

# Social Cost Benefit Analysis

ENGGEN 403 - Lecture 10

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NEW ZEALAND

ENGINEERING

# This Week

3	29 Jul	<u>Traditional CBA</u>	<u>Societal Considerations</u>	<u>GDP and Govt. Spending</u>	<u>Quiz 1</u>
4	5 Aug	Social CBA	Guest Speaker: Dame Prof Juliet Gerrard	Meet the Team	Lecture Participation Team Canvas
5	12 Aug	Business Case Analysis	Research and Resources	Introduction to Team Project	Quiz 2

## Reminders

- Lecture participation for tomorrow's guest lecture
- Team canvas
- Check out this week's announcement for more information

# Learning Outcomes



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By the end of this session, students should be able to:

- Identify and differentiate between economic and non-economic impacts (benefits and costs) for a systems level project.
- Monetise, Quantify or Qualify economic and non-economic impacts using cost benefit analysis and the Living Standards Framework, and determine the impact of solutions on the wellbeing of New Zealand.
- Discuss how economic and non-economic impacts are used in decision making.

# Agenda

1. Identifying Impacts
2. Monetising Impacts
3. Non-Monetary Impacts
4. Discounting
5. Economic Metrics
6. Wrap up & Reminders

**Cases:** - Auckland Light Rail, City Rail Link,  
Previous Systems Projects

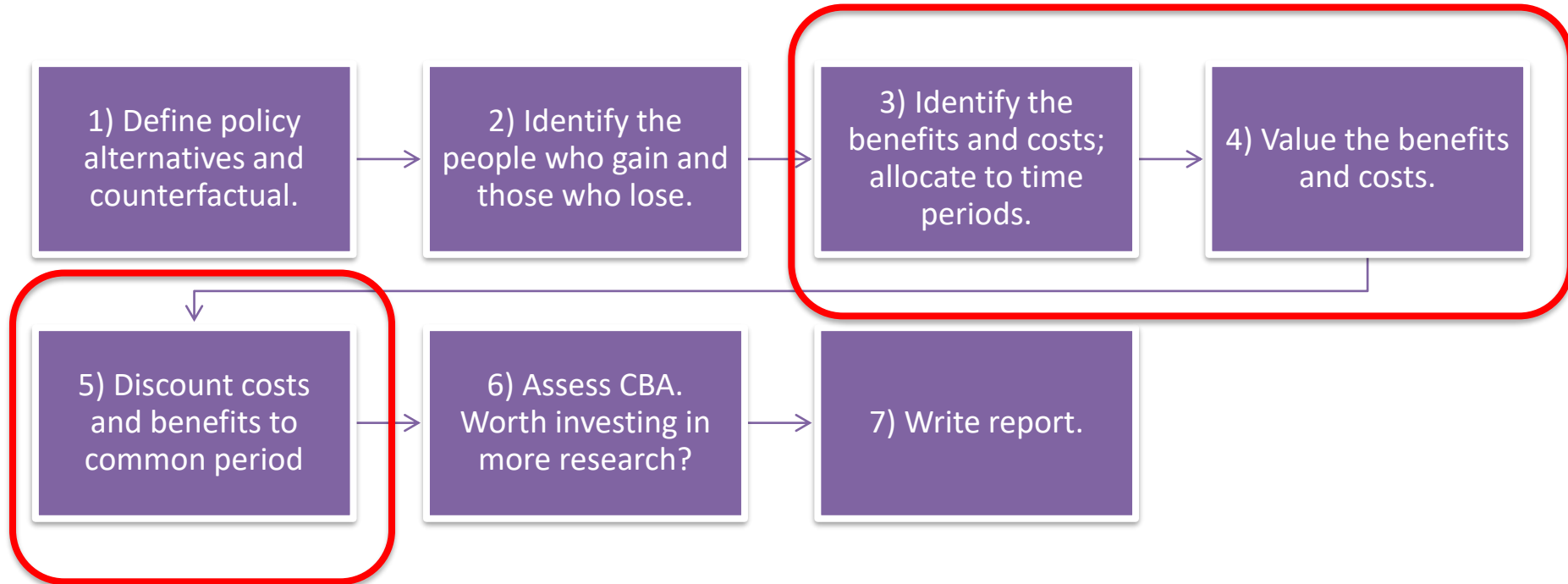


VS



# The Financial Case

At the national (systems) level the steps for the CBA are:



Once you've identified who will be impacted by your solutions through **stakeholder analysis**, you need to identify, monetise, quantify or qualify the impacts of your solutions. Social impacts can be both **monetary** and **non-monetary**.

