Table of Contents

TE TAI ŌHANGA
THE TREASURY

CBAx Community of Practice #6

Improving CBA Practice

with Amie White & Kirsten Jensen

6 NOVEMBER 2023 | IN CONFIDENCE

IN-CONFIDENCE

Whāinga e te rōpū / group objectives

- **Empower** you to feel confident inproviding well-considered, evidence-based advice
- Provide **support** to do a CBA using CBAx
- Create a space for **kōrero** on using the tool
- **Share insights** and answer **questions**

Also you can reach out to us at cbax@treasury.govt.nz

IN-CONFIDENCE

Rōpū rārangi take / group agenda

Lifting CBA practice 2023 series

Slides / recordings available online for Session #1 to #5 (note session #1 is slides only)

#1 Learn and develop: CBAx update for Budget 2024, Budget 2023 CBAs experiences and intervention logic and a CBA (and other methods)

#2 Evaluation: CBA: What is CBA, when to do it and why, evaluating CBAx summary outputs, how other methods complement a CBA

#3 Value for Money in Budget 2024: Applying a value for money lens, Panel – insights into how Treasury looks at CBA submissions

#4 Different aspects and approaches to CBA: Guest panel on Living Standards Framework, He Ara Waiora, Social Investment and Outcomes / Performance Reporting.

#5 Worked example of CBA: Guest panel Transport intervention; Building CBA capability

Date	Agenda
Mon 6 Nov 2 – 3 pm	**Cost pressures, sensitivity analysis and reverse analysis** When do we do it, why do we do it and how do we do it?

Date	Agenda
Mon 13 Nov 2 – 3 pm	**Dive into the Impacts Database and how to include non-monetised impacts and add new impacts**
Mon 20 Nov 2 – 3 pm	Topic TBC – Climate change / transformational change using CBA and other methods.
Mon 27 Nov 2 – 3 pm	Topic TBC – Ex-post analysis and CBA Guest speakers – Wellbeing Researchers Panel

Future series – monthly from January 2024!

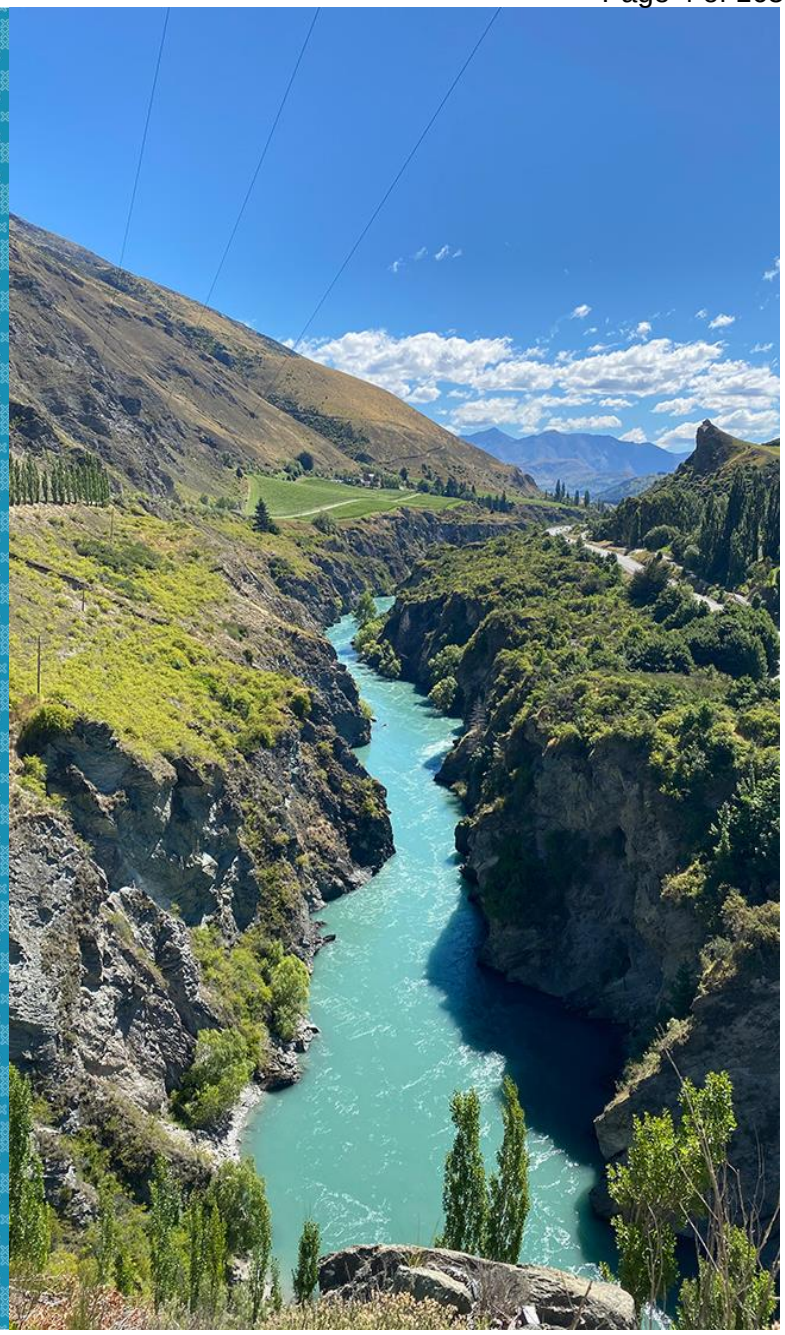
Email cbax@treasury.govt.nz with session topic suggestions.

SECTION ONE

Cost pressures

Sensitivity analysis

Reverse analysis



IN-CONFIDENCE

What is a cost pressure?

Existing services and outputs facing wage, price, volume and/or other pressures cannot continue to deliver the agreed level or quality of service within existing baselines

Volume pressures – can arise from population growth, changes in population characteristics, or changes in the economic environment.

Personnel and wage pressures – bargaining and remuneration, labour market and/or retention issues affecting agencies' ability to deliver key functions.

Other price pressures – changes in costs of inputs and capital-related operating expenditure resulting from increases in the value of capital assets

IN-CONFIDENCE

Cost pressure initiatives and value for money

- Cover a very wide range of proposals that the government might fund.
- Depending on the initiative and information available, CBAx works well for some e.g., specific service reductions, but provides less insight for others e.g., harder when lots of smaller unspecified actions
- A well-considered counterfactual is crucial for a CBAx for a cost pressure proposal.
- Consider using the five value for money elements to assess a cost pressure: alignment, benefits – costs, delivery and equity.
- The Treasury is developing some supporting prompts for considering cost pressures that are expected over the coming months.

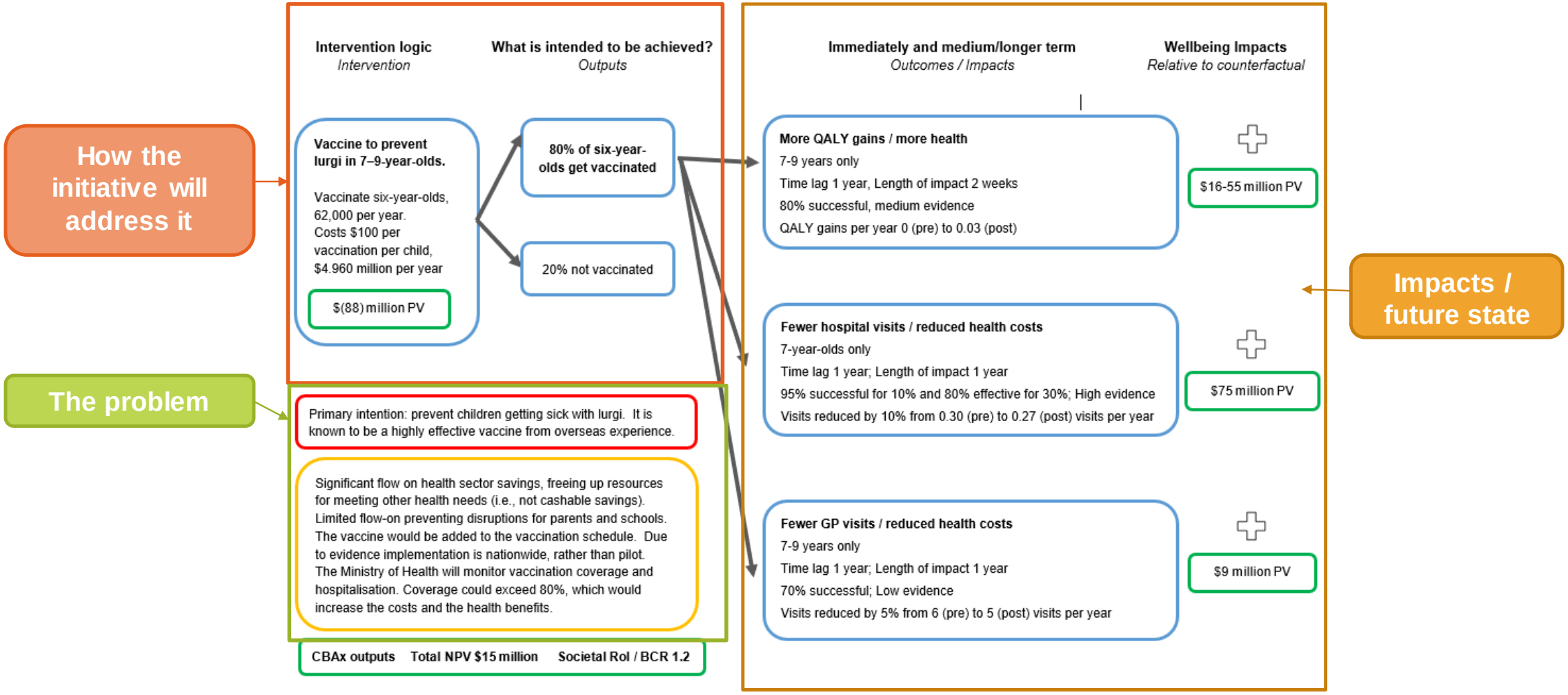
IN-CONFIDENCE

Intervention logic map for cost pressures

- Intervention logic maps are an overview of the relationship between the initiative's current state (eg, the problem), the outputs, and the medium-term and long-term outcomes (eg, future state).
- It doesn’t have to be in a specific format, but it should be on one page and communicate:
  - **the problem** the cost pressure initiative will address;
  - **how the initiative will address it**, with respect to the outputs;
  - the wellbeing **impacts and the future state** this will contribute to

IN-CONFIDENCE

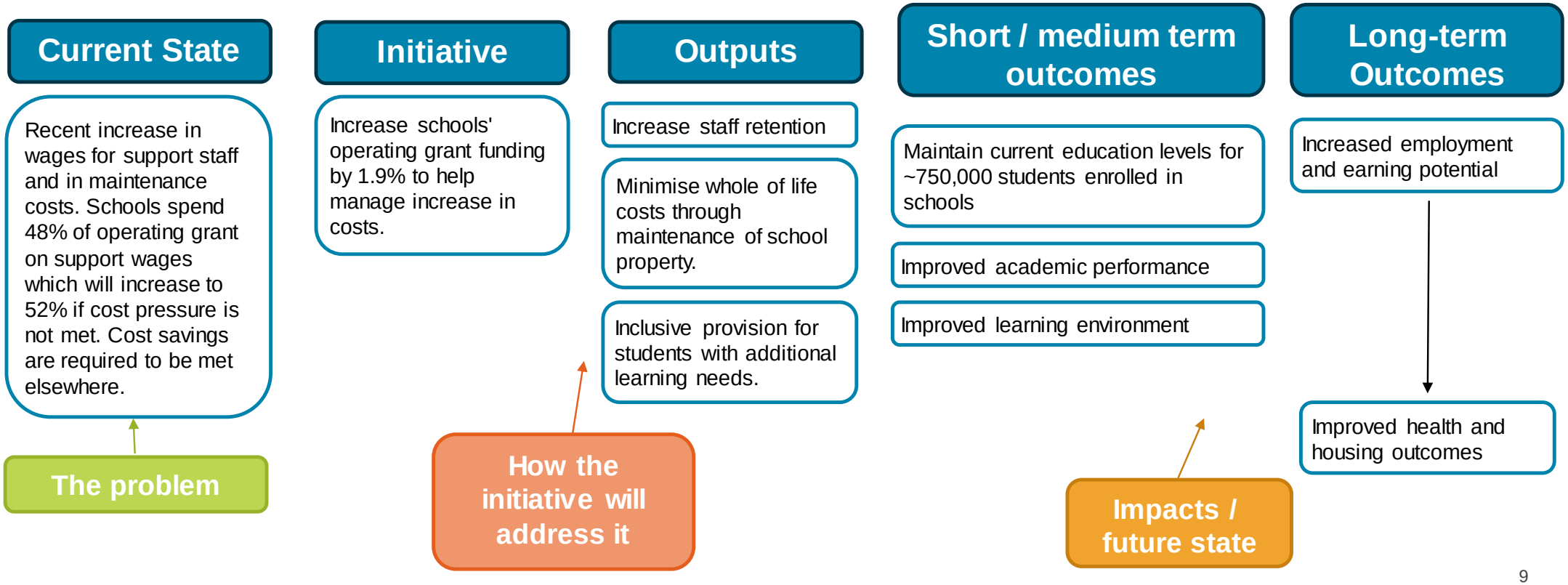
An example of an intervention logic map



IN-CONFIDENCE

Intervention logic map: Education example

Increase schools' operating grant funding to help manage increases in costs e.g., support staff wages and maintenance costs.



IN-CONFIDENCE

Education 2018 – School's operating grant

- Submission supported by a CBAx
- Independently reviewed by NZIER
  8 / 10, covered all CBA steps, but no ranges provided, impacts were uncertain / low evidence quality
- The transparent assumptions provide an opportunity to discuss and test
- Income is the main impact

Overall assessment (see Annex 1 for rating and scoring guide): 8
Problem definition Problem clear, & taken through in sufficient detail to show wider effects.
General comments on the quality of CBA analysis and advice
Given this is a cost pressure claim, a relatively straight forward CBA has been undertaken. This is apt.
Currently use of 1 as standard CBA ratio to set the standard.

CBA analysis covered CBA steps (Shaded means adequately covered). Overall: Spreadsheet yes, advice no.

Yes — no ranges

Major impacts are monetised? **Is it, or would it be, helpful to monetise more impacts?** What is done is a bit uncertain. Further efforts would become even more speculative.

Unit: 2018 ($m)

	Evidence Quality			5-Year NPV $m	10-Year NPV $m	50-Year NPV $m	2018	2019	2020	2021	2022
Impact 1	Low	Government	Health costs estimate: Level 3 Qualification or above at age 18: Total Population	(3)	(16)	(143)	-	-	(1)	(1)	(2)
Impact 2	Low	Government	Health costs estimate: No Qualification at age 18: Total Population	5	23	203	-	-	1	2	3
Impact 3	Low	Non-Government	Personal Income estimate: Level 3 Qualification or above at age 18: Total Population	58	290	2,602	-	-	12	24	36
Impact 4	Low	Non-Government	Personal Income estimate: No Qualification at age 18: Total Population	(37)	(187)	(1,675)	-	-	(8)	(16)	(23)
Impact 5	Low	Government	Income Tax estimate: Level 3 Qualification or above at age 18: Total Population	10	48	429	-	-	2	4	6
Impact 6	Low	Government	Income Tax estimate: No Qualification at age 18: Total Population	(6)	(28)	(249)	-	-	(1)	(2)	(3)

Summary metrics

Return on Investment, Societal Total (50y)	3.5
Return on Investment with high evidence quality only, Societal Total (50y)	0.0
Return on Investment, Government only (50y)	1.0
Return on Investment with high evidence quality only, Government only (50y)	0.0
Benefit cost ratio, Societal Total (50y)	1.4
Benefit cost ratio with high evidence quality only, Societal Total (50y)	0.0

Net economic benefit per cohort member (50y)	$ 291
Net economic benefit per cohort member high evidence quality only (50y)	$ -
Initiative NPV costs per cohort member (50y)	$ 118

Agency assessment

Value for money	4 - High Returns - Likely
Strategic alignment	4 - High Alignment

Common issues

There is not a clear counter factual

If not funded, then you plan to reduce cost across a range of areas

You can model as if preventing the service loss and make clear in the text that the actual approach would not be to reduce services.

Reduced quality, while maintaining quantity of services

Effectiveness assumption? Pre / post assumptions?

Small increase for operational costs

Qualitative CBA or reverse analysis may be sufficient

IN-CONFIDENCE

Applying IQM to cost pressures

Levels	Effort / cover of impacts	Comment
1. **Identify**	Comprehensive • Positive and negative • All people • Total Economic Value	• Think broadly • Link with other agencies/ perspectives • Indicate across domains and in intervention logic
2. **Quantify** a subset of identified impacts	To extent/where possible • Impact assumptions • Put most effort into the most significant impacts • Include in wellbeing analysis as non-monetised	• What do you know? • Important impacts may be outside the sector and expertise, ie don't focus on what you know most about • Iterate, eg, run quick CBAx analysis to help guide efforts and research • Indicate magnitude in final advice
3. **Monetise** a subset of quantified impacts	Selective and robust • Significant impacts • Good evidence base	• Focus monetisation on key 1-3 impacts, to include in final advice • Provide present values for the key impacts

Only monetise a subset of impacts – focus on key impacts with good evidence.

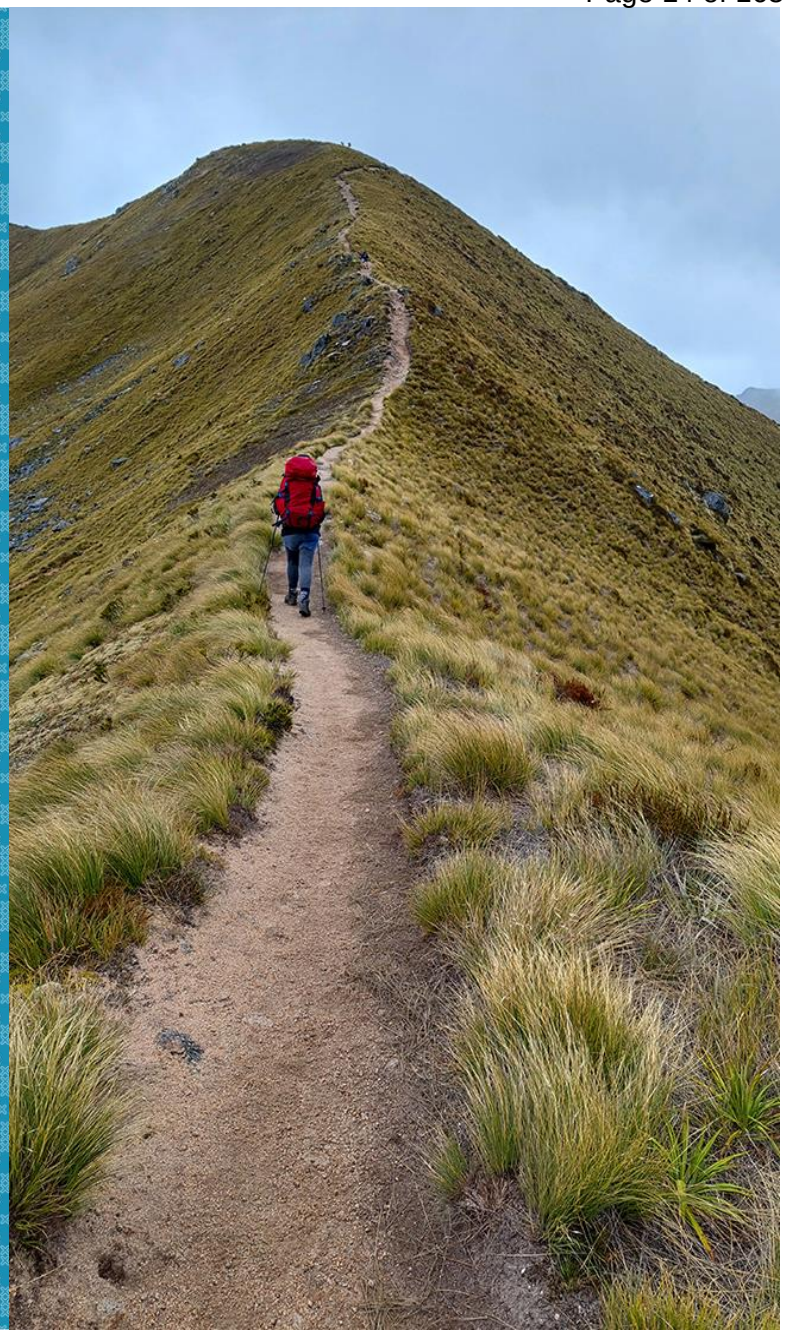
IN-CONFIDENCE

Pātai / Questions?

Photo credit: Chris Chapman
Description: Fox Glacier Valley

SECTION TWO

Cost pressures
Sensitivity analysis
Reverse analysis



IN-CONFIDENCE

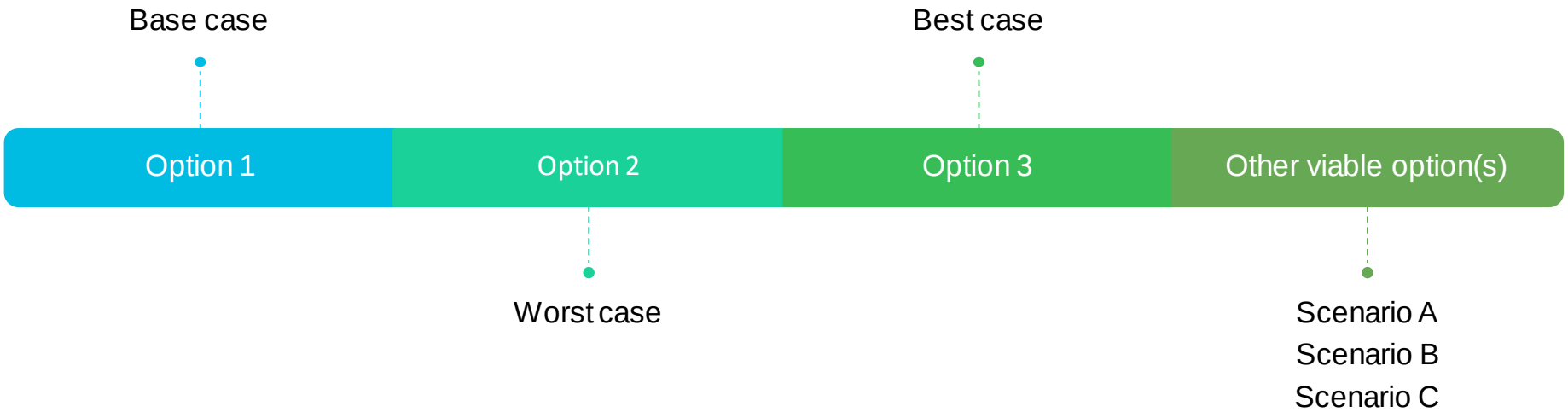
A reminder about step 6…

Do the results look clear enough / make sense?

Policy evaluation *using CBA on each feasible option*	
Inputs to CBAx	**Step 1:** Define policy and counterfactual **Step 2:** Identify those who gain and those who lose **Step 3:** Identify the benefits and costs; allocate to time periods
Analysis in CBAx	**Step 4:** Quantify the benefits and costs within ranges **Step 5:** Discount to a common period, compare benefits and costs
Outputs from CBAx	**Step 6:** Is the result clear enough? If not, consider whether it is worth investing in more research, repeat previous steps **Step 7:** Write report

Running sensitivity analysis for different options

If the CBAx results are uncertain or not clear enough, you can use **sensitivity analysis** to run different scenarios to test the sensitivity to assumptions and consider obtaining additional information.



What is sensitivity analysis?

- Sensitivity analysis involves working through some alternative scenarios.
- It could be as simple as considering the impact of using different discount rates. The CBAx model produces two output sheets using different discount rates (currently 5% and 2%). Both are populated using your inputs.
- To do sensitivity analysis you can easily change the assumptions in CBAx. For example, changing the segment, success rate or length of impacts.

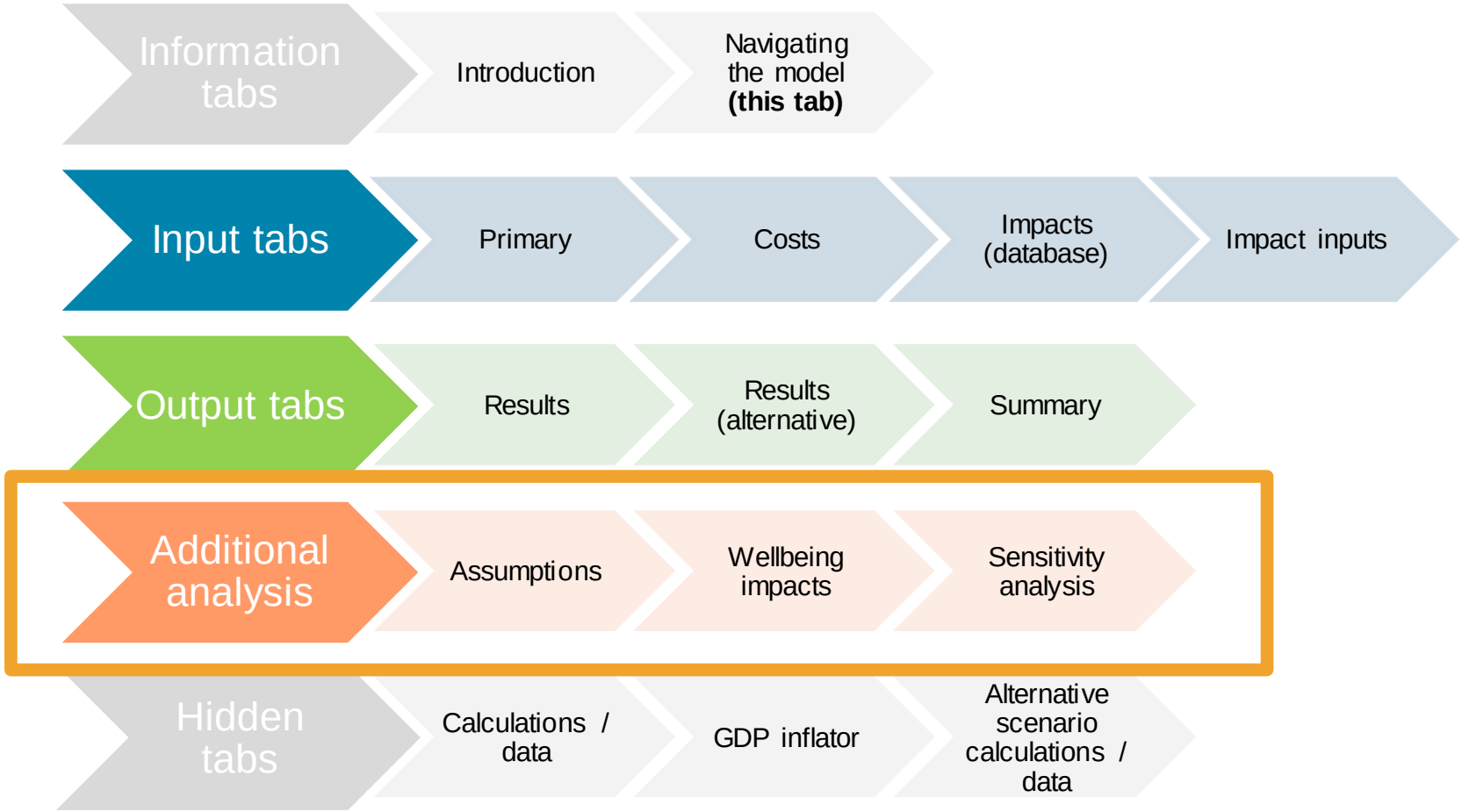
IN-CONFIDENCE

Is the result clear enough?

