yet to be worked out, meaning we base our workings on similar regulatory schemes. These are explained later in the analysis.

2. MCA of benefits and costs

The two options that are subject to detailed analysis in this CBA are:

- **License high-risk practice fields only**
- **Mandatory registration and licensing for high-risk practice field.**

We first undertake an MCA of the benefits and costs of the status quo and these two options, with our analysis outlined in Table 3 and Table 4. This determines which option we take forward for detailed cost benefit analysis. Our MCA findings are:

- **License high-risk practice fields only** reduces health, safety, economic and environmental risks of engineering failure in high-risk practice areas. Licensing will restrict who can practise in specialised fields and licensed engineers will be subject to mandatory CPD, a code of conduct and a robust process for complaints and discipline. However this option does not address risks relating to engineers in lower-risk practice fields that are not subject to occupational regulation. This option scores higher on benefits than the status quo option, but lower than Option 5.
- **Mandatory registration and licensing for high-risk fields** reduces health, safety and economic risks of engineering failure in all areas of engineering. This means all engineers will practise inside a regulatory regime. Licensing will restrict who can practise in specialised fields and all engineers will be subject to mandatory CPD, a code of conduct and a robust process for complaints and discipline. The costs of this are considered proportionate because engineers in lower-risk areas are subject to less costly and restrictive regulation.

Detailed cost benefit analysis of **Mandatory registration and licensing for high-risk fields** is presented in Sections 4 and 5.

2.1 MCA benefits analysis

Table 3: Multi-criteria benefits analysis

Benefits:	**1. Status quo**	**3. License high-risk practice fields only**	**5. Mandatory registration and licensing for high-risk fields**
Reduced risk to public (financial, life safety, environment)	0 Limited accountability mechanisms, engineers working outside their areas of expertise and poor quality work mean there is a high level of risk to the public.	++ Increased accountability mechanisms and more stringent entry requirements will decrease the risk and therefore the incidence of issues of high-risk practice fields. However, there will be no change in frequency of issues for other engineers that are not licensed.	+++ Increased accountability mechanisms, more stringent entry requirements and mandatory CPD requirements will decrease the risk and therefore the incidence of issues of high-risk practice fields. While accountability mechanisms will appropriately lower the risk and incidence of issues in low risk fields.
Efficiency gain from CPD	0 CPD requirements are limited to those in regulatory regimes. Everyone outside these regimes do not have a requirement to undertake CPD.	+ Engineers in high-risk fields will be subject to CPD requirements. The benefit is derived from improved skillsets, knowledge acquisition, retention, and application because of the additional licensed engineers now undertaking CPD. This benefit is limited to licensed engineers.	+++ All engineers will be subject to CPD requirements. Benefits are derived from improved skillsets, knowledge acquisition, retention, and application because of the additional registered or licensed engineers now undertaking CPD.
Increased information on quality	0 Limited information on quality and risk. An outcome of this is councils deciding to	+ Consumers of engineering services will be able to rely on the licensing system and information search costs should be reduced Only licensed engineers able to	+ As per Option 3, although registration will also cover engineers not in high-risk fields. This is rated the same score as Option 3, as restrictions on who can

Benefits:	1. Status quo	3. License high-risk practice fields only	5. Mandatory registration and licensing for high-risk fields
	maintain Producer Author Statement registers to help ensure quality.	practice in high risk fields which means there is a clear indicator of quality available. The need for the registers may disappear if these standards ensure a sufficient professional standard able to sign off producer statements.	practise in lower-risk practice fields are not expected to result in significantly higher benefits because of the lower risk level.
Overall assessment	0	++++	++++++

2.2 MCA cost analysis

Table 4: Multi-criteria cost analysis

Costs:	1. Status quo	3. License high-risk practice fields only	5. Mandatory registration and licensing for high-risk fields
Registration	0 Engineers' costs will be limited to those in existing registration regimes.	0 No registration cost.	- Engineers' costs will increase. The increase above the status quo will depend on the number of engineers previously not part of a registry regime.
Licensing	0 Engineers' costs will be limited to those in existing licensing regimes.	-- Engineers' costs will increase. The increase above the status quo will depend on the number of additional engineers in the high-risk fields now involved in the licensing regime.	-- Engineers' costs will increase. The increase above the status quo will depend on the number of additional engineers in the high-risk fields now involved in the licensing regime.

Costs:	1. Status quo	3. License high-risk practice fields only	5. Mandatory registration and licensing for high-risk fields
Regulator	0 Costs associated with maintaining the current mix of regimes.	- Cost will be associated with the establishment and maintenance of the new licensing system. The extent of the change in these costs will depend on the regime's details.	-- Cost will be associated with the establishment and maintenance of the new regulatory system. The extent of these costs will depend on the regime's details.
Overall assessment	0	---	-----

Table 5: Multi-criteria analysis results

Benefits - Costs	0	+	++
Ranking	3	2	1

3. CBA framework for detailed analysis

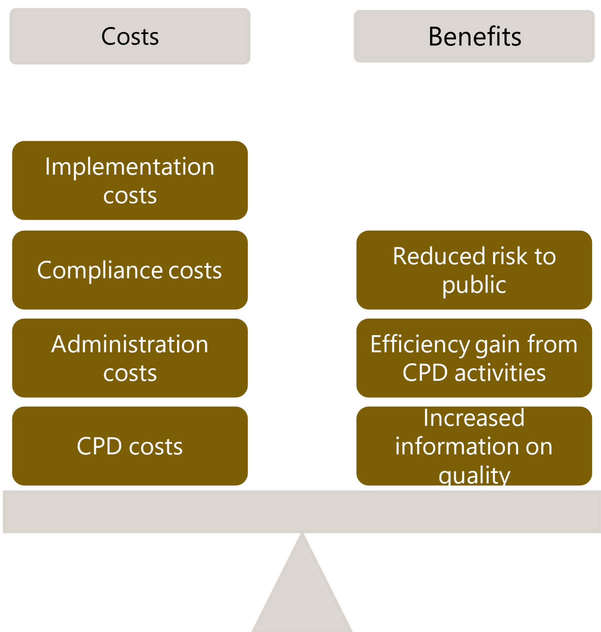
We have undertaken a CBA of **Mandatory registration and licensing for high-risk fields**.

Cost benefit analysis systematically compares the costs associated with undertaking an option with the anticipated benefits, relative to a likely status quo/counterfactual in the absence of the option being pursued. The purpose here is to show the extent of a change in societal welfare as a result of the proposed changes to the occupational regulation of engineers.

Error! Reference source not found. shows the categories of cost and benefits able to be quantified. O ther likely benefits, not able to be quantified, include wellbeing impacts from a change in the incidence of poor engineering conduct and performance, welfare gains including skill acquisition and income gains from increased CPD, and catalysed behavioural changes in engineering and related industries.

Cost analysis is provided in Section 5 and benefits analysis is provided in Section 6.

Figure 1: Quantified economic costs and benefits assessed (unweighted)



3.1 Costs

Table 4 describes the costs of the preferred option, relative to the status quo and the License high-risk practice fields only option. We consider four categories of costs:

- Administrative costs – represent the costs charged to engineers for manging the system
- Compliance costs – is the time taken for engineers to fulfil requirements
- CPD costs – are technically part of the compliance costs but we separate out for ease of presentation and discussion
- Implementation costs – represents government spending require to establish the options.

The increased cost engineers face is expected to flow through to customers in the form of higher prices. It is, however, possible that some of this would be absorbed by engineering firms and result in less profit.

Costs are discussed in more detail in Section 5.

Table 6: Cost categories for the preferred option

Cost – preferred option	Affected party	Status quo	License high-risk practice fields only

Administration
 	
The cost to set up and maintain the registration and licensing schemes including:
- New registrations: cost of undertaking one-off competency check (registration)
- New licences: cost of assessment process including assess application, meeting, follow up if required, decision/approval.
- Licence renewals: cost of assessment process
- Registration and licensing:
    - Cost of verifying and auditing CPD
    - Complaints and discipline costs
    - Board costs
    - Occupancy costs
    - IT system costs
	Most costs will be incurred by the regulator but will be cost recovered through fees paid by engineers, which are expected to be passed on to consumers in the form of higher prices for engineering services.	Current ENZ membership and CPEng administration costs incurred by ENZ and funded through annual fees.	Only the administration costs for licensing of high-risk practice fields.

Compliance Cost of the time required for engineers to become licensed and registered: - Application process - Assessment process	This cost is likely to be passed on to consumers, although it is possible employers could absorb some of these costs.	Current costs of compliance for ENZ member and CPEng engineers. Includes application process for both, and assessment process for CPEng.	Compliance costs for licensed engineers only.

Cost – preferred option	Affected party	Status quo	License high-risk practice fields only
	Carving out time for CPD for employees could be treated as cost of employment, which would in effect increase the cost of labour and be passed on to consumers in the form of higher prices.		
CPD costs Cost to engineers of undertaking compulsory CPD including time and cost of specific CPD activity e.g. learning units undertaken.	Will be incurred by individual engineer or employer. Engineers may do CPD during their own time or during work time.	ENZ members and CPEng currently have CPD requirements they need to meet. CPD costs are included as a status quo cost using the same unit cost assumptions as for the preferred option.	CPD costs for licensed engineers only.
Implementation costs Costs not covered by engineers include the IT system setup costs and a shortfall in cost recovery during the licensing phase in period.	IT system costs and some shortfall in costs recovered over the first six years (due to a phase-in period where the fixed costs would be spread over a smaller number of engineers) are expected to be Government funded.	No change	Shortfall in cost recovery during phase in period

3.2 Benefits

The proposal will lead to benefits for the general public, engineers and engineering firms. The general public is expected to benefit from a reduction in the risk posed to their health and safety, and the environment from a reduction in the incidence of poor engineering outcomes. The different components of the proposal will together contribute to these benefits.

Engineers and engineering firms are expected to benefit mainly from increased CPD activity that can increase productivity, profits and wage rates. These could be shared with consumers in the form of lower prices.

Building owners and occupiers are expected to benefit from a reduction in the rate of engineering issues. We monetise this benefit by looking at issues with seismic noncompliance, The reduction in the incidence of noncompliant buildings reduces the costs associated with fixing issues, reduces lost income and lost trading time. However it is highly likely benefits will also arise outside of this area, for example. wellbeing impacts related to the stress involved with pursuing compensation for substandard engineering.

Related professions and trades may see benefits such as reduced delays, search costs and more efficient interactions with engineers.

Table 7 shows how we have thought about how the components of the registration and licensing will translate into benefits for which we have been able to assign monetary values. The table shows all components of the proposal are expected to result in less risk to the public.

Benefits are discussed in more detail in Section 6.

Table 7: Benefits mapping process

Mechanisms	Change	Outcomes	Benefits	Quantification
Competency assessments, qualification, experience and CPD checks	More information on quality/competency of engineers available to the market. Engineers only allowed to practice if qualified with appropriate experience and CPD evidence.	Consumers able to make better decisions on price and quality trade off, and easier for them to do so. Restrictions on entry resulting in fewer unqualified/low experience engineers delivering engineering services.	Reduced information search costs for adequate engineering quality Minimum quality standard signalled to market Higher quality engineering services Less substandard engineering including over engineering.	Less risk to public (financial, environmental, life and injury) Less information search costs, monetised as reduced need for independent registers (producer authors registers).
Code of conduct	Increased number of engineers subject to Code of Conduct.	More ethical behaviour Increased professionalism	Less substandard engineering Reduction in unnecessary or excess charges	Less risk to public (financial, environmental, life and injury)
Strengthened complaints and disciplinary process	Number of engineers subject to robust complaints and disciplinary process increases.	Greater threat to "cowboys" possibly leading to a small reduction in number of practising engineers.	Less unethical practice Less substandard engineering	Less risk to public (financial, environmental, life and injury)
Increased CPD requirements	Increase in number of engineers undertaking CPD and/or increase in hours of CPD per engineer.	Efficiency trade off, more time not billable but more efficient billable time.	More efficient and innovative engineers and engineering.	Less risk to public (financial, environmental, life and injury)

Mechanisms	Change	Outcomes	Benefits	Quantification
	Structure and reporting of on the job training and graduate development.		Career enhancement for engineers. Reduction in the time it takes for a job or task to be completed Materials (cost savings) from a job done right (increased quality of final product). Better quality design/engineering outcomes Engineers maintain and utilise up-to-date best practice techniques and knowledge. Less substandard engineering	Efficiency gain leading to cheaper engineering services or more profit to engineering firms and higher wages for engineers. Salary premium proxy for returns to CPD

3.3 Parameters and assumptions

We list below the key assumptions and parameters used in deriving our costs and benefits.

Key assumptions

- Full cost recovery of government's administrative costs – for the purpose of our CBA these costs are assumed to be passed through to engineers in registration and licence fees. However, some regime establishment costs in initial years might be covered by government.
- Costs to engineers will ultimately be passed down to clients through higher prices for engineering services.
- There are annual renewals of registrations.
- There is a six-year phase-in period for licensing of Structural, Geotechnical and Fire practice areas.
- Registration of engineers begins in year one.

Key parameters:

- The annual growth rate of registrants is assumed equal to the compound annual growth rate of CPEng membership from 2017 to 2020, i.e. 2.6 per cent.[2]
- Discount rate of 5 per cent is used.[3]
- We analyse the present value impacts over a 25 year period.[4]
- CPD requirements of 40 hours.[5]
- The number of engineers that will be registered and licensed under the proposed schemes is a critical driver of costs, and its impact is investigated in sensitivity testing.
- The opportunity cost of engineers' time is $51.[6]
- The current level of CPD activity undertaken by engineers outside ENZ/CPEng is 20 hours a year.[7]

3.3.1 Opportunity cost of engineers' time

To estimate engineer compliance cost, we assume there is an opportunity cost in the form of billable work that CPD displaces. This assumes that there a high level of unmet demand for engineering

[2] Tested in sensitivity analysis.
[3] The Treasury default rate, tested in sensitivity analysis.
[4] A 25 year period represents a period sufficient enough for the benefits and costs to be realised, with a 5% discount rate making impacts beyond this largely immaterial, this is tested in the sensitivity analysis.
[5] 40 hours is the current CPD requirement for ENZ and CPEng members. A relevant comparison includes Engineering Associates with at least 50 hours required. We choose the ENZ and CPEng CPD requirement as this most accurately reflects the proposed mandatory registration. This is tested in the sensitivity analysis.
[6] Based on an average of relevant opportunity costs of time, tested in sensitivity analysis.
[7] Based on anecdotal evidence, is tested in sensitivity analysis.

services. Given a tight labour market for engineers and their services this seems reasonable, but it is possible the opportunity cost, or some part of it, is leisure time. We therefore use a cost of time that averages the cost of time across working time and leisure time.