## **Monetary Impacts (Benefits/Costs)**

- Are expressed in terms of money AKA economic impacts.
- Are quantitative as well
- Are assessed through CBA

## **Non-Monetary Impacts (Benefits/Costs)**

- Are expressed in numbers (quantified) or words/discussion (qualitative), AKA non-economic
- Are assessed through:
  - Statistical analysis (quant)
  - Discussion (qual)
  - Multi criteria analysis (MCA) (both)

# Identifying Impacts

You need to identify both Monetary and non-monetary impacts before trying to value them. Problem analysis will identify the main areas of wellbeing.

## **Monetary Impacts include:**

- Any revenues produced
- Capital and ongoing costs
- Any cost savings (benefits) or dis-benefits (costs)
- Any Impacts on wellbeing that can be monetised (economic impacts).
- Identified through CBA and LSF

## **Non-Monetary Impacts include:**

- Quantifiable but not monetisable impacts on wellbeing.
- Non-quantifiable impacts e.g. impact on 4 capitals/indicators.
- Identified through the LSF or other wellbeing framework He ara Waiora
  - Includes ordinal variables e.g. high,med,low

# Identifying Impacts

You need to identify both Monetary and non-monetary impacts before trying to value them.

## **Monetary Impacts include:**

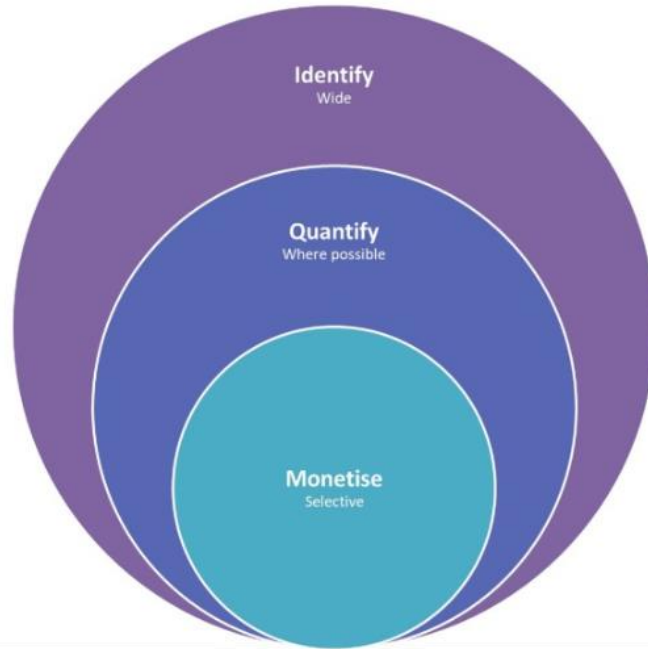
- Number of hospital beds in terms of money.
- Hospital patient visits
- Monetised through the CBAX

## **Non-Monetary Impacts include:**

- Quantifiable
  - Age, weight, height
  - Number of hospital beds
- Qualitative
  - Colour, taste, smell
  - Discussion of impact on 4 capitals
- Ordinal (largely qualitative but “in between”) are discrete
  - Categories (high, medium, low)
  - Rankings (1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>)