- Consider if it is worth investing in more research to get better information and improve quality of the CBA. Weigh up the importance of improved information and more research. The value of obtaining additional information should outweigh the cost.
- Be mindful of unmonetised impacts. A proposal may have an ROI of 0.5 but have large unmonetised impacts that could increase the total ROI above 1. In such cases, the interpretation of the CBAx results hinges on the unmonetised impacts. Use sensitivity analysis to test the assumptions for the unmonetised impacts for the initiative to break-even.

IN-CONFIDENCE

Navigating CBAx



IN-CONFIDENCE

Sensitivity analysis

Sensitivity Analysis

Results from Outputs Summary tab — *Discount rate* — Copy and paste your results in column C or D into this table, when you have changed the assumptions in the model.

Net benefit summary 50-year PVs		*5%*	*2%*	*Central*	*Worst case*	*Best case*	*Scenario A*	*Scenario B*	*Scenario C*
Initiative costs present value i.e. Government investmer	$m	(88)	(153)	(88)			(88)		
Government impacts $m		84	148	81			81		
Wider societal impacts $m		39	69	37			55		
Total societal impacts, net present value $m		34	65	30			48		
Non-monetised impacts		Medium (+)	Medium (+)	Low (+)			Low (+)		
Benefit cost ratio, Societal Total (50y)		1.4	1.4	1			2		
Return on Investment, Societal Total (50y)		1.4	1.4	1			2		
Return on Investment, Government only (50y)		1.0	1.0	1			1		

Description of case / scenario. Set out the key assumptions.	
Central	Conservative assumptions - Low QALY value
Worst case	
Best case	
Scenario A	Assumptions - Higher QALY value more comparable internationally. Only change to the model is on the Impact Inputs sheet in column L. Switched on impact 6 (the higher QALY assumption) by setting length of impact to 0.04 (15 days). Switched off impact 5 (lower QALY assumption) by setting length of impact to zero.
Scenario B	
Scenario C	

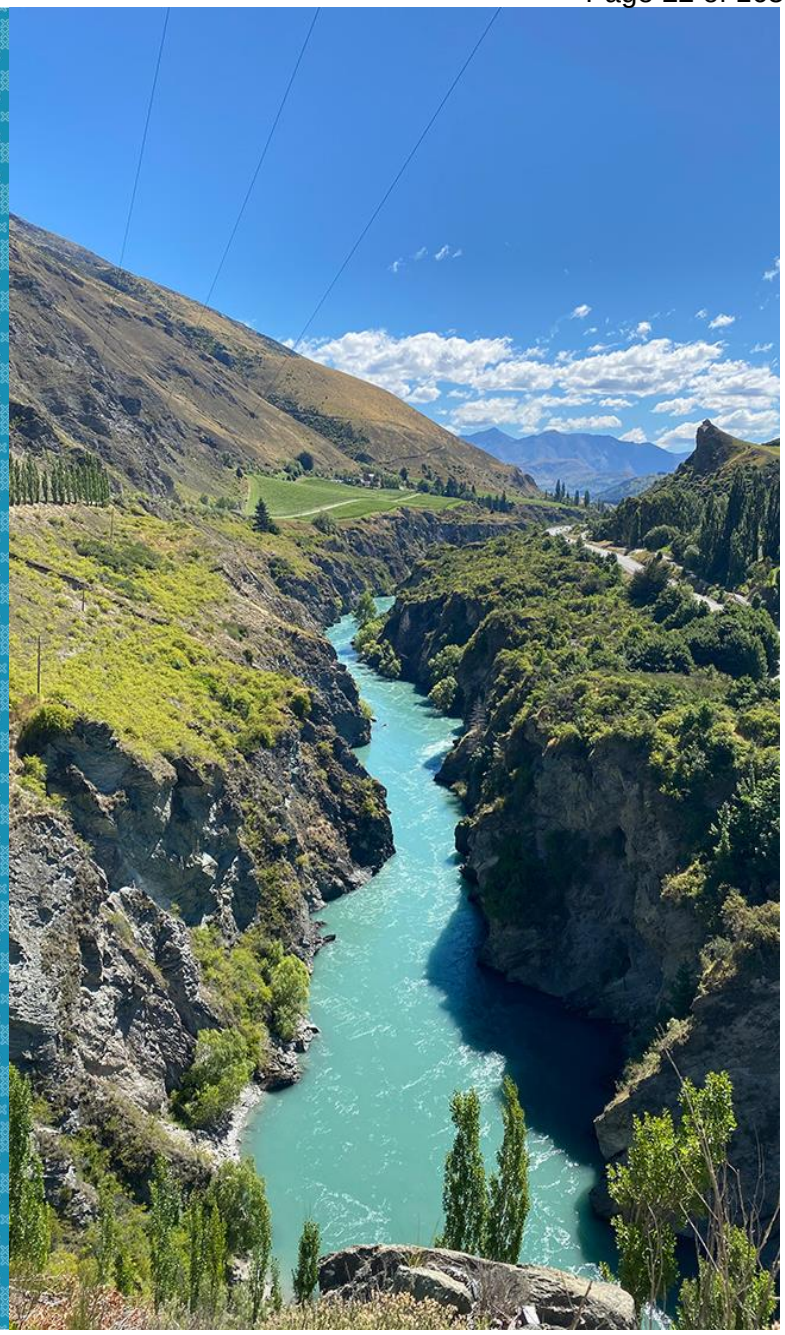
IN-CONFIDENCE

Pātai / Questions?

Photo credit: Chris Chapman
Description: Fox Glacier Valley

SECTION THREE

Cost pressures
Sensitivity analysis
Reverse analysis



IN-CONFIDENCE

Standard CBA or Reverse Analysis?

Reverse analysis shows you what you would have to assume to (for example) break-even. reverse analysis uses information efficiently and reduces the information-demands of analysis. This can also be a good option for doing a CBAx when the impacts are known, but hard to monetise.

The following table summarises the difference between the Standard and Reverse Analysis.

Type of analysis	Answers the question...	Results	Assess whether worthwhile
Standard CBA - *The best option*	What is the magnitude of the societal benefits relative to costs?	Estimates the expected total net benefits	Is the ROI > 1 and better than alternative options?
Reverse Analysis – *An option if evidence is weak*	What would it take for the proposal to break-even i.e., ROI = 1?	Identifies the minimum assumptions for benefits to match costs	Are the minimum assumptions likely to be reasonable and achieved?

A reverse analysis means approaching the CBA from the viewpoint of 'what would it take to make the proposal be worthwhile?' or generate a return on investment of 1 with societal benefits outweighing costs. Even if the evidence base is weak, e.g., in the case of pilot programmes, being transparent about these assumptions provides a basis for developing an evaluation plan.

Why reverse analysis?

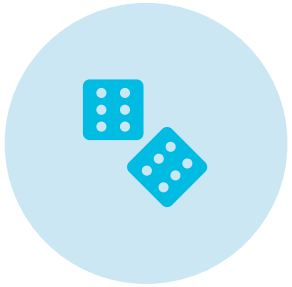
Ideally any investment proposal is informed by a CBA

Sometimes limited information and/or urgency means that a fuller CBA process can't be done

Knowing what would be required to break even (RoI = 1) can help to assess the economic case:

Have we got confidence in the economic case?
What would it take to break even?
Does that look reasonable to achieve?

What?



Use CBAx ‘Reverse analysis’ to determine the assumptions

Use costings – how much does it cost?

Keep it simple and focus on one key impact (can use more)

Make initial assumptions and iterate these until RoI = 1

IN-CONFIDENCE

Example – draft Cabinet paper - limited time and info

What information can we use?

- A 1 in 500-year event that could lead to between 4,000 and 33,000 fatalities.
- We know the costs across the years.

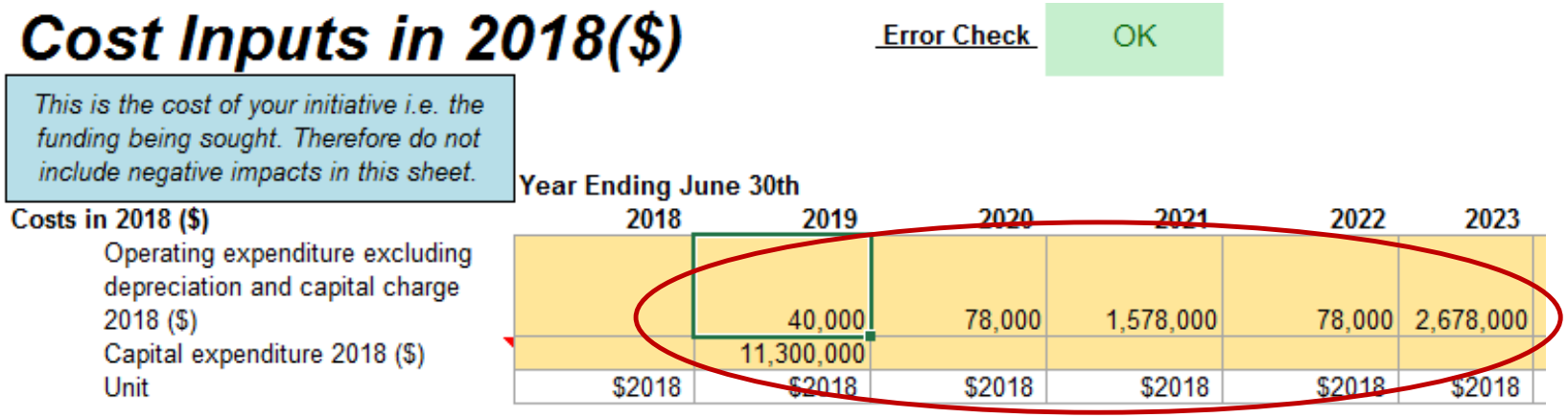
We can **start with some simple assumptions** in the CBAx model

- The event could happen in year 50
- Look for relevant impacts in the CBAx impacts database (e.g., Value of a statistical life (VoSL) = at the time $4.6 million)
- For example, how many lives would need to be saved to break even?
- Run quick iterations of these simple assumptions

IN-CONFIDENCE

Example – Step 1

- Enter the initiative costs information into “Cost Inputs” sheet
- NB remember to exclude depreciation.
- In this example, there is capital expenditure in the first year of $11.3m, and varying costs over the next few years (up to the full 50 years)



Cost Inputs in 2018($)

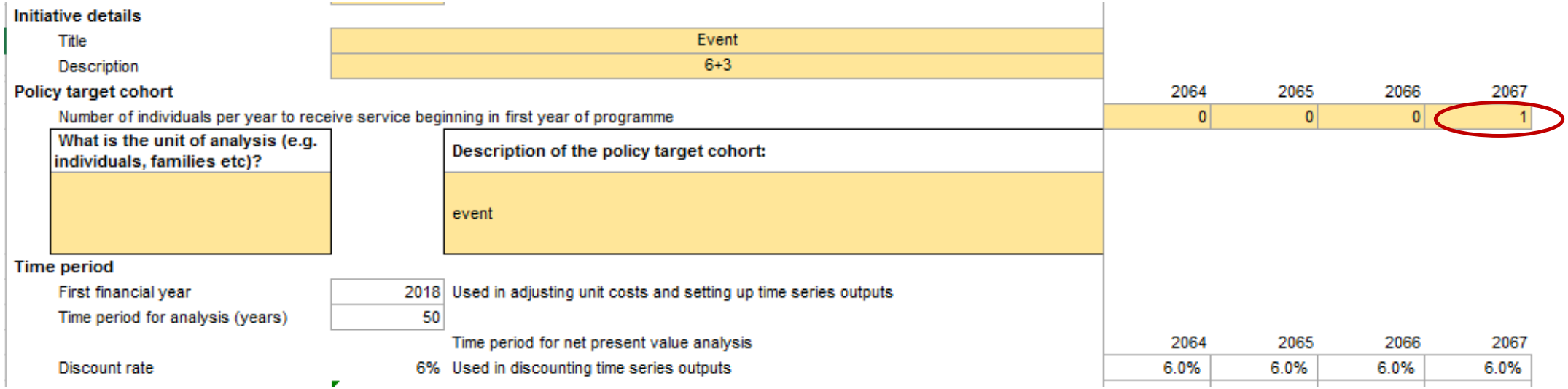
Error Check OK

This is the cost of your initiative i.e. the funding being sought. Therefore do not include negative impacts in this sheet.

Costs in 2018 ($)	Year Ending June 30th 2018	2019	2020	2021	2022	2023
Operating expenditure excluding depreciation and capital charge 2018 ($)		40,000	78,000	1,578,000	78,000	2,678,000
Capital expenditure 2018 ($)		11,300,000				
Unit	$2018	$2018	$2018	$2018	$2018	$2018

Example – Step 2

- Complete “Primary Inputs” sheet. In this example, the cohort size is 1, in the 50th year (ie, one occurence of the event).
- Here assume benefit year starts / occurs in year 50, so there the 'event' has a 50-year delay. Cohort details are entered in the 50th year.



Initiative details						
Title	Event					
Description	6+3					
Policy target cohort			2064	2065	2066	2067
Number of individuals per year to receive service beginning in first year of programme			0	0	0	1
What is the unit of analysis (e.g. individuals, families etc)?	**Description of the policy target cohort:**					
	event					
Time period						
First financial year	2018	Used in adjusting unit costs and setting up time series outputs				
Time period for analysis (years)	50					
		Time period for net present value analysis	2064	2065	2066	2067
Discount rate	6%	Used in discounting time series outputs	6.0%	6.0%	6.0%	6.0%

Example – Step 3

- Select desired marginal impact(s) in “Impact Inputs” sheet.
- Using VoSL - you can vary assumptions in the yellow boxes such as length of impact, how much of the cohort will be targeted and the percent of success.

Row Number		Impact	Length of impact (years)	End year	Segment of policy target cohort per year (percentage)	Success rate (Percentage)	Impact type	Units per person per annum	Annual value ($) Per cohort member
Impact 1	143	Value of a Statistical Life	1.0	1.0	100%	100%	Pre intervention level	(4,000.00)	(18,492,651,044)
OK		INCLUDED					Post intervention level	(3,900.00)	(18,030,334,768)
							Marginal impact	100.00	462,316,276
Impact 2	196	Avoid serious injury	1.0	1.0	100%	100%	Pre intervention level	(30,000.00)	(24,120,849,187)
ERROR		EXCLUDED					Post intervention level	(30,000.00)	(24,120,849,187)
							Marginal impact	-	-

Start with length of impact 1 year, time lag 1 year, and 100% success rate. Pre-intervention level is 4000, post-intervention is 3900 (effectively, pre-intervention this impact loss of life is 4000, however post-intervention 100 lives are saved and this impact is achieved).

Example – Step 4

- Once you've populated these details in the model, look at the **Output Results** tab. We can see that the return on investment (RoI) is 1.011. Return on Investment needs to be 1 for break-even.
- You can adjust marginal impact(s) in Step 3 as necessary until ROI is ~1. We could also change other assumptions, for example the segmentation and the success rate.

What did this allow us to say?

"Using Treasury's CBAx model a conservative break-even point for the proposed investment is 100 lives saved in an event occurring over the next 50 years. This is conservative estimate as it:

- assumes the event occurs in the 50th year and so discounts the value of the lives saved to the maximum extent;
  - if it occurs in the 25th year then the break-even point is 23 lives saved, and
  - in the 10th year, 10 lives saved
- does not consider other potential gains, such as from avoidance of serious injuries, property loss and false alarms."

IN-CONFIDENCE

Fit-for-purpose CBA

Reverse analysis provides for quick turn-around with limited information:

- Using what we know, e.g. about impacts
- Listening to our intuition, e.g. about what looks right for break-even

> We were able to do the analysis in less than 1 hour, using the information contained in the draft Cabinet paper

As a result we were able to be confident about the economic case and provide better advice for Ministers

IN-CONFIDENCE

Pātai / Questions?

Photo credit: Chris Chapman
Description: Fox Glacier Valley

IN-CONFIDENCE

Rōpū rārangi take (online October to November on Monday 2 pm – 3 pm)

Lifting CBA practice 2023 series

Slides / recordings available online for Session #1 to #5 (note session #1 is slides only)

#1 Learn and develop: CBAx update for Budget 2024, Budget 2023 CBAs experiences and intervention logic and a CBA (and other methods)

#2 Evaluation: CBA: What is CBA, when to do it and why, evaluating CBAx summary outputs, how other methods complement a CBA

#3 Value for Money in Budget 2024: Applying a value for money lens, Panel – insights into how Treasury looks at CBA submissions

#4 Different aspects and approaches to CBA: Guest panel on Living Standards Framework, He Ara Waiora, Social Investment and Outcomes / Performance Reporting.

#5 Worked example of CBA: Guest panel Transport intervention; Building CBA capability

Date	Agenda
Mon 6 Nov 2 – 3 pm	**Cost pressures, sensitivity analysis and reverse analysis** When do we do it, why do we do it and how do we do it?

Date	Agenda
Mon 13 Nov 2 – 3 pm	**Dive into the Impacts Database and how to include non-monetised impacts and add new impacts**
Mon 20 Nov 2 – 3 pm	Climate change / Enrivonment using CBA and other methods.
Mon 27 Nov 2 – 3 pm	Ex-post analysis and CBA

Future series – monthly from January 2024!

Email cbax@treasury.govt.nz with session topic suggestions.

Get in touch: cbax@treasury.govt.nz

Hei tērā wiki! See you next week.

TE TAI ŌHANGA
THE TREASURY

TE TAI ŌHANGA
THE TREASURY

CBAx Community of Practice #7

Improving CBA Practice

with Amie White & Kirsten Jensen

13 NOVEMBER 2023 | IN CONFIDENCE

Whāinga e te rōpū / group objectives

- **Empower** you to feel confident in providing well-considered, evidence-based advice
- Provide **support** to do a CBA using CBAx
- Create a space for **kōrero** on using the tool
- **Share insights** and answer questions

You can also reach out to us at cbax@treasury.govt.nz

IN-CONFIDENCE

Rōpū rārangi take / group agenda

Lifting CBA practice 2023 series

Slides / recordings available online for Session #1 to #6 (note session #1 is slides only)

#1 Learn and develop: CBAx update for Budget 2024, Budget 2023 CBAs experiences and intervention logic and a CBA (and other methods)

#2 Evaluation: CBA: What is CBA, when to do it and why, evaluating CBAx summary outputs, how other methods complement a CBA

#3 Value for Money in Budget 2024: Applying a value for money lens, Panel – insights into how Treasury looks at CBA submissions

#4 Different aspects and approaches to CBA: Guest panel on Living Standards Framework, He Ara Waiora, Social Investment and Outcomes / Performance Reporting.

#5 Worked example of CBA: Guest panel Health intervention; Transport intervention

#6 Sensitivity analysis and reverse analysis: When do we do it, why do we do it, how to we do it?

Date	Agenda
Mon 13 Nov 2 – 3 pm	**Dive into the Impacts Database and how to include non-monetised impacts and add new impacts**
Mon 20 Nov 2 – 3 pm	Topic TBC – Climate change / transformational change using CBA and other methods.
Mon 27 Nov 2 – 3 pm	Topic TBC – Ex-post analysis and CBA Guest speakers – Wellbeing Researchers Panel

Future series – monthly from February 2024!

Email cbax@treasury.govt.nz with session topic suggestions.

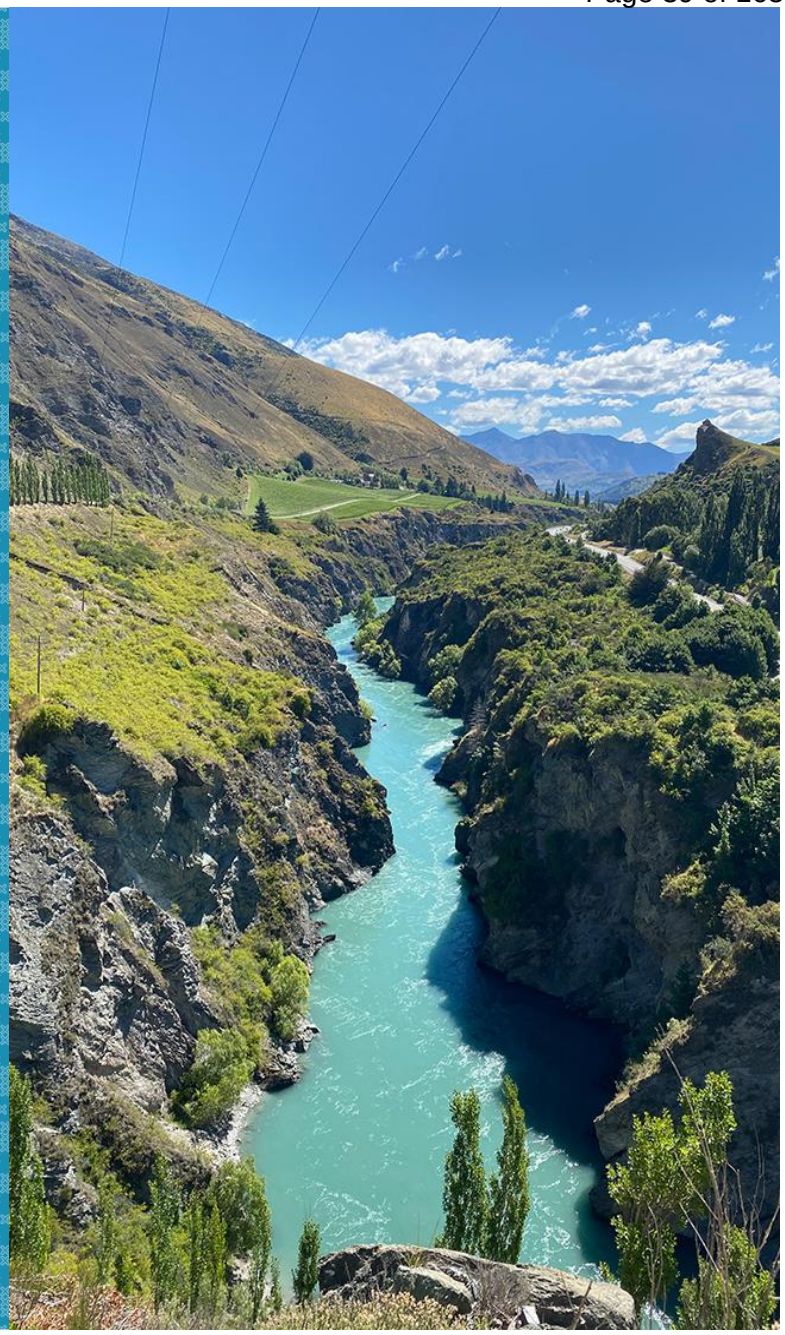
SECTION ONE

Overview of the Impacts Database

Using the Impacts Database

Including non-monetised impacts

Adding your own impact to the database



IN-CONFIDENCE

CBA considers impacts from a societal perspective

CBA considers more than fiscal impact for government and looks at impacts from an NZ societal perspective

CBA covers the total economic value that is being created, or destroyed, for society

Costs and benefits to government tend to be the easiest impacts to quantify because they are often already measured in monetary terms

IN-CONFIDENCE

It can help to summarise impacts in a table

Think about the impacts:

- within government e.g. changes in revenue / changes in costs - fiscal impacts
- and for society more broadly e.g. increases in wellbeing from use

Consider both gains / positive impacts and losses / negative impacts.

	Government (often fiscal)	Wider society (wellbeing, non-government)
Gains / Positive impacts	• Reduced costs • Resilience • Response capability	• Increased health • Lives saved • Increased income • Cleaner water • Protected birds • Safer communities
Losses / Negative impacts	• Increased costs • Inefficiencies • Risks	• Pollution • Compliance user costs • Time delays

What is the Impacts Database?

- CBAx provides a database of values to monetise impacts the "Impacts Database"
- There are around **200 monetised impacts** in the Impacts Database.
- All impacts are **publicly available**, and the source is provided in a column in the worksheet.
- Focus on quantifying and monetising **significant impacts**, rather than all impacts.
- The values are adjusted to reflect a common period (**adjusted values**).
- If you have a relevant impact that is not in the database (and that has a monetary value), you can **add an impact** at the bottom of the database for use in your analysis. *More on this later.*

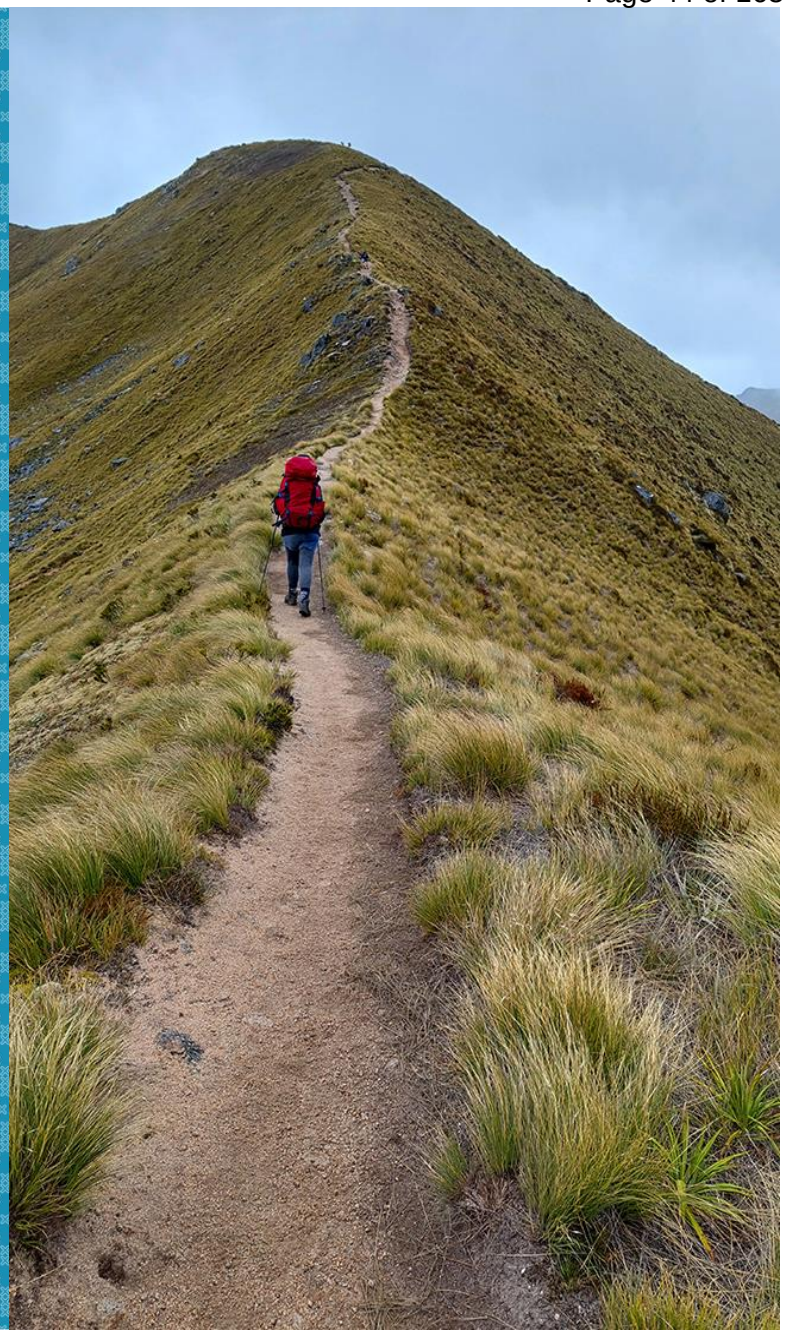
IN-CONFIDENCE

Pātai / Questions?