Our estimation of the average engineer cost is based on average engineer salary data as shown in Table 8. We use a high-level rule of thirds to estimate charge-out costs of $154 per hour and adjust this down for 75 per cent of hours being billable to get an engineer opportunity cost of $116 per hour.[8]

Table 8: Calculation of average engineer salary

Career stage	Salary	Ratio of workforce	Contribution
Graduate	$60,000	0.16	$9,600
Independent Practice	$85,000	0.43	$36,550
Team Leader	$110,000	0.23	$25,300
Technical Manager	$140,000	0.13	$18,200
General Manager	$180,000	0.05	$9,000
Average salary			**$98,650**

Source: ENZ data available at https://d2rjvl4n5h2b61.cloudfront.net/media/documents/RemSurvey2020-Snapshot_FINAL.pdf

At the other end of the spectrum, the opportunity cost could be zero. If the trade-off is leisure time, we could say this is costless, but all time has some value that is not monetizable. A method for valuing time comes from the NZTA Economic Evaluation Manual (EEM). In 2002 it was estimated that Other non-work travel time was worth $6.90 per hour, updating for inflation puts this value at around $10.14 this is the lowest of estimate of time costs contained in the NZTA EEM.

Another readily available estimate of time cost is in the treasury CBAx impact database. The one hour citizen compliance burden, or cost of an individual's time is $27 an hour which corresponds to the median wage. This figure is recommended as a value to capture the cost of compliance with government processes e.g. filling in forms.

Our central estimate uses a simple average of the NZTA EEM, the citizen compliance burden, and the value of working.

3.4 Data limitations

There are several critical gaps in information, knowledge or data that impact the confidence of our estimates.

A large uncertainty is the number of engineers operating outside of existing regimes. Lack of sufficient data means there are significant challenges to estimating an accurate number of engineers who will

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8 1/3rd each for staff cost, overheads and profit.

be covered by the regime. We have adopted a conservative approach by using NZ Census data on the number of engineers. Comparisons with other sources of MBIE and PwC estimates suggest the Census figures are an upper bound estimate of the number of engineers that will be covered, meaning the cost figures reported are also on the higher side than what might actually occur. This is discussed in detail in Section 4.

There is also a large gap in knowledge of the number of engineers outside ENZ that are currently undertaking CPD. About a third of engineers are ENZ members or CPEng so currently incur costs for CPD, which are estimated in the status quo. It is likely some portion of engineers outside ENZ are currently undertaking some level of CPD. For simplicity, we assume half of engineers outside of ENZ undertake CPD activity or equivalently all engineers undertake CPD at half the rate (20 hours).

We also have little information on how much engineers currently spend on CPD activities including attending courses and conferences. We use a selection of courses advertised on ENZ to calculate a cost per hour for formal CPD and assume 25 per cent of CPD is this formal paid activity. It is highly likely that the spending on CPD activity will increase, but given we don’t have information on the current level of costs, we have not attempted to estimate this change.

Other data limitations and uncertainties are discussed throughout the report.

4. The number of engineers

The number of engineers to be registered and licensed is a key driver of the costs of the proposal.

Currently, most engineering work in New Zealand is not directly restricted, which means most engineers in New Zealand will need to be registered or licensed. However, there are restrictions set out in New Zealand legislation, regulation and operating practice which impact structural, fire safety, electrical, heavy vehicle certifiers, recreational safety, and design verifying engineers. There are also regulations that cover aspects of marine and aeronautical engineering, products engineers help develop, and health and safety regulations that cover the workplace.

4.1 Registration

The exact definition of engineers and the services that registration requirements will apply to could provide for certain exclusions. We model costs and benefits using a range for registration numbers (before current ENZ numbers are excluded):

- 61,248 is used as the baseline upper bound for registration numbers, and is the inflated 2018 Census total number of engineers minus associates (i.e. diploma-qualified engineering technicians or technologists).
- 36,578 is used as the lower bound, which in addition excludes partially covered engineers (i.e. partially covered by existing regulations or otherwise excluded).

The status quo is represented by ENZ membership and CPEng numbers, with partially covered engineers excluded.

Our approach and considerations in determining the lower and upper bound for modelling are outlined here.

Engineering New Zealand (ENZ) Members

Table 9 shows current ENZ membership numbers and CPEng numbers. The number of engineers with ENZ membership is currently 22,585. If registration becomes mandatory, we expect that some ENZ members will retain their membership but not all will continue to see value in professional body membership. ENZ members may be automatically registered and may see a reduction in the fees ENZ charges or an adjusted offering as fulfilling CPD requirements becomes more important.

There are 4,010 CPEng, with 802 CPEng who are not members of ENZ (CPEng numbers are discussed further below in relation to licensing).

Table 9: Number of engineers currently covered by ENZ membership and CPEng

Measure	2020
Number of CPEng	4,010
Number of ENZ members (includes most CPEng ~80%)	22,585
CPEng not ENZ (~20%)	802
Total status quo	**23,387**

Note: We add the CPEng that are not currently ENZ members as they will be required to register.

MBIE, ENZ, PwC have each looked at census data, graduate, and membership numbers to find a likely range of engineers impacted by occupational regulation.[9] We replicate the numbers and adjust to 2020 figures by 4 per cent, which is the average yearly growth rate since the previous census. A constant growth rate of 2.6 per cent is applied beyond 2020.

Table 10: Estimate of total number of engineers

Category	2018	2020 (estimated)
Census total – Engineer	82,149	89,007
Census total – Associates	25,620	27,759
Partially covered/excluded*	22,761	24,661
Census total of engineers minus associates (upper bound)	56,529	61,248
Minus associates and partially covered (lower bound)	33,768	36,587

Note – *partially covered or excluded numbers requires a judgement call on Census data.

4.2 Licensing

The proposal is to prioritise the licensing of structural, geotechnical and fire safety engineers, with the licensing scheme to enable other practice areas to be added in the future. CPEng is likely to be replaced by this licensing scheme. We need to estimate the number of structural, geotechnical and fire safety engineers who will need to be licensed under the proposal but who are not currently CPEng engineers.

There are currently 4,010 CPEng across all practice fields. Of this figure, 1,891 are in structural, geotechnical, and fire areas.

[9] MBIE estimates were sourced from Sapere's communication with MBIE, ENZ estimates were sourced directly from exchanges with ENZ, and PwC figures were sourced from https://d2rjvl4n5h2b61.cloudfront.net/media/documents/Economic_contribution_of_engineering_PwC_February_2020.pdf.

Using Census data and graduate numbers, PwC estimated that within structural, geotechnical and fire safety engineers, 5,063 or 4,702 engineers would need to be licensed. The average of these two estimates is 4,883 engineers. We use this averaged figure as the number of engineers requiring licensing.

However, as some engineers work across multiple high-risk practice fields, they will require more than one licence. We scale up the 4,883 engineer requiring licensing by the ratio of duplicate licenses in the current CPEng regime, i.e. 5705 total licenses to 4010 engineers, or 42 per cent. This estimation forecasts 6,946 licenses to be required.[10]

Table 11: Number of CPEng engineers in licensing areas

Category	Number (2020)
CPEng engineers	4,010
Structural	1,402
Geotechnical	392
Fire	97
CPEng (structural, fire, geotechnical) licences	1,891
Forecast engineers working in licensed areas (structural, fire safety, geotechnical) – PwC average	4,833
Forecast total number of licences (scaled up from 4,833)	**6,946**

Note – we do not include the impact of other fields that may require licensing at a later stage.

[10] We test this assumption in the sensitivity analysis.

5. Costs

To estimate the net change in costs under the preferred option, we first estimate the cost of the status quo and then estimate the cost of the preferred option. The difference between these two estimates is the forecast net costs of the proposal.

5.1 Status quo costs of $2.4 billion

Status quo costs are the costs of administering the current ENZ member and CPEng schemes and complying with the requirements of these schemes. To estimate status quo costs we use current ENZ costs as well as data that is available for other occupational regulation schemes.

As set out in Table 12 the total estimated status quo cost is $2,438 million over 25 years. Most of the estimated status quo cost is associated with the opportunity cost of time invested in CPD. The current commitment to CPD is largely voluntary so may not technically be a compliance cost; however, we have classified it as such to enable comparisons with the costs associated with CPD requirements proposed under the registration requirement.

Table 12: Status quo cost summary ($ millions)

Option	Category	Description	PV (25 years)
Registration	**Administration**	ENZ membership	107
	Compliance	Time burden to join ENZ	11
	CPD costs	Time and course costs	1,978
Total registration			**2,095**
Licensing	**Administration**	CPEng fees	36
		Assessments and renewals	27
	Compliance	Time burden of CPEng	5
	CPD costs	Time and course costs	**274**
Total licensing			**342**
Total status quo costs			**2,438**

5.1.1 Status quo administrative costs of $170 million

We use fees collected for ENZ and CPEng as a proxy for ENZ's cost of administering these services. The direct cost from fees charged under the current system of voluntary membership to ENZ and the CPEng regime is forecast to be $170 million over the next 25 years. With the current CPEng system making a loss of about $200,000 a year and relying on some unpaid engineer time for assessments, it is likely these estimates are lower than true costs, i.e. because the CPEng system is not recovering enough fees to cover its costs.

ENZ membership costs of $107 million

ENZ average annual membership fees of $240 per year for 22,585 members give a 2020 baseline of $5.4 million. The number of engineers is then inflated at 2.6 per cent for a total 25 year present value (PV) of $107 million.

CPEng fees of $36 million

The current system is running at a loss and would be subject to a range of adjustments if it continued. We have not accounted for these uncertainties which means the current CPEng cost estimates are likely to be conservative.

CPEng annual fees of $460 are applied to the 4,010 CPEng engineers and then inflated by 2.6 per cent growth in the number of CPEng engineers to estimate fees charged of $36 million over 25 years.

Table 13: CPEng fees calculations ($ millions)

	2020 numbers	Cost baseline	PV (25 years)
Totals	4,010	1.8	36

CPEng assessments and renewals of $27 million

CPEng engineers must pay an application fee and assessment fees.[11] There are a range of cost structures for CPEng assessments, to aid with analysis we have adopted a simplified version of the fee structure and also included voluntary time costs of assessors. This includes three main cost categories:

- First assessments – a one off fee charged to all new applicants to cover their initial assessment(s), excludes those with mutual recognition.
- Mutual recognition – a one off fee charged to all new applicants that have mutually recognised qualifications. We estimate the average per cent of CPEng's mutually recognised over the past four years and extrapolate this figure to future years' mutual recognition.
- Renewals – a fee charged for the renewal of applications. Renewals occur once every six years.

Summing these three categories, we estimate the present value cost to be $25 million over 25 years.

[11] See table in Appendix D which shows the CPEng fee structure including rebates if certain aspects of assessment are not required.

Table 14: CPEng assessment and renewal cost calculations

Assessments	Number (2020)	Cost per item	Cost baseline 2020 ($ millions)	PV (25 years) ($ millions)
First assessment	325	$3,253	0.9	17
Mutual recognition	43	$2,078	0.1	2
Renewal	470	$640	0.4	8
Total			**1.4**	**27**

No estimate of costs for areas of the engineering industry partially covered by existing rules and regulations

There are costs associated with engineers regulated outside CPEng and ENZ (e.g. electrical engineers, aeronautical engineers), but we do not estimate status quo costs as for those engineers only registration costs will be additional, and we assume no change in status quo costs.

5.1.2 Status quo compliance costs of $16 million

This is the current cost of compliance for ENZ members and CPEng engineers, which includes application and assessment costs. It is calculated by estimating the opportunity cost of time spent by engineers on compliance requirements. The cost of time for engineers is estimated to be $51 per hour as described in section 3.3.

We estimate a cost of $11 million for time spent on ENZ membership, $5 million for CPEng applications and renewals (PV over 25 years).

ENZ compliance costs of $11 million

ENZ compliance costs involves the time taken to join ENZ and pay membership fees. We allow half an hour a year at $51 per hour.

CPEng compliance costs of $5 million

CPEng compliance time involves completing and submitting an application form including providing evidence of qualifications and experience, providing referees, meeting with an assessor, and completing an assessment.

We allow eight hours of applicant time for first CPEng assessments and four hours for renewals at $51 per hour.[12]

Table 15: CPEng compliance costs

Category	Cost per item	Cost baseline 2020 ($ millions)	PV (25 years) ($ millions)
First assessment	$407	0.13	2.6
Renewal	$204	0.13	2.7
Total		**0.27**	**5.3**

5.1.3 CPD costs are estimated to be $2.25 billion

The estimate covers the opportunity cost of engineers' time, spending on courses, and the CPD record keeping burden. CPD time is based on 40 hour per year at $51 per hour for ENZ members and CPEng. For those outside ENZ/CPEng we assume they currently undertake 20 hours of CPD and half the activity and administrative burden as set out in the Table 16 below.

The cost of CPD activities is based on a sample of the costs of CPD courses offered on the ENZ website. The CPD courses sample average is $76 per hour. We assume this type of activity would make up about a quarter of CPD requirements with the rest being free. Therefore, we allow $760 per engineer for CPD activity costs.

Two hours is allowed for the administrative burden of CPD record keeping for ENZ/CPEng.[13]

Table 16: Status quo CPD cost calculations

Regime	Category	Cost per item	Cost baseline ($ millions)	PV (25 years, $ millions)
ENZ and CPEng	CPD time	$2,037	47.6	937
	CPD activities	$760	17.8	350
	CPD admin burden	$102	2.4	47
Sub total			67.8	**1,333**
Others	CPD time	$1,018	38.6	758
	CPD activities	$380	14.4	142
	CPD admin burden	$51	1.9	19

[12] These assumptions are Sapere judgements based on experience in similar cost analyses.
[13] This is a Sapere judgement based on similar analyses.