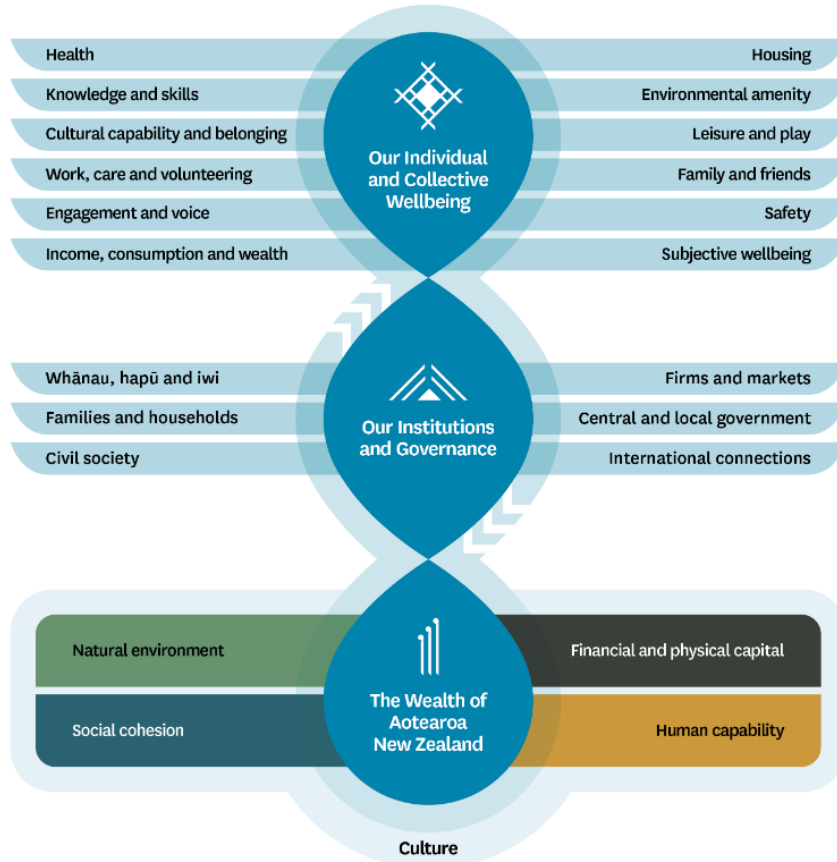
# Identifying Impacts



**Diagram 1. CBA analysis of impacts - only a subset of the impacts are monetised**

CBA Steps	1. Identify impacts - Comprehensive - Unquantified	2. Quantify impacts - To extent/where possible - Quantified but un-monetised	3. Monetise impacts - Selective - Quantified and monetised
Analysis	<ul style="list-style-type: none"> <li>Problem/opportunity and intervention logic</li> <li>Counterfactual and options</li> <li>Broad range of impacts: positive/negative, people, wellbeing domains, sectors, government/non-government, total economic value</li> <li>Qualitative judgements</li> </ul>	<ul style="list-style-type: none"> <li>Assumptions relative to counterfactual: Who are affected? In what way? To what extent? When? For how long?</li> <li>Transparent quantification</li> <li>Evidence base</li> <li>Quantitative, e.g. could be used in cost-effectiveness (one main objective) or cost-utility analysis</li> </ul>	<ul style="list-style-type: none"> <li>Monetise key impacts</li> <li>Sensitivity analysis</li> <li>Discount future impacts</li> <li>Calculate overall net present value (NVP) across all monetised impacts and benefit/cost ratio (BCR)</li> <li>If evidence is weak, use reverse CBA analysis</li> </ul>
In practice	<ul style="list-style-type: none"> <li>Minimum analysis to give a sense of whether an option is doing some good</li> <li>Check whether too narrow</li> <li>Other perspectives?</li> </ul>	<ul style="list-style-type: none"> <li>Difficult and time consuming</li> <li>Involves research / modelling</li> <li>Start with what you know</li> <li>Stronger evidence base gives more confidence</li> </ul>	<ul style="list-style-type: none"> <li>Model present value (PV)</li> <li>Focus on PVs for key impacts, less on summary measures</li> <li>CBAX tool includes database of monetary values</li> </ul>
Measures	<ul style="list-style-type: none"> <li>Multi-dimensional wellbeing such as Living Standards wellbeing domains</li> <li>Safety/Health: "Reduced road deaths"</li> </ul>	<ul style="list-style-type: none"> <li>Quantified assumptions and evidence base</li> <li>Marginal "number of prevented road deaths", types, settings etc.</li> </ul>	<ul style="list-style-type: none"> <li>PV of impacts in dollar terms, using quantified analysis and impact values in modelling</li> <li>Summary measures: NPV, BCR, and return-on-investment</li> </ul>

# Identifying Impacts



[Enter LSF Dashboard here](#)

Monetizable  
through CBAX

Distribution

Resilience

Productivity

Sustainability

Quantitative or  
Qualitative assessment  
(MCA)

## CBAX spreadsheet

The CBAX spreadsheet tool is a spreadsheet model that contains a database of values for monetising impacts on the 12 domains of wellbeing.

- Allows for consistent approach to cost benefit analysis through common assumptions and values.
- Long term and broad view of societal impacts, costs and benefits.
- Monetise and discount impacts where possible
- Transparency around assumptions and evidence base
- Can carry out reverse analysis. What level of improvement is required to an indicator to be worth it?
  - If our costs are this much, we need to generate at least this much benefit.

# Monetising Impacts

## Impact database

Over 250 monetised impacts. Check the Impacts Database Tab.