Photo credit: Chris Chapman
Description: Fox Glacier Valley

SECTION TWO

Overview of the Impacts Database
Using the Impacts Database
Including non-monetised impacts
Adding your own impact to the database



IN-CONFIDENCE

Choose the relevant impacts

- **Impacts Database** tab in CBAx. ~200 prepopulated impacts you can use (each one has a corresponding number in the left column, and a wellbeing domain).
- Choose the relevant impacts for your analysis. Note down the corresponding number(s), these are used in the Impact Inputs tab.

Impacts Database

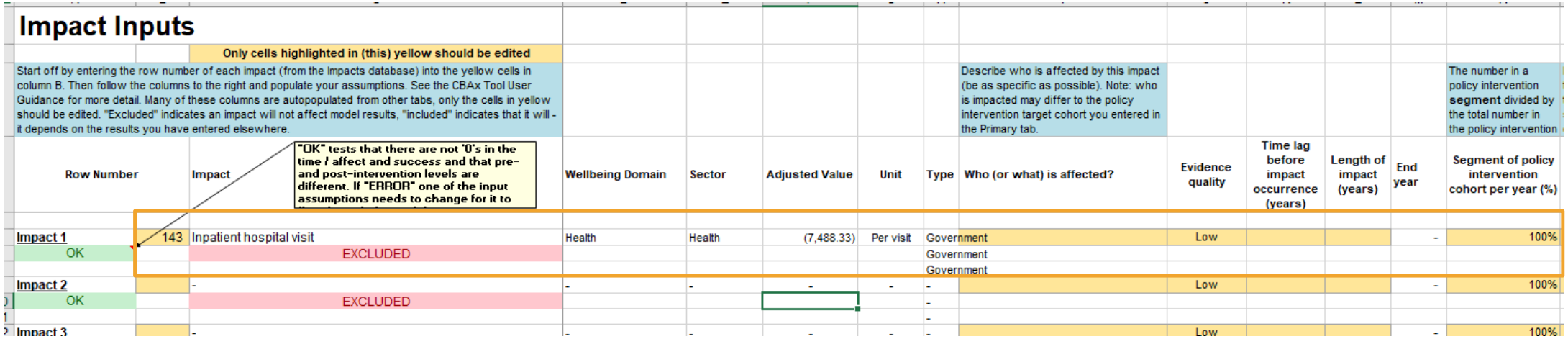
Take note of the row number (column A) for the relevant impact(s) values you want to use in the Impact Inp table. See the CBAx Tool User Guidance for more information about entering your own impacts.

Row Number	Wellbeing Domain	Description	Value adjusted to 2024	Value	Unit	Government/Non-Government	Sector
3	Income, consumption a	Superannuation - Generalised	-23,119	-21,840	Per year	Government	Social Deve
4	Income, consumption a	Superannuation or veterans pension - Single, living alone	-27,323	-25,811	Per year	Government	Social Deve
5	Income, consumption a	Superannuation or veterans pension - Single, sharing	-25,220	-23,825	Per year	Government	Social Deve
6	Income, consumption a	Superannuation or veterans pension - Married, civil union, or de facto couple, both qualify (	-21,017	-19,855	Per year	Government	Social Deve
7	Income, consumption a	Superannuation or veterans pension - Married, civil union, or de facto couple, with non-qua	-21,017	-19,855	Per year	Government	Social Deve
8	Income, consumption a	Superannuation or veterans pension - Married couple, with non-qualified spouse included b	-21,017	-19,855	Per year	Government	Social Deve
9	Income, consumption a	Orphan's Benefit or Unsupported Child's Benefit - Generalised	-16,005	-15,119	Per year	Government	Social Deve
10	Income, consumption a	Orphan's Benefit or Unsupported Child's Benefit - Under 5	-15,047	-14,215	Per year	Government	Social Deve
11	Income, consumption a	Orphan's Benefit or Unsupported Child's Benefit - 5 to 9	-15,151	-14,313	Per year	Government	Social Deve
12	Income, consumption a	Orphan's Benefit or Unsupported Child's Benefit - 10 to 13	-16,326	-15,423	Per year	Government	Social Deve
13	Income, consumption a	Orphan's Benefit or Unsupported Child's Benefit - 14+	-17,494	-16,527	Per year	Government	Social Deve
14	Income, consumption a	Foster care allowance - Generalised	-16,117	-15,226	Per year	Government	Social Deve
15	Income, consumption a	Foster care allowance - under 5	-15,047	-14,215	Per year	Government	Social Deve
16	Income, consumption a	Foster care allowance - 5 to 9	-15,151	-14,313	Per year	Government	Social Deve
17	Income, consumption a	Foster care allowance - 10 to 13	-16,326	-15,423	Per year	Government	Social Deve
18	Income, consumption a	Foster care allowance - 14+	-17,494	-16,527	Per year	Government	Social Deve
19	Income, consumption a	Foster care allowance - Family home	-16,568	-15,652	Per year	Government	Social Deve
20	Income, consumption a	Family tax credit - Generalised	-6,700	-6,330	Per year	Government	Social Deve
21	Income, consumption a	Family tax credit - First or only child, aged 0 to 15 years	-7,538	-7,121	Per year	Government	Social Deve

IN-CONFIDENCE

Choose the relevant impacts (cont.)

For example, let's select the cost of an **inpatient hospital visit**. In the Impacts Database we identify this as row number: '143'. In the Impact Inputs tab enter this corresponding number in the first yellow cell. Several of the cells are then auto-populated.



Impact Inputs

Only cells highlighted in (this) yellow should be edited

Start off by entering the row number of each impact (from the Impacts database) into the yellow cells in column B. Then follow the columns to the right and populate your assumptions. See the CBAx Tool User Guidance for more detail. Many of these columns are autopopulated from other tabs, only the cells in yellow should be edited. "Excluded" indicates an impact will not affect model results, "included" indicates that it will - it depends on the results you have entered elsewhere.

"OK" tests that there are not '0's in the time / affect and success and that pre- and post-intervention levels are different. If "ERROR" one of the input assumptions needs to change for it to

Describe who is affected by this impact (be as specific as possible). Note: who is impacted may differ to the policy intervention target cohort you entered in the Primary tab.

The number in a policy intervention **segment** divided by the total number in the policy intervention

Row Number		Impact	Wellbeing Domain	Sector	Adjusted Value	Unit	Type	Who (or what) is affected?	Evidence quality	Time lag before impact occurrence (years)	Length of impact (years)	End year	Segment of policy intervention cohort per year (%)
Impact 1	143	Inpatient hospital visit	Health	Health	(7,488.33)	Per visit	Government		Low			-	100%
OK		EXCLUDED					Government						
							Government						
Impact 2		-	-	-	-	-	-		Low			-	100%
OK		EXCLUDED					-						
							-						
Impact 3		-	-	-	-	-	-		Low			-	100%

Detail who / what is affected

- Describe who is affected, when, and the evidence to support it.
- First, detail who or what is affected by the impact. Be as detailed as possible.

Row Number		Impact	"OK" tests that there are not '0's in the time / affect and success and that pre- and post-intervention levels are different. If "ERROR" one of the input assumptions needs to change for it to	Type	Who (or what) is affected?	Evidence quality	Time lag before impact occurrence (years)	Length of impact (years)	End year	Segment of policy intervention cohort per year (%)	Success rate (%)	Impact type	Units per person / cohort member per annum	Annual v Per co meml
Impact 1	143	Inpatient hospital visit		Gover	health sector, patients	High	1.0	1.0	2.0	30%	80%	Pre intervention level	0.30	
OK		INCLUDED		Government								Post intervention level	0.27	
				Government								Marginal impact	(0.03)	
Impact 2		-		-		Low			-	100%	100%	Pre intervention level		
OK		EXCLUDED		-								Post intervention level		

- In the above example, impacts on inpatient hospital visits are likely to affect the health sector and patients.

IN-CONFIDENCE

All proposals should be supported by evidence

It is a judgement call on how you rate each impact on the evidence (low, medium, or high). Here are some things to consider:

- Have there been any **previous evaluations** undertaken on the proposal elsewhere?
- Is there information on how **successful similar proposals** have been in realising benefits?
- How applicable is the **evidence to the New Zealand context**? For proposals imported from overseas, what evidence or information exists to suggest that it can be successfully delivered here? How confident are you that the evidence might apply in the same way?

For pilot initiatives evidence on effectiveness will be limited. Perform sensitivity analysis or use advice from independent experts and stakeholders to indicate confidence. There should also be a commitment to collect evidence of impact of the pilot (as should be the case for non-pilot initiatives) to support any extension of the pilot in the future.

Considering timing

- For each impact you need to consider three dimensions for “timing”.
- Time lag, length of impact and how long an intervention lasts.

Row Number		Impact	"OK" tests that there are not '0's in the time *I* affect and success and that pre- and post-intervention levels are different. If "ERROR" one of the input assumptions needs to change for it to	Type	Who (or what) is affected?	Evidence quality	Time lag before impact occurrence (years)	Length of impact (years)	End year	Segment of policy intervention cohort per year (%)	Success rate (%)	Impact type	Units per person / cohort member per annum	Annual v Per co memb
Impact 1	143	Inpatient hospital visit		Gover	health sector, patients	High	1.0	1.0	2.0	30%	80%	Pre intervention level	0.30	
OK		INCLUDED		Government								Post intervention level	0.27	
				Government								Marginal impact	(0.03)	
Impact 2		-		-		Low			-	100%	100%	Pre intervention level		
OK		EXCLUDED		-								Post intervention level		
												Marginal impact	-	

IN-CONFIDENCE

Timing: Lag, Length and Recurrence

Year / time lag

How long after the intervention will the impact come into effect?

Example: the benefits from formal education come into effect after the fact.

Length / duration

How long will the impact last?

Example: an impact that increases income might be effective for 2 years+ but when is the impact due to other factors such as skill or experience?

Rule of thumb: a reasonable length of impact is 2-5 years.

Recurrence in future

How long does an intervention last for before it no longer impacts the cohort?

Example: In a 5-year programme where the impacts don't continue without it, the next cohort will miss out.

IN-CONFIDENCE

Segment of policy intervention cohort impacted

Hypothetical proposal to fund a vaccine for children to prevent Lurgi (a made-up sickness doing the rounds in New Zealand). Suppose that the programme includes a range of interventions, such as a social media campaign that will apply to the whole 62,000 strong cohort, as well as more intensive and costly interventions (such as local community centre seminars), that will apply to a smaller sub-group of the cohort.

In this case, it would make sense to segment the impacts as they relate to the cohort. The social media campaign might apply to the full 100% of the cohort, whereas the community centre seminars might only apply to 40%. This may affect the way in which the impacts are modelled, since the specific intervention might result in a different impact. If the costs of a programme differ between segments, then the impacts may also differ.

Identify what percentage of the policy intervention cohort that an impact relates to.

A specific segment of the cohort may have different impacts, and different populations may have different segments.

Exanmple: if your initiative affects only those who are employed (say 8 out of 10 of the cohort) then you would record 80% as the ‘segment’ impacted.

IN-CONFIDENCE

Probability / Success Rate

- What is the likelihood the outcome will occur?
- This can be thought of as the ‘success rate’.
- Using the previous example, perhaps not everyone will see the social media campaign, the proportion of those that do determines the **success rate** of that impact.

Row Number		Impact	"OK" tests that there are not '0's in the time I affect and success and that pre- and post-intervention levels are different. If "ERROR" one of the input assumptions needs to change for it to	Type	Who (or what) is affected?	Evidence quality	Time lag before impact occurrence (years)	Length of impact (years)	End year	Segment of policy intervention cohort per year (%)	Success rate (%)	Impact type	Units per person / cohort member per annum	Annual v Per co memb
Impact 1	143	Inpatient hospital visit		Gover	health sector, patients	High	1.0	1.0	2.0	30%	80%	Pre intervention level	0.30	
OK		INCLUDED		Government								Post intervention level	0.27	
				Government								Marginal impact	(0.03)	
Impact 2		-		-		Low			-	100%	100%	Pre intervention level		
OK		EXCLUDED		-								Post intervention level		
												Marginal impact	-	

Pre- and post-intervention levels

- There are three ways to specify the pre and post intervention levels.
- It links back to the type of unit for the value impacts that you have chosen.
- Using our example, the unit type is frequency. Let's assume the pre-intervention level is 0.3 hospital visits per child per year and post-intervention this level is 0.27 (around 10% of inpatient hospital visits are prevented by this intervention)

IMPACT UNIT TYPE	WHEN TO USE THIS OPTION
Binary	Something happens or does not happen. Unit type: per year, incident, event 0 (pre-intervention) and 1 (post-intervention) OR 1 (pre-intervention) and 0 (post-intervention)
Frequency	Something happens less or more often. Unit type: per day, hour, event, visit, incident For example: 6 (pre-intervention occurrence of an incident) and 5.7 (post-intervention less occurrence of an incident)
Proportional	The pre- or post-intervention level is a reference point. Unit type: per year For example: 0.8 (pre-intervention Job Seeker benefit is 80% of new income) and 1 (post-intervention new income level)

IN-CONFIDENCE

Bringing it all together

In the example illustrated below we have assumed:

- it affects health sector costs and that resources will be re-allocated within health, benefiting other patients
- the evidence quality is high
- the impact will start in a year and last for a year
- 30% (or 3 out of 10) of the cohort will be affected
- a success rate of 80%
- the pre-intervention level is 0.3 hospital visits per child per year and post-intervention this level is 0.27 (around 10% of inpatient hospital visits are prevented by this intervention)

Row Number		Impact	"OK" tests that there are not '0's in the time *l* affect and success and that pre- and post-intervention levels are different. If "ERROR" one of the input assumptions needs to change for it to	Type	Who (or what) is affected?	Evidence quality	Time lag before impact occurrence (years)	Length of impact (years)	End year	Segment of policy intervention cohort per year (%)	Success rate (%)	Impact type	Units per person / cohort member per annum	Annual va Per co meml
Impact 1	143	Inpatient hospital visit		Gover	health sector, patients	High	1.0	1.0	2.0	30%	80%	Pre intervention level	0.30	
OK		INCLUDED		Government								Post intervention level	0.27	
				Government								Marginal impact	(0.03)	
Impact 2		-		-		Low			-	100%	100%	Pre intervention level		
OK		EXCLUDED		-								Post intervention level		

And finally ...

- Once these are entered, we have completed almost all the information that we need to put into CBAx.
- CBAx then calculates the difference that the intervention makes i.e., the marginal impact (that is, pre intervention level minus post intervention level).
- Clearly document any assumptions made about the evidence.

Can you use an impact twice?

Yes, you can include the same impact multiple times to address variations in impact, such as the number of people affected differing over time, or segments of the cohort being affected differently. You can then vary the assumptions.

- ***Warning***: Be careful not to double count impacts if using the same impact several times – make sure the assumptions are clearly documented and each use addresses different segments / periods.
- CBAx calculates the net present value (NPV) for each impact entry separately. Impacts would be double counted if the same segment and period was covered in both impact entries.
- This flexibility also enables you to calculate the NPV for several scenarios of an impact in one CBAx model. Use the results for individual impact entry **only**, but *not* the overall results, for example ROI, as these would include double counted impacts. This can be useful for quick "what if" sensitivity analysis and development of ranges.

IN-CONFIDENCE

Pātai / Questions?

Photo credit: Chris Chapman
Description: Fox Glacier Valley

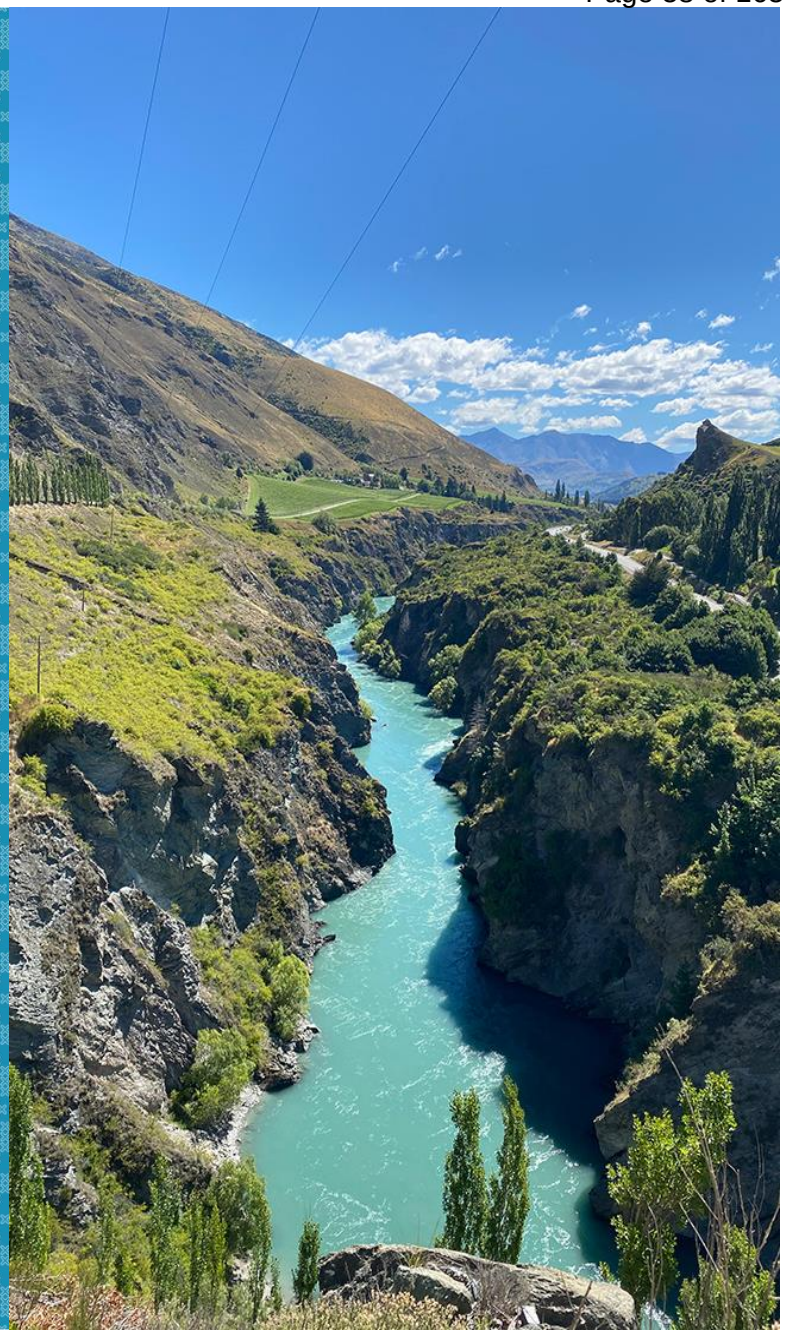
SECTION THREE

Overview of the Impacts Database

Using the Impacts Database

Including non-monetised impacts

Adding your own impact to the database



Not all impacts can be monetised.

In some cases, the monetised values from the CBAx modelling may be all that is needed.

However, populating the Wellbeing Impacts tab helps to summarise what the monetised and non-monetised impacts are.

For example: School Lunches

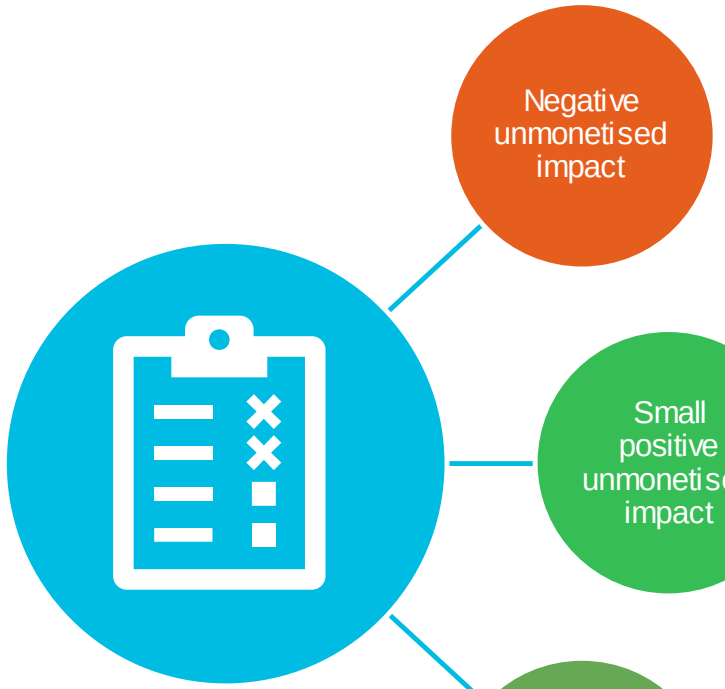
We might be able to quantify impacts such as changes in academic performance, but it may be hard or unnecessary to quantify the difference in "settledness" in the classrooms or the sense of belonging that disadvantaged kids feel, as they are not the odd ones out with no lunch. This might be medium positive non-monetised impacts. Use your judgement, and write these up in the Wellbeing Impacts tab.

What do you find hard to quantify?

Or monetise?

IN-CONFIDENCE

Examples of non-monetised impacts



Negative unmonetised impact

- Urban design might
- Make people feel unsafe
- Lead to isolation for e.g., elderly or women

Small positive unmonetised impact

- Outlook to nature in hospital might
- Calm and cheer up
- Lead to quicker recovery

Big positive unmonetised impact

- Birds in cities might
- Improve mental health

IN-CONFIDENCE

How you include all impacts in CBAx

- Signal unmonetised impacts and their magnitude – Use drop-down in the output summary tab
- Describe and quantify important impacts, even if you can't give them a dollar value – Use the Wellbeing impacts tab or word template

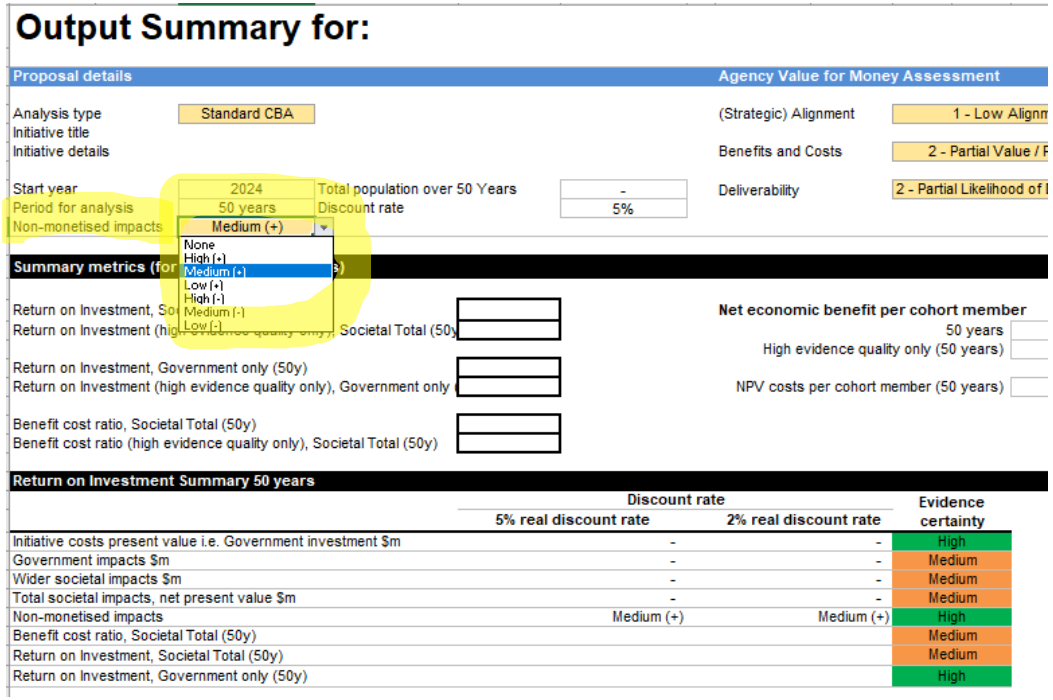
Wellbeing Impacts

You can include information from the auto-populated table B below as appropriate.

Also include non-monetised impacts that are not modelled in CBAx.

Wellbeing Impacts table. Summary of monetised and non-monetised impacts.