Sub total			54.9	**919**
Total			**122.7**	**2,252**

To allocate CPD costs across CPEng and ENZ we use the ratio of CPEng to all ENZ member and CPEng this results in $1,978 million for registration (ENZ) and $274 million for licensing (CPEng).

5.2 Forecast costs of preferred option of $3.8 billion

This section provides analysis of the costs of the proposal, including:

- costs of administering the registration scheme
- costs of administering the licensing scheme
- costs of compliance for engineers
- costs of CPD.

We look at a range of publicly available cost information from similar regulation schemes for those involved in the construction industry, other regulated professions and engineers regulated in Australia.

MBIE proposes to establish a new regulatory board to oversee registration and licensing of engineers. The Board would be appointed by and accountable to the Minister for Building and Construction, with MBIE responsible for monitoring performance. The Minister may choose to have the day-to-day services of the regulator provided by a Regulatory Services Provider (RSP). The exact form and function of each entity would depend on what decisions are made for registration and licensing.

Table 17 provides an overview of the allocation and categorisation of the forecast costs.

Table 17: Summary of forecast costs of proposal ($ millions)

Option	Category	Description	PV (25 years)
Registration	**Administration**	Registration fees	173
	Compliance	Time burden to register	61
	CPD costs	Time and activity cost	3,213
Allocation of implementation costs			5.7
Total registration			**3,455**
Licensing	**Administration**	Licensing fees	90
	Compliance	Time burden of licensing	6
	CPD costs	Time and activity cost	278
Allocation of implementation costs			0.5
Total licensing			**372**

Implementation	IT systems setup	5
	Deadweight loss	1.2
Total implementation		**6.2**
Total forecast costs		**3,829**

5.2.1 Forecast registration administration costs of $173 million

Costs of administering the registration of engineers will include:

- cost of undertaking a one-off competency check
- cost of verifying and auditing CPD
- complaints and discipline costs
- board costs
- occupancy costs
- IT system cost.

Table 18 shows total estimated costs for administering the registration scheme per engineer. We have estimated lower and upper estimates for administering the registration scheme based on review of estimates for similar schemes in New Zealand and Australia. As a comparison, we find the current average fee of $240 for ENZ membership and the current cost $120 allocated for registry and assessment fees align reasonably well with the bottom-up estimates.

The upper estimate is close to the highest cost (converted to NZ $320) per engineer found for similar schemes. This was for Western Australia where only 2,000 engineers share the costs. This is not surprising, as scale efficiencies are expected in several areas.

A detailed description of each cost is outlined in the sections below.

Table 18: Summary of costs – administering the registration scheme (cost per check $ per engineer)

Category	Lower	Upper	Average
One off qualification check	20	20	20
Verify and audit CPD	14	72	43
Complaints and discipline costs	17	107	62
Board costs	6	14	10
Occupancy costs	8	20	14
IT system	11	16	14
Total	**76**	**249**	**163**

To calculate the total costs of administering the registration scheme for all engineers that will need to register (estimated in section 4), we multiply the estimated unit cost per engineer by the number of engineers, as shown in Table 19.

The estimated cost range is $41 million to $278 million. We prefer inclusion of all partially covered engineers, so using the 61,248 estimate of engineers gives a range of $69 million to $278 million in forecast costs using the range of cost per engineer from Table 18.

This represents the administrative costs of registration; we assume full cost recovery so that all these costs fall on the engineers but it is likely the regulator will need budget support to cover initial investment in website and database.

Table 19: Range of costs forecast for registration administration

Cost per engineer	Number of engineers	25 year PV ($ millions)
Low ($76)	Lower (36,587)	41
	Upper (61,248)	69
Central ($163)	Lower	104
	Upper	173
High ($249)	Lower	166
	Upper	278

Compliance costs are estimated in section 5.2.3.

Qualification checks

We assume there will be widespread recognition of existing schemes and mutual agreements. While the details are uncertain for new registrants, we expect at a minimum that a system for applicants to provide proof of qualifications that can be verified will be required. It is also likely some assessment of experience and knowledge of the local context could be considered a requirement. A cost of $20 per check is assumed based on an hourly wage rate of $40 and 30 minutes per check.[14]

Verification and audit of CPD records

To help ensure the competency of engineers, there is likely to be some form of random and targeted auditing for both the Code of Conduct and the CPD requirements. For the purpose of this RIS we assume 2-6 per cent of total registrants audited are tested yearly with a cost per audit based on a one-hour interview with the engineer, two hours for the interviewer and a half day of administrative

[14] Wage rate based on licensing staff salaries from the Registration of Building Engineers in WA Regulation Impact Statement.

checks (engineer opportunity cost $51 per hour, interviewer time $150 per hour, admin time $40 per hour).[15]

With the addition of 30 per cent for costs of salaried staff (interviewer and administrator),[16] we estimate a total cost $664 per audit, which corresponds to $0.7 million to $2.6 million per year, given the range of engineers modelled and the range of frequency of audits. This cost is equivalent to a range in cost per engineer of $14 to $72.

Based on our review of available information, it is difficult to benchmark our estimate against other scheme examples because of limited information and use of different calculation methods.

Complaints and discipline

We reviewed the available information for costs structures of complaints and discipline processes of Australian and New Zealand regulators to determine a range of $17 to $107 per engineer.

- There was an average of 43 complaints against Chartered Professional Engineers over the years 2018 to 2020. Over 2019 and 2020, there was an average of $382,982, or $97 per registrant.
- RAB averaged 11 complaints over the last four years, with an average cost of almost $15,000 per complaint for last two years or about $81 per registrant (NZRAB, 2020).
- PGDB had direct expenditure of $460,000 on the discipline process and almost $1.3 million of associated overheads in 2020 financial year, $130,000 in direct expenditure for prosecutions, and $670,000 of associated overheads, for a total of $1.7 million in discipline and $0.8 million in offences, making up approximately half of total 2020 expenditure (PGDB, 2020). Based on 189 enquiries and 99 complaints in 2020, this works out to around $13,000 per enquiry and $25,000 per complaint or about $107 per person. We note this figure includes prosecution against those practising unlicensed.
- The EWRB reports $0.3 million in personnel costs and $0.07 million in legal services for investigations and complaints. There is also $0.45 million in call centre costs. There are approximately 49,000 registered electrical workers, with over 28,000 of these workers holding current practising licences (MBIE, 2018). This indicates a range of $17 to $29 per participant.
- The Victoria RIS for engineers allocated almost $500,000 for receiving and managing enquiries and complaints spread across 27,000 engineers which works out at less than $18 per engineer. Another $1.6 million or $58 per engineer is allocated for monitoring compliance and investigating complaints for a total of around $76 per engineer.[17]

[15] These assumptions are Sapere judgements based on experience in similar cost analyses.
[16] An assumption used in Registration of Building Engineers in WA Regulation Impact Statement to cover on costs.
[17] Professional Engineers Registration (Fees) Regulations 2021 Regulatory Impact Statement, https://engage.vic.gov.au/engineers-registration

Board costs

We find a range of costs allocated to the board that vary with accounting method (i.e. what costs have been allocated to the board).

- CPEC 2020, council costs of $25,956. For the nine board members, this included payment for meeting costs, meeting fees and meeting travel (CPEC, 2020).
- PGDB 2020, $120,000 for the 10 board members' remuneration, and $50,000 for disciplinary functions (PGDB, 2020).
- Governance costs of RAB in 2020 were $85,000 for seven board members (NZRAB, 2020).
- Personnel cost of EWRB were $352,000, including payment for travel, accommodation, and remuneration. (MBIE, 2018).
- For the LBP board, costs were $853,000, including payment for travel, accommodation, and remuneration (MBIE, 2018).

A simple average of these cost is used as the lower estimate at $365,000 or around $6 per engineer based on around 60,000 registrants. For the upper estimate the LBP cost is used, which equates to $14 per engineer assuming around 60,000 engineers registered.

Occupancy costs

Occupancy costs are costs associated with occupying a space e.g. rent. Where these are not explicitly given, we take overheads as a proxy. These costs also vary depending on the accounting approach.

- Occupancy costs of RAB in 2020 were $65,000 or about 4 per cent of total costs (NZRAB, 2020).
- The PGDB reports rent costs of $136,000 in 2020, about 4 per cent of total administration costs (PGDB, 2020).
- For the LBP, overhead costs of $1.2 million or about 20 per cent of total costs (MBIE, 2018).
- The EWRB allocates $1.7 million to overheads (management support, corporate support (Legal, IT, Finance, HR), and building occupation costs), around 32 per cent of total costs (MBIE, 2018).

A simple average of these costs is used as the lower estimate $413,000 or around $8 per engineer based on around 60,000 registrants. For the upper estimate we use the total EWRB overhead cost minus IT system costs of $1.2 million, which equates to $20 per engineer assuming around 60,000 registered engineers. We note that by using a simple average we are implicitly assuming that the number of engineers in a scheme is not a significant driver of costs. In practice, these costs might vary from this estimate, but they are considered difficult to estimate with certainty and are also small in the context of our analysis.

IT system cost: website and software maintenance and development

A website with a secure database and a user-friendly interface for CPD records and public display of the register is required. Some investment will be required immediately and is estimated in section 5.2.5. It may be possible to stage development to limit costs in the transition period where it is expected there will be fewer engineers registered. This estimate is for the ongoing cost of established IT system.

PGDB 2020 accounts estimate the database and website value at a total value of $2 million with disposals of almost $1 million. This is based on estimated useful lives of the database and websites, resulting in the following amortisation rates:

- Old database – 4 years – 25%.
- New database – eight years – 12.5%. Based on the environment the Board operates in and the processes the database handles, an expected life of the new database was considered to be eight years.
- Website – four years - 25% (PGDB, 2020).

In reviewing fees, the EWRB allocated almost $0.5 million of costs to IT systems with approximately 49,000 registered electrical workers, and over 28,000 of these workers holding current practising licences (MBIE, 2018).

For a lower bound cost estimate, we allocate half of the LBP overhead costs to IT to produce an average of $700,000 or around $11 per engineer based on 60,000 registrants. For an upper bound we use the PGDB of $1 million, which equates to around $16 per engineer.

Renewals

We expect the renewal fee to be slightly less than initial application fee as the qualification check is not required for renewals. We assume renewals are required on an annual basis, and test longer periods in the sensitivity analysis. Victoria engineering regulation requires renewals every three years, the RAB every five years, EWRB every two years, and LBP every year.

For the LBP, the licence application fee proposed in 2018 was $217 and the annual renewal $208 (MBIE, 2018).

5.2.2 Forecast licensing administration cost of $88 million

A key change from the status quo estimate is that CPEng annual fees are multiplied by the forecast number of licences rather than number of engineers i.e. because fees are charged on a per licence basis and engineers can have more than one licence. The number of licenses required is expected to grow at the same rate as registrants (2.6 per cent).

We feel the current CPEng charges are appropriate to estimate the new licensing system costs, given the likely similarities between the proposed licensing regime and CPEng. The cost level here looks broadly appropriate, we expect scale efficiencies on fixed costs from increased licence numbers and efficiencies if the licensing system management is incorporated with the registration system.

Table 20: Licensing fees forecast

Category	Cost per item	Number (2020)	Number (2026)	Number (2027)	25 year PV ($ millions)
New assessments	$3,253	325	2,727	209	**19**
With mutual recognition	$2,078	41	343	26	**2**
Renewals (every six years)	$640	668	779	1,118	**11**
CPEng annual fee	$460	4,010	8,094	8,303	**56**
Total cost ($ millions)		**3.4**	**13.8**	**5.3**	**88**

To examine how the phase in period impacts cost we look at a time series of the costs over a ten year time frame.

Figure 2: Impact of phase-in period on licensing administration costs

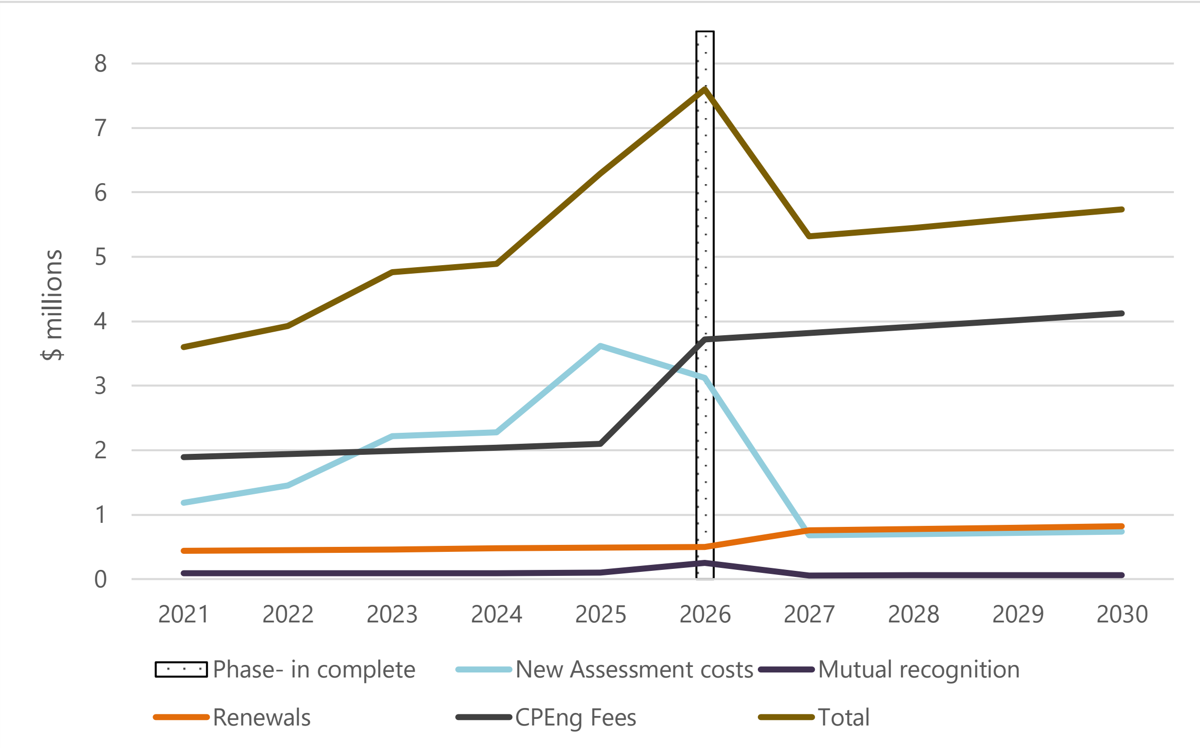

Figure 2 shows the increase and then return to steady state level of costs at the end of the phase-in period when the licensing scheme takes over CPEng. The increase in fees collected per licence (versus previously per engineer) are the primary driver of the increase, shifting the steady state up by the difference in number of fees collected (number of licenses minus number of engineers) multiplied the assessment costs. Also shown is that new assessment cost changes are the main drivers in fluctuations of total costs.