### Impacts Database

Take note of the row number (column A) for the relevant impact(s) values you want of this table. See the CBAX Tool User Guidance for more information about entering

Row Number	Wellbeing Domain	Description	Value adjusted to 2024	Value	Unit	Government/Non Government
129	Health	Cost to health system from fatal crash	-17,149	-16,200	Per incident	Government
130	Health	Cost to health system of serious crash	-20,642	-19,500	Per incident	Government
131	Health	Physical health gain from walking	10	10	Per pedestrian k	Non-Government
132	Health	Physical health gain from cycling (conventional)	5	5	Per pedestrian k	Non-Government
133	Health	Physical health gain from cycling (electric-assisted)	3	3	Per pedestrian k	Non-Government
141	Health	Dementia care	-240	-170	Per day	Government
142	Health	Hospice care	-972	-690	Per day	Government
143	Health	Inpatient hospital visit	-7,488	-6,530	Per visit	Government
144	Health	Outpatient hospital visit	-493	-350	Per visit	Government
145	Health	Intensive care unit	-8,318	-5,500	Per day	Government
146	Health	Emergency room	-521	-370	Per visit	Government
147	Health	Specialist visit (initial)	-493	-350	Per visit	Government
148	Health	Specialist (subsequent)	-352	-250	Per visit	Government
149	Health	Specialist (per hour)	-211	-150	Per hour	Government
150	Health	Practice nurse visit	-60	-40	Per visit	Government
151	Health	Home nurse visit	-141	-100	Per visit	Government

# Monetising Impacts

## Using the CBAX

- Check the **Impacts Database**, are impacts relevant to you?
- Try to monetise the impacts (1-3 primary impacts) you are trying to improve (problem statement).
- CBAX your best bet, can try other tools.
  - [Waka Kotahi Monetsied Benefits and Costs Manual](#)
  - [Project emissions estimation tool \(PEET\)](#)
- Otherwise, will need to default to primary and secondary resources.

Region	Insurance cost in million (Inflated)	City factor	Predicted Damage Cost 2050
Northland	48.2	0.70	\$2,200,000,000
Auckland	43.6	0.63	\$1,930,000,000
Bay of Plenty	47.1	0.68	\$2,100,000,000
Gisborne	5.8	0.08	\$260,000,000
Hawke's Bay	14.3	0.21	\$640,000,000
Taranaki	3.1	0.05	\$140,000,000
Wellington	62.2	0.90	\$2,800,000,000
Tasman/Nelson	68.8	1.00	<b>\$3,100,000,000</b>
Marlborough	6.4	0.09	\$290,000,000
West Coast	97.2	1.41	\$4,400,000,000
Canterbury	50.1	0.73	\$2,300,000,000
Otago	151.4	2.20	\$6,800,000,000
Southland	147.7	2.15	\$6,600,000,000
SUM			<b>\$33,000,000,000</b>

## Price of life: Govt to value safer and faster journeys nearly three times more

- 2018 report recommended removing car parks leading into roundabout, was not implemented.
- 2022 -Driver opens door, cyclist thrown in front of oncoming traffic. Dies at the scene.
- As Engineers you may make decisions around changes to infrastructure that impact PEOPLE.
- As callous as it sounds, need to weigh safety and damages against things like convenience.



Image - Royal oak roundabout



# The Value of a Human Life



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## How do we value a human life?

NZTA – value of a statistical human life

700-person survey **1991 = \$2M NZD**

Doubled in **1998 = \$4M NZD**

Before COVID Inflation pushed it to **\$4.53M NZD**

8000-person survey **2023 = \$12.5M NZD**

Weighed against the value of convenience and time savings.

Saving transport time \$7.80/hr (pre-2023) to **\$19.53/h** (post-2023)

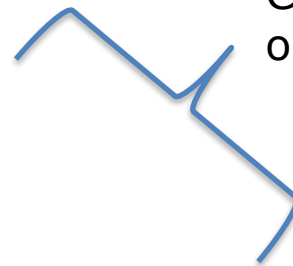
Increases to **\$36.18/hr** to not be stuck in congestion.