Reference	Impact description	Affected	Timeframe	Wellbeing domain	Magnitude / Present value	Quantification, assumptions and evidence	Evidence quality
Impact 1							
Impact 2							
Impact 3							
Impact 4							
Impact 5							
Impact 6							
Impact 7							



Output Summary for:

Proposal details

Analysis type: Standard CBA
Initiative title
Initiative details

Start year: 2024
Period for analysis: 50 years
Non-monetised impacts: Medium (+)

None
High (+)
Medium (+)
Low (+)
High (-)
Medium (-)
Low (-)

Total population over 50 Years: -
Discount rate: 5%

Agency Value for Money Assessment

(Strategic) Alignment: 1 - Low Alignm
Benefits and Costs: 2 - Partial Value / P
Deliverability: 2 - Partial Likelihood of

Summary metrics (for

Return on Investment, So
Return on Investment (high
Societal Total (50y)

Return on Investment, Government only (50y)
Return on Investment (high evidence quality only), Government only

Benefit cost ratio, Societal Total (50y)
Benefit cost ratio (high evidence quality only), Societal Total (50y)

Net economic benefit per cohort member
50 years
High evidence quality only (50 years)

NPV costs per cohort member (50 years)

Return on Investment Summary 50 years

	Discount rate		Evidence certainty
	5% real discount rate	2% real discount rate	
Initiative costs present value i.e. Government investment $m	-	-	High
Government impacts $m	-	-	Medium
Wider societal impacts $m	-	-	Medium
Total societal impacts, net present value $m	-	-	Medium
Non-monetised impacts	Medium (+)	Medium (+)	High
Benefit cost ratio, Societal Total (50y)			Medium
Return on Investment, Societal Total (50y)			Medium
Return on Investment, Government only (50y)			High

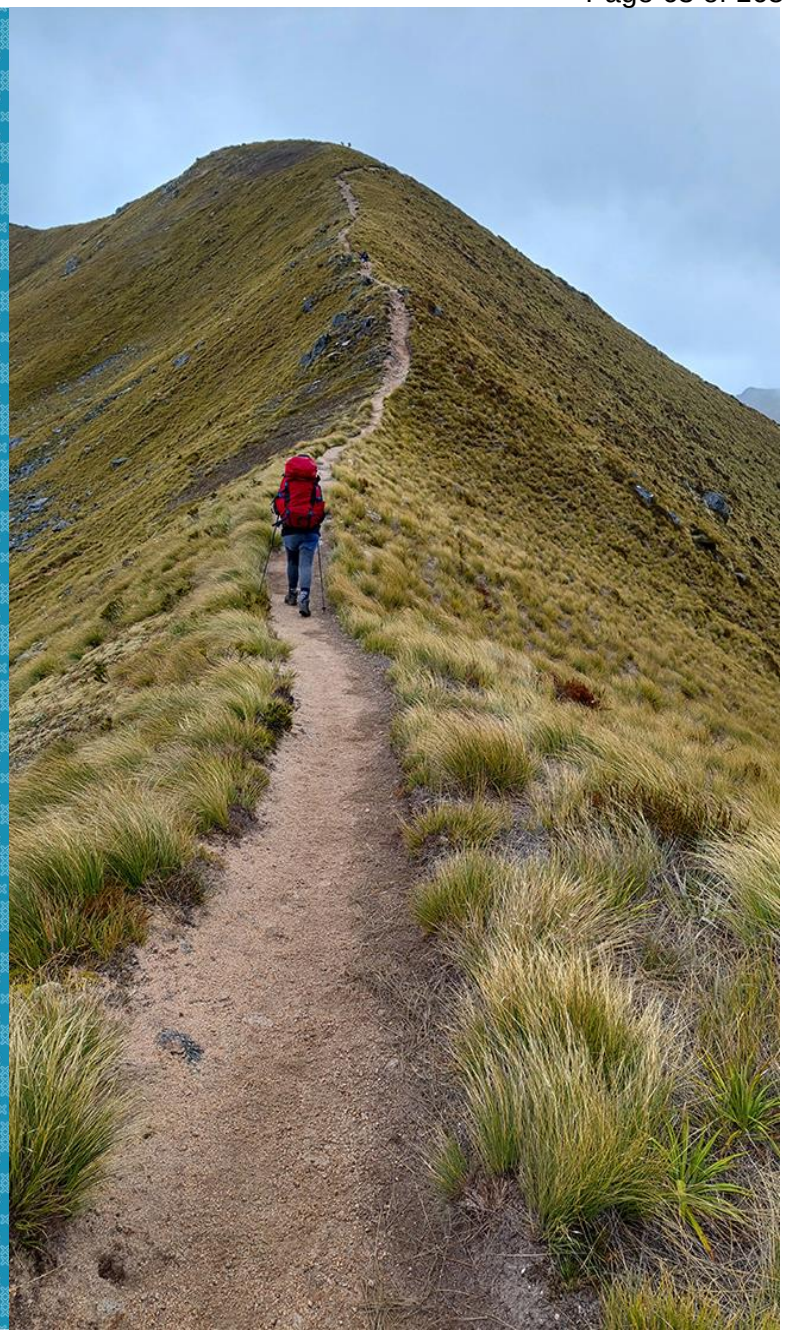
IN-CONFIDENCE

Pātai / Questions?

Photo credit: Chris Chapman
Description: Fox Glacier Valley

SECTION FOUR

Overview of the Impacts Database
Using the Impacts Database
Including non-monetised impacts
Adding your own impact to the database



Values in the Impacts Database

- Some values may not be available in the CBAx impacts database.
- You can add your own values to the database for a specific intervention at the bottom of the table. Analysis then flows through the model like any other value.
- You can add values to explore 'what if' or 'what would it take to…'
- The evidence base for a new value may vary, and judgement is needed to decide whether to add a value and what value to use. Any new values should be based on solid evidence where possible
- Values that are publicly available can be incorporated into the standard CBAx impacts database (email cbax@treasury.govt.nz to have them included).

You can add your own!

- You can add a monetised impact in a CBAx that is not already in the 'Impacts Database tab' by adding it at the end of the table.
- Open the Impacts Database tab of the CBAx tool and scroll to the bottom where the rows are yellow.

Row Number	Wellbeing Domain	Description	Value adjusted to 2024	Value	Unit	Government/Non-Government	Sector	Year of data	Sc
276	Knowledge and skills	Average annual cost of Early Childhood Educ	-14,460	-7,596	Per year	Government	Health	2013	M
277	Knowledge and skills	Average annual cost of Early Childhood Educ	-3,223	-1,693	Per year	Government	Health	2013	M
278	Safety	Adding a new impact	161	100	Per year	Non-Government	Justice	2016	
279									

Inputs you will need

- Wellbeing domain
- Description of the impact
- Value
- Unit of measure
- Government / non-government
- Sector
- Year of data

To input your own impact in the database table you'll need a few details (see left).

Note: some of the fields are drop-down boxes (e.g., unit of measure, and sector) – while there may not be a direct fit, just select the closest option. This will not impact the ROI calculations.

An example

Row Number	Wellbeing Domain	Description	Value adjusted to 2024	Value	Unit	Government/Non-Government	Sector	Year of data	Sc
276	Knowledge and skills	Average annual cost of Early Childhood Educ	-14,460	-7,596	Per year	Government	Health	2013	M
277	Knowledge and skills	Average annual cost of Early Childhood Educ	-3,223	-1,693	Per year	Government	Health	2013	M
278	Safety	Adding a new impact	161	100	Per year	Non-Government	Justice	2016	
279									

- We have entered information into each of the yellow cells for an impact relating to **Safety**. Note the column reading ‘value adjusted to 2024’. The $100 we entered in the ‘value’ column is current for a particular year; in this case 2016. The ‘value adjusted to 2024’ automatically adjusts this to bring impact values on a common year basis. This is the value that will be used in CBAx calculations.
- Once the impact is included in the database, we treat it the same as for any other impact in the Impact Inputs tab. We take the corresponding row number (far left column) and enter that into the Impact Inputs tab to continue our analysis.

Using and developing

- The Australian Social Value Bank (ASVB) values are developed by international experts using robust econometric analysis and adjusted for New Zealand purposes. The Treasury has license arrangements with the ASVB which provides a list of quantified wellbeing values. You can consider using these wellbeing values in your analysis. ASVB values can be used in CBAx modelling in accordance with the license agreement
- Check the list of quantified wellbeing values available through Treasury's licence arrangements with the ASVB see: www.asvb.com.au
- Contact the Treasury (cbax@treasury.govt.nz) to purchase an ASVB sub-licence.

Methods for creating your own.

Several non-market valuation methodologies available for developing values. The simplest values are where these are already expressed in monetary terms and part of regular reporting, such as costs of public services or people's income. Most of the CBAx values are of this nature.

The CBAx model distinguishes fiscal impacts for the government (classified as "government") and total economic value or wellbeing impacts for people (classified as "non-government"). Both government and non-government impacts are included in the total societal impacts.

CBAx values should only be applied if there is justified causation between the intervention, and the impact in question.

IN-CONFIDENCE

Pātai / Questions?

Photo credit: Chris Chapman
Description: Fox Glacier Valley

IN-CONFIDENCE

Rōpū rārangi take (online October to November on Monday 2 pm – 3 pm)

Lifting CBA practice 2023 series

Slides and recordings available for previous sessions

#1 Learn and develop: CBAx update for Budget 2024, Budget 2023 CBAs experiences and intervention logic and a CBA (and other methods)

#2 Evaluation: CBA: What is CBA, when to do it and why, evaluating CBAx summary outputs, how other methods complement a CBA

#3 Value for Money and reviewing CBAs: Applying a value for money lens, Guest panel insights into how Treasury looks at CBA submissions

#4 Different aspects and approaches to CBA: Guest panel on Living Standards Framework, He Ara Waiora, Social Investment and Outcomes / Performance Reporting.

#5 Worked example of CBA: Transport intervention

#6 Cost pressures, sensitivity analysis and reverse analysis: When do we do it, why do we do it, how do we do it?

Date	Agenda
Mon 13 Nov 2 – 3 pm	Dive into the Impacts Database and how to include non-monetised impacts and add new impacts
Mon 20 Nov 2 – 3 pm	**The environment / climate change using CBA and other methods.**
Mon 27 Nov 2 – 3 pm	**Ex-post analysis and CBA.**

Future series – monthly from January 2024!

Email cbax@treasury.govt.nz with session topic suggestions.

Get in touch: cbax@treasury.govt.nz

Hei tērā wiki! See you next week.

TE TAI ŌHANGA
THE TREASURY

TE TAI ŌHANGA
THE TREASURY

CBAx Community of Practice #8

Improving CBA Practice

with Chair Tim Ng Treasury (Sorry, Amie White & Kirsten Jensen are both away)
Guests:
Camilla Lundbak (DoC), Sharon Pells (MBIE), Geoff Simmons (PCE), Stuart Brodie, Tim Denne, Anne-Gaelle Ausseil and Spencer Clubb (MfE), and Melanie Craxton (Treasury)

20 NOVEMBER 2023 | IN CONFIDENCE

IN-CONFIDENCE

Whāinga e te rōpū / group objectives

- **Empower** you to feel confident in providing well-considered, evidence-based advice
- Provide **support** to do a CBA using CBAx
- Create a space for **kōrero** on using the tool
- **Share insights** and answer questions

IN-CONFIDENCE

Rōpū rārangi take / group agenda

Lifting CBA practice 2023 series

Slides / recordings available online for Session #1 to #7 (note session #1 is slides only)

#1 Learn and develop: CBAx update for Budget 2024, Budget 2023 CBAs experiences and intervention logic and a CBA (and other methods)

#2 Evaluation: CBA: What is CBA, when to do it and why, evaluating CBAx summary outputs, how other methods complement a CBA

#3 Value for Money in Budget 2024: Applying a value for money lens, Panel – insights into how Treasury looks at CBA submissions

#4 Different aspects and approaches to CBA: Guest panel on Living Standards Framework, He Ara Waiora, Social Investment and Outcomes / Performance Reporting

#5 Worked example of CBA: Guest panel Health intervention; Transport intervention

#6 Sensitivity analysis and reverse analysis: When do we do it, why do we do it, how to we do it?

#7 Impacts Database – how to use impacts, how to include non-monetised impacts,and how to add new impacts

Date	Agenda
Mon 20 Nov 2 – 3 pm	**Environment, climate and transformational change using CBA**
Mon 27 Nov 3 – 4 pm	Topic – Ex-post analysis and CBA Guest speakers – Wellbeing Researchers Panel

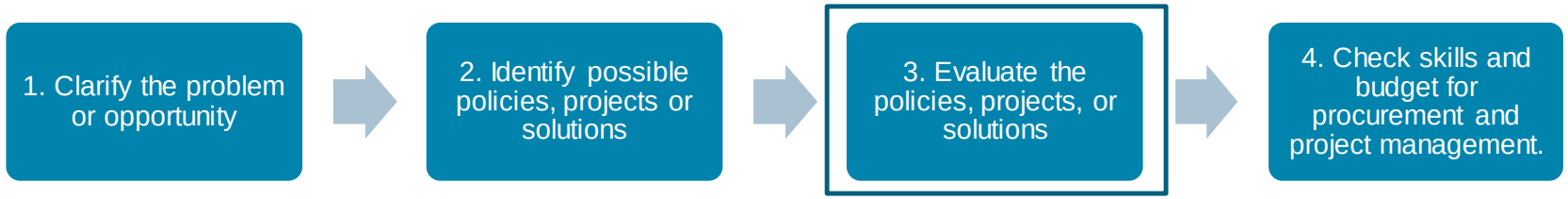
Future series – monthly from January 2024!

Email cbax@treasury.govt.nz with session topic suggestions.

IN-CONFIDENCE

The 7 steps of a CBA and inputs to CBAx

CBA is part of the **evaluation stage** of the policy development process. It is a method for assessing proposed options that have been developed to respond to a policy problem



Using CBAx is a 7-step evaluative process as follows:

Policy evaluation *using CBA on each feasible option*	
Inputs to CBAx	**Step 1:** Define policy and counterfactual **Step 2:** Identify those who gain and those who lose **Step 3:** Identify the benefits and costs; allocate to time periods
Analysis in CBAx	**Step 4:** Quantify the benefits and costs within ranges **Step 5:** Discount to a common period, compare benefits and costs
Outputs from CBAx	**Step 6:** Is the result clear enough? If not, consider whether it is worth investing in more research, repeat previous steps **Step 7:** Write report

IN-CONFIDENCE

Environment, climate and transformational change

Topics	Presenters	
Tools for transformative change	Sharon Pells	Chief Economist Unit, Ministry of Business, Innovation and Employment (MBIE)
Environmental valuation	Geoff Simmons	Chief Economist, Parliamentary Commissioner for the Environment (PCE)
Environmental CBA in practice	Tim Denne	Principal Economist, Climate Change, Ministry for the Environment (MfE)
Ecosystem services	Anne-Gaelle Ausseil	Ecosystems, Ministry for the Environment (MfE)
Environmental panel	Presenters, joined by Camilla Lundbak (DoC) Stuart Brodie and Spencer Clubb (MfE) Melanie Craxton and Tim Ng (Treasury)	

Please raise questions and comments in the chat.
We will cover your questions with the panel at the end.

SECTION ONE

Sharon Pells

Chief Economist Unit, Ministry of Business, Innovation and Employment (MBIE)

,

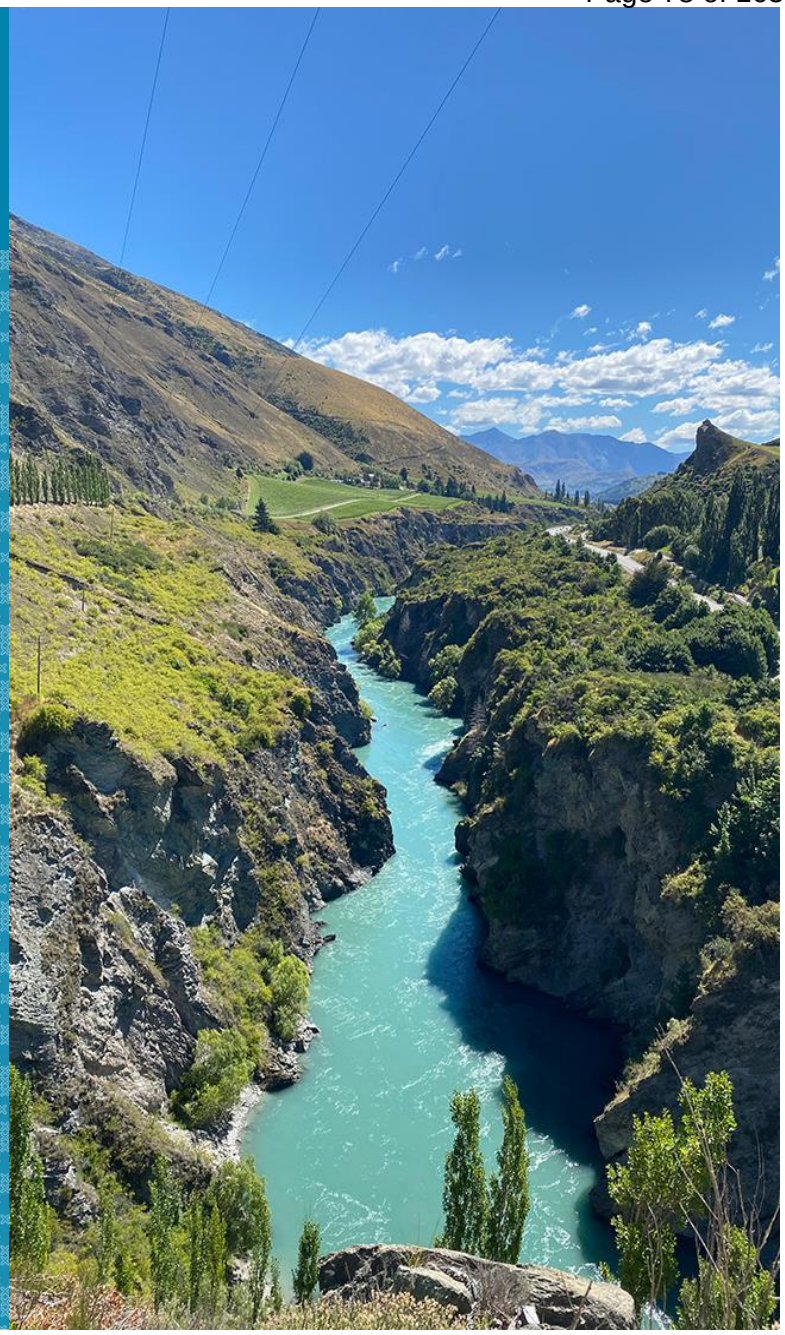
Tools for transformative change (MBIE)

Environmental valuation (PCE)

Environmental CBAs in practice (MfE)

Ecosystem services framework (MfE)

Environmental panel



MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

Which analytical tools are suited to transformative change?

Sharon Pells, Chief Economist Unit

CBAx workshop

New Zealand Government

What is this about?

- MBIE's Chief Economist Unit has been looking at analytical tools suited to transformative change – see paper here
- The motivation is a growing focus on policies that target complex, long-term challenges and opportunities
- Questions are being raised about which analytical tools are most suitable
- In particular, the role of cost-benefit analysis is being queried
- The work involved a literature review and agency engagement
- We define 'transformative change' as:

"a major change in the structure of the economy brought about by deliberate policy efforts aimed at supporting specific long-term environmental, social, economic or other goals, or in response to long-term challenges and trends such as climate change"

Analytical tools suited to transformative change include ones that reflect its features

- **Goal-oriented policy** eg Multi-Criteria Analysis, Cost-Effectiveness Analysis, (re unintended consequences) Cost-benefit Analysis
- **Long-term and future-focused** eg Scenario Analysis & other foresighting tools
- **Systemic including innovation systems** eg System Dynamics
- **Risk and uncertainty** eg Real Options Analysis, Portfolio Analysis, Risk-Opportunity Analysis

Some of these tools are particularly relevant to environmental impacts

Analytical tool	Description	Relevance to transformative change
Cost-Benefit Analysis	Quantifies the benefits and costs of a policy	Appraise policy options where impacts are quantifiable/monetisable
Multi-Criteria Analysis	Ranks options based on how well they satisfy criteria	Appraise policy options where impacts are hard-to-quantify/monetise eg climate change adaptation
Cost-Effectiveness Analysis	Identifies least-cost option for achieving a specific goal	Appraise policy options where there is a pre-defined goal eg reducing GHG emissions
Scenario Analysis	Describes alternative ways the future might unfold	Understand the future context, combine with other techniques
System Dynamics	Models complex dynamic systems	Understand complex systems
Real Options Analysis	Per CBA but incorporates risk/ uncertainty	Appraise policy options when timing and other decisions are flexible eg large infrastructure projects
Portfolio Analysis	Analyses risk/return/other objectives	Appraise multiple policies in combination
Risk-Opportunity Analysis	Assesses the risks and opportunities of a policy	Appraise policy options in the face of risk/ uncertainty eg 'clean' technologies and innovations

Source: author based on: Browne and Ryan (2011), *Comparative analysis of evaluation techniques for transport policies*; Watkiss, Hunt, Blyth and Dyszynski (2014), *The use of new economic decision support tools for adaptation assessment: A review of methods and applications, towards guidance on applicability.*

Cost-benefit analysis is a valuable tool in general but has limitations regarding transformative change

- Cost-benefit analysis (CBA) has many strengths, can be applied in many contexts, and is generally seen as the dominant tool in the policy toolkit
- However, the use of CBA is patchy and compliance is low
- CBA's limitations regarding transformative change include:
  - a status quo bias
  - a tendency to underplay environmental and other non-monetary impacts
  - a narrow focus
- Treasury's CBAx tool has some features relevant to transformative change

These limitations can be overcome to some extent, but…

- Some techniques may make CBA more suited to transformative change:
  - lower discount rates to prioritise future impacts
  - use scenario analysis etc to look beyond the status quo
  - use techniques to assess non-monetary impacts:
    - revealed preferences
    - stated preferences
    - subjective wellbeing
  - use reverse/break-even analysis to avoid monetising all benefits
- But CBA is more about static efficiency rather than dynamic effectiveness
- Even HM Treasury's 'Green Book' notes CBA's core limitations regarding transformative change
- Overall, the more transformative the policy, and the less amenable to monetisation, the more that CBA's role should be questioned

Instead, other tools could be upweighted

- There is no silver bullet – each tool has strengths and weaknesses
- Multiple tools, and 'triangulation', are probably needed
- Selecting the right tool(s) for the job requires knowledge of diverse tools
- But analytical capability is limited, and perspectives about analytical tools are deeply held
- Some analytical tools seem under-utilised, while others are new
- Also important is who has standing in the analysis, and upholding Te Tiriti

To wrap up… What does this mean for you?

1. Big challenges like climate change involve ‘transformative change’
2. Analytical tools suited to transformative change include ones that reflect its features
3. Cost-benefit analysis, while valuable in general, has significant limitations regarding transformative change
4. Other relevant tools are new or seem under-utilised
5. Key implications include the need to:
   - broaden the toolkit
   - weight more heavily tools most suited to transformative change
   - improve analytical capability

Want to know more?

The full paper is available on MBIE's website: Pells (2023), *Which analytical tools are suited to transformative change?*

Analytical tool	Reference
Cost-Benefit Analysis	Abelson (2022), *Cost-benefit analysis: Then and now.* HM Treasury (2022), *The Green Book.* Treasury (2022), *CBAx Tool User Guidance: Guide for departments and agencies using Treasury's CBAx tool for cost benefit analysis*.
Multi-Criteria Analysis	Watkiss, Hunt, Blyth and Dyszynski (2014), *The use of new economic decision support tools for adaptation assessment: A review of methods and applications, towards guidance on applicability*.
Cost-Effectiveness Analysis	Watkiss, Hunt, Blyth and Dyszynski (2014), *The use of new economic decision support tools for adaptation assessment: A review of methods and applications, towards guidance on applicability*.
Scenario Analysis	Waverley Consultants (2017), *The Futures Toolkit: Tools for Futures Thinking and Foresight Across UK Government*. Wilkinson (2017), *Strategic Foresight Primer*.
System Dynamics	Currie, Smith, and Jagals (2018), *The application of system dynamics modelling to environmental health decision-making and policy - a scoping review.*
Real Options Analysis	Hallegatte, Shah, Lempert, Brown and Gill (2012), *Investment decision making under deep uncertainty - application to climate change.* Stroombergen and Lawrence (2022), *A novel illustration of real options analysis to address the problem of probabilities under deep uncertainty and changing climate risk*.
Portfolio Analysis	Watkiss, Hunt, Blyth and Dyszynski (2014), *The use of new economic decision support tools for adaptation assessment: A review of methods and applications, towards guidance on applicability*.
Risk-Opportunity Analysis	Mercure, Sharpe, Ives, Grubb, Pollitt, Knobloch and Nijsse (2020), *Risk-Opportunity Analysis for Transformative Policy Design and Appraisal.*

SECTION TWO

Geoff Simmons

Chief Economist, Parliamentary Commissioner for the Environment (PCE)

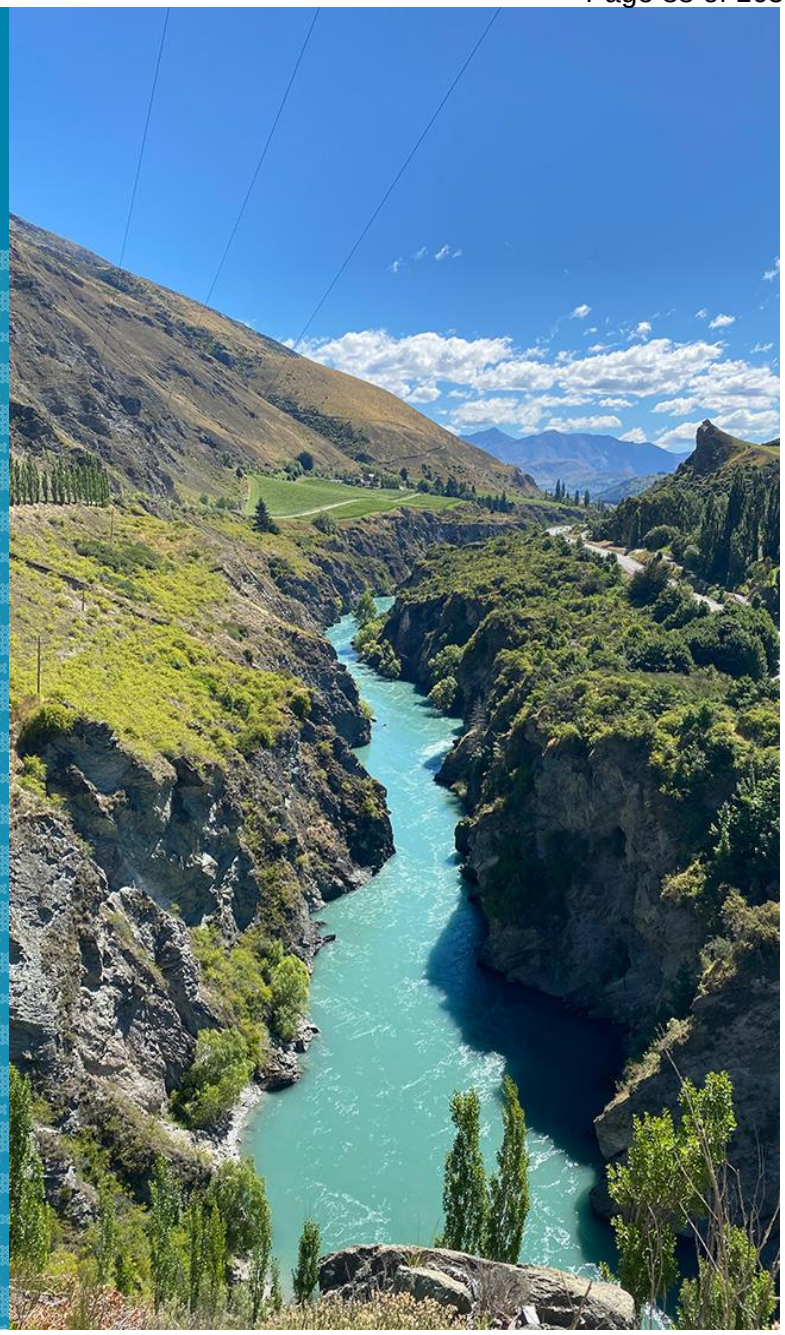
Tools for transformative change (MBIE)

Environmental valuation (PCE)

Environmental CBAs in practice (MfE)

Ecosystem services framework (MfE)

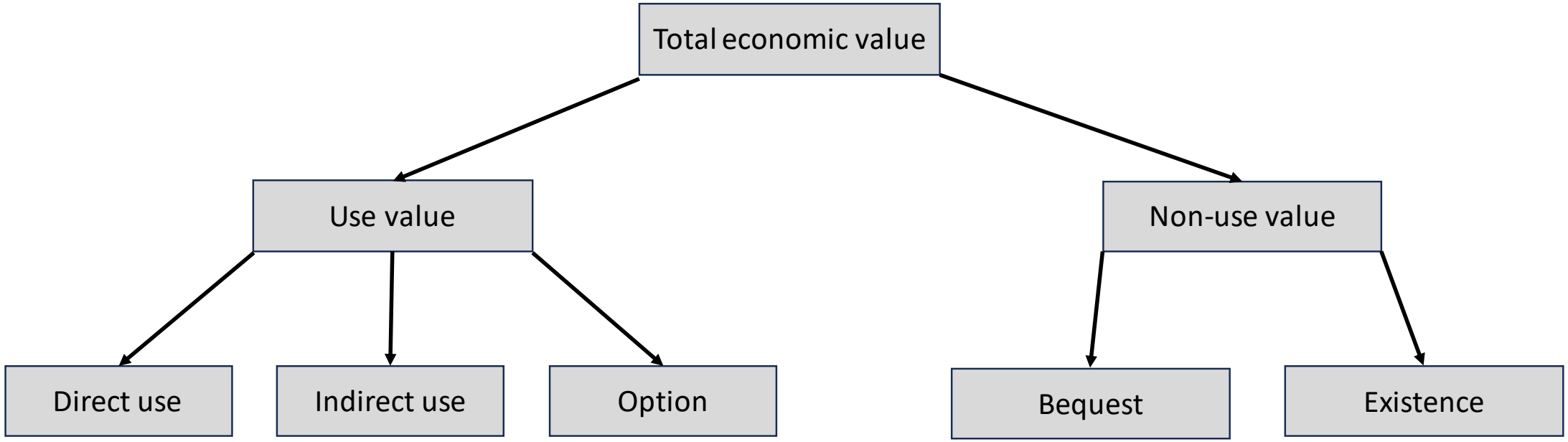
Environmental panel



Environmental valuation: some context

- Incorporating the environment into CBA requires valuation (some already in CBAX)
- Challenging: many environmental goods and services aren't traded in markets
- A host of valuation of techniques have been developed to try and address that. These are controversial:
  - "The environment is priceless"
  - Questions about accuracy and reliability of valuation techniques – "is some value better than no value"?
- A bigger question: continue with CBA as the primary decision support tool for public policy. Or substitute or complement with other approaches
  - Marginal vs large changes?
  - Tipping points and strong sustainability?