We test other cost structures and the length of the phase in period in the sensitivity testing.

New assessments $19 million

We model new assessments and renewals to continue at the current CPEng rate until 2026. Then the difference between the total number of licences forecast and the sum of the new assessments and renewals for the last six years enters the scheme, with 3,800 new assessments in 2026.

New assessments will be more rigorous than the current, so this estimate could be on the low side. However, with more licences, there are economies of scale.

With mutual recognition $2 million

We assume the reduced cost for assessments with mutual recognition continues at the current CPEng rate of 13 per cent of first assessments throughout the 25-year model timeframe.[18]

How mutual recognition will be handled is an area of concern for some employers and large consumers of engineering services. As seen here, the direct costs measured are small.

Renewals $11 million

Renewals follow the CPEng trend until 2026, when they become the total number of licences six years earlier divided by the renewal frequency (six years).

This cost changes in a linear fashion: if renewals were required every three years, then the costs would double.

Annual licensing fees $56 million

CPEng fees of $460 per year are paid on around 8,000 licences once the phase-in period is complete. The per year cost goes up significantly in the last year of phase-in, then reverts to a steady state of about a 75 per cent increase in costs compared to the current settings.

After phase in period the CPEng fees cover the ongoing administration costs, high level of uncertainty as board, occupancy and IT costs could be shared with registration regime.

5.2.3 Forecast compliance costs estimate of $67 million

This section estimates the compliance costs for engineers to be registered or licensed. We calculate an engineer opportunity cost per hour and apply this to estimates of hours needed to comply across the registration process (e.g. submit an application) and the assessment process for initial application and renewals.

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[18] Note this rate is the average mutual recognition rate for CPEng over the past 4 years.

Table 21: Compliance costs summary

Category	25-year PV
Registration	61
Licensing	6
Total	**67**

Registration compliance $61 million

We allow one hour for registration compliance at a cost of $51 per hour times the number of registrants. Over 25 years this cost is $61 million.

Licensing compliance cost of $6 million over 25 years

We allow eight hours for the initial assessment and four hours for assessments with mutual recognition and for renewals, all at cost of $51 per hour for a 25-year cost of $6 million.

5.2.4 Forecast CPD costs of $3.5 billion

The estimated CPD cost is driven by the assumption that engineer time invested in CPD would otherwise have been revenue generating. It is possible CPD time actually displaces leisure or administrative time rather than billable time. Changing this assumption would reduce the total cost by an order of magnitude.

$2.5 billion in CPD time opportunity cost

This cost assumes all 60,000 registered engineers would have been able to bill clients $2,037 a year, which equates to an opportunity cost of $128 million per year and over 25 years $2.5 billion.

Spending on CPD activities allocated $916 million of costs

The exact mix and type of CPD required will depend on the details of the design. To provide a high level estimate we took a sample of the costs of CPD courses offered on the ENZ website. On average the CPD courses equate to $76 per hour. We assume this type of activity would make up about a quarter of CPD requirements with the rest being free. Therefore, we allow $760 per engineers for CPD activity costs. Summed over 25 years this results in an estimate of $916 million in costs.

This assumption looks reasonable when compared to the $500 per year CPD expert Lyal Douglas suggests Australian engineers would pay on average to reach their required 150 hours over five years (Engineers Australia, 2021). This Australian estimate works out to about $17 per hour, the $760 over 40 hours is $19 per hour. We investigate the impact of this assumption in sensitivity testing.

CPD record keeping $123 million in costs

We allow two hours per year for the burden of CPD record keeping. This results in $123 million of compliance costs.

Note – there is a small allocation for engineer compliance time in the audit and review estimate in section 5.2.1.

5.2.5 Implementation costs of $7.5 million

There are two implementation aspects:

- The IT systems for registration and licensing which will be an upfront cost. This could be cost recovered but previous experience suggests this would be hard to do. Stakeholders with experience in occupational regulation suggest that it is better to set charges at a rate that will cover the ongoing operations rather than the upfront investment in establishing the scheme.
- The estimated shortfall in fixed cost recovery for the licensing phase in period.

The costs of passing and implementing the legislation are considered the costs of governance so are excluded from the CBA.

Implementation of the registration system is a cost to government. There is not expected to be a shortfall in the cost recovery as it is assumed there will be a short phase in period.

IT establishment costs allowance of $5 million

Determining the costs involved in the upfront investment in developing the appropriate IT systems to manage CPD records, display record of registration and other requirements are highly uncertain with a range of $1-10 million suggested. These costs are shared across licensing and registration with potential for leveraging existing IT systems.

We use $5 million with a two-year phase in period.

Licensing phase in period fixed costs of $1.2 million

A funding shortfall is expected for the licensing phase in period where the CPEng system is still operational, and the new licensing scheme is also an option. The fixed costs of the licensing will be spread over a very small number of engineers who join the licensing scheme early, with these costs continuing until the CPEng system is fully replaced at the end of the phase-in period when all costs will be recovered i.e. people join before the end of the 6th year when all high-risk engineers are licensed. The inability to cost recover results in a funding shortfall.

Fixed costs of $969,000 are estimated by summing the midpoints of the occupancy and board costs ($24), and multiplying by the number of licenses required (7,126).

IT costs of $545,000 are estimated using midpoint of IT costs ($14) and multiplying by the number of licenses required (7,126).

We estimate the shortfall as the difference between funding required and the fees received. The funding required is estimated by multiplying the total number of licenses required (if all high-risk engineers had licenses) by the per engineer cost of implementation and IT ($38). The fees received is estimated by multiplying the per engineer cost of implementation and IT ($38) with the assumed engineers joining early, assumed at rates of 1 per cent in 2021, 2 per cent in 2022, 5 per cent in 2023, 5 per cent in 2024, and 10 per cent in 2025.[19] This process estimates a funding shortfall of $1.2 million.

We note that after the 5th year, all high-risk engineers join, and the regime can fully cost recover.

These costs are tested in the sensitivity analysis.

Deadweight loss of $1.2 million

The implementation costs are expected to be funded by government, as such a 20 per cent deadweight loss is added to these costs to account for the distortionary effects of tax funded expenditure.

Cost of governance excluded

The costs associated with the development of policy/regulation and general parliamentary servicing roles of government are excluded. Such activities represent the broader roles of government and would exist regardless. It is assumed other similar policy/regulation would consume the government resources allocated to this policy process.

Just because we do not count these costs in a CBA doesn't mean they don't exist. Resources will be required to establish a board and there is likely a full-time role for at a project manager.

We have not estimated implementation costs for the registration system as the short phase in period will minimise any shortfall in cost recovery.

5.3 Net change in costs of $1.4 billion

Based on the analysis undertaken, we have estimated total costs of the status quo and the costs of the proposed options over a 25-year timeframe. In section 0 we then examine the net change in costs. We note totals may not reflect the sum of the numbers in the table due to rounding.

Under the status quo, costs are estimated to be $2,438 million (present value) over a 25-year period. Comparing this to a total cost of $3,829, there is a net increase in costs of $1,391 million. On average this is an increase of around $56 million per year over 25 years.

This can be separated into the registration and licensing components. Table 22 shows that the net costs of licensing high-risk fields will be $32 million, a figure much smaller in magnitude than the $1,391 in net costs for mandatory registration and licensing of high-risk fields. This is because registration causes a large change in the level of CPD whereas licencing largely replaces the current CPEng regime.

[19] These figures are based on a Sapere judgement.

Table 22: Summary of change in costs ($ millions 25 year PV)

Period	Status quo	Proposed regulation	Net change in costs
Registration	2,095	3,455	1,359
Licensing	343	375	32
Total	**2,438**	**3,829**	**1,391**

6. Forecast benefits of $1.7 billion

The proposal is expected to improve the standard of engineering delivered in New Zealand. This reduces risk to the public (financial, life, injury, and illness) and the environment. Benefits are also expected to accrue to engineers and engineering firms as a result of improved productivity.

6.1 Summary of monetised benefits

We illustrate the potential benefits of the proposal by quantifying three benefit categories:

- reduced risk to public: financial benefit of avoided incidents
- increased information on quality of engineers
- returns from increased CPD investment

Table 23 shows a summary of benefits for the 25-year modelling period. In total it is estimated that there will be $1,683 million benefits from our monetised benefit categories. The largest estimated monetised benefit is returns to engineers from CPD investment, with most of this attributed to registration as that is where the most change in the level of CPD activity happens.

This does not include monetisation of other benefits that are expected to occur, such as the value of lives saved (see section 6.2 for further discussion). We therefore expect the benefits to be significantly greater than the value of benefits that we have monetised.

Table 23: Summary of estimated quantifiable benefits ($ millions)

Benefit category	25-year PV	Attribution to registration	Attribution to licensing
Reduced risk to public: financial	199	-	199
Increased information on quality	1.5	-	1.5
Returns to CPD investment	1,482	1,448	34
Total	**1,683**	**1,448**	**235**

Detailed discussion of how we have quantified these benefits is provided in section 6.3.

6.1.1 Attribution of benefits

Attribution of monetised benefits between licensing and registration is challenging. We have chosen one approach and recognise there are others that may also be valid.

We have spilt the efficiency benefits derived from increased CPD activity based on the change in volume of activity. About 98 per cent of the change in hours of CPD undertaken forecast is from registration requirements so we have used this ratio to allocate the benefits.

The other benefits have been allocated to licensing. Licensing covers structural, geotechnical and fire safety engineering which aligns with the estimates of financial benefits based on evidence of substandard seismic engineering in commercial buildings. Registration would likely also contribute to this benefit, but we have not been able to determine a method to allocate these benefits to registration.

6.2 Other benefits not monetised

The proposed regulation of engineers will also lead to other benefits however we have not monetised these due to uncertainty and a lack of data:

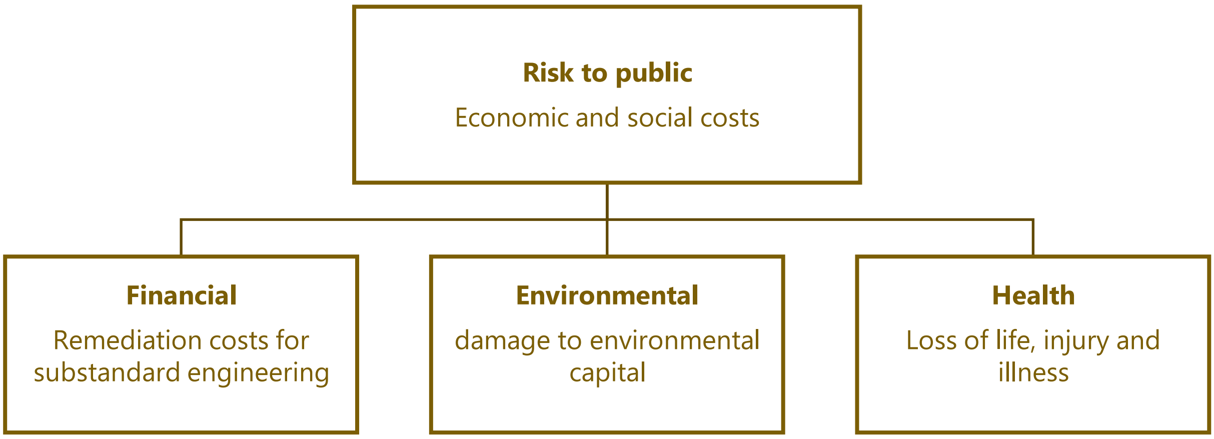
- Lives saved: the proposed regulation is expected to save lives as a result of avoided incidents. Incidents such the Christchurch earthquake can lead to significant fatalities, but it is difficult to predict frequency and impact. This is discussed further in section 6.3.1.
- Reduced health risks: through reduction of incidents such as contaminated drinking water from waste facility failures, badly designed or 'sick' buildings (e.g. from poor air-conditioning, rising damp, low natural light levels), or through the failure of hazardous services such as gas, electricity or mechanical works.
- Reduction in economic risks: involving financial costs such as design and construction costs, litigation costs, lost production, and rectification costs.
- Environmental benefits: through reduction in incidence of things such as flooding of natural environment due to dam failure.
- Benefits to other professions: there may be benefits to other professions that are dependent on engineering services, including reduced search costs (i.e. to assess suitability of engineer being employed) and reduced costs such as delay or legal costs due to engineering problems.
- Insurance benefits: in the long term there may be reduction in insurance premiums as lower risk flows through to insurance pricing.

6.3 Monetised benefits

6.3.1 Reduction in risk to public

The reduction in risk to public benefit is spilt into three categories: financial, environmental and health as shown in the figure below.

Figure 3: Components of risk to public



Our quantification of financial risks considers the costs to remedy buildings with seismic issues because we have sufficient information and data available to quantify this. However, it is important to note that the proposed options would also result in reductions in other financial risks including lost income from idle resources, legal costs and financial costs not related to seismic engineering issues.

Risks to the environment are considered low probability or frequency but if and when incidents occurred, they could be of high impact. The current risk to the environment from poor engineering cannot be determined and we do not have recent New Zealand examples. There are international examples such as chemical spills or dam overflow and floods but determining the current risk of a similar event occurring in New Zealand is too speculative let alone trying to determine the attribution to engineering failure or the incremental change in the relative risk attributable to the regulatory changes proposed.