## Auckland Light Rail

Table 28: Annual additional farebox revenue estimate (nominal, NZ\$m)

Year	Tunnelled Light Rail
2033	19.3
2041	32.4
2051	55.0

Not modelled  
through LSF or  
CBAX contracted  
out to big 4



## City Rail Link

Farebox revenue in 2023 is expected to be \$20.4M, leaving \$28.9M OPEX to be funded by council and NZTA

	Annual opex estimate (\$2015)
Maintenance and renewals	\$17m
CRL service costs	\$25m
Total annual operating costs	\$42m

Source: AT, PwC Analysis



## Auckland Light Rail

Table 12: Economic Costs

	Light Rail	Light Metro	Tunnelled Light Rail
Unescalated (P50) Capital Cost (M)	\$7,312	\$12,773	\$11,410
Escalated (P50) Capital Cost (M)	\$9,047	\$16,291	\$14,601
Unescalated OPEX (M pa <sup>55</sup> )	\$105	\$115	\$120
Economic NPV (M)	<b>\$7,141</b>	<b>\$11,196</b>	<b>\$10,362</b>

## City Rail Link

Figure 74 – Capital Costs

Costs	Totals (\$million)
Investigation and design	150
Construction - enabling works	302
Construction - main works	1,802
Gross land purchases (excluding land sales)	242
Maintenance unit and Operational Readiness	36
Wider Network Impact Project	114
Gross capex costs (excluding land sales)	2,646
Land sales	-116
Capex costs after land sales	2,531

## Auckland Light Rail

**Table 13: Economic Benefits**

	Light Rail	Light Metro	Tunnelled Light Rail
Traditional transport benefits (NPV) (M)	\$3,747	\$6,063	\$5,278
Wider economic benefits (NPV) (M)	\$3,989	\$6,988	\$5,760
Total benefits (NPV) (M)	\$7,736	\$13,051	\$11,038

## Auckland Light Rail

### Primary benefits

- Reduce crowding on existing services
- Reducing crowding on other services due to transfer to this service
- Improved quality of service on the existing line i.e getting to the airport
- Reduction in travel times
- Reliability benefits (better than bus to airport)
- Safety, emissions benefits

### Wider benefits

- Agglomeration benefit – increases in productivity and efficiency through better spatial concentration.
- Improved labour supply benefits – easier to get to work therefore more labour available in certain areas
- Improved transportation impact on cost margins for companies

## City Rail Link

Figure 52 - Total travel time savings benefits (annual undiscounted values)

Model/area		2026	2036	2046
APT	New users	\$12.9m	\$20.7m	\$23.4m
	Existing users	\$102.6m	\$152.3m	\$203.9m

Figure 64 - Total emissions reductions benefits (annual undiscounted values)

Emission type	2026	2036	2046
CO2	\$203k	\$218k	\$535k
PM10	\$261k	\$342k	\$418k
NOx	\$68k	\$74k	\$106k
Total	\$532k	\$635k	\$1.1m

Figure 56 - Total vehicle operating cost reduction benefits (annual undiscounted values)

Model/area		2026	2036	2046
ART (outside SATURN)	All trip purposes	\$0.5m	\$1.5m	\$1.6m
SATURN	All trip purposes	\$0.2m	\$0.2m	\$0.1m

## City Rail Link

Figure 64 - Total emissions reductions benefits (annual undiscounted values)

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## City Rail Link

Figure 66 - Benefits for modelling outputs from the medium growth scenario over 40 years

Benefit category	Undiscounted	Present Value (6% discount rate)
Travel time		
PT users	\$5,405.4m	\$1,278.9m
Road users	\$623.8m	\$136.4m
Decongestion benefits	\$67.5m	\$14.3m
Vehicle operating cost reduction benefits	\$40.9m	\$9.6m
Additional PT user benefits	\$171.8m	\$42.4m
Reliability benefits	\$1,242.7m	\$317.0m
Health benefits from walking	\$523.4m	\$125.0m
Emissions reduction benefits	\$23.9m	\$5.6m
Residual value	\$967.1m	\$94.0m
Total conventional benefits	\$9,066.3m	\$2,023.3m

## Limitations of the CBAX spreadsheet

- Not all impacts will be relevant to your projects.
- Not all impacts are listed in the database
  - Check the impacts database first, then move to other sources
- Organisations need to quantify impacts based on the best available evidence (sometimes it might not be the best evidence).
- Data sets can be incomplete (especially if trying something new).
- Gives exact dollar values, we know this estimation to not be that accurate (IMPORTANT FOR SYSTEMS WEEK).



## Multicriteria Analysis

Multi criteria analysis is used to compare both quantitative and qualitative pieces of information. Mainly used in options assessment.

A scoring framework needs to be established.