Total economic value



Adapted from OECD (2006)

Environmental valuation: techniques (1)

		Market prices	Production function approaches	Revealed preference	Stated preference	Cost-wellbeing analysis
Use value	Direct use value	Y	Y	Y	Y	?
	Indirect use value		Y	?	Y	Y
	Option value			?	Y	?
Non-use value	Existence value				Y	?
	Bequest value				Y	?

Environmental valuation: techniques (2)

Market prices	Production function approaches	Revealed preference	Stated preference	Cost wellbeing analysis
Market prices	Foregone production	Travel cost method	Contingent valuation	Experienced wellbeing
	Loss averting expenditure	Hedonic price	Choice modelling	Overall life satisfaction
	Replacement cost			

Source: adapted from Hanley and Barbier (2009)

A forest example

- Direct (consumptive) use value: timber
- Direct (non-consumptive) use value: recreation
- Indirect use value: stormwater mitigation, water purification, carbon sequestration
- Non use value: existence value

A forest example (continued …)

- Direct (consumptive) use value (timber): market prices
- Direct (non-consumptive) use value (recreation): revealed preference (travel cost method); cost wellbeing analysis
- Indirect use value (stormwater mitigation) – loss averting expenditure or replacement cost analysis
- Indirect use value (water purification) – replacement cost analysis
- Indirect use value (carbon sequestration) – market prices? Or social cost of carbon (mostly from production function approaches)
- Non-use value (existence or bequest): stated preference survey

- https://www.ecosystemvaluation.org/uses.htm - this site has always been absolutely amazing. It goes through examples, it describes how to do the analysis and it provides case studies. An incredible resource.

Environmental valuation (7): Maori perspectives

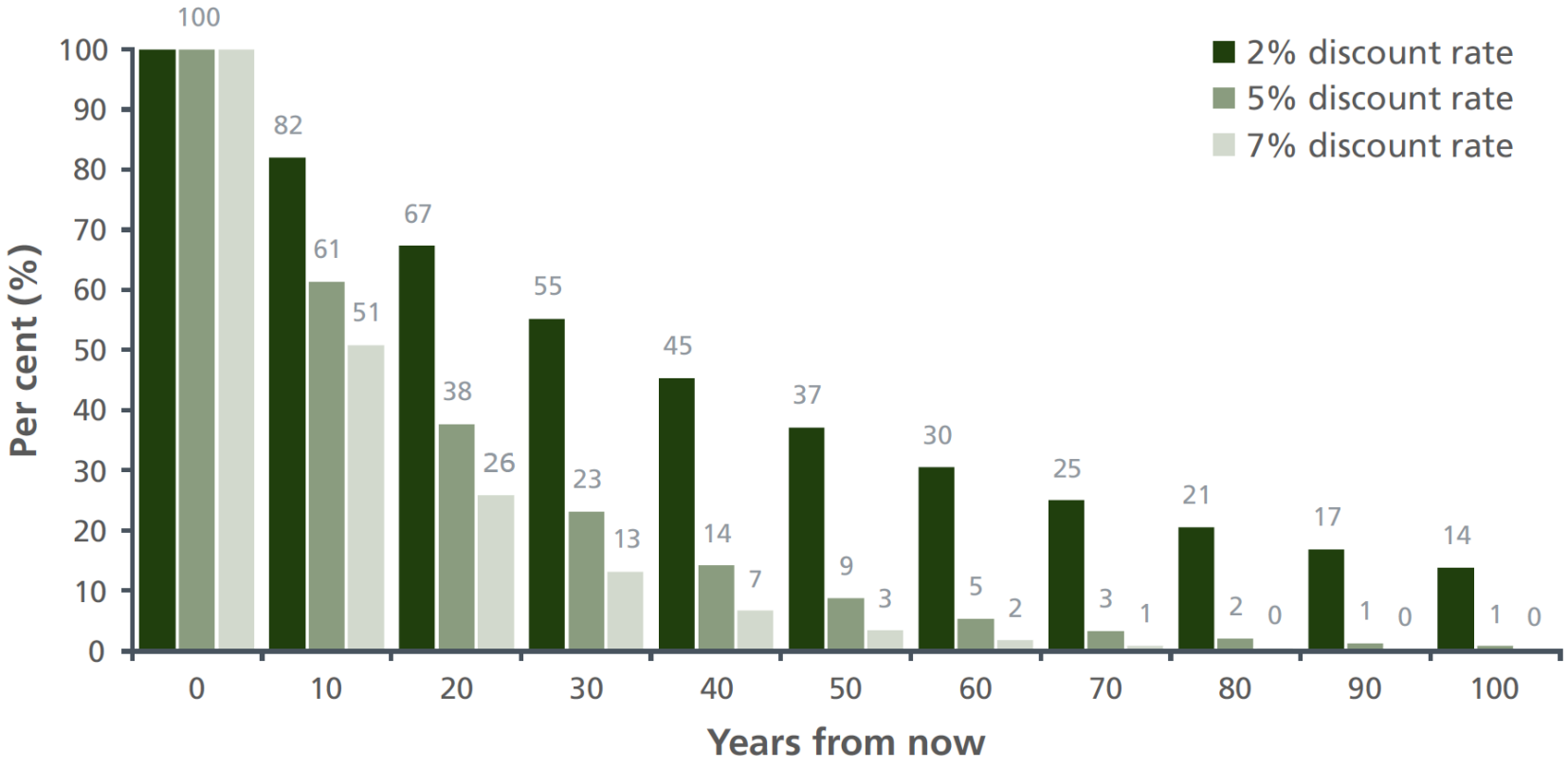
Very different world view:

- Whakapapa and intrinsic/ existence value
- Reciprosity vs “conservation”

Weightings

- Inevitably trying to conflate different perspectives into one number involves combining different inputs
- Ideally this can be done objectively, but sometimes inputs need to be weighted
- Can rapidly get into tricky normative territory
- Might be worth thinking about alternatives like MCDA to make weightings transparent
- Best example of this is weighting over time…

Discounting is mucky, but discounting the environment is a wetland



Discount rate thoughts

1. The discount rate is ultimately a philosophical question!
2. International practice varies – many ways to skin this cat
3. Māori perspectives are interesting and important
4. A different approach to discount rates could help, but also add complexity
5. We also need higher quality environmental data at the right level of abstraction to inform decision making
6. Changing discount rate won't alter the amount of resource at our disposal, just how it is allocated between current and future benefits.

Importance of the counterfactual

- In most CBAs the counterfactual is do nothing, a continuation of business as usual
- As a result, environmental action often has a poor CBA result
- But with the environment, doing nothing *usually means things get worse – the CBA should factor this in*
- Consider the counterfactual seriously:
  - What happens if you don't do the thing?
  - Systems maps can help you think dynamically – knock on effects
  - Scenario analysis can help think long term

Summary & some questions

- Environmental costs and benefits difficult to measure, but possible
- Just ask your friendly neighbourhood economist
- Won't provide "the truth" but can vaguely inform decision making

- Questions:
  - Are there potential tipping points or step changes? Is CBA appropriate in this case?
  - Would it be appropriate to elevate the results of the 2% discount rate scenario used for sensitivity testing?
  - What happens if we do nothing (the counterfactual)?
  - How can we best use limited resources across the public sector to boost the collective pool of environmental valuation?

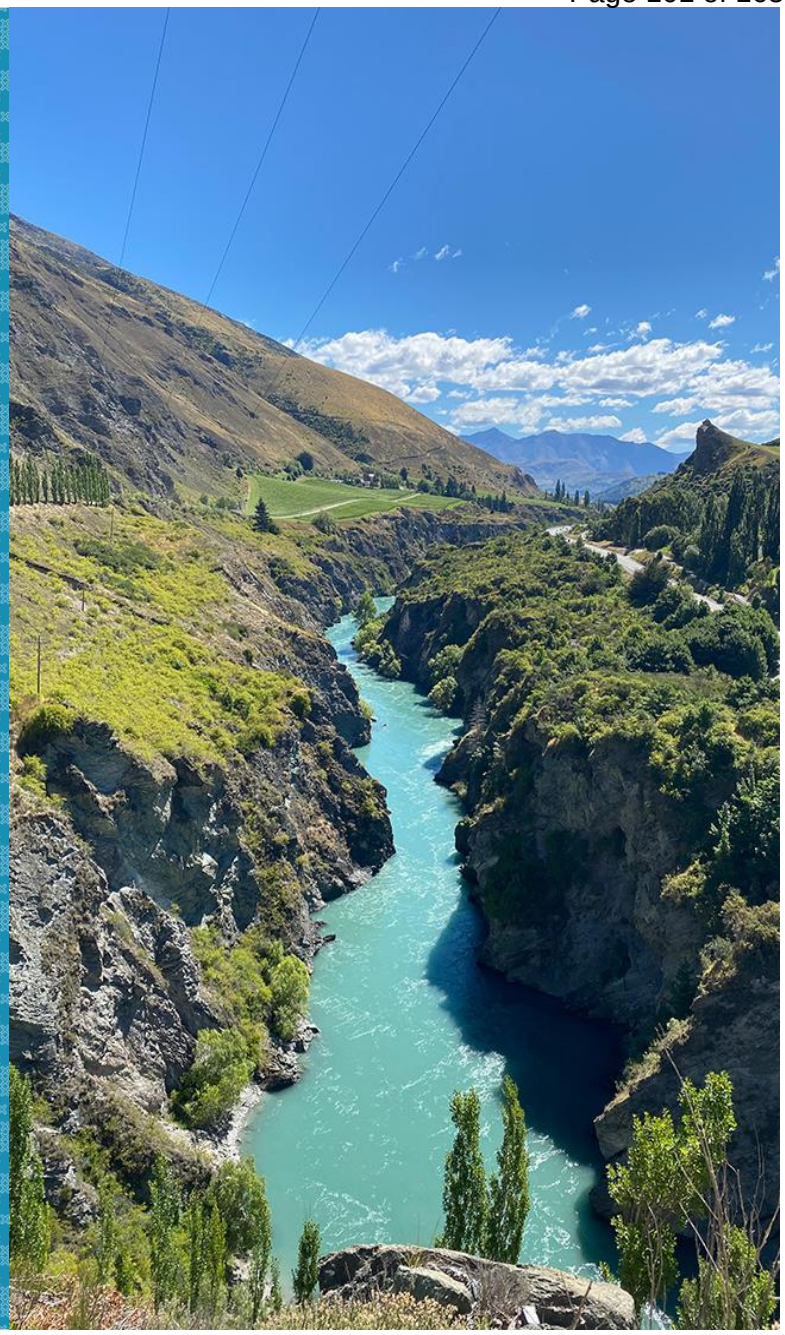
• SECTION THREE

Tim Denne

Principal Economist, Climate Change, Ministry for the Environment (MfE)

,

Tools for transformative change (MBIE)
Environmental valuation (PCE)
Environmental CBA in practice (MfE)
Ecosystem services framework (MfE)
Environmental panel



Introductory comments

- The natural environment is a complex adaptive system. There continue to be significant gaps in our understanding of that system and our interactions with it.

- It is generally accepted that the state of the environment (globally and nationally) is declining with implications for our current and future well-being (touching on the work of all agencies). We face the dual challenge of addressing a legacy of environmental degradation and mitigating and adapting to future changes in the physical environment.

- Many of the options to address these challenges offer co-benefits (economic, social and environmental), which can be used to strengthen the case in support of relevant options.

- We continue to invest in data and various techniques to better inform decision makers. There is opportunity to improve guidance on environmental considerations (data, indicators, co-benefits) to enhance CBA products. A decision support tool could also offer guidance on which analytical tools are best suited to the level of uncertainty, scale, data, cost, and time.

- The basic message of the Intergovernmental Panel on Climate Change to "take climate action" has remained the same since its first assessment in 1990, while the information and analysis has become much more detailed and precise.

Ministry for the Environment
Manatū Mō Te Taiao

CBA and the environment: *lessons from practice*

Tim Denne (MfE) 20/11/23

Air Quality

- HAPINZ 3.0 study identified observed relationship between pollutant concentrations and changes in mortality & other health outcomes. It also estimated costs (mortality effects dominate)
  Kuschel et al (2022) Health and air pollution in New Zealand 2016 (HAPINZ 3.0)

- Value of reduced mortality estimated using Value of Statistical Life (VoSL = $4.5m – recently updated to $12.5m (2021$) using choice experiment and WTP for reducing road toll, updating VoSL from 30 yr-old study)
  As used in: MoT Social cost of road crashes and injuries and Waka Kotahi *Monetised Benefits and Costs Manual* (p54)

- Results used to produce costs per tonne of PM and NOx in Waka Kotahi *Monetised Benefits and Costs Manual* based on new $12.5m VoSL

QS1 Which of the following would you prefer?

	Current (no changes made)	Investment option one	Investment option two
Deaths (per year)	250	200	250
Serious injuries (per year)	1750	1000	1500
Minor injuries (per year)	6000	5000	6000
Increase in your personal costs (per year)	$0	**$200** more per year	**$100** more per year
	Prefer this (no change)	Prefer option 1	Prefer option 2

Choice experiment study (>7,000 face-to-face interviews): Waka Kotahi Research Report 698

Table 9: Emissions damage costs ($/tonne – 2021)

Pollutant	Urban costs in NZ$/tonne	Rural costs in NZ$/tonne	National costs in NZ$/tonne
$PM_{2.5}$	$853,824.00	$49,075.00	$530,676.00
NO_X	$865,797.00	$24,040.00	$325,312.00
CO	$4.87	$0.19	$2.99
Volatile organic compounds	$1,545.00	$61.00	$949.00
SO_2	$39,334.00	$1,546.00	$24,160.00

Waka Kotahi (2023) Monetised Benefits and Costs Manual Version 1.6.1

Air Quality Studies - Issues

- Science emphasis has been communicating complex ideas simply - air pollution mortality impacts described as “premature deaths”. But we all die prematurely of something (we’re not otherwise living to 120). Air pollution is making deaths slightly more premature. How should that be valued?

- Average age of vehicle crash deaths used for VoSL is ~43 years (with ~40 years of life expectancy) but air pollution means earlier death particularly of the elderly. Value of life years lost (VoLY) is an alternative measure but how to define and does it vary with age?
  - Option 1: Simple = annualised value that would equal VoSL as PV over 40 years at 5% ? HAPINZ used $263,843 based on VoSL of $4.5 million
  - Option 2: revealed preference, eg Swedish study asked people earlier in life their WTP to extend life by one year at age 85. The resulting VoLY averages approximately US$2,700 (in 1995$ values) (~NZ$10,000 in 2023). A range of values ($5,000, $25,000 and $199,000) used in analysis for MoT of policy options for reducing household emissions https://www.transport.govt.nz/assets/Uploads/Report/Policies-to-Reduce-Harmful-Emissions-from-Vehicles-Costs-and-Benefits-May-2015.pdf

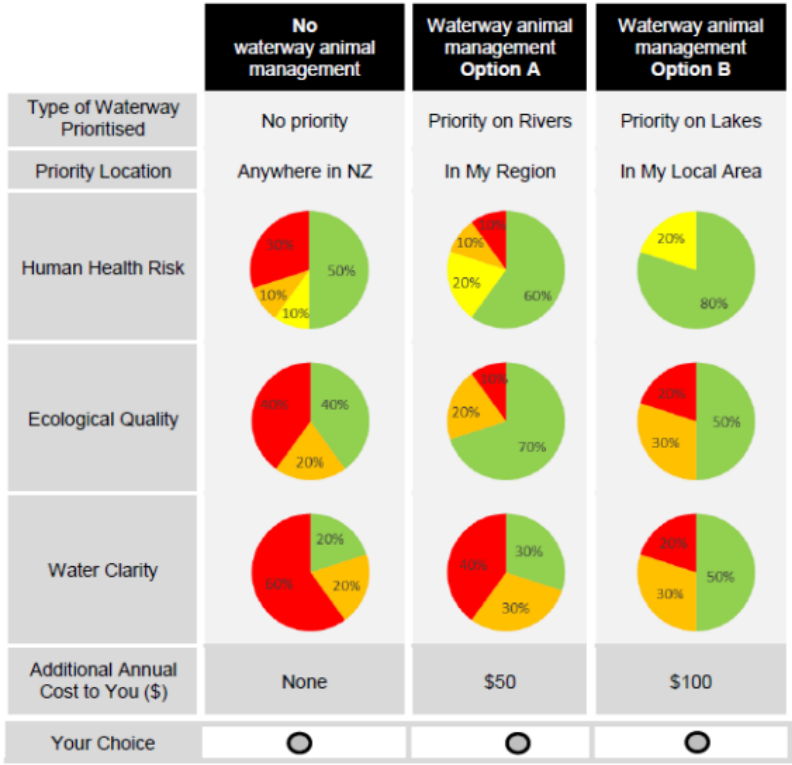
- Marginal or average – the HAPINZ values (using VoSL) have been used in CBAs of reduced air pollution. But the effects of air pollution are chronic and the full benefits will only be received after living many years at lower pollution levels – some lags have been used, including in HAPINZ 3.0, but this is only partially understood.

Freshwater Reforms

- Reforms expected to result in limits to discharges and corresponding reductions in concentrations in water bodies
- For valuation, changes need be identified for factors people value, eg Tait *et al* choice experiment placed values on health risk, ecological quality and water clarity
- Limited values available used to show a positive NPV in CBA

Issues

- The values identified in the WTP study do not necessarily relate to factors measured, eg ecological quality expressed as good, moderate or poor, and respondents will have had their own interpretation. Effects of policy measured as changes in MCI (macroinvertebrate community index)
- Other significant effects not valued, eg impacts on periphyton (slime) or the effects of reduced N&P on MCI
- Timing of effects are highly uncertain, eg very limited information
on rates of transfer of contaminants through soil (and therefore time delay for benefit realisation).



Tait et al (2016) Non-market valuation of improvements in freshwater quality for New Zealand residents. MPI Technical Paper No: 2017/08

https://environment.govt.nz/assets/Publications/Files/essential-freshwater-package-benefits-analysis.pdf

Agriculture emissions pricing

- Purpose-built and industry models used to estimate impacts of different pricing levels and structure on GHG emissions and costs
  - Difficult to predict farmer response to price that does not exist currently, especially when financial analysis suggests a high proportion of sheep & beef farmers would make more money in forestry
- On the benefits side, how do we value reductions in GHG emissions in a CBA? And should we use the marginal global damage cost?
- William Nordhaus: "*The most important single economic concept in the economics of climate change is the social cost of carbon (SCC)*" https://doi.org/10.1073/pnas.1609244114
- But:
  - **It's the wrong number** – socially optimal level of emissions in NZ is not where marginal costs = SCC (defined as marginal global damage costs) – we have agreed to meet a target consistent with the precautionary principle and with doing more than others as a developed country
  - **It is inconsistent** with how we do CBA everywhere else, which is NZ-centric
  - **It is highly uncertain**, depending on uncertain effects, the VoSL problem writ large, uncertain discount rates etc etc
- The better number is the marginal cost of abatement to meet NZ's commitments, which is consistent with Treasury's shadow price approach (imperfect as those numbers are)

Some lessons learned

- CBAs for the environment are necessarily multi-disciplinary. You need to understand the science to properly estimate the effects.
  - But the questions economists ask are often different to those that scientists ask, eg what are **marginal impacts of changes in pollution** rather than total costs/impacts
- There are huge uncertainties and data are frequently missing
  - Little relevant revealed preference data and stated preference surveys are expensive with considerable difficulty in overcoming hypothetical bias
  - Values exist in the literature for only some of the effects and even then it is not clear that survey respondents understand outcomes in the same way (eg what is good ecological quality?)
  - High levels of complexity, eg relationships between nutrient discharges and outcomes in waterways that will differ in very site-specific ways
- Economists differ on significant questions
  - Should marginal global damage costs be used for social cost of carbon?
  - Should VoSL vary with age?
- But despite this, CBA usefully brings out these issues and ensures we use empirical data where available rather than relying on subjective judgements

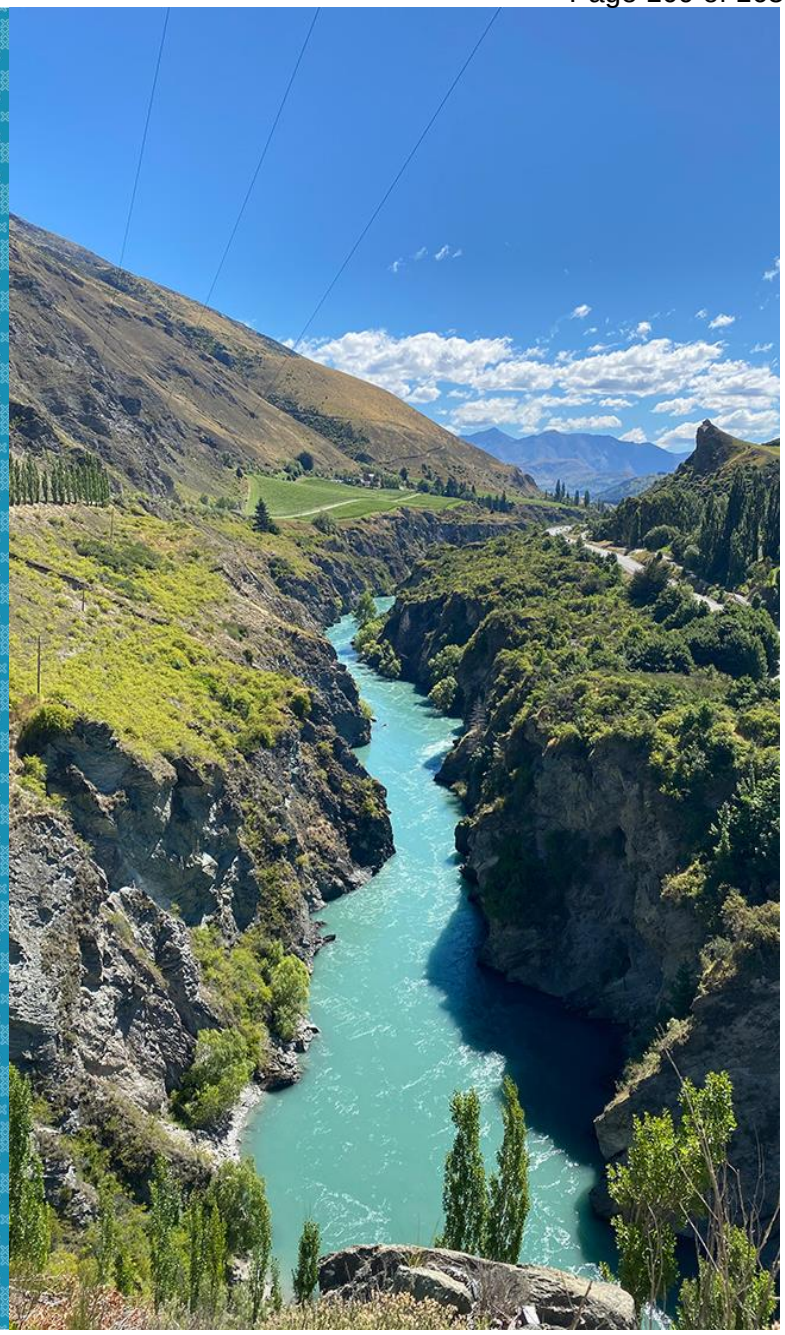
• SECTION FOUR

Anne-Gaelle Ausseil

Ecosystems, Ministry for the Environment (MfE)