We have used a value of statistical life (VOSL) to illustrate the potential benefits of avoided loss of life and injury as a result of the proposed regulations what you would need to believe for this regulation to deliver benefits to society, however the estimates are considered too uncertain to include in our total estimated benefit.

Quantifying benefits that involve a reduction in risk is an inherently speculative exercise, with the current level of risk largely unknown making any estimates based on a change in risk highly uncertain. Where possible we use ranges to indicate the uncertainty involved in the calculations.

All components of the proposal contribute to this benefit with attribution between registration and licensing components essentially a judgement call as discussed in section 6.1.1.

Table 24: Summary of reduction in risk to public monetised benefits ($ millions)

Category	**25 years**
Financial	199
Environmental	Not monetised

Life safety	Illustrative only
Total	**199**

Reduced frequency of seismic non-compliance produces $199 million financial benefit (range $74 million to $681 million)

The proposed regulation is expected to reduce the incidence of seismic non-compliance in residential and commercial buildings throughout New Zealand.

We investigate this benefit by looking at the frequency of seismic issues identified through stakeholder consultation, and the cost associated with bringing a building up to standard. The actual incidence of substandard seismic design and construction of buildings and the built environment is unknown. Adding to the uncertainty is that many seismic issues may never be identified or cause a problem unless there is a major earthquake.

Stakeholder consultation identified a very high incidence of issues with commercial buildings in regional New Zealand. We have examples of over 50 per cent of commercial buildings sampled being found deficient, with the average costs to fix the issues at over $1 million per building.[20] While this is anecdotal evidence based on a small sample, a basic media scan turns up reports of major engineering issues throughout New Zealand.

We use this evidence of seismic noncompliance in commercial buildings to estimate a reduction in the number of buildings with seismic noncompliance and avoided costs as set out below, noting this estimation is based on several assumptions and there is significant uncertainty.

- We use the number of building consents issued over the last 20 years to forecast the number of residential and commercial consents expected per year.
- We then apply a range of incident rates[21] (1 to 3 per cent for residential consents and 10 to 30 per cent for commercial buildings)[22] to forecast the number of consents that have engineering issues each year (under the status quo).
- Then we apply an incident reduction rate (0.1 to 1 per cent for residential and 1 to 3 per cent for commercial). This attribution is speculative but useful to illustrate what would be required in terms of benefits to justify the costs involved.
- This means in 2021 we forecast a reduction in seismic non-compliance by four residential buildings and 21 commercial buildings. This is theoretical, and we would expect a significant lag before seeing any actual change in incidence if ever visible.
- Modelling of benefits from reduced incidence begins in year 6 once the licensing scheme has been fully implemented.

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[20] Confidential source from stakeholder interviews.

[21] Percentage of building consent that would not comply with seismic requirements.

[22] We were told residential building are often simple wooden framed structures and are less likely to have seismic non-compliance.

Table 25: Forecasting building consents

	Consents 2021	Incident rate	Incidents 2021	Reduction rate	Reduction in incidents
Residential	39,065	1% (3%)	391 (1,172)	0.1% (1%)	0.4 (11.7)
Commercial	5,252	10% (30%)	525 (1,575)	1% (3%)	5 (47)

Source: Statistics New Zealand building consents issued over past 20 years used to forecast 2021 numbers of consents

To estimate the benefit from the reduction in incidents, we apply an average financial burden per incident of $73,000 for residential and $1.1 million for commercial buildings. This is based on the average cost to repair five buildings with seismic noncompliance in regional New Zealand.[23]

This results in a total benefit of around $49 million to $451 million over 25 years. With a central estimate of $199 million.

Table 26: Benefit from reduction in seismic non-compliance (25 tear PV $ millions)

Consent type	Low	Midpoint	High
Residential	0.5	5	14
Commercial	48.5	194	437
Total	**49**	**199**	**451**

In addition to this monetised benefit there would be other benefits in relation to the following avoided costs: opportunity cost of capital, lost income, legal expenses, time and wellbeing costs. However these benefits are more challenging to estimate. We therefore consider our estimate of this benefit is based on conservative assumptions and does not capture all potential benefits.

Life safety risk reduction

We have investigated quantification of lives saved to illustrate that this is a significant benefit from the proposed regulation, but due to uncertainty around frequency of incidents and rate of unknown issues, and avoided fatalities, we have not included this in our monetised results. Instead the analysis here is included to illustrate the potential significance of this benefit.

We have focused our analysis on seismic non-compliant construction because there are significant risks associated with engineering failure in this area. However the risk to life does not only come from seismic risk or the construction sector, almost all fields of engineering could have life safety implications. During our stakeholder consultation we heard of incidents of poor engineering in transport that could have resulted in injury or death. For example a poorly designed towing connection failed while a vehicle was on the road. It was fortunate this happened at a time and place where no one was hurt. Past issues with heavy vehicle certifiers resulted in NZTA covering the costs of

[23] Confidential source from stakeholder interviews.

recertification and rectification of more than 1,400 towbars Laestimated to be between $1 million and $1.5 million.[24]

A method to forecast the benefit of lives saved would:

- Assume the proposed regulation results in a reduction in the current prevalence of seismic non-compliant construction
- Then assume a deadly earthquake happens in the next 25 years and that lives would be saved due to a reduction in the rate of existing but unknown issues with the engineering of buildings and the build environment.

The VOSL is maintained by Waka Kotahi (Ministry of Transport) and represents the most common figure used to value a life in New Zealand.[25] The most recent value published in the Treasury's Cost Benefit Analysis (CBAx) Tool 2021 is $4.56 million.

Applying Waka Kotahi VOSL to the following examples gives an indication of the value of lives saved because of improved regulation of engineers:

- The 115 lives that were lost in the 2011 Christchurch CTV building collapse are valued at approximately $520 million.
- Saving one life a year over 25 years (i.e. 25 lives in total) returns $67.5 million present value using a 5 per cent discount rate.
- The 2016 Mt Victoria tuk-tuk incident resulted in five minor injuries. A reduction of one minor injury per year is $0.4 million (present value over 25 years) and a serious injury per year $7 million present value.

There are also illness events such as contamination of water supply at Havelock North (estimated to cost $21 million) that all will become less likely in the future if the regulation achieves its objectives.

We can compare these life value estimates to costs of the proposal as follows, noting this is a stand-along comparison which only considers the value of lives saved against costs:

- The net cost of licensing is $32 million, which is equivalent to the benefit of saving 0.5 lives per year for the 25-year analysis period (12.5 lives).
- The net cost of registration is $1,359 million which is equivalent to over 21 lives per year for 25 years (525 lives).

Given the uncertainty about outcomes as discussed already, these are illustrative and not included in our net benefit result.

[24] See https://www.stuff.co.nz/business/110440801/uturn-on-1400-towbar-checks-by-transport-agency

[25] This value represents the willingness-to-pay to avoid a fatality from a road crash. It was originally estimated in 1991 and updated by indexing to average hourly earnings.

6.3.2 Increased information on quality

Information asymmetric occurs where one party in a market transaction has more information than the other. Adverse selection is defined as making a sub-optimal decision because of incomplete or imperfect information regarding either risks or quality.

Engineering services are purchased by governments, large and small business, and individual consumers. Asymmetric information on quality is present because it is difficult for a buyer of engineering services or consumer (i.e. the person using the product) of the engineering product to assess the quality of the engineering service offered before or after a purchase (e.g. foundations of a building or inside a piece of mechanical equipment) or understand the risks of poor engineering. The service is not observable or able to be inspected before purchase, engineering services are by nature often complex and require considerable knowledge and skill to produce and assess, the quality of the service is difficult to assess even after it is complete, and many buyers/consumers of engineering services are not frequent buyers/consumers.

The consequences of poor buying/consumer choices can be significant as the service may be a large financial cost and a poor quality service can cause significant harm. There is a risk that substandard engineering work will lead to catastrophic failures, harm to the public, significant economic costs, and damage to the public's confidence in the engineering sector.

The licensing and registration of engineers provides more information to the market on the quality of engineers and is expected to lead to a reduction in the incidence of substandard engineering and the risk to public.

Additionally, the proposed change may reduce information search costs incurred by the market when assessing quality of engineering services. This is difficult to estimate but a tangible example is provided by council run producer authors registers, the presence of which is signals that consumers of engineering services have difficulty assessing the quality of engineering services. Implemented by Auckland Council and other councils, they allow the council to restrict who is able to sign off producer statements. This allows the council to assess the suitability of engineers to be authors of producer statements.

It is possible that the introduction of registration and licensing of engineers will mean that producer authors registers run by councils are no longer required. We estimate the cost of maintaining these registers below and suggest that a tangible benefit would be realised if these registers are no longer required.

Avoided duplicate registers at least $1.5 million in avoided costs

Auckland Council is by far the largest of the councils that operates a register, with the direct costs charged to engineers relatively small as shown in Table 27.

Searching the Auckland register under Structural, Geotechnical and Fire returns 1,113 results for the number of registered engineers. Using the costs shown in Table 27, we forecast $1.2 million of fees and $0.3 million of engineer compliance cost over 25 years, although it is likely this does not cover the full cost of managing the system (if there is not full cost recovery). If we consider the opportunity cost of council resources spent on maintaining this register and others like it around the country, the costs of producing and managing these registers could easily be in the range of $3 to $5 million.

Table 27: Auckland Council producer statement author register fees

Fee category	Cost
Registration as a producer statement author	$345
Renewal of registration (three-yearly)	$200
Register as a high-risk producer statement author – fixed fee (non-refundable, no additional charges)	$200

6.3.3 Returns to CPD of $1.7 billion

Many professions have requirements for ongoing CPD, including legal, medical, and accounting professions. CPD can provide value to engineers and engineering firms in a variety of ways including:

- maintaining and enhancing knowledge and skills to deliver a professional service
- keeping pace with the standards of others in the same field
- keeping up to date with changing trends in the industry including technology, legislative and regulatory changes.

There is a strong argument for CPD based on knowledge decay. Knowledge decay was addressed by Institute of Electrical and Electronics Engineers (IEEE) Fellow and President of the University of South Carolina, Thomas Jones, in 1966. He estimated undergraduate engineers need to invest five hours a week just to replace obsolete knowledge. In 1991 the IEEE stated that degrees earned by engineering graduates would be irrelevant within five years' time (Engineers Australia, 2021).

Engineers Australia's National Competency Assessor and resident CPD expert Lyal Douglas says:

> "To be able to do good work now, you need to keep up to date with what's going on in the industry. It's not a static industry. What was the latest technique of 10 years ago, is not necessarily the latest technique of today." (Engineers Australia, 2021)

The requirement for engineers to fulfil CPD requirements is a key part of the proposed regulation and will contribute to reduced risks to the public through improved engineering standards. In addition it is expected that CPD will lead efficiency gains across the engineering industry and potentially some personal gains to engineers in the form of higher salaries.

Different types of CPD activity will deliver different benefits and the optimal mix of CPD activity differs amongst engineers. Our analysis is high level and we have not assessed different types of CPD or the mix of CPD in this CBA.

In the following sections we explore different methods for quantifying the efficiency gains and salary gains value of CPD.

Efficiency gain of $1.6 to $1.9 billion

Increased knowledge created by CPD may help engineers become more effective in the workplace. Determining how and to what level CPD can increase productivity is challenging as there are a variety of CPD activities and not all CPD will provide the same efficiency benefit.

For engineers currently not doing enough CPD or the right mix of CPD there may be efficiency gains from changing the type and quantity of CPD activity. These gains could be captured by the engineer, engineering businesses or be passed onto consumers.

We have been unable to find any work clearly demonstrating the CPD benefits realisation process. The use of surveys is recommended as a pathway to understanding how engineers and others retain and apply learnings from CPD. We look to literature on the returns to training to help gauge the level of efficiency gain possible.

Lyau and Pucel (1995) found when labour productivity is measured as value added per worker, measures of training investment have strong positive correlation between direct costs and value added per worker. The study suggests that if an average firm invests an additional 10 per cent of its current training expenditures on additional training it can expect to gain 1.0 -1.2 per cent increase in labour productivity (Lyau & Pucel, 1995).

Our central estimate of the status quo rate of CPD activity has about 38,000 engineers completing 20 hours of CPD and 23,000 doing 40 hours. The change represents about 45 per cent more hours of CPD overall or a 50 per cent increase for around 38,000 engineers.

PwC (2020) estimates engineering contributes $10 billion to $15 billion to GDP. We adjust this figure to account for 38 per cent of engineers that will not change their level of CPD. So only 62 per cent of the contribution to GDP is relevant, giving a range of $6.2 billion to $9.3 billion. A 1 per cent increase in productivity across these engineers would be $62 million to $93 million a year. Using the same 2.6 per cent growth rate and forecasting out 25 years sums to a present value of $1.1 billion to $1.6 billion.

Using the GDP contribution is a very high-level proxy so not an ideal method. We get a similar result by estimating the total value of billable hours for the 38,000 engineers that would increase their level of CPD. Using 44.8 working weeks per year and with only 75 per cent of hours billable we estimate 1,344 hours at a rate of $154.[26] This estimates the value of engineer's output at $7.8 billion.

The central estimate from Lyau & Pucel (1995) is 1.1 per cent gain which gives $86 million a year for a present value of $1.48 billion over 25 years.

As the value of billable hours method is in the range of the PwC GDP based estimate, we use that as our preferred value.

[26] Allows for 11 days public holiday, 4 weeks annual leave and 1 week for CPD

Table 28: Efficiency gain from CPD ($ millions PV)

Efficiency gain	25 years
1 per cent	1,347
1.1 per cent	**1,482**
1.2 per cent	1,617

Efficiency gains might not only be derived from CPD changes, licensing and other registration requirement could also contribute to efficiency gains.

Salary premium maintenance produces $1.6 billion

Another method to illustrate the potential benefits from CPD is through a salary premium that represents the return to engineers on CPD investment. The details of these assumptions and calculation can be seen in Appendix E.

Engineers are broken down into 16 per cent graduates with the base salary of $60k and 84 per cent experienced with the base salary of $90k. This results in 38,514 engineers in year 2 of registration getting a 5 per cent salary premium ($4,260 each) for a total of $164 million salary premium. This continues until year until year 10. New graduate engineers entering the registration scheme follow this same pattern. Over 25 years the total present value of CPD is $1,592 million.