- Does not meet expectation, partially meets, meets, exceeds
- Ranked options (1-5 exclusive)
- Weighted scoring (1-5 inclusive), high, med, low (green, red, yellow)

Magnitude	Definition	Score
Large positive (+ve)	Major positive impacts resulting in substantial and long-term improvements or enhancements of the existing environment.	3
Moderate positive (+ve)	Moderate positive impact, possibly of short-, medium- or long-term duration. Positive impacts may be in terms of new opportunities and outcomes of enhancement or improvement.	2
Slight positive (+ve)	Minimal positive impact, possibly only lasting over the short term. May be confined to a limited area.	1
Neutral	Neutral – no discernible or predicted positive or negative impact. Counterfactual could be the do-minimum or do-nothing,	0
Slight negative (-ve)	Minimal negative impact, possibly only lasting over the short term, and definitely able to be managed or mitigated. May be confined to a small area.	-1
Moderate negative (-ve)	Moderate negative impact. Impacts may be short-, medium- or long-term and are highly likely to respond to management actions.	-2
Large negative (-ve)	Impacts with serious, long-term and possibly irreversible effect leading to serious damage, degradation or deterioration of the physical, economic, cultural or social environment. Required major rescope of concept, design, location and justification, or requires major commitment to extensive management strategies to mitigate the effect.	-3

# Previous Systems Project

## Climate Change Adaptation

Muti criteria analysis followed by qualitative analysis of the 4 capitals.

Compare monetary impacts through metrics.

Savings made in future costs avoided, e.g. maintenance of old infrastructure, avoiding catastrophe.

What impacts are most important?

Options	Flooding barriers	River modification	Dry dam	Do nothing	
Financial – Costs & Savings	\$2.1B–Cost \$9.9B–Saving	\$6.3B–Cost \$15B–Saving	\$3.1B–Cost \$23B–Saving	\$0–Cost –\$33B–Saving	
Cost-benefit ratio	4.7	2.4	7.45	–	
Natural Capital					
Human Capital					
Social Capital					
He Ara Waiora framework					
KEY	Highly –ve	Slightly –ve	Neutral	Slightly +ve	Highly +ve

# Previous Systems Project



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Options	Flooding barriers	River modification	Dry dam	Do nothing
Natural Capital	-Hinders marine migration.		+Green roofs absorb pollutants	-Erosion of river banks
	-Significant changes to landscape.	-Altered river ecology	-Disrupt river and local landscape	+Improved soil quality
	+Trees decrease subsidence, absorb GHGs	+Promotes fertile land	-Improve air quality	
Human Capital	+Reduced casualties	-Only mitigates effect from rivers	+Employment	-Increased risk of casualties
	+Increased education stability	+Reduced casualties	+Reduced casualties	-Closure of schools and workplaces
	+Employment opportunities	+Employment opportunities	-Green roof disturb institutions	
Social Capital	+Reduced commercial disruptions from floods	+Reduced commercial disruptions from floods	+Reduced commercial disruptions from floods	-Government perceived as unorganised
		-Disrupt river and local landscape		-Closure of schools and workplaces
He Ara Waiora framework	+Planting native fauna aligns with Te Taiao and Tiakitanga.	-Alteration of rivers and water bodies which are highly regarded by Maori.	+Dry dams retain farmland except in periods of flooding. This allows food and employment security which are an impetus for Maori wellbeing.	-Future flood may become a bigger threat to local iwi
	-Barriers may be seen as cultural invasion.	-Fish migration in Maori awa disrupts Maori fisheries downstream. Impacts food and employment security.		

	Key	<div></div> Yes	<div></div> Maybe	<div></div> No	<div></div> N/A											
#	Option	D	F	V		S	CSF					PS				
				B	C		1	2	3	4	5	1	2	3	4	
1	Do Nothing	<div></div>	<div></div>	0	0	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>
2	Boost Locally Produced Workforce	<div></div>	<div></div>	100	100	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>
3	Boost Internationally Sourced Workforce	<div></div>	<div></div>	100	100	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>
4	Unique Professional Development Opportunities	<div></div>	<div></div>	100	100	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>
5	Boost Workforce through Subsidising Studies	<div></div>	<div></div>	100	100	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>
6	Better Working Conditions and Pay	<div></div>	<div></div>	100	100	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>
7	Prevention Through Education	<div></div>	<div></div>	1000	10	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>
8	Better Integration of Technology in Health Practices	<div></div>	<div></div>	1	0.1	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>
9	Expand Rural Access to Healthcare Schemes	<div></div>	<div></div>	10	10	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>
10	Health Website Update and Awareness Campaign	<div></div>	<div></div>	1	10	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>
11	Promote Use of Private Healthcare for Higher Socioeconomic Groups	<div></div>	<div></div>	100	100	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>
12	Online Healthcare Information and Consultation	<div></div>	<div></div>	1	1	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>
13	90 Day Healthcare Guarantee	<div></div>	<div></div>	1	100	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>
14	Increase Medical Resources	<div></div>	<div></div>	100	1000	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>
15	Centralised Referral Process	<div></div>	<div></div>	100	10	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>

There is  
always an  
impact on  
all of the  
capitals!