,

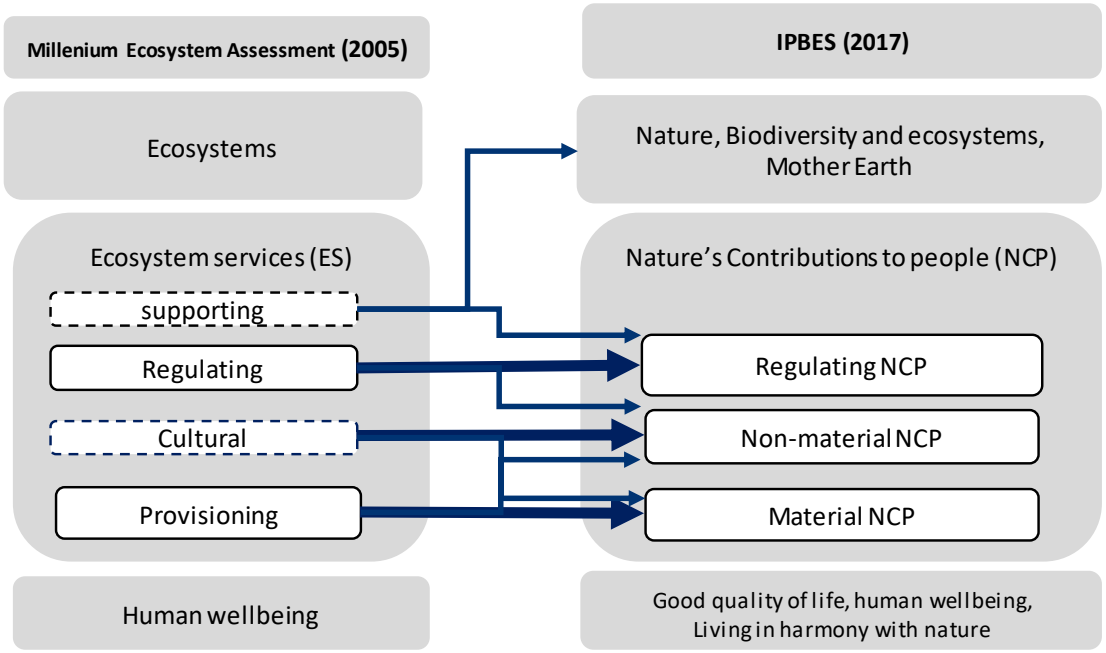
Tools for transformative change (MBIE)
Environmental valuation (PCE)
Environmental CBAs in practice (MfE)
Ecosystem services framework (MfE)
Environmental panel



Introduction

- Ecosystem services (ES) are the "**contributions that ecosystems make to human well-being**"

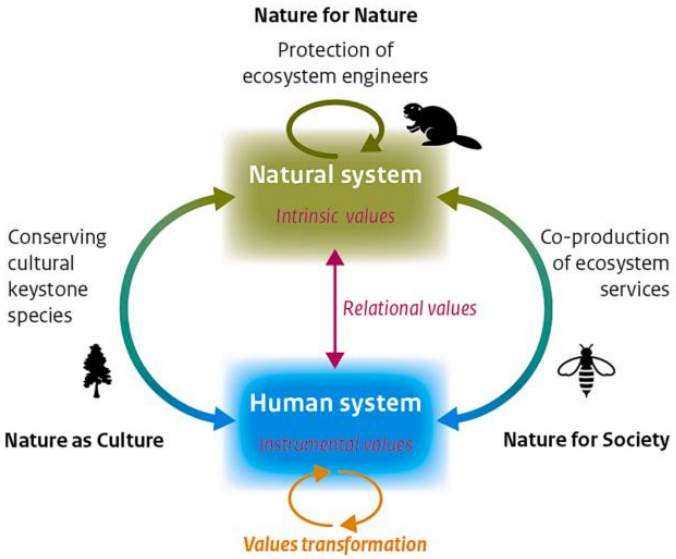
- An **ecosystem services framework** is a useful tool to:
  - **Acknowledge diversity of values**
  - Provide a **common language**
  - Communicate the importance of the environment in **comprehensive** and **equitable** way



MfE (2018)

Key international developments

- IPBES methodological assessment on values (2022) key messages:
  - Focus on narrow set of values (mainly instrumental) underpins the global biodiversity crisis
  - ES quantification focus on **provisioning**, over many regulating and non-material ES
  - Leverage points:
    - **Recognizing** the diverse values of nature
    - **Embedding** valuation into decision-making
    - **Reforming** policies and regulations to internalize nature's values
    - **Shifting** underlying societal norms and goals to align with global sustainability and justice objectives
- Other IPBES resources: global assessment, policy tools, scenarios and models
- The Kunming-Montreal Global Biodiversity Framework: setting goals and targets on biodiversity and nature's contributions to people for 2030



Kim et al, (2023)

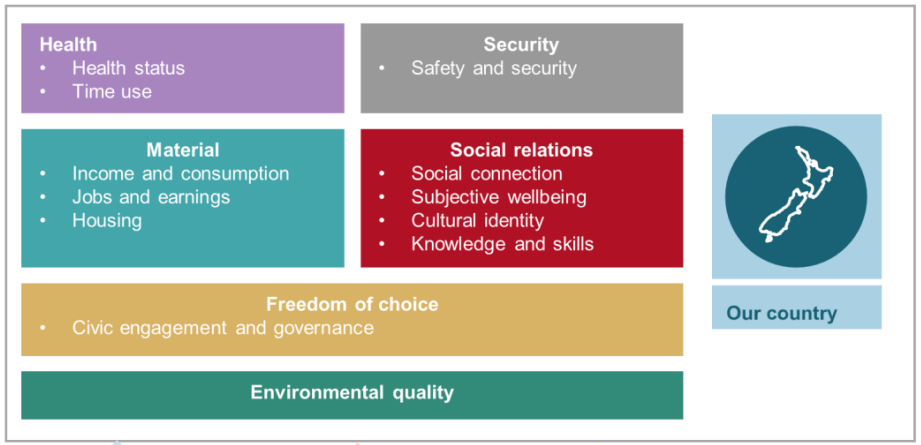
Work to date in NZ

Ministry for the Environment
Manatū Mō Te Taiao

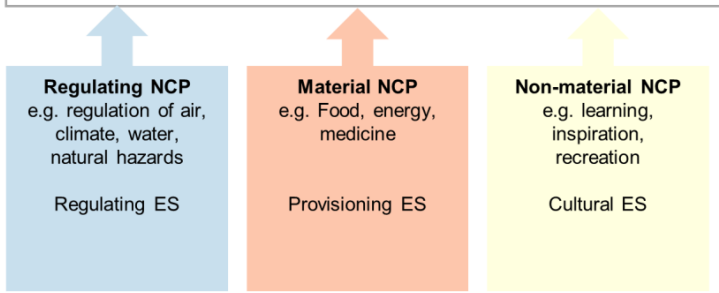
- StatsNZ Data Investment Plan and IANZ
  - Identified indicator gaps
- PMCSA fellowship (2020-21)
  - framework for designing nature-wellbeing indicators
- MfE/Treasury work for the Living Standards Dashboard (2021)
  - Prioritised natural capital indicators
- PCE reports on wellbeing budget (2022)
  - Highlight need for transparency and accountability towards environmental outcomes
- MfE/DOC Environmental Monitoring and Reporting System project and Te Mana o te Taiao Outcome Monitoring Framework (current)
  - Aligning indicator needs and partnership

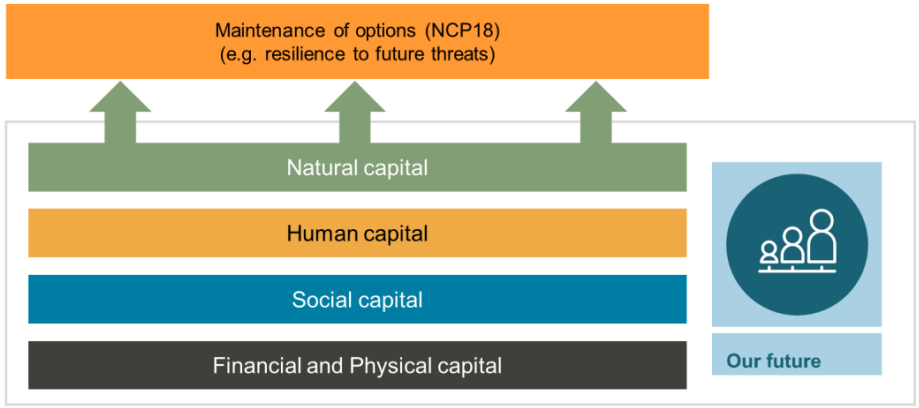
Fellowship PMCSA

Living Standards Framework (2018): 12 wellbeing domains classified into 6 broad categories

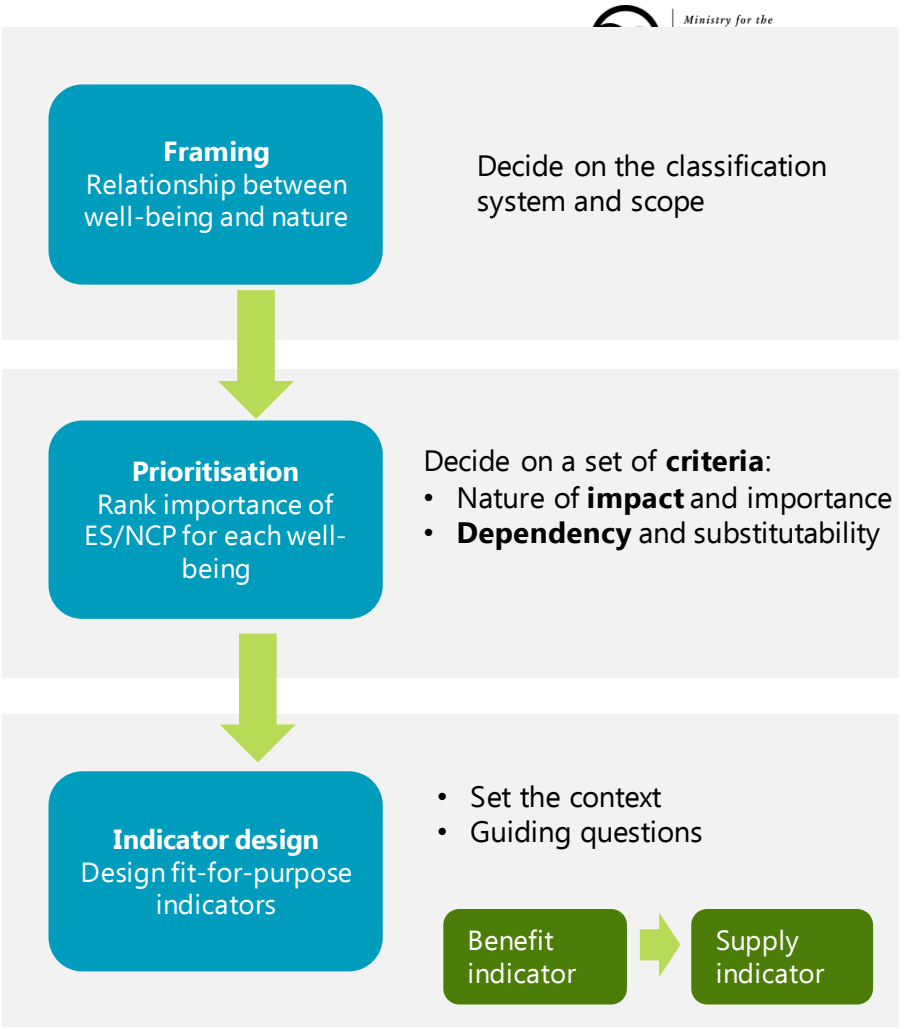


Ecosystem services (ES)/ Nature's Contribution to People (NCP) (IPBES, 2019)





Living Standards Framework (2018)



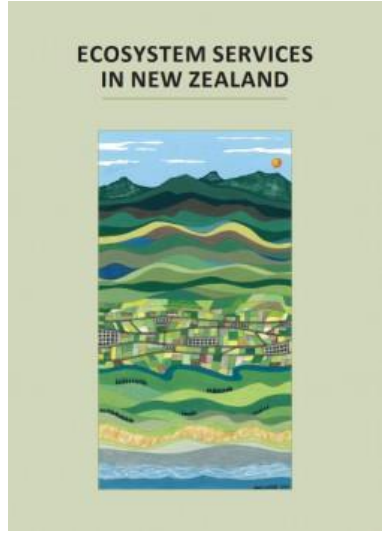
Ausseil et al (2022)

Thank you for listening!

Ministry for the Environment
Manatū Mō Te Taiao

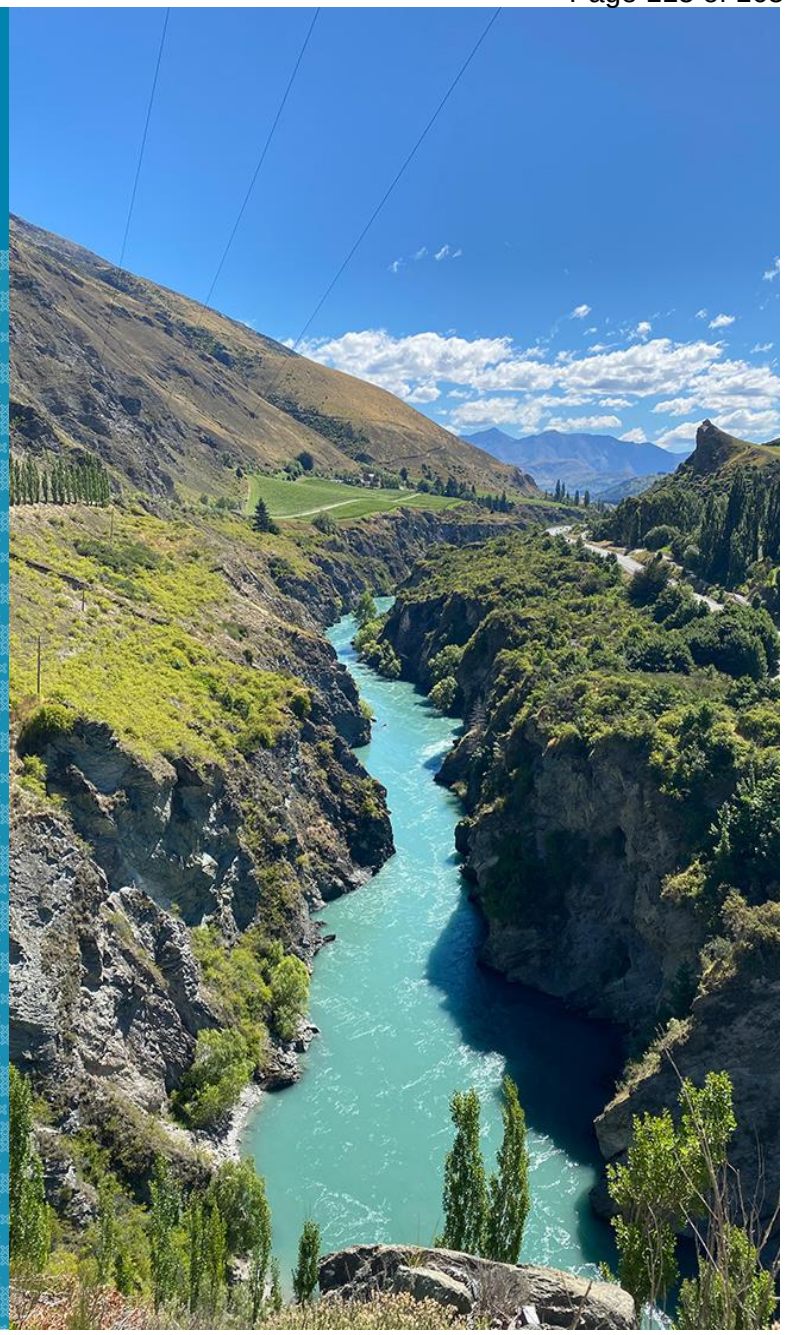
Some useful resources (non-exhaustive):

- Review of ecosystem services as a book (Dymond, 2013) and synopsis (Dymond et al, 2014)
- A review of ecosystem services provided by indigenous biodiversity (Chick and Lawrence, 2014)
- Review of use of ecosystem services in businesses/councils (Greenhalgh and Hart, 2015)
- The nature of wellbeing (Roberts et al, 2015)
- Ecosystem services framework used to underpin CBA for Pukekohe land conversion to housing (Greenhalgh et al, 2017)
- Environmental stewardship and wellbeing (Ausseil et al, 2021)
- Gap in knowledge on Nature's Contributions to people and policy-relevant information (Mastrangelo et al, 2019)



SECTION FIVE

Tools for transformative change (MBIE)
Environmental valuation (PCE)
Environmental CBAs in practice (MfE)
Ecosystem services framework (MfE)
Environmental panel



IN-CONFIDENCE

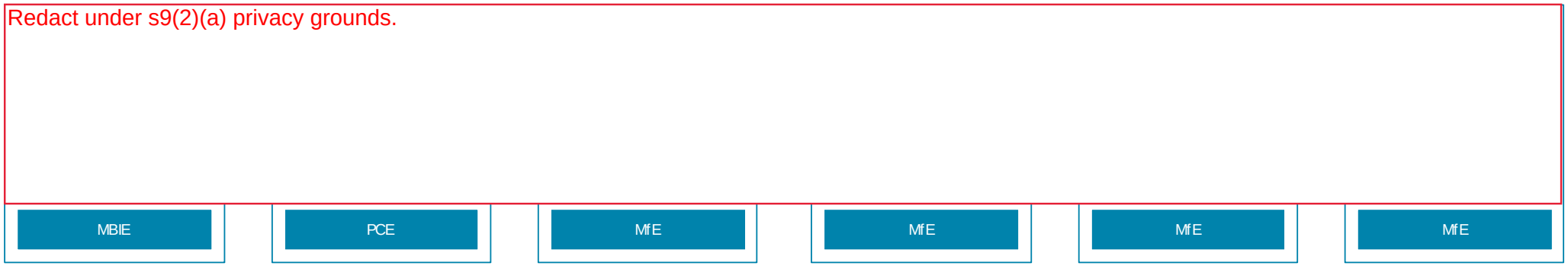
Pātai / Questions?

Photo credit: Chris Chapman
Description: Fox Glacier Valley

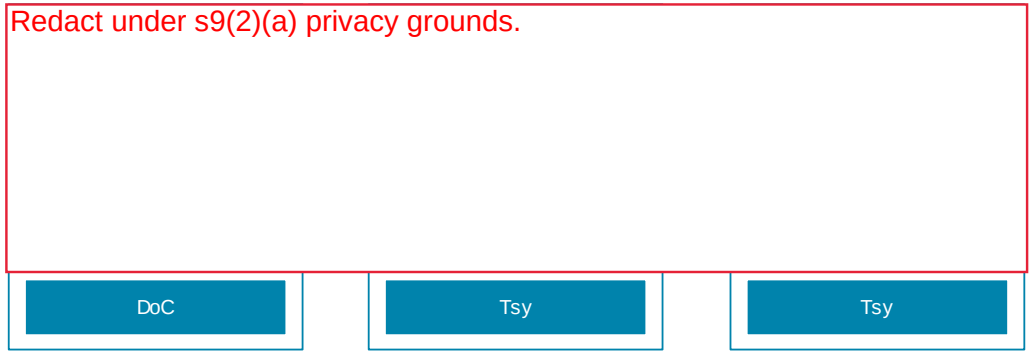
IN-CONFIDENCE

Panel members

Redact under s9(2)(a) privacy grounds.



Redact under s9(2)(a) privacy grounds.



Pātai / Questions?

- What can CBA add?
- Watch out for …
- Try ...

IN-CONFIDENCE

Rōpū rārangi take / group agenda

Lifting CBA practice 2023 series

Slides / recordings available online for Session #1 to #7 (note session #1 is slides only)

#1 Learn and develop: CBAx update for Budget 2024, Budget 2023 CBAs experiences and intervention logic and a CBA (and other methods)

#2 Evaluation: CBA: What is CBA, when to do it and why, evaluating CBAx summary outputs, how other methods complement a CBA

#3 Value for Money in Budget 2024: Applying a value for money lens, Panel – insights into how Treasury looks at CBA submissions

#4 Different aspects and approaches to CBA: Guest panel on Living Standards Framework, He Ara Waiora, Social Investment and Outcomes / Performance Reporting.

#5 Worked example of CBA: Guest panel Health intervention; Transport intervention

#6 Sensitivity analysis and reverse analysis: When do we do it, why do we do it, how to we do it?

#7 Impacts Database – how to use impacts, how to include non-monetised impacts,and how to add new impacts.

Date	Agenda
Mon 20 Nov 2 – 3 pm	Environment, climate and transformational change using CBA
Mon 27 Nov 3 – 4 pm Note the new time	**Ex-post analysis and CBA**

Future series – monthly from January 2024!

Email cbax@treasury.govt.nz with session topic suggestions.

Get in touch: cbax@treasury.govt.nz

Hei tērā wiki! See you next week.

TE TAI ŌHANGA
THE TREASURY

Te Tai Ohanga – The Treasury
Productivity in a Changing World seminar series, 23 November 2023

Please contact me if you would like to quote the slides. Thank you.

CLIMATE CHANGE, PRODUCTIVITY AND INNOVATION – EXPLORING THE LINKS

Dirk Pilat
Research Fellow, The Productivity Institute, Manchester
Associate Researcher, Valencia Institute for Economic Research
dirkpilatparis@gmail.com

THE PRODUCTIVITY INSTITUTE

Key questions

- *What are the links between different measures of productivity and climate change? What measures matter?*
- *What do we know about the relationships? How is productivity expected to evolve in the transition to net zero?*
- *Are productivity growth and addressing climate change compatible? Can we have green growth, or is "degrowth" the way forward? What indicators should we focus on, GDP or something else?*
- *What policies can address climate change while also supporting productivity? What role for innovation policies?*

Outline

Key questions

1. Concepts and measurement
2. What do we know about the links?
3. And how will these links evolve in the transition to net zero?
4. Productivity, green growth and degrowth
5. Addressing climate change while boosting productivity – and a little about innovation
6. Conclusions

1. KEY CONCEPTS AND MEASUREMENT

What productivity measures matter? Some standard ones, but with important extensions …

Table 1: Overview of key Productivity Measures relevant to Climate Change

Type of Output Measure	Type of Input Measure				
	Labour	**Capital (including natural capital)**	**Energy or materials**	**Capital and labour**	**Capital, labour & intermediate inputs**
Gross Output	Labour productivity (based on gross output)	Capital productivity (based on gross output)	Materials productivity (based on gross output)	Capital-labour MFP (based on gross output)	KLEMS multifactor productivity
Value Added	Labour productivity (based on value added)	Capital productivity (based on value added)	Materials productivity (based on value added)	Capital-labour MFP (based on value added)	-
	Single factor productivity measures			**Multifactor productivity measures**	

Source: Modified from OECD (2001).

… and some that adjust for the environment and for natural capital

Table 2: Selected environmentally adjusted productivity measures

Measures	Definition	Adjustments
A. Adjustments to output – environmental externalities		
1. Labour productivity adjusted for bad outputs	Output adjusted for bad outputs / Hours worked	The value of bad outputs (e.g., GHG emissions or air pollution) is **deducted** from output
2. Labour productivity adjusted for unmeasured environmental protection output	Output adjusted for unmeasured environmental protection output / Hours worked	The value of unmeasured environmental protection is **added** to output
B. Adjustments to capital input – natural capital		
3 Multifactor productivity measures adjusted for investment in natural capital at private costs	Output / Factor inputs (including natural capital valued at **private costs**)	The services of natural capital, valued at **private costs**, are **added** as a capital input
4. Multifactor productivity measures adjusted for investment in natural capital at social costs	Output / Factor inputs (including natural capital valued at **social costs**)	The services of natural capital, valued at **social costs**, are **added** as a capital input

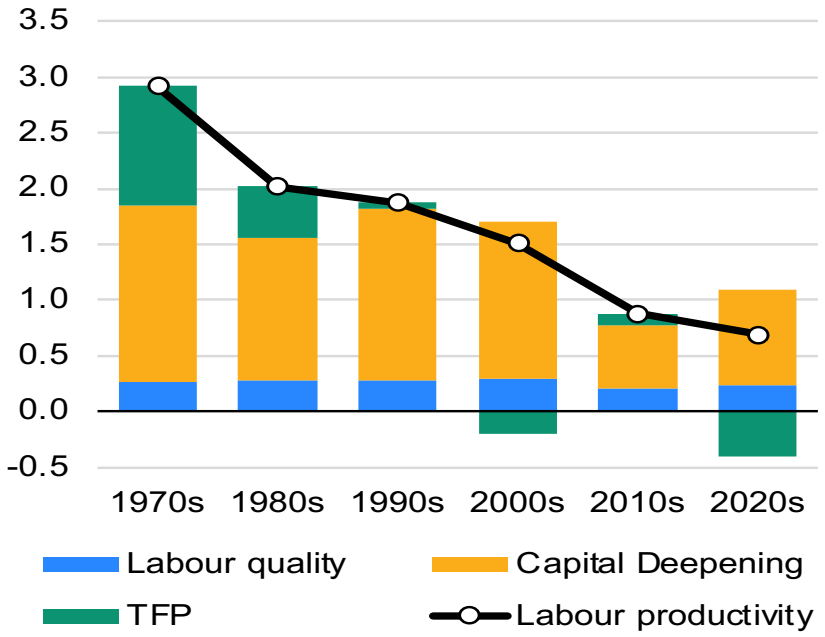
Source: Modified from Agarwala and Martin (2022).

2. WHAT DO WE KNOW? DATA AND EVIDENCE

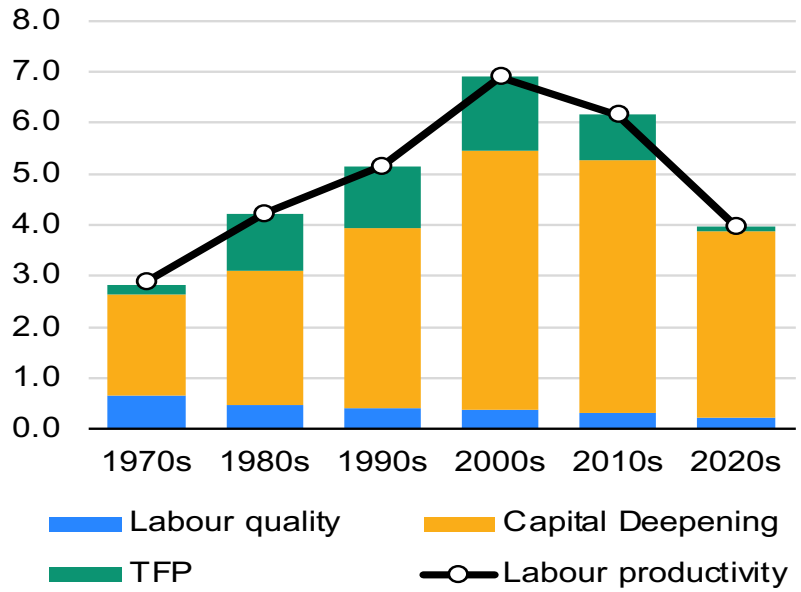
The context for productivity – a global slowdown in productivity, now extending to catching up economies

- **Achieving net zero** would benefit from greater efficiency in the use of all resources, i.e. higher TFP growth – **but TFP/MFP growth has been declining**.
- Most growth is due to capital deepening, **some of which involves intangible assets**, such as R&D, software, data, and organisational capital. We're not seeing a **"weightless economy"** yet.