The benefit level associated with CPD is highly uncertain but we feel this represents a relatively conservative set of assumptions and another way to think about how benefits from CPD may accrue.

Put simply, highly trained workers earn higher wages. CPD plays an important role throughout the working life – it serves to ameliorate the inevitable depreciation of the human capital acquired during education (Belfield, Morris, Bullock, & Frame, 2001).

Summary of CPD value

We investigated two methods to illustrate how benefits from increased CPD activity could accrue. We report on the simple efficiency gain as this is the easiest to understand. The 1.1 per cent increase in efficiency translates to almost 15 more hours of billable work a year. We feel this is plausible particularly when viewed alongside another method (salary premium maintenance) that produces a similar value. This indicates the likely returns from CPD are likely to be at least as high as the costs involved.

7. Net CBA result

The central or midpoint assumptions and calculations in this CBA results in licensing of high-risk practice fields and registration of engineers delivering a net benefit of $292 million over 25 years with a BCR of 1.21. If only licensing of high-risk practice fields is included, there is a $203 million net benefit with a BCR of over 7.

In addition, there are significant benefits likely to be achieved which have not been monetised, such as more lives saved and reduced environment costs from avoided incidents. Mandatory registration and licensing for high-risk fields is expected to decrease the risk to public safety from engineering failure by increasing engineering standards. This risk can be large, though unpredictable and infrequent. Although we have discussed these potential benefits in our report, a high level of uncertainty means we have not included it in our monetised net benefit. Our benefits are therefore likely to be higher than the monetised benefit.

Table 29: Net result ($ millions, 25-year PV)

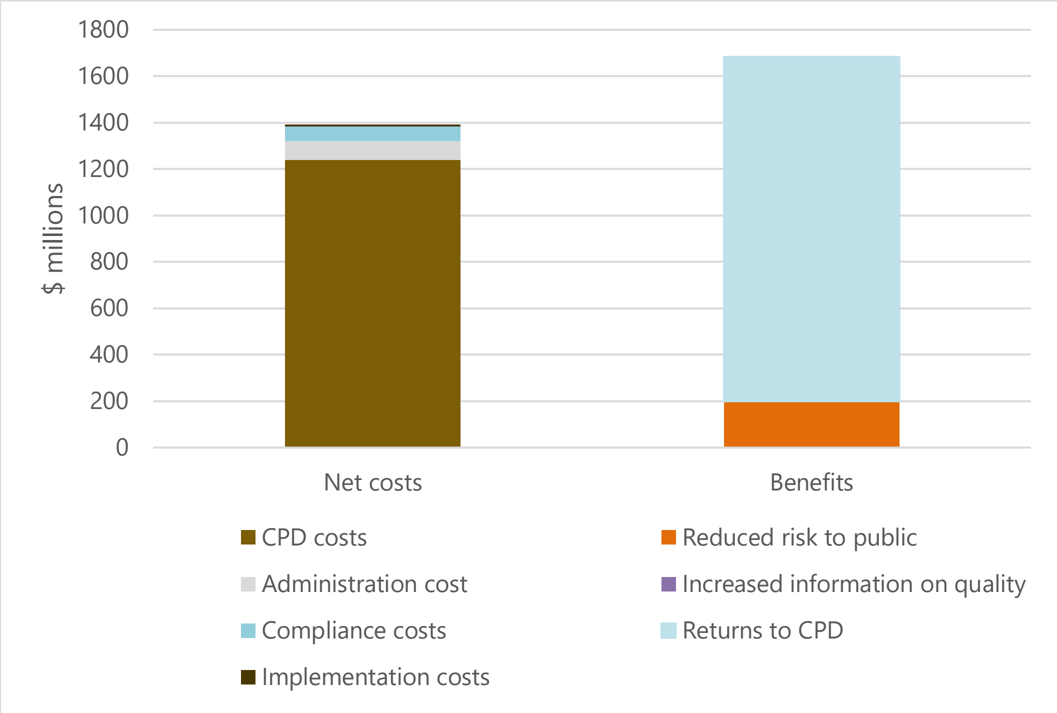
Category	Registration & licensing	Registration only	Licensing only
Net costs	1,391	1,359	32
Net benefits	1,683	1,448	235
Net present value	**292**	**89**	**203**
BCR	**1.21**	**1.07**	**7.41**

The registration result is sensitive to the value placed on engineers' time for CPD undertaken. If this time is valued at what we calculate to approximate a market rate for engineers ($116 per hour), instead of midpoint value of $51 per hour then the result is around $800 million net cost to society. See section **Error! Reference source not found.** for full sensitivity discussion on opportunity cost of t ime. We feel it is unlikely that all CPD undertaken will substitute for billable time making the central estimate of $51 an hour an appropriate balance between the cost of lost work and leisure time.

The high BCR estimated for the licensing only option is the result of a small change in net costs and the decision on allocation of benefits. The small change in net costs is due to the new licensing scheme replacing the existing one with about half of the current CPEng being transferred to the new licensing scheme. This means the other half of current CPEng will stop paying licensing cost once the new licensing system is phased in, and be registered instead. Some of the current CPEng outside of structural, geotechnical and fire safety practice fields may be included in licensing at a later stage, but this CBA has not accounted for that outcome.

As shown in Figure 4, the majority of both the estimated costs and monetised benefits result from increased CPD.

Figure 4: Net costs and benefits ($ millions, 25-year present value)



The benefits calculations and allocation decisions are uncertain but represent best use of the available data and conservative assumptions. The largest of the estimated benefits comes from an efficiency gain resulting from increased CPD. There are several ways to think about the returns from CPD which will differ depending on the type and mix of CPD undertaken. For example, if the change in CPD resulted in an engineer developing a mentor relationship that would not have occurred otherwise this would be expected to result in better career planning and may translate into faster career and salary advancement. Other types of CPD could increases the level of interprofessional interactions or the knowledge of the consenting process that might improve site management and reduce delays. We expect benefits from CPD to be shared by engineers and the public and to be at least equal to the costs of undertaking CPD.

Monitoring and evaluation

For the purpose of monitoring and evaluation, tracking benefits realisation would be challenging and require almost immediate work on establishing a baseline. It is possible the use of surveys as part of the CPD record keeping requirement could shed light on the process of knowledge acquisition, retention and application and perhaps infer value. For the seismic noncompliance benefit estimate some form of ongoing monitoring post construction would be required. For example, a random auditing process of buildings post construction once issues like settling are visible.

8. Sensitivity analysis

This section looks at the impact of adjusting core assumptions. Doing this individually and combined gives a range that reflects the uncertainty associated with the estimates. All costs are in millions and for a 25-year present value, unless where specified. Figures highlighted in bold are the figures used in the CBA.

8.1 Uncertainty around the number of registrations

Reflecting uncertainty regarding engineering numbers (addressed earlier in section 4) and engineering areas required to be registered, we test a range of numbers for this assumption.

We know some engineers will be excluded from the regime i.e. technicians, while others may be excluded due to coverage by other schemes e.g. maritime and aeronautical. However, as the details of coverage are yet to be determined, we implement three ranges using 2018 Census figures:

- The low estimate uses the total number of engineers and excludes engineering associates and partially covered engineers.
- The central estimate uses the total number of engineers and excludes engineering associates only.
- The high estimate uses the total number of engineers.

Estimating costs using these assumptions gives the following estimates – noting status quo costs are not impacted because the number of ENZ and CPEng members are known.

Table 30: Sensitivity of estimates to changes in the number of registrants

	Low (36,587)	Central (61,248)	High (89,007)
Status quo costs	1,840	**2,438**	3,112
Forecast costs	2,329	**3,829**	5,518
Net costs	489	**1,391**	2,406
Net benefits	718	**1,683**	2,770
Net impact	228	**292**	363

There is a plausible spread of $1,917 million in net costs, $2,052 in net benefits, and $135 million in net impact. These spreads are largely driven by changes in compliance costs from CPD requirements and the number of engineers that benefits are applied to, directly influencing the magnitude of benefits.

We recommend using the central estimate of 61,248 engineers. We argue this number is the most plausible, given that engineering associates will be excluded and the uncertainty around the exclusion of partially covered regimes.

8.2 Uncertainty of CPD costs

This section examines two main areas of uncertainty around the cost of CPD; the opportunity cost of time and the current level of CPD undertaken.

8.2.1 The opportunity cost of time

Determining what engineers would otherwise be doing with their time if not required to undertake CPD is highly speculative. The highest value we can justify putting on this time is the opportunity cost of lost time working. We calculate this to be $116 per hour, based on average engineer wages, an assumed translation from wages to charge out rates and adjusting for not all time being billable.

At the other end of the spectrum, the opportunity cost could be zero. If the trade-off is leisure time, we could say this is costless, but all time has some value that is not monetizable. A method for valuing time comes from the NZTA Economic Evaluation Manual (EEM). In 2002 it was estimated that Other non-work travel time was worth $6.90 per hour, updating for inflation puts this value at around $10.14 this is the lowest of estimate of time costs contained in the NZTA EEM.

Another readily available estimate of time cost is in the treasury CBAx impact database. The one hour citizen compliance burden, or cost of an individual's time is $27 an hour which corresponds to the median wage. This figure is recommended as a value to capture the cost of compliance with government processes e.g. filling in forms.

The low estimate uses the NZTA EEM figure, the high estimate uses the value of lost time working, and the central estimate uses a simple average of the NZTA EEM, the citizen compliance burden, and the value of lost time working.

Table 31: Sensitivity of estimates to the opportunity cost of time

	Low ($10)	Central ($51)	High ($116)
Status quo costs	1,015	**2,438**	4,696
Forecast costs	1,713	**3,829**	7,187
Net costs	698	**1,391**	2,491
Net impact	985	**292**	-807

Uncertainty around the opportunity cost of time has a large impact on costs. There is a spread of $3,681 in status quo costs, $5,474 in forecast costs, and $1,792 in net cost, where the $1,792 flows through to the spread in net impacts. These spreads are largely driven by changes in the opportunity cost of CPD, with a minor impact from compliance costs.

We recommend using the central estimate of $51 an hour. This figure represents a balance between the cost of working and cost of leisure, which we use as the forecasted distribution of this mix in the population is unknown.

8.2.2 Current level of CPD activity

We are uncertain about the baseline level of CPD activity i.e. CPD currently undertaken by engineers. ENZ currently has a CPD requirement with around 20,000 engineers having to undertake 40 hours of CPD per year. Yet there is very little information available about how much CPD is done by the other 40,000 or so engineers not covered by a mandatory CPD requirement.

We know some employers of engineers have graduate development programmes. Online resources are widely available, experienced engineers are involved in the development of the industry and there are active institutes and societies. This still leaves some portion of engineers that are not currently doing much or any CPD. These engineers might benefit personally from committing to more CPD which would help society by raising the standard of engineering.

One approach is to look for upper and lower bounds.

- The lower assumes no engineers beyond ENZ are doing any form of CPD. So the status quo costs are just the ENZ member CPD costs.
- The upper bound assumes all engineers are doing CPD to the same level as the ENZ commitment.
- The central estimate assumes half the engineers are doing CPD to the same level as the ENZ commitment, or equivalently, all engineers are doing half the hours of the ENZ commitment.

Implementing these bounds yields the following table:

Table 32: Sensitivity of estimates to changing status quo CPD hours

	Low (0 hrs)	Central (20 hrs)	High (40 hrs)
Status quo costs	1,520	**2,438**	3,357
Forecast costs	3,829	**3,829**	3,829
Net costs	2,310	**1,391**	473
Net benefit	3,165	**1,683**	201
Net impact	855	**292**	-272

Assumptions around the current level of CPD have a large influence on costs and benefits. There is a spread of $1,127 in net impact, ranging from $855 million in net benefits using zero hours of CPD for non ENZ members to $272 in net losses using 40 hours of CPD. This spread is a result of the change in net benefit having a proportionately greater impact than the change in status quo costs i.e. for the low estimate, the gain in net benefit (from more incremental CPD hours being undertaken) is greater than the gain in net costs (from greater status quo CPD costs).

We recommend using the central estimate assuming 20 hours of CPD is done in the current setting. Because the current level of CPD is unknown, there is a risk of underestimating the current level of CPD and overstating the net impact, or vice versa overestimating the current level of CPD and understating the net impact. The central estimate balances these two risks to estimate the current level of CPD being undertaken.

8.2.3 Cost of CPD activities

The cost of CPD activities is uncertain. ENZ provided information online about their available courses and the costs of these. As an approximation, we use the cost and duration to calculate hourly rates. We average these to get a cost of $76 per hour. However, there is significant uncertainty around how many of an engineers required 40 hours will be at these activities versus other CPD activities e.g. on the job learning. We estimate this to be around 10 hours, or 25 per cent of the required time.

For the low estimate, we estimate this as five hours of their time, meaning an average of 35 hours will be spent learning on the job. Contrastingly for the high estimate, we use 20 hours of CPD activities and only 20 hours of on the job learning.

These estimates can be seen below:

Table 33: Sensitivity of estimates to the cost of CPD activities

	Low	Central	High
Status quo costs	2,193	**2,438**	2,929
Forecast costs	3,371	**3,829**	4,745
Net costs	1,179	**1,391**	1,816
Net benefit	1,683	**1,683**	1,683
Net impact	504	**292**	-133

There is a spread of $737 million in status quo costs, $1,374 million in forecast costs, and $637 million in net costs which flow through to net impacts. These are driven by the change in CPD activities costs, reflecting that there is significant uncertainty in the cost of these activities.

We recommend using the central estimate in the absence of information on the mix of CPD activities undertaken.

8.3 Uncertainty of licensing costs

This section examines key assumptions influencing licensing costs, namely the number of licenses, the costs of licensing, and the licensing phase in period.

8.3.1 Number of licences

There is no definitive view on the number of licences that will be required. The current scenario is that additional CPEng practice areas come at no additional charge i.e. fees are charged for the 4,010 engineers, not for the 5,705 practice fields. However, it is unknown whether this will continue, or whether the new scheme will require charges for each practice area. Additionally, it is not known how many practice area registrants there will be.