## Financial

- Prevented costs incurred by damage and repairs. Helps offset initial development costs.
- Minimised disruptions to utilities and supply chains (food, fuel, water, etc).

**Metric:** 70% reduction in utility shut offs during severe weather by 2050.

- Minimised damage to infrastructure equates to less debt accumulated via international disaster relief.

**Metric:** Costs through associated flood damage should not exceed \$9.9 billion by 2050 in areas where our solution is implemented

## Natural

- The water quality and marine health of connected rivers is expected to remain consistent before and after installation of respective dry dams.

**Metric:** River quality can be tested by comparing marine health, growth of ecosystems, pH testing, oxygen levels, turbidity, and flow rate.

- Mana Whenua land and surrounding areas are relatively unaffected.
- Reduced stress on ecosystem and native wildlife as flood impacts are mitigated.

## Social

- NZ maintains a 'clean green' image.
- Reduces flood damage to communities, particularly low-lying/flat areas.
- Meeting the New Zealand Government's National Adaptation Act of 2019.
- The number of emergency call-outs reduced by at least 70% during severe weather events (70% is the effectiveness of dry dams mitigating floods)

**Metric** = Callout statistics

## Human

- Introduces jobs to local communities, such as engineering design, construction and maintenance of green roofs.
- The strain on emergency services will reduce due to fewer number of people requiring urgent attention.
- Loss of life

**Metric:** Casualties during severe weather events statistics.

- Emotional distress from flooding is reduced.

## Auckland Light Rail-Build out

- Constructability
- Disruption
- Community impacts
- Property
- Consentability

Construction impacts are significant  
as CRL has shown

Impacts are over the whole lifecycle, includes buildout as well as operating lifetime.

- Environmental, Social, Financial, Human

Remember the 4 capitals!

# Non-Monetary Impacts

	Option 1A: Light Rail Sandringham	Option 1B: Light Rail Dominion	Option 2A: Light Metro Sandringham	Option 2B: Light Metro Dominion	Option 3: Tunnelled Light Rail
Impacts and Opportunities					
Achievability	<ul style="list-style-type: none"> <li>Carries <b>significant consenting risk</b> due to duration and impact of construction on Fanshawe Street, Queens Street (up to 5 years) and Sandringham and Dominion (due to relocation of power cable from Sandringham Road)</li> <li>Balanced by safety benefits</li> </ul>	<ul style="list-style-type: none"> <li>Carries <b>significant consenting risk</b> due to duration and impact of construction on Fanshawe Street, Queens Street and Dominion Road (up to 5 years)</li> <li>Balanced by safety benefits</li> </ul>	<ul style="list-style-type: none"> <li>Has some consenting challenges around tunnel portals</li> <li>Balanced by safety benefits</li> </ul>	<ul style="list-style-type: none"> <li>Has some consenting challenges around tunnel portals</li> <li>Balanced by safety benefits</li> </ul>	<ul style="list-style-type: none"> <li>The Tunnelled Light Rail solution combines the best of the underground section in the city centre and Isthmus, whilst removing the need to trench in Onehunga.</li> <li>Construction impacts through Māngere</li> </ul>
Environmental Effects	<ul style="list-style-type: none"> <li>Long project through built up area, will have environmental impacts that can be managed</li> </ul>	<ul style="list-style-type: none"> <li>Long project through built up area, will have localised environmental impacts that can be managed</li> </ul>	<ul style="list-style-type: none"> <li>Localised impacts at the tunnel portal locations</li> <li><b>Significant embodied carbon</b> from tunnel construction</li> </ul>	<ul style="list-style-type: none"> <li>Localised impacts at the tunnel portal locations</li> <li><b>Significant embodied carbon</b> from tunnel construction</li> </ul>	<ul style="list-style-type: none"> <li>Closer to Option 2A (than 1A), however overall impacts considered minor.</li> </ul>
Social and community	<ul style="list-style-type: none"> <li>Impacts during construction considerable as there are two corridors</li> <li>Accessibility benefits</li> <li>Long term impacts also considered negative overall given severance and right turn restrictions along route and construction impacts on two corridors</li> </ul>	<ul style="list-style-type: none"> <li>Impacts during construction</li> <li>Long term impacts also considered negative overall given severance and right turn restrictions along route and construction impacts on two corridors</li> <li>Accessibility benefits</li> <li>Overall these issues balance themselves</li> </ul>	<ul style="list-style-type: none"> <li>Impacts during construction, but lesser north of Mt Roskill</li> <li>Little segregation</li> <li>Considerable accessibility benefits, particularly to education and social for the southern section</li> </ul>	<ul style="list-style-type: none"> <li>Impacts during construction, but lesser north of Mt Roskill</li> <li>Little segregation</li> <li>Considerable accessibility benefits, particularly to education and social for the southern section</li> </ul>	<ul style="list-style-type: none"> <li>Closer aligned to Option 2A, but still impacts of construction and severance through Māngere without significant accessibility improvement</li> </ul>
Impacts on Te Ao Māori	<ul style="list-style-type: none"> <li>The Māori land parcel at Princess Street – which would require land take</li> <li>Wai o horotiu runs in queen street and there is an associated Pā around the town hall</li> </ul>	<ul style="list-style-type: none"> <li>The Māori land parcel at Princess Street – which would require land take</li> <li>Wai o horotiu runs in queen street and there is an associated Pā around the town hall</li> </ul>	<ul style="list-style-type: none"> <li>Mana Whenua been engaged with CRL so understand the technology and the positives and negatives of boring</li> <li>two main concerns are around Aquafer and potential lava caves when boring close to Māngere bridge or when close to Puketapapa</li> </ul>	<ul style="list-style-type: none"> <li>Most Mana Whenua have been engaged with CRL so understand the technology and the positives and negatives of tunnel boring</li> <li>Two main concerns are around Aquafer and potential lava caves when tunnel boring close to Māngere bridge or when close to Puketapapa</li> </ul>	<ul style="list-style-type: none"> <li>Closer to Option 2A, but there is still Māngere disruption</li> </ul>