"Leading but Slowing" G20 countries (G7 + Australia)

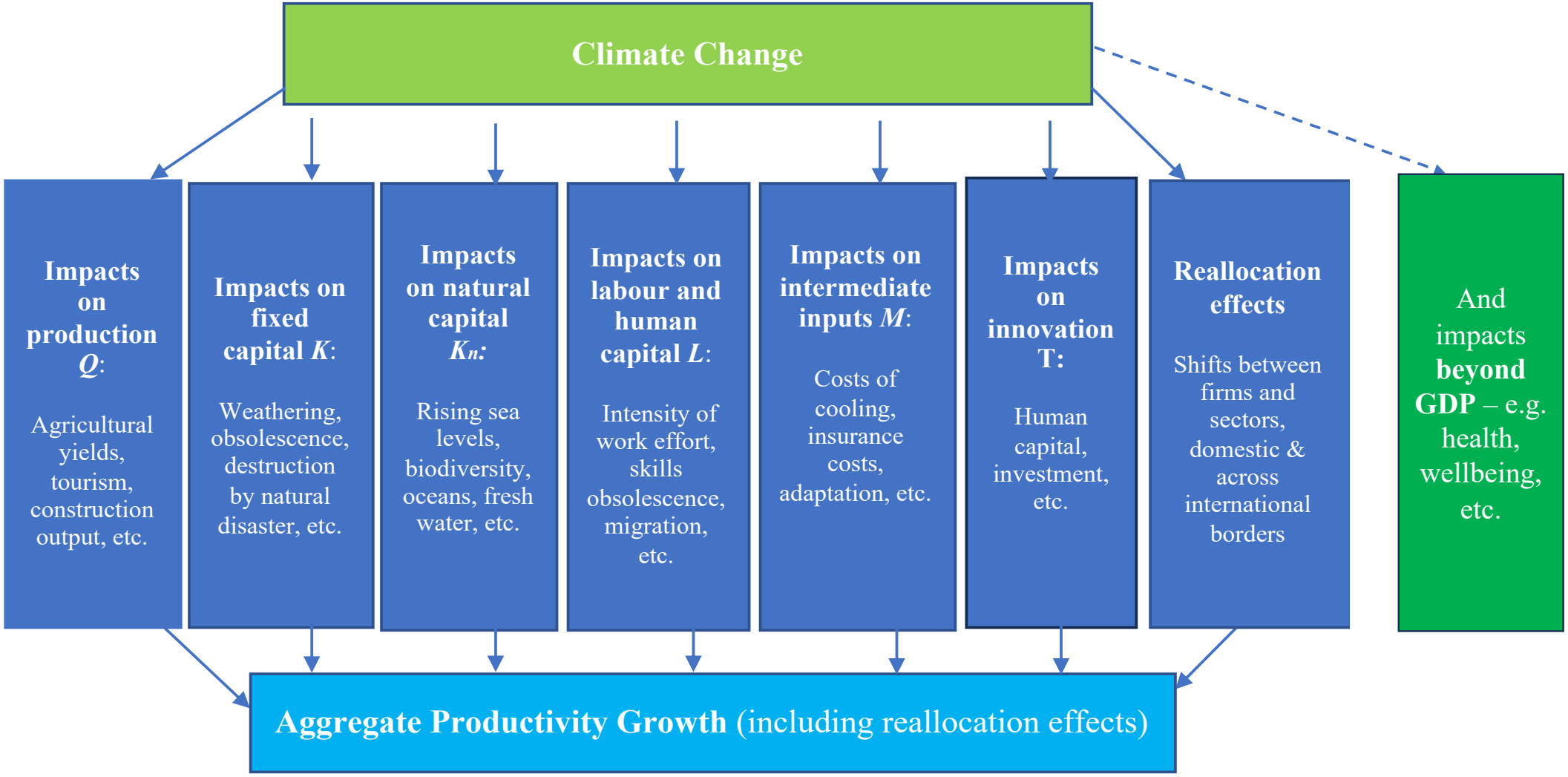


"Lagging but growing" G20 countries (China, India, Indonesia, Korea, Turkey)



Source: Van Ark, de Vries and Pilat, 2023

What direct impacts could climate change have on productivity?



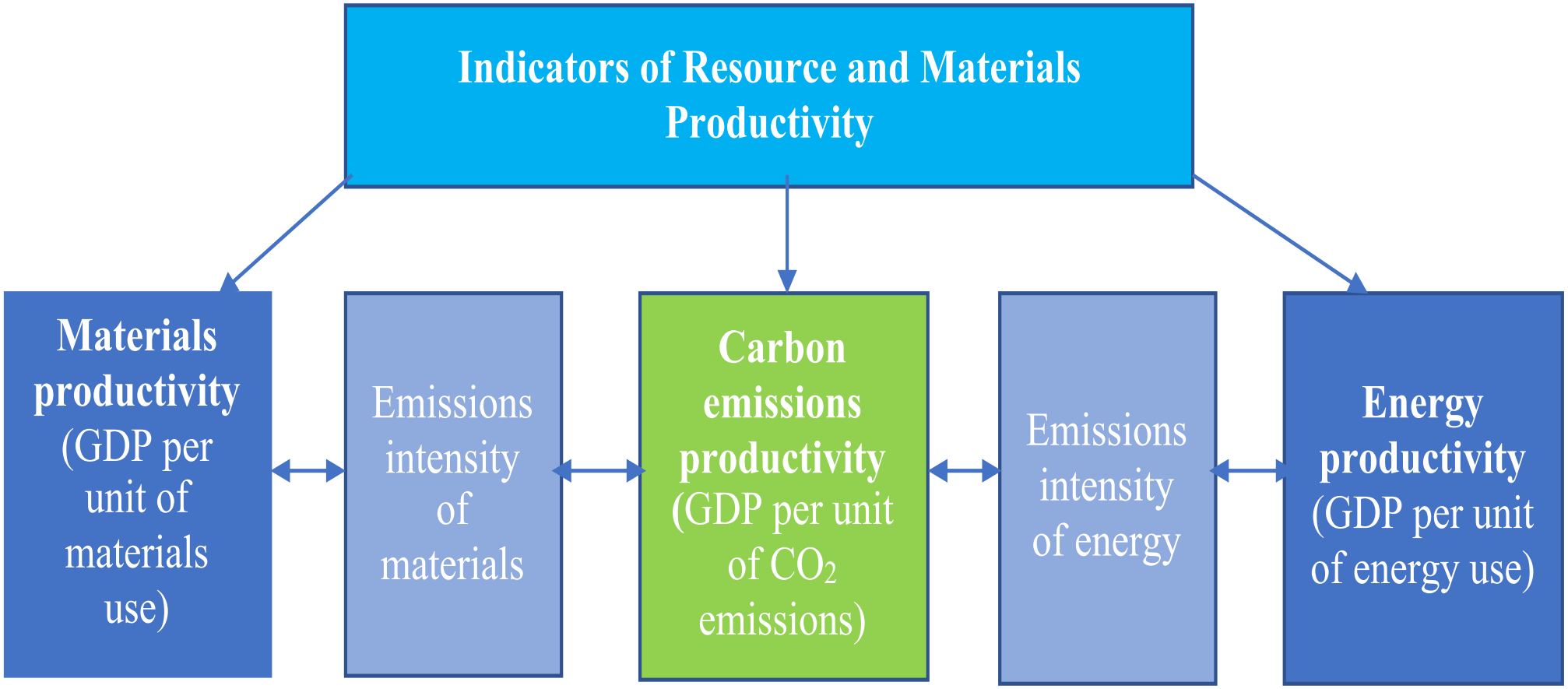
The macroeconomic impacts of climate change on growth and productivity

- **Long history of Integrated Assessment Modelling (IAM):**
  - Relatively small impacts on GDP in the long run, with potentially positive impacts on GDP with moderate (e.g., 1◦C) warming – e.g., work by Nordhaus, Tol and many others
  - Latest IMF review of studies (Aligishiev, et al., 2022) still points to relatively small impacts – median loss of 3.3% of global GDP by 2100 with global warming between 2.9 and 4.3◦C
  - But IMF review notes that these studies may substantially underestimate global costs, e.g. by ignoring worst-case scenarios, and by not accounting for the unequal distribution of impacts.
- **Growing criticism** of IAM studies, e.g., by Stern and Stiglitz (2022, 2023):
  - Many of the underlying **assumptions** are questionable
  - Risk of climate passing "**tipping points**" is ignored or underestimated – and some are already close to being breached.
  - Scientific consensus that climate change would have devastating impacts on economy and society – large parts of the world would not be habitable with more than 4◦C of warming.
- Growing evidence that mainstream economics has **systematically and significantly underestimated** the impacts and costs of climate change

Main criticisms of IAM studies

- **Key criticisms on assumptions of IAM models:**
  - Underestimate risk, notably the systematic nature of risk
  - Future is discounted at a high rate, leading to short-termism and underinvestment
  - Ignore distributional effects – in particular, large differences between countries
  - Too much focused on GDP, which ignores key impacts, e.g. on health
  - Ignore many market failures that affect efficiency
  - Future GDP growth often exogenous – based on questionable assumptions
- **Tipping points**:
  - IAM models don't sufficiently consider science of climate change, notably risk of large-scale climate events or "tipping points", such as:
    - The possible disintegration of the Greenland ice sheet;
    - The possible collapse of the West Antarctic ice sheet,
    - The possible saturation of oceans as a carbon sink;
    - The dieback of the Amazon forest as a carbon sink;
    - Etc.

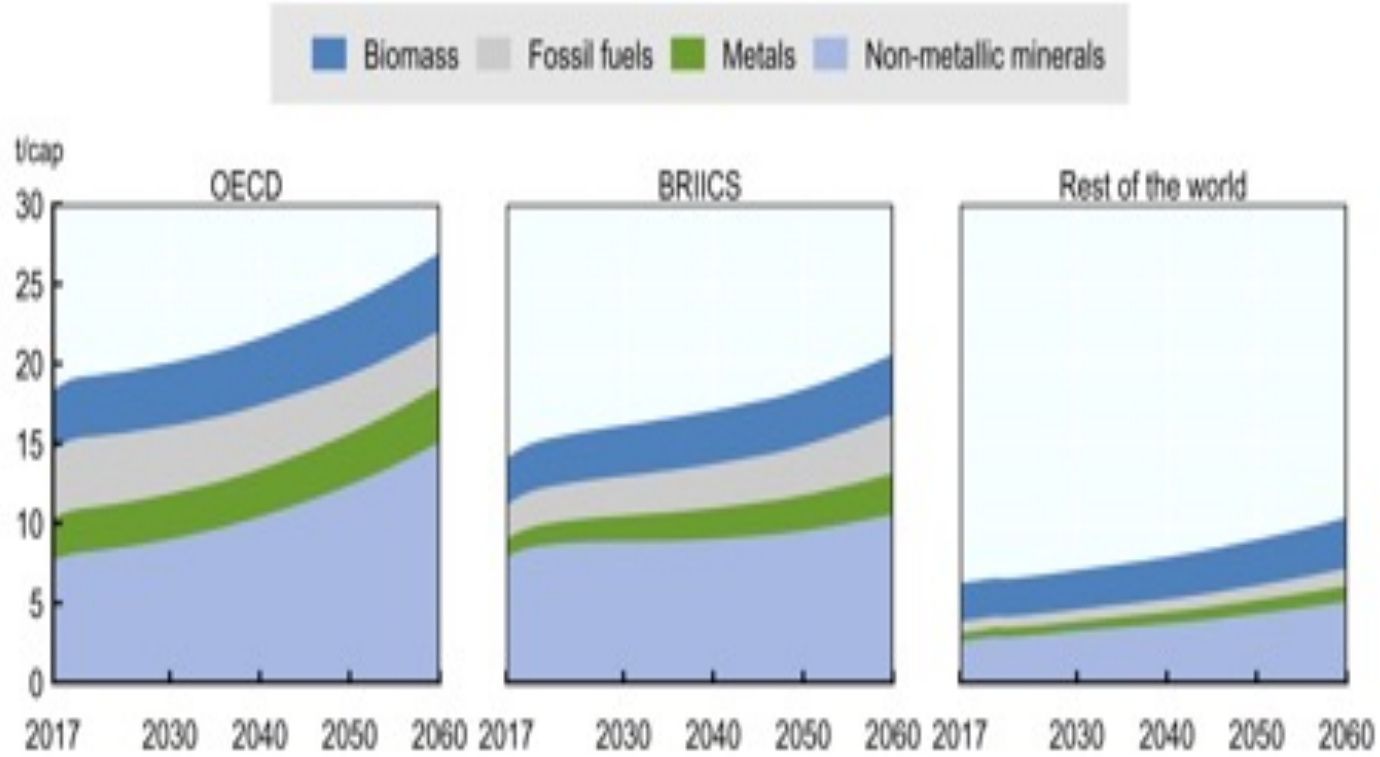
Impacts on materials and resource productivity – key indicators



Global materials use continues to increase, with impacts on the climate and the environment more generally

- **Materials** include fossil fuels, metals, biomass (e.g. agriculture) and non-metallic minerals (e.g. for construction)
- Materials use affects **climate change** through emissions linked to energy supply, industrial production and agriculture.
- But their growing use can have other impacts too, e.g., on **biodiversity**.

Materials use per capita for key regions, in tonne per capita

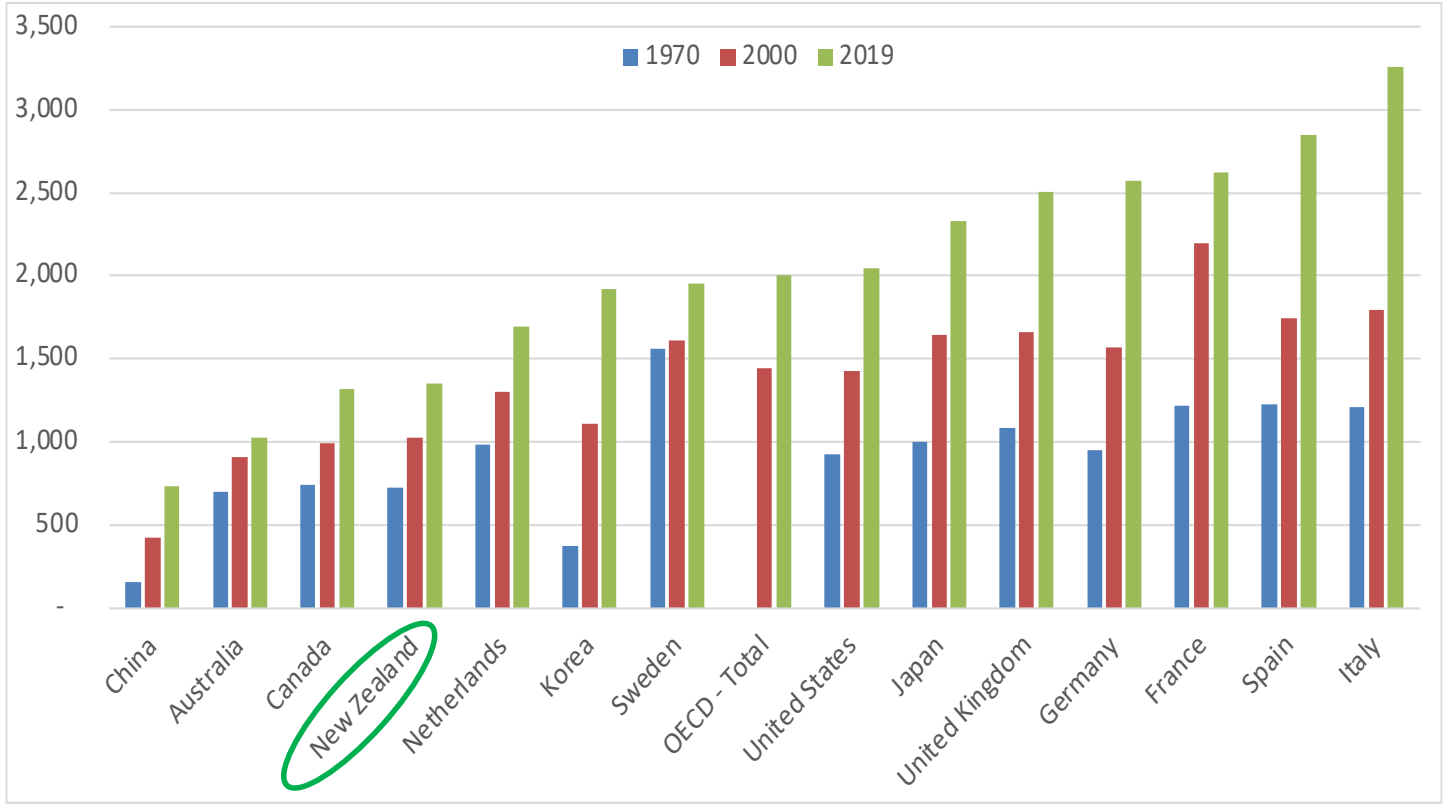


Source: OECD (2017), Global Materials Outlook to 2060

Materials productivity is increasing, but only slowly, and with large cross-country gaps

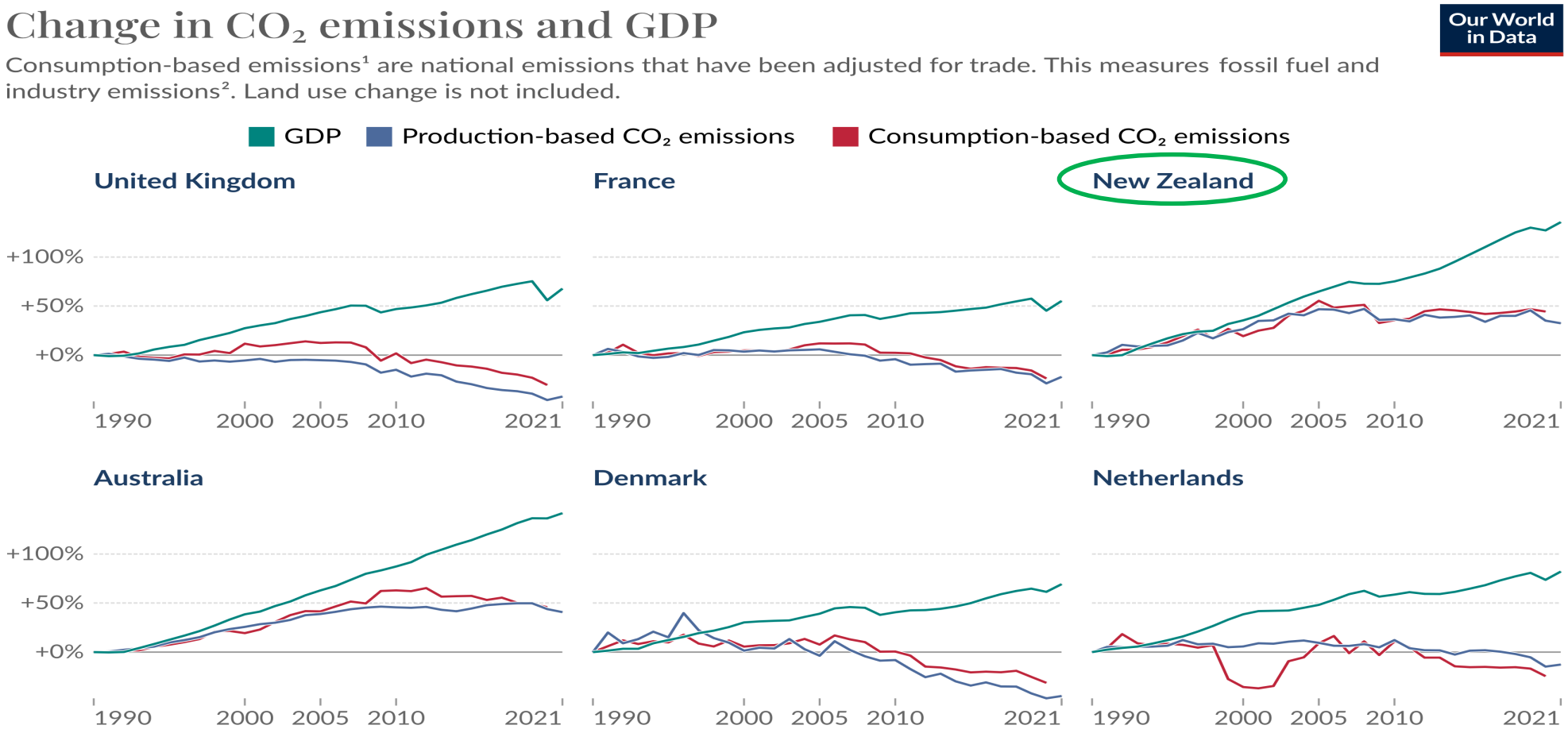
- **Materials productivity** is increasing, but too slow to address growing global use
- Indicators of **material footprint** go beyond domestic consumption of materials and adjust for international trade.

GDP relative to material footprint, in USD per tonne



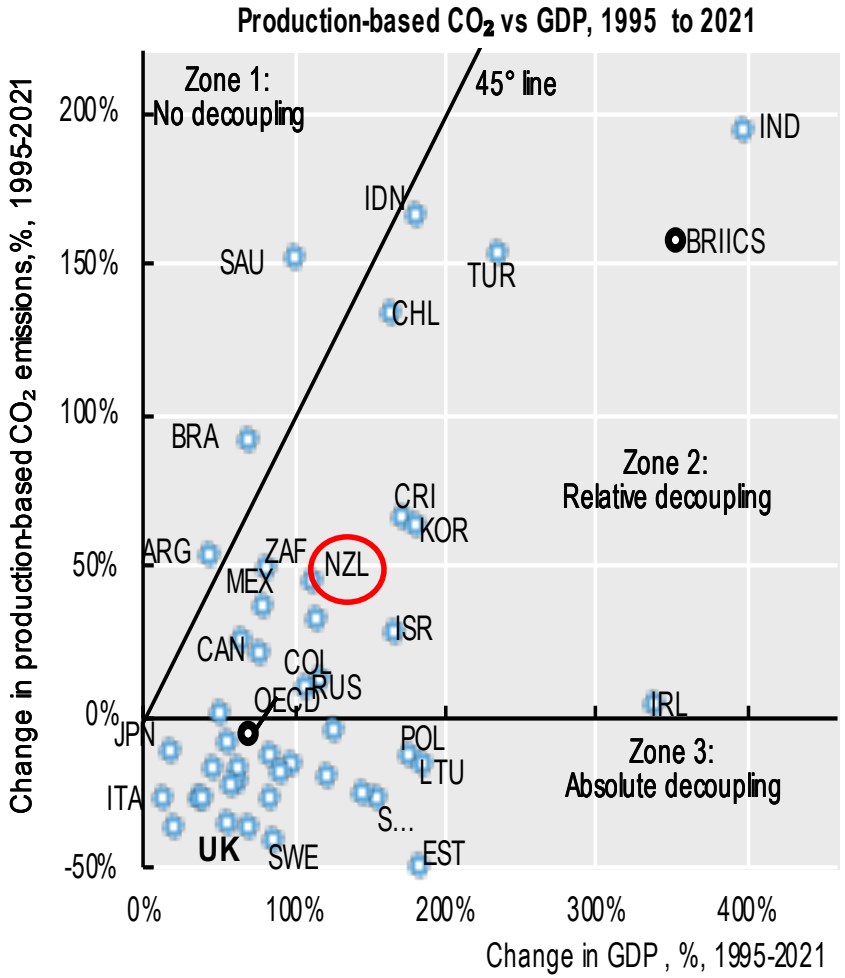
Source: OECD

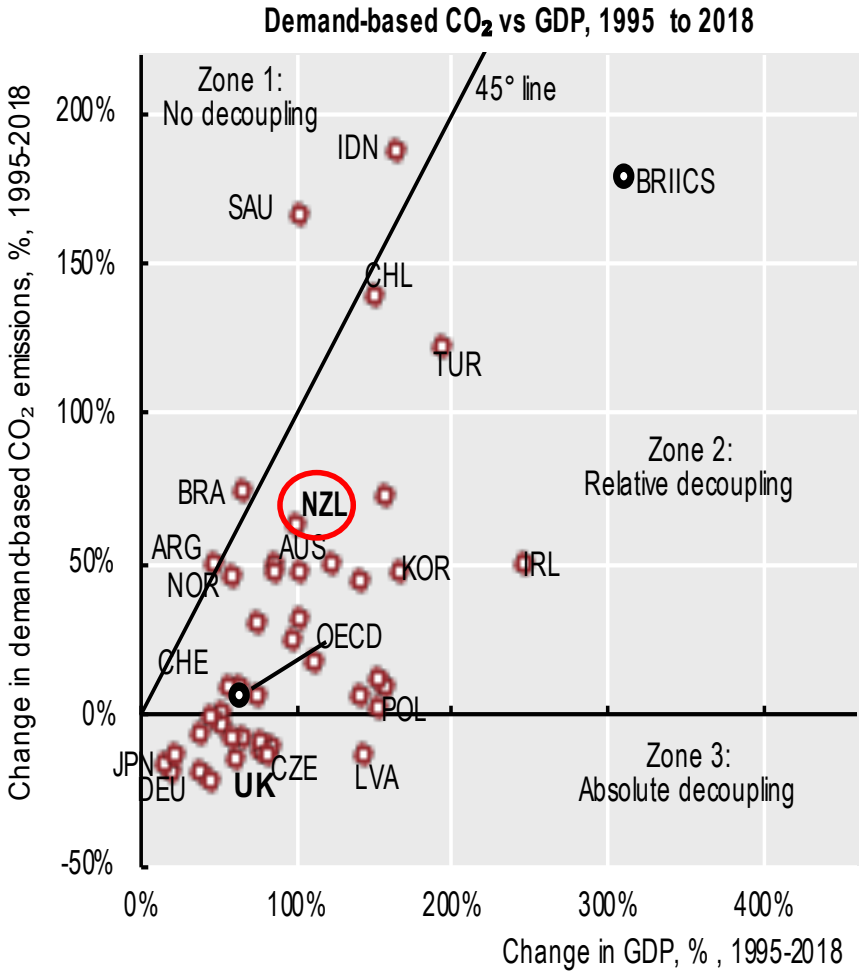
Carbon emissions productivity: relative decoupling in most countries; absolute decoupling in some (Denmark, France, UK)



Only few countries have achieved an absolute decoupling of consumption-based emissions with GDP, and rates are still low

- Carbon productivity is **higher from a production perspective than a consumption perspective** – most advanced economies import large amounts of embodied carbon
- Growth in carbon productivity has been slow and **cross-country differences** remain large.