To deal with this issue, we create three estimates:

- The low estimate uses the 2018 Census number of structural and geotechnical engineers. We adjust for fire engineers by extrapolating the proportion fire engineers are of all structural, geotechnical, and fire engineers in ENZ i.e. because fire engineers are giver per cent of the total, we divide the 2018 Census figure by 95 per cent. We then inflate to 2020 using the 2.6 percent growth rate. Costs are charged to each engineer.

- The central estimate uses the adjusted 2018 Census figure (the number of engineers used in the low estimate). However, we now increase it by half of the current duplication in the CPEng regime and charge based on this figure i.e. charging costs per licence rather than per engineer.
- The high estimate uses the average of the PwC estimates and inflates it for the entire duplication in the current regime – assumes that the current rate of duplication in the CPEng scheme will remain. Costs are then charged on this inflated figure.

Interestingly, the number of engineers estimated using the adjusted 2018 figures and the number of engineering estimated by averaging PwC's figures are very similar, 4,876 versus 4,883 respectively. The majority of the difference in estimates will therefore be from the rates of duplication.

Table 34: Sensitivity of estimates to the number of licences

	Low (Census)	Central (Census + half duplication)	High (PwC + duplication)
Status quo costs	2,438	2,438	**2,438**
Forecast costs	3,801	3,815	**3,829**
Net costs	1,363	1,377	**1,391**
Net benefit	1,683	1,683	**1,683**
Net impact	320	306	**292**

Costs are only marginally sensitive to the number of licences, namely due to CPD costs remaining constant. There is a spread of $29 million in forecast costs which flows through to net costs and then net impacts. $26 million of the spread is due to the changes in administration costs, with the remainder being from changes in compliance costs.

We recommend using the high estimate in our model. PwC methods incorporate graduate and Census figures into their estimate, compared to just the Census. Charging for licenses compared to engineers seems the appropriate option given the current structure of the proposed regime.

8.3.2 Costs of licensing

There is uncertainty around the licensing charges. Of the observable data in the public domain, CPEng figures are most relevant. Adding to the uncertainty in this proxy is that CPEng is not cost recovering, over the past year, the CPEng Registration Authority realised a loss of $426,000. This loss was noted to be from too lower fees, with a fees reviewing being deferred due to this regulatory proposal.

Too deal with this uncertainty, we implement low, central, and high estimates of licensing costs.

- The low estimate uses the CPEng fees outlined in the CBA, and subtracts the annual fee (as per guidance from MBIE) and 50 per cent of the remaining figure.
- The central estimate uses the CPEng fees.
- The high estimate uses the CPEng fees and adds on 50 per cent.

These estimates impact only the licensing administration fees which then flow though to net costs and the overall net CBA result. The low estimate results in administration fees of $41 million, the central in $90 million, and the high $140 million – representing a range of $99 million.

We recommend using the central estimate of $90 million. Given the lack of information available, we can reasonably expect the licensing fees of the new regime to be largely similar to the current CPEng fees.

8.3.3 Licensing phase-in period

There is uncertainty around the phase-in period. MBIE have suggested a six year phase in period however we have tested with a three year period too show sensitivity to this parameter.

The main impact of shortening the phase-in period is the bringing forward of all engineers involved in the scheme, increasing licensing administration and compliance fees. We note CPD costs remain fixed because they are a product of registration engineering numbers.

Table 35: Sensitivity of estimates to the licensing phase-in period

	Low (3 years)	High (6 years)
Status quo costs	2,438	**2,438**
Forecast costs	3,849	**3,829**
Net costs	1,411	**1,391**
Net benefit	1,740	**1,683**
Net impact	329	**292**

There is a small change in licensing administration and compliance costs. Shortening the phase in period increases administration costs by $18 million, increases compliance costs by $2 million, and increases net benefits by $57 million. Combining these impacts results in an overall net costs increase of $37 million. This change is relatively immaterial in the overall cost scheme.

We recommend using the six year phase in period given this is what is currently proposed.

8.4 Implementation and IT costs

Implementation and IT costs are still being planned, meaning there is significant uncertainty around their size.

For the initial start-up costs, we use a range of one to $10 million with a midpoint of $5 million.

For licensing implementation and IT costs, we use similar schemes' costs as a base, estimating on a cost per engineer basis and multiplying by the number of engineers involved – the are explained in detail under forecast registration costs *see Chapter 5).

Uncertainty around these two components results in the following range:

- The low estimate uses 1 million as initial IT establishment costs, and assumes zero licensing implementation and IT costs i.e. the early licensing registrants can use the registration system and there will be no shortfall.
- The midpoint uses 5 million as initial IT establishment costs, and uses the product of the total number of licenses required multiplied by the per engineer licensing and implementation cost, i.e. implementation and IT costs increase proportionately to the number of licenses required.
- The high estimate uses 10 million as initial IT establishment costs, and uses the product of the total number of registrants multiplied by the per engineer licensing and implementation cost, i.e. the system costs the same as the registration system.

Table 36: Sensitivity of estimates to implementation and IT cost uncertainty

	Low	Central	High
Forecast costs	3,822	**3,829**	3,835
Net costs	1,383	**1,391**	1,397
Net impact	300	**292**	286

There is a spread of $14 million in forecast costs which flow through to net costs and net impacts. $9 million of this spread is driven by changes in the initial cost with the remainder being attributable to licensing and IT implementation costs.

Though materially small, this estimate has important cost implications to MBIE. With these assumptions, the shortfall ranges from $1 million to $11 million, consequently, the deadweight loss ranges from 0 to 2 million.

We recommend using the central estimate as it minimises the risk of under and overestimating implementation and IT costs.

8.5 Growth rate

There is uncertainty around the growth rate of engineers. We used a value of 2.6% based on the compound annual growth rate of CPEng registrants by practice field from 2017 to 2020. This proxy is applied to all engineers, including registrants. To test this assumption we implement high and low estimates around this central figure.

Estimating the high and low estimates involved graduate numbers. The high estimate uses the upper bound of graduate numbers as a proportion of the total number of relevant engineers in 2020 (census total minus associates). Similarly, the low estimate uses the lower bound of graduate numbers as a proportion of the total number of relevant engineers in 2020. These estimates can be seen below.

Table 37: Sensitivity of estimates to engineers' growth rate

	Low (2.56%)	Central (2.58%)	High (2.94%)
Status quo costs	2,433	**2,438**	2,543
Forecast costs	3,821	**3,829**	3,995
Net costs	1,388	**1,391**	1,452
Net benefit	1,680	**1,683**	1,748
Net impact	292	**292**	296

Uncertainty around engineers' annual growth rate results in a spread of $110 million for status quo costs, $173 million for forecast costs, and $64 for net costs. Contrastingly, net benefits have a spread of $68 million, negating net costs' effect and resulting in a spread of $4 million for net impact. Each cost component rises relatively proportionally to the number of engineers involved in the scheme, as such, the net impact of the scheme only changes marginally with growth rate uncertainty.

We use the central growth rate, arguing that the historical CAGR of CPEng registrants is the most appropriate figure.

8.6 Time period

Changing the time period analysed influences results. A longer period allows for more impacts to be realised, while a shorter one allows for a better perspective of the short term cost implications.

For our low estimate we use a period of 15 years, for the central estimate 25 years, and for the high estimate 50 years. The impacts of varying the time period can be seen below.

Table 38: Sensitivity of estimates to changes in time period

	Low (15 years)	Central (25 years)	High (50 years)
Status quo costs	1,629	**2,438**	3,800
Forecast costs	2,562	**3,829**	5,962
Net costs	933	**1,391**	2,162
Net benefit	1,062	**1,683**	2,663
Net impact	129	**292**	502

Analysing results over different time periods results in a spread of $2,171 million for status quo costs, $3,399 million for forecast costs, and $1,228 for net costs (where the change in forecast costs are partially offset by the change in status quo costs). In contrast, the spread of net benefits amounts to $1,602, there due to the offsetting effect of net costs, results in a spread of $373 million for net impacts.

We recommend using a 25 year time frame in this CBA as it sufficiently balances the costs of implementing the regime and the benefits from decreases in engineering incidence (where the full benefits are realised in the long term).

8.7 Discount rate

Discount rates reflect the opportunity cost of consuming now, rather than in the future. They allow us to compare the present value of costs/benefits in different time periods by appropriately adjusting to the same period. Treasury CBA guidance is to use 5 per cent, which is the default rate for hard to categorise projects. Higher rates can be used when the item being discounted is in a fast paced environment where there is more risk e.g. IT. They place a higher value on short term values by discounting future cash flows at a higher rate. Lower rates are used for longer term projects where the benefits or costs are more likely to be realised in the future. A lower rate places a higher value on future cashflows by discounting less.

In this case, a higher and lower rate can be argued. A higher rate may be appropriate given the long lives of the products of engineers' work. For example, structures are expected to remain at a high standard for long periods of time. Benefits from an increased standard of structure would be realised in the future with a decrease in incidents, meaning a lower discount rate would be appropriate for the value of this to be realised. However, the fast evolving nature of skills and technology in the engineering profession means a high discount rate can also be justified. For examples, skills becoming obsolete with technological change or methods becoming obsolete due to new and improved ideas. For these reasons, we look at low and high discount rates of 4 and 6 per cent.

Table 39: Sensitivity of estimates to changes in the discount rate

	Low (4%)	Central (5%)	High (6%)
Status quo costs	2,710	**2,438**	2,206
Forecast costs	4,255	**3,829**	3,466
Net costs	1,545	**1,391**	1,260
Net benefit	1,895	**1,683**	1,502
Net impact	350	**292**	242

Varying the discount rate used results in a spread of $285 million in net costs, $393 million in net benefits and $108 million in net impacts. Costs and benefits vary as we expect given the nature of the scheme. Costs occur are more upfront while benefits take a longer time to be realised, as such, higher discount rates affect net benefits proportionately more than costs, and vice versa. This outcome is evident in the net impacts, where a lower discount rate results in a higher benefits to costs ratio compared to the higher discount rate.

We use the discount rate of 5 per cent based on Treasury guidance.

8.8 Wider sensitivity analysis

This subsection examines relevant scenarios that combine sensitivity components to show the uncertainty inherent in our estimates.

8.8.1 CPD uncertainty

There is significant uncertainty around CPD, as shown above. To reflect this uncertainty we propose a scenario combining all the main factors influencing CPDs, i.e. the opportunity cost of time, the current level of CPD activity, and the cost of CPD activities.

Each scenario is proposed as follows:

- The worst case scenario uses the highest opportunity cost of time ($116), no CPD outside of ENZ, and the low cost of CPD activities.
- The central scenario uses the central opportunity cost of time ($51), 20 hours of CPD outside of ENZ, and the midpoint for the cost of CPD activities.
- The best case scenario uses the lowest opportunity cost of time ($10), no CPD outside of ENZ, and the cost of CPD activities is low.

We note for both the worst case and best case scenarios the "no CPD outside of ENZ estimate" is used. The opportunity cost of time figure influences the trade-off between net costs and net benefits i.e. when the opportunity cost of time is higher, the influence of CPD costs on the status quo is greater than the influence on benefits from engineers undertaking CPD.

Table 40: Sensitivity of estimates to CPD uncertainty

	Worst case	Central	Best case
Status quo costs	3,140	**2,438**	544
Forecast costs	8,103	**3,829**	1,255
Net costs	4,963	**1,391**	711
Net benefit	3,165	**1,683**	3,165
Net impact	- 1,797	**292**	2,453

There is a spread of almost $7 billion in forecast costs. When compared to a spread of $2.6 billion in status quo costs, there is a spread of $4.3 billion in net impacts.[27] These changes arise from the compounding effect of changes in the core assumptions of our CPD calculations.

Our best estimate is the central scenario. However, these ranges show the significant uncertainty inherent in the estimate.

[27] Numbers do not sum to $7 billion due to rounding.

8.8.2 Combined primary sources of uncertainty

We examine the core components influencing uncertainty in our estimate. These components primarily influence CPD and registration costs due to these being the primary drivers of the net impacts.

Using the perspective of observing the largest range in net impacts, each scenario is proposed as follows:

- The worst case scenario uses the highest opportunity cost of time ($116), no CPD outside of ENZ, the low cost of CPD activities, the upper range of registration costs, and the low discount rate of four per cent.
- The central scenario uses the central opportunity cost of time ($51), 20 hours of CPD outside of ENZ, the midpoint for the cost of CPD activities, and the central discount rate of five per cent.
- The best case scenario uses the lowest opportunity cost of time ($10), no CPD outside of ENZ, the low cost of CPD activities, the upper range of registration costs, and the low discount rate of four per cent.

We note the use of a 25 year analysis period to be consistent with our analysis, and the use of 61,248 engineers given the high unlikelihood of all engineers (89,007) being included.

Table 41: Sensitivity of estimates to the primary sources of uncertainty

	Worst case	Central	Best case
Status quo costs	3,490	**2,438**	605
Forecast costs	9,120	**3,829**	1,510
Net costs	5,630	**1,391**	905
Net benefit	3,561	**1,683**	3,560
Net impact	- 2,069	**292**	2,655

Uncertainty around estimates results in significant spreads. There is a spread of $2.9 billion in status quo costs, $7.6 billion in forecast costs, and $0.9 billion in net costs. Interestingly, although there is a spread of $1.9 billion in net benefits, the low and high estimates are within one million of each other. This small difference arises from using the assumptions of no CPD done outside of ENZ, low cost of CPD activities, and the four per cent discount rates across both the worst and best case scenarios. The $4.7 billion spread in net impacts is therefore primarily driven by changes in net costs, which largely reflects the uncertainty in our estimation.

References

Akerlof, G. A. (1970). The Market for a "Lemons": Quality Uncertainty and the Market Mechanism. *Quarterly Journal of Economics*, 488-500.

Belfield, C. R., Morris, Z. S., Bullock, A. D., & Frame, J. W. (2001). The benefits and costs of continuing professional development (CPD) for general dental practice: a discussion. *European Journal of Dental Education*, 47-52.

Corbett, S. (2019). *Financial advice: licensing fees and the FMA levy Cost Recovery Impact Statement.* Ministry of Business, Innovation and Employment.