Category	Rate
Default rate (for projects that are difficult to categorise including regulatory proposals, and most social sector projects):	5.0% p.a.
General purpose office and accommodation buildings	5.0% p.a.
Infrastructure and special purpose (single-use) buildings: <ul style="list-style-type: none"><li>• Water and energy</li><li>• Prisons</li><li>• Hospitals</li><li>• Hospital energy plants</li><li>• Road and other transport projects</li></ul>	5.0% p.a.
Telecommunications, media and technology , IT and equipment, Knowledge economy (R&D)	6.0% p.a.

Assume a 5% discount  
rate for your projects

## Auckland Light Rail

Table 14: BCR summary

	Light Rail	Light Metro	Tunnelled Light Rail
Traditional transport benefits (NPV) (M)	\$3,747	\$6,063	\$5,278
Wider economic benefits (NPV) (M)	\$3,989	\$6,988	\$5,760
Total Benefits (NPV) (M)	\$7,736	\$13,051	\$11,038
Total Cost (NPV) (M)	\$7,141	\$11,196	\$10,362
BCR (Transport benefits only)	0.5	0.5	0.5
BCR (TOTAL benefits)	1.1	1.2	1.1
Project NPV (M) (with WEBS)	\$595	\$1,855	\$676

IRR can be used but harder to calculate for monetised impacts.

## Previous Systems Projects

Table 11: Economic CBA summary (rounded up to nearest \$50 million)

	Do Nothing	Package 1	Package 2	Package 3
Cost (PV, \$Million)	74500	4200	600	2800
Benefits (PV, \$Million)	150	8800	6850	21500
Benefit/Cost	0	2.1	11.5	7.8
NPV (\$Million)	-74350	4600	6250	18700

Table 7. Costs and benefits of shortlisted options

	Do Nothing	Package 1 - Mobile	Package 2 - Healthline
Cost (\$M)	0	368	421
Benefits (\$M)	-51,705	1,610	1,869
Cost Benefit Ratio	N/A	4.37	4.44
Natural			
Human			
Social			



# Wrap up & Reminders



ENGINEERING

- Compare monetary with CBA, monetise impacts (CBAX) if possible.
- Compare non-monetary impacts using quantitative/qualitative analysis like MCA, or discussion.
- Look at monetary, then quantifiable if you can, and then qualitative.
- Even when you have a great business case it might not get approved by decision makers or can be discontinued. Dame Professor Juliet Gerrard will talk more about this tomorrow.



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