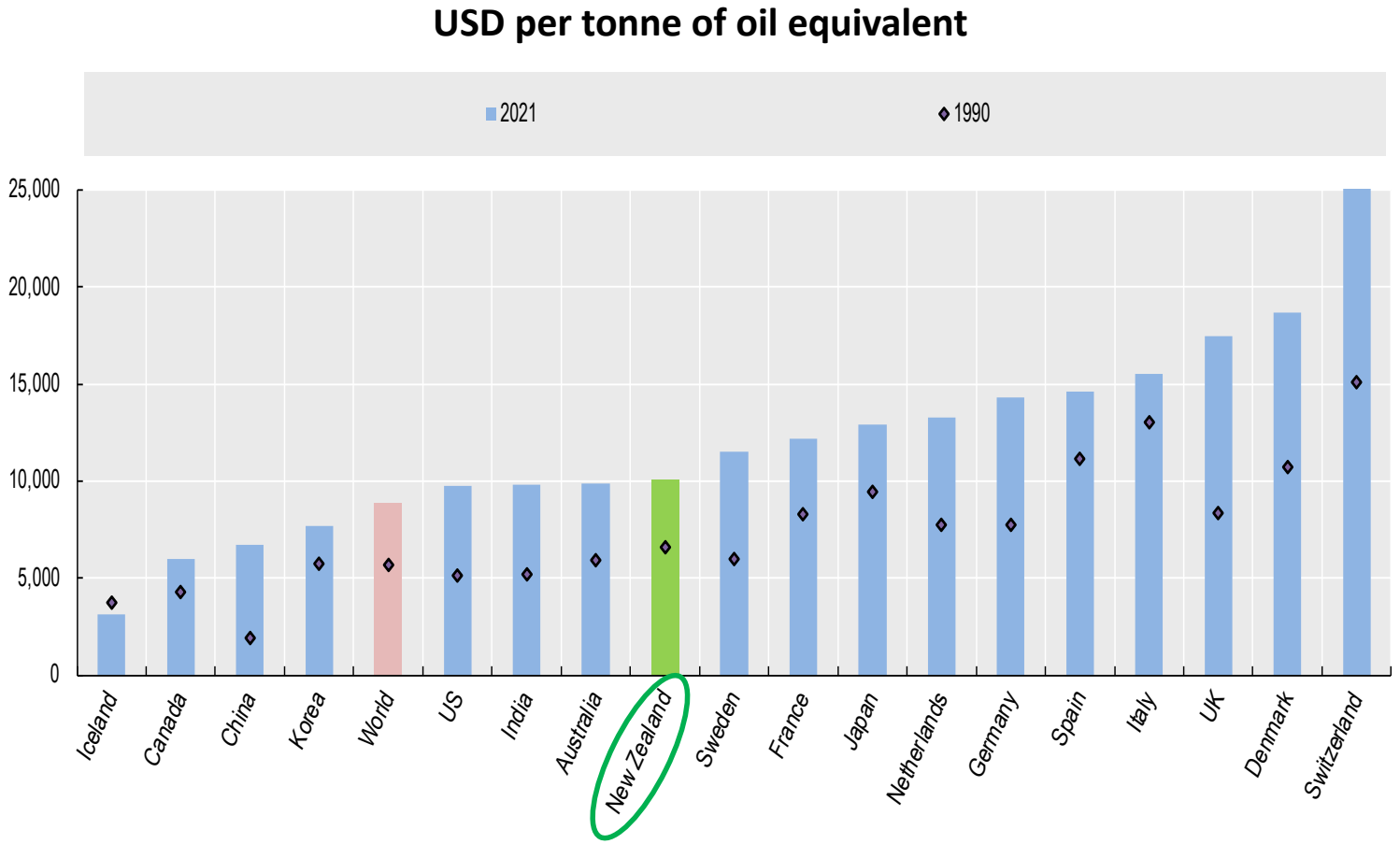




Source: OECD, Green Growth Database.

Energy productivity is increasing too, but relatively slowly, and also with large cross-country gaps

- **Global energy productivity** grew by 50% between 1990 and 2021 – annual average growth of 1.3%
- Key drivers include **energy efficiency and electrification**, with limited role for sectoral shifts.
- Risk of **rebound effects** – energy consumption could increase if efficiency grows and prices fall – but limited evidence.

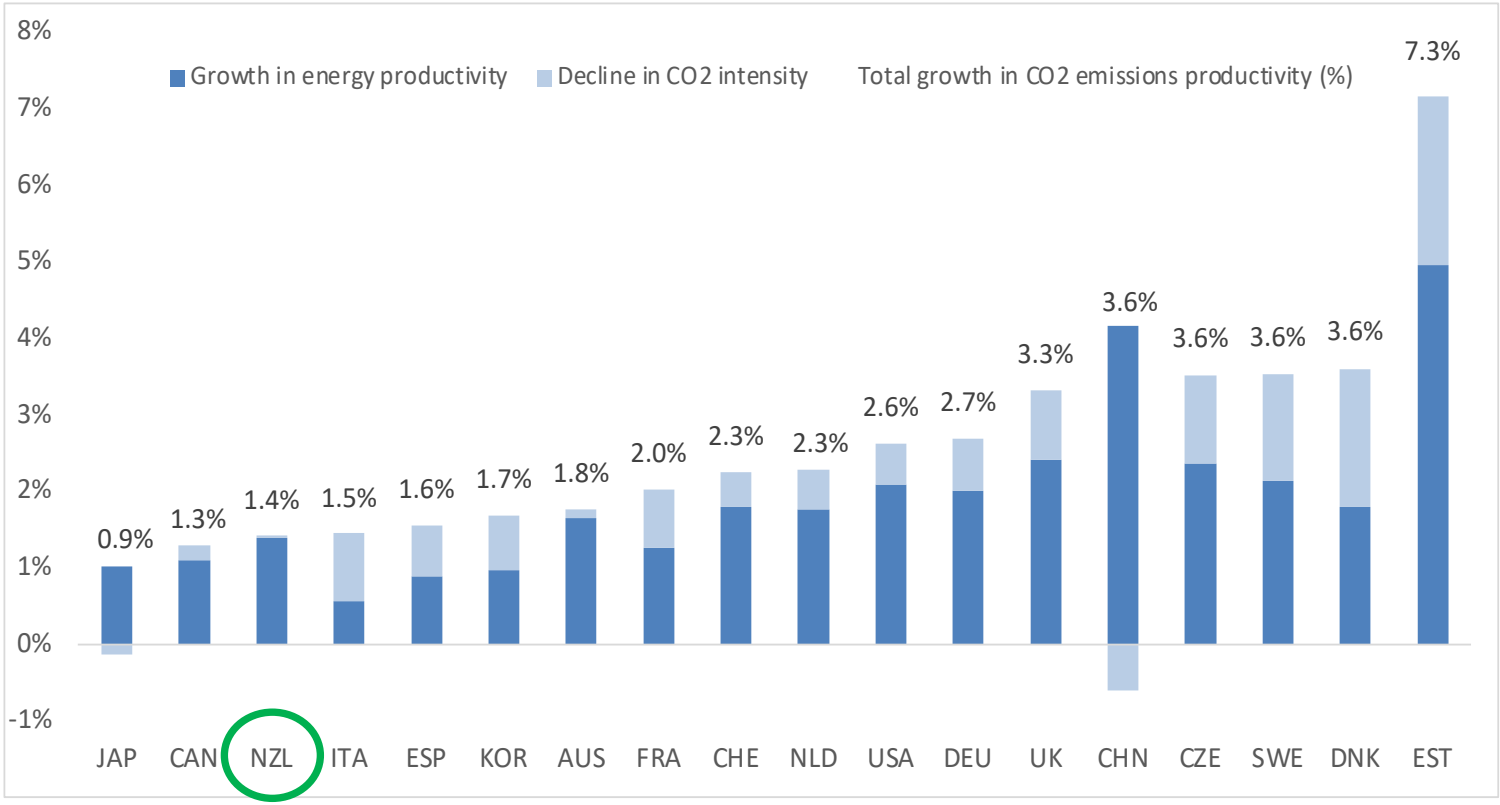


Source: OECD, Green Growth Database.

Growing energy productivity has contributed significantly to improvements in carbon emissions productivity

- In most countries, improvements in **energy productivity** (incl. energy efficiency) account for the bulk of the improvement in carbon productivity
- Changes in **carbon intensity** – e.g. linked to shifts in the energy mix – also matter for most countries.

Contribution to changes in carbon emissions productivity, annual averages, 1990-2021, in percentage points



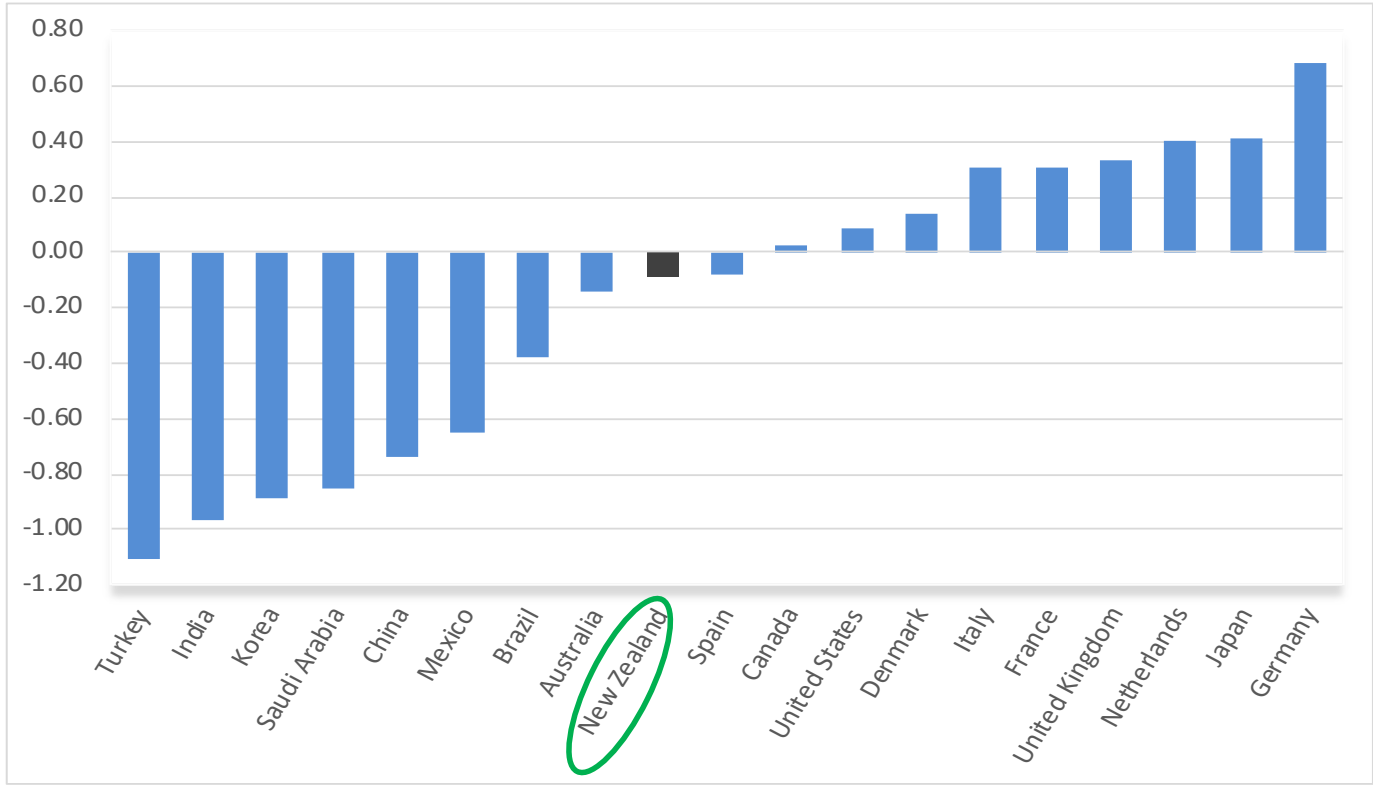
Source: OECD, Green Growth Database.

Adjusting for pollution abatement can lead to considerable adjustments to productivity growth, both positive and negative

- Adjusting growth for pollution abatement – **air pollutants and greenhouse gases** – increases growth in countries where pollution has decreased and reduces it in countries where emissions have increased.
- **Negative adjustments** to growth are highest in Turkey, India, Korea, Saudi Arabia and China, whereas **positive adjustments** are highest in Germany.

Growth adjustment for pollution abatement

Long-term average, 1991-2013, percentage points



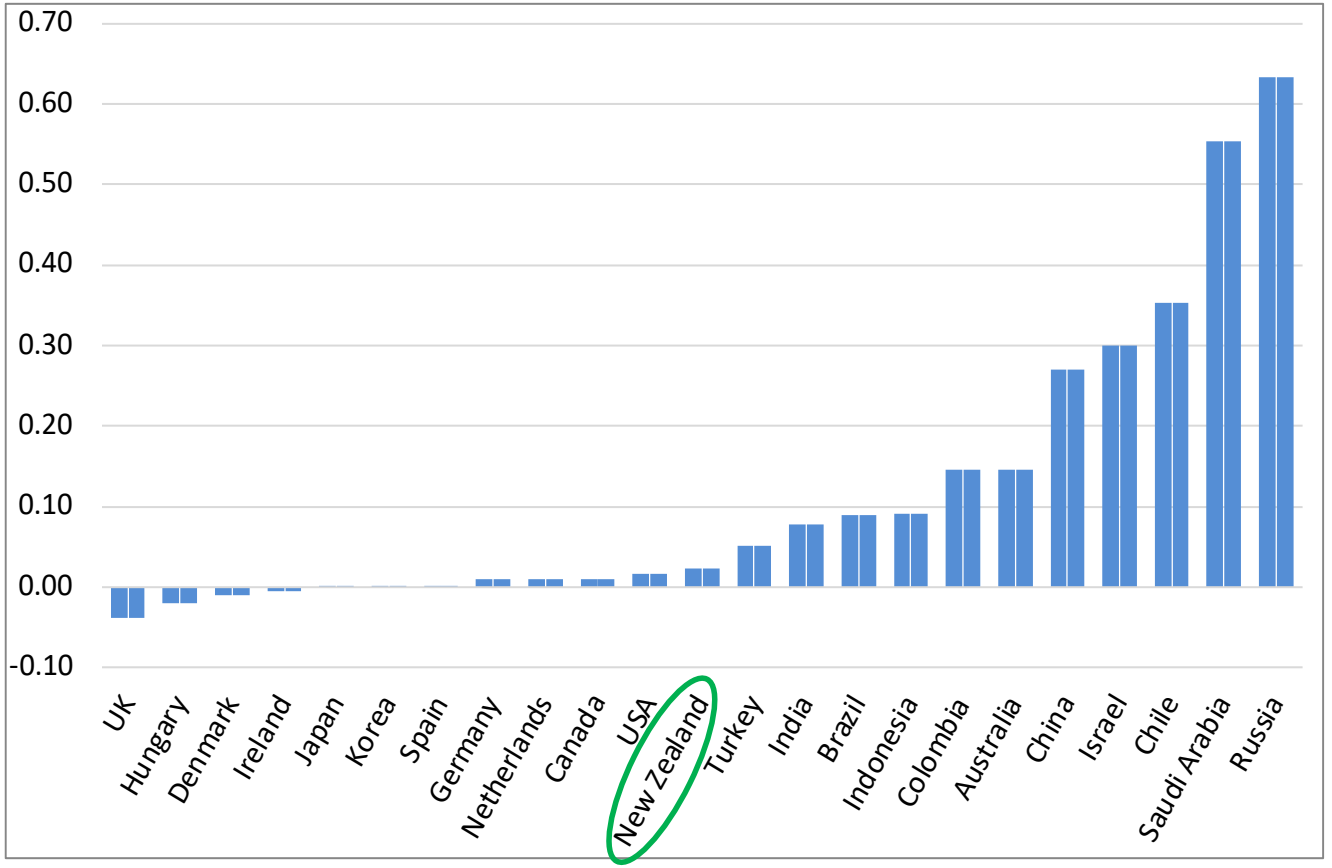
Source: OECD (2016), Environmentally Adjusted Multifactor Productivity, OECD Environment Statistics Database

Natural capital made a positive contribution to GDP and productivity in several countries, when valued at private cost

- Natural capital added to productivity growth in some countries, as they **generated value from the extraction of domestic natural resources**
- In **Russia**, this accounted for some 25% of output growth, and for 15% in **Saudi Arabia**.
- This approach does not account for the **environmental and social value** of such capital, e.g. for biodiversity and the environmental eco-system.

Growth adjustment for natural capital, selected countries

Long-term average (circa 1991-2013), in percentage points

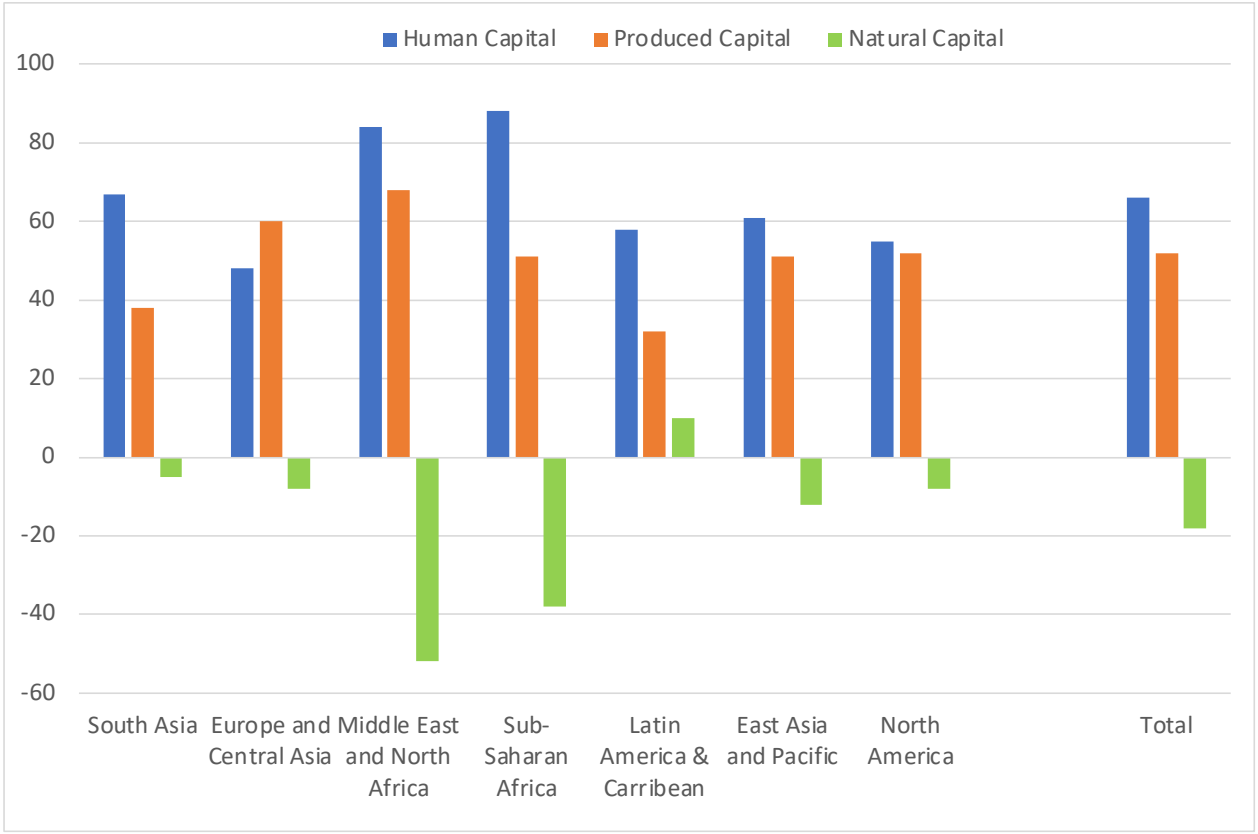


Source: OECD, Environment Statistics Database, based on Cardenas, et al. (2016).

Globally, natural capital depletion contributed negatively to the growth of total capital (inclusive wealth)

- Over the past decades, growth in most countries was **mainly due to growth of produced and human capital**, with these stocks and wealth growing.
- Natural capital also contributed to growth, **but stocks and wealth declined as natural capital depleted**, sometimes heavily (e.g. in the Middle East and North Africa).
- Natural capital **includes** fish, timber, mineral and fossil fuel deposits and a stable climate.

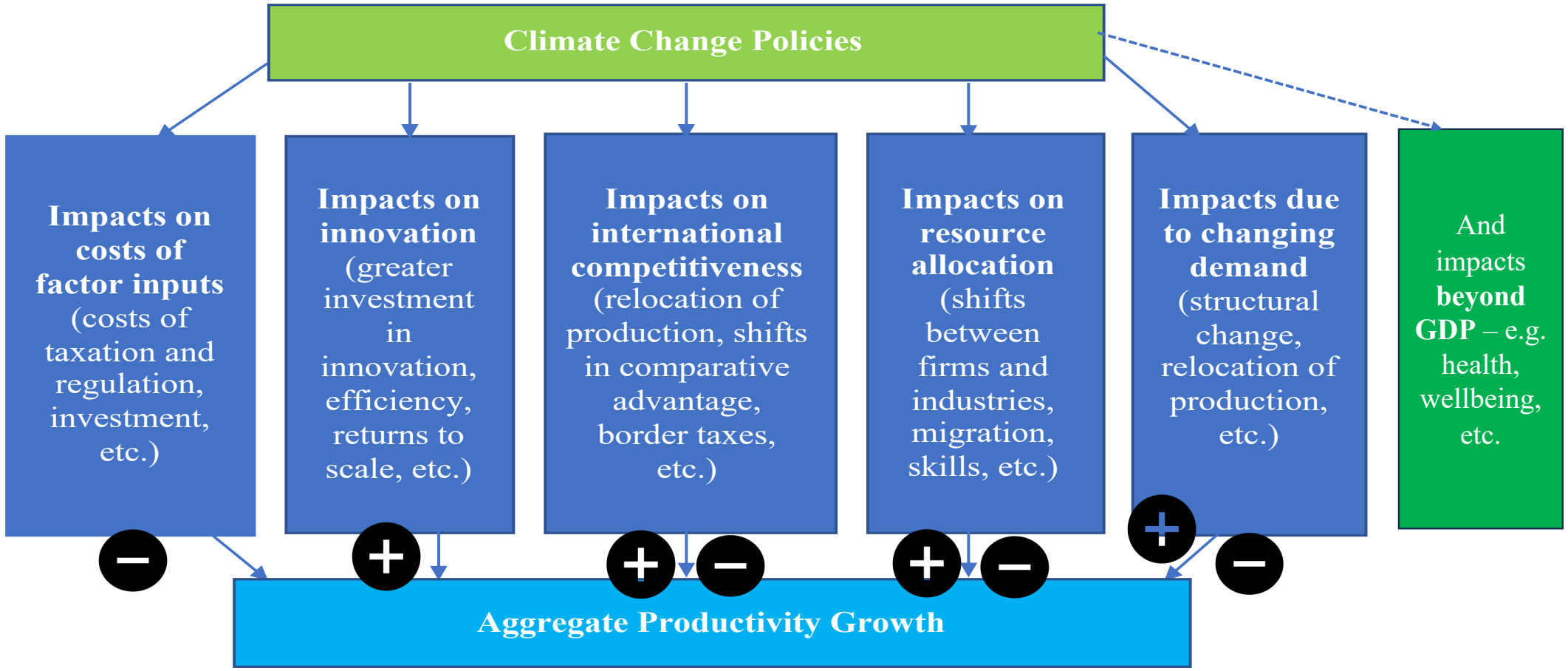
Relative contribution of human, produced and natural capital to growth of "inclusive" wealth (by region, 1990-2008, in %)



Source: UNEP (2023), Inclusive Wealth Report 2023 – Measuring Sustainability and Equity, Nairobi.

3. WHAT CAN WE EXPECT FOR PRODUCTIVITY FROM POLICIES FOR NET ZERO?

What impacts could policies to address climate change have on productivity?



Porter hypothesis: well-designed environmental policies and regulation may encourage firms to innovate – which could help increase productivity

What about productivity growth in the context of net zero policies – what is needed, what can we expect? (1)

Future labour productivity and MFP growth are highly uncertain, with both positive and negative factors affecting growth:

- **Potentially positive factors**:
  - Modelling estimates of costs of policy action have been going down (Stern, 2022), partly due to rapid pace of technological change and falling costs, e.g. of renewable energy. Current estimates show relatively small costs of policy action on GDP (OECD, 2023).
  - Recent large-scale studies of firm behaviour in response to environmental and climate change policies find evidence of stronger innovation (Porter hypothesis) and no evidence of high transition costs (e.g., CPB, 2022)
- **Potentially negative factors**:
  - Policies will have to play out over a short period and will likely be deeper than previous environmental policies – costs higher than before
  - Fragmentation of global effort and loss of political momentum – risk of uncoordinated policies with higher cost
  - Challenging macroeconomic environment
  - Growing pushback from fossil fuel and other incumbents – rent-seeking behaviour may increase costs

What about productivity growth in the context of net zero policies – what is needed, what can we expect? (2)

- **Materials and carbon productivity**:
  - Current pace of resource and carbon productivity growth far too low – will need to accelerate rapidly to achieve net zero goals
  - Some materials can be phased out (fossil fuels) and metals needed for transition involve far fewer materials and mining than current fossil-fuels based mining – but use will need to go down and recycling and circularity of material use increased
- **Energy productivity**:
  - Has thus far been important source of improvements in carbon productivity – energy efficiency and electrification (e.g. of heating) seen as important sources of future growth
  - Risk of rebound effects as prices of renewable energy decline and efficiency improves
- **Natural resources and productivity**:
  - Natural resources are still being depleted in most parts of the world
  - Meeting net zero will require greater investment in natural capital (e.g. forestry, biodiversity, fish stocks, etc.) – especially in developing countries – including for restoration and adaptation

4. PRODUCTIVITY, GREEN GROWTH AND DEGROWTH

Green growth and degrowth – can we continue to have growth in the transition to net zero?

- **Green growth** (e.g. OECD, 2011) has two versions:
  - **Strong version**: Environmental policies can have positive effects on growth and productivity, even in the short term. Equivalent to strong version of **Porter hypothesis**.
  - **Weak version**: Climate change can be addressed at relatively modest costs, with both future and present benefits. This version is relatively closely aligned with mainstream thinking, e.g. at the OECD. Equivalent to weak version of **Porter hypothesis**.

- **Degrowth proposals (e.g. Hickel, et al., 2022) claim that (advanced) countries should abandon GDP growth as a policy goal** and reduce or close down polluting (e.g. fossil fuels, aviation) and unnecessary production (e.g. fast fashion), **thus reducing GDP**, while increasing circularity in production.

Main criticisms of degrowth

- **Key economic criticisms:**
  - Almost all of the current growth in emissions is in emerging economies, where poverty is still high. Reducing GDP in advanced economies will have little impact on global emissions.
  - Reducing GDP (i.e. a prolonged recession) carries high economic risks and costs, including on macroeconomic stability, public finances and employment
  - Reducing GDP is more costly way of reducing emissions than many alternatives (e.g. renewables). Reducing GDP also has only small impact on emissions, as GDP is only one factor driving emissions
  - Proposals for degrowth ignore the need for, and role of, structural and technological change
  - Proposals mainly focus on command and control mechanisms, with little role for markets
- **Criticisms on implementation and feasibility:**
  - Degrowth perspective involves a zero-sum society where societal tensions between groups would increase – hard to see how such proposals