CPEC. (2020). *Chartered Professional Engineers Council 2019-2020 Annual Report.* Retrieved from CPEC: https://www.cpec.org.nz/annual-reports

Engineers Australia. (2021). *Why CPD is the key to unlocking an engineer's full potential*. Retrieved from Engineers Australia: https://www.engineersaustralia.org.au/News/why-cpd-key-unlocking-engineers-full-potential

Gamage, G., Vickers, J., Fisher, B., & Nebel, B. (2019). *Under construction: Hidden emissions and untapped potential of buildings for New Zealand's 2050 zero carbon goal.* New Zealand Green Building Council.

Jianxun, D. (2013). Game Analysis of the Adverse Selection Formation Mechanism on Engineering Quality Risk based on Information Asymmetry. *Applied Mechanics and Materials*, 334-337.

Lyau, N. M., & Pucel, D. (1995). Economic return on training at the organizational level. *Performance Improvement Quarterly*, 68-79.

Madsen, J. B., & Murtin, F. (2017). British economic growth since 1270: the role of education. *J. Econ. Growth*, 229-272.

MBIE. (2018). *Regulatory Impact Analysis: Cost Recovery Impact Statement – Regulations to adjust electrical workers fees.* MBIE.

MBIE. (2018). *Stage 2 Cost Recovery Impact Statement: Regulations to adjust Licensed Building Practitioner Fees and Levy, September 2018.* MBIE.

NZRAB. (2020). *New Zealand Registered Architects Board: Annual Report 2020.* New Zealand Registered Architects Board.

PGDB. (2020). *Plumbers, Gasfitters and Drainlayers Board: Annual Report 2020.* Wellington: Plumbers, Gasfitters and Drainlayers Board.

PwC. (2020). *Economic contribution of engineering.* Wellington: Engineering New Zealand.

Slivovsky, L., Vanasupa, L., & Chen, K. C. (2006). Global challenges as inspiration: A classroom strategy to foster social responsibility,. *Science and Engineering Ethics,*, 373-380.

Waka Kotahi. (2021). *Monetised benefits and costs manual.* Waka Kotahi.

Weisbrod, B. (1964). External benefits of public education: An economic analysis. *Princeton University Press*.

Appendix A Analysis of engineer numbers

PwC estimates

Total number of engineers in New Zealand

PwC and Engineering New Zealand recently estimated total number of engineers in New Zealand. Using two methods, they found that there are 59,400 to 87,900 engineers currently employed in New Zealand. Data from the 2018 Census indicated 83,552 people work within engineering occupations. Averaging high and low estimates and the number derived from the census data produces the figure of 76,950 engineers working in New Zealand.

The number is reduced to 61,561 engineers by excluding 20 per cent of the workforce because they are diploma-qualified engineering technicians or technologists.

An additional number (33 per cent of total) could be excluded by only including those not working under supervision. This reduces the number to 36,167.

The Economic Contribution of Engineering (2020) report states the mid-point estimate as 73,650 engineers working in an engineering role, which excludes the census estimate.

Licensed fields

Restrict unsupervised professional engineering services within certain fields (if structural, geotechnical and fire safety engineers were restricted this is estimated to impact 4,883 engineers).

This figure is based on two estimates, one using census numbers and the other using graduate numbers.

Census figures

These numbers rely on self-reporting and rather subjective decisions as to classification of associates and engineers already covered by other legislation or that should otherwise be excluded. We include any category in the total from searching the occupation field for "engineer". Technologists, technicians and draftspersons are considered associates.

We categorise some engineering areas as partially covered by other schemes. Partially covered areas are areas of engineering where there are existing competency ensuring measures in place, generally through legislation. For example, Electrical Engineers, where the Electricity Act 1982 requires registration as an Electrical Engineer for any persons with relevant qualifications to undertake prescribed electrical work.[28] For this reason, we the (Census) categories of Ships' Engineer, Transport Engineer, Electrical Engineer, Aeronautical Engineer, Biomedical Engineer, Software Engineer, Computer Network and Systems Engineer, and ICT Quality Assurance Engineer as partially covered by other schemes.

[28] A detailed list and description of associated competency ensuring Acts can be found in the accompanying RIS document.

Table 42: Census 2018 occupation (engineer)

Category	Number (2018)
Need to register	56,529
Classified as associates	25,620
Partially covered by other schemes/excluded	22,761
Total	**82,149**

There is no category for fire safety engineers. As seen below, 4,383 engineers identify as Geotechnical and Structural.

Table 43: Census 2018 initially licensed fields

Code	Occupation	Employed census usually resident population count aged 15 years and over
233212	Geotechnical Engineer	726
233214	Structural Engineer	3,657
Total		**4,383**

Graduate numbers

Based on high level Bachelor of Engineering graduate numbers (17,400 to 2,260) and a career length of 43 years, we would expect a stock of around 75,000 to 97,000 engineers that would fluctuate with departures from the industry and the net immigration of engineers.

Assumptions about the percentage of civil engineers that go on to specialise as structural, geotechnical or fire safety engineers are required to estimate the stock of engineers working in these fields. PwC calculates this to be in the vicinity of 4,702 engineers.

Appendix B Producer statements

Auckland register

In addition to the information required on the application form, applicants must provide three copies of the type of producer statement they intend to issue for review; statements should be noted as being examples only. Attachments should be included e.g. warrantees, applicator licenses, etc. This will enable the Council to check and confirm that the standard of documentation provided at Code of Compliance will be acceptable.

18.1 Authors are responsible for ensuring their approval remains current. Council will notify authors by email prior to their registration lapsing.

18.2 To avoid registration lapsing and the author being removed from the register:

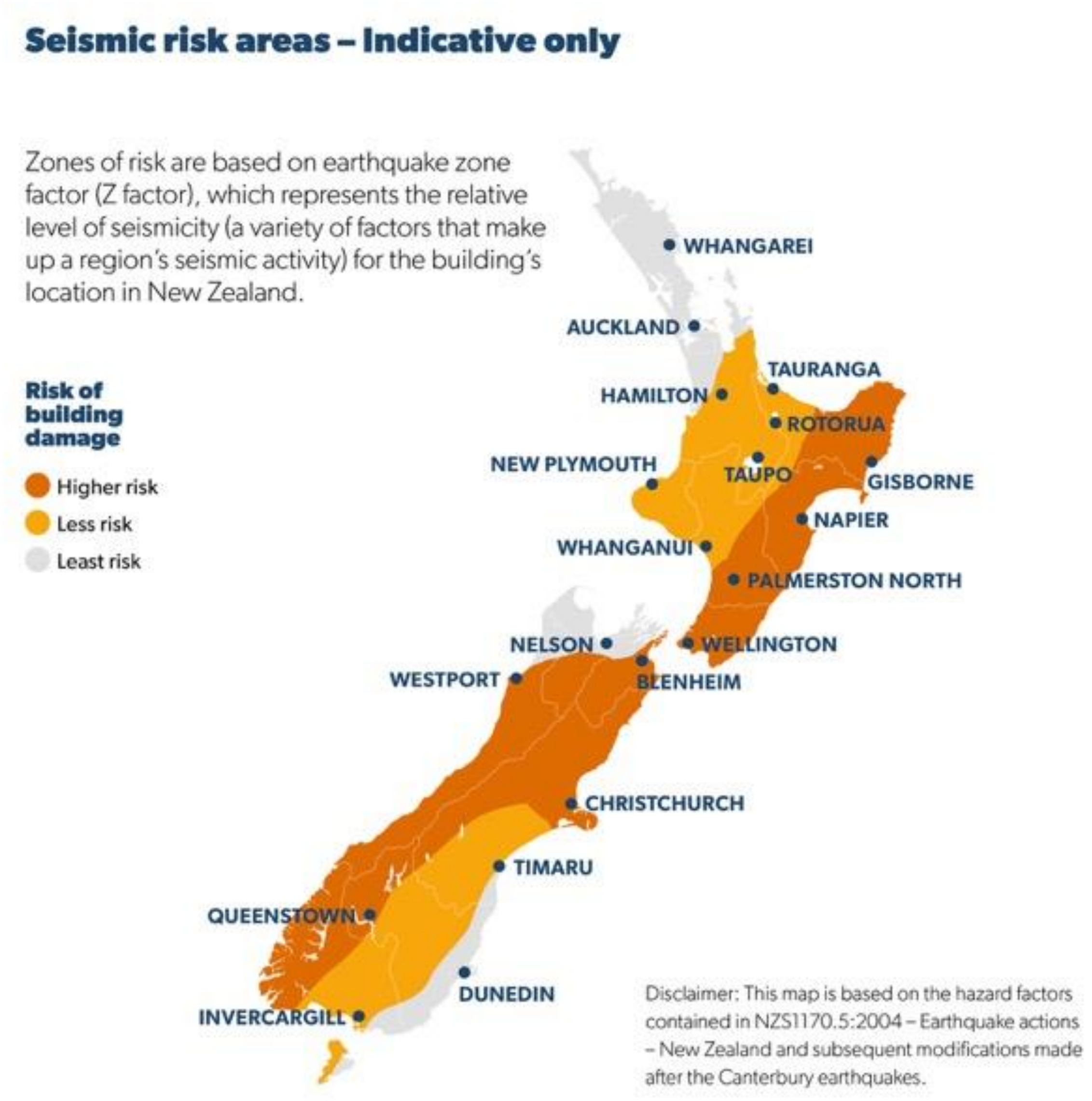
- an application for renewal must be received at least 20 working days prior to the date that an author's approval expires; and
- be successfully approved prior to the date that the previous approval expires

18.3 If successful, registration is extended for a further 36-month period.

Producer statements

Producer statements are not embedded in regulation but are well-established and widely used to provide Building Consent Authorities (BCAs) with assurances that specialist (including engineering) design, design review, construction and construction review have been done to an appropriate standard. In practice, CPEng is used by BCAs as a standard to ensure the engineering author of the producer statement is suitably qualified. This drives engineers to become CPEng and provides an accountability mechanism should outcomes be adverse.

Appendix C Benefits data



Source: New Zealand Earthquake Commission (EQC) available from: https://www.eqc.govt.nz/be-prepared/natural-hazards-where-you-live?gclid=CjwKCAjwvuGJBhB1EiwACU1AiTnJzvix-wSaSGiMU67wMy8U3nyV6VOLyVIrBAlFskXviMTlIKsJqxoCFcsQAvD_BwE&gclsrc=aw.ds#node-detail-1644

Appendix D CPEng fee structure

Table 44: CPEng assessment fees

CPEng fees 2020	Amount (excl. GST)	Total
Registration application charge	3,253	3,253
less any of the following rebates that apply:		
if there is no engineering knowledge assessment	1,175	2,078
if there is no interactive assessment	270	1,808
for each assessor (if any) who is not remunerated for an assessment during which there is an interactive assessment	513	1,295
for each assessor (if any) who is not remunerated for an assessment during which there is no interactive assessment	378	917
for applicants exempted under rule 9(2) from having to provide certain information, if the assessment panel uses only a single interactive assessment	350	567
Continued registration	640	
less the following rebate if it applies: for each assessor (if any) who is not remunerated for the further interactive assessment	225	415
Review of registration	1,000	
CPEng annual fee	460	

Appendix E CPD benefit calculations

The following assumptions are used to illustrate the CPD benefit:

- All engineers enter the registration scheme in 2022. It is assumed 16 per cent of the engineers are graduates or have less than five years' experience and the 84 per cent have more than five years' experience.
- The average 2020 salary for engineers with less than five years' experience is $60,000 and for engineers with more than five years' experience $90,000 (median salary for engineers that are Not Charted)
- 2,105 graduate engineers become registered in 2023 (2020 estimate of the number of graduate engineers 2,000 inflated to 2023), with an annual growth rate of 2.6 per cent for graduate engineers.
- A 5 per cent salary premium[29] for registered engineers is calculated from the second to tenth year after registration.[30]
- After 10 years the salary premium in no longer measured.

Table 45: CPD benefits calculation detail ($millions)

Year	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047
Number of new licensed engineers	38,514	1,653	1,696	1,740	1,785	1,831	1,879	1,928	1,978	2,029	2,082	2,136	2,192	2,249	2,307	2,367	2,429	2,492	2,557	2,623	2,691	2,761	2,833	2,907	2,983	3,060
CPD second year return		164	5	5	5	5	5	6	6	6	6	6	6	7	7	7	7	7	7	8	8	8	8	8	9	9
CPD third year return		-	164	5	5	5	5	5	6	6	6	6	6	6	7	7	7	7	7	7	8	8	8	8	8	9
CPD fourth year return		-	-	164	5	5	5	5	5	6	6	6	6	6	6	7	7	7	7	7	7	8	8	8	8	8

[29] Sapere assumption

[30] Sapere assumption, the assumed premiums are significantly lower than CPEng salary premium of 49% in 2020 based on engineering New Zealand remuneration survey 2020 available form: https://d2rjvl4n5h2b61.cloudfront.net/media/documents/RemSurvey2020-Snapshot_FINAL.pdf

CPD fifth year return		-	-	-	164	5	5	5	5	5	6	6	6	6	6	6	7	7	7	7	7	7	8	8	8	8
CPD sixth year return		-	-	-	-	328	10	10	10	11	11	11	12	12	12	12	13	13	13	14	14	15	15	15	16	16
CPD seventh year return		-	-	-	-	-	328	10	10	10	11	11	11	12	12	12	12	13	13	13	14	14	15	15	15	16
CPD eighth year return		-	-	-	-	-	-	328	10	10	10	11	11	11	12	12	12	12	13	13	13	14	14	15	15	15
CPD nineth year return		-	-	-	-	-	-	-	328	10	10	10	11	11	11	12	12	12	12	13	13	13	14	14	15	15
CPD tenth year return		-	-	-	-	-	-	-	-	328	10	10	10	11	11	11	12	12	12	12	13	13	13	14	14	15
Total		164	169	174	179	349	359	370	381	392	76	78	80	82	84	86	88	91	93	95	98	100	103	106	108	111
Discounted		149	146	143	141	260	255	250	246	241	44	43	42	41	40	39	39	38	37	36	35	34	34	33	32	31
Cumulative		149	295	438	579	839	1,094	1,345	1,590	1,831	1,875	1,918	1,961	2,002	2,042	2,082	2,120	2,158	2,195	2,230	2,266	2,300	2,333	2,366	2,398	2,429

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.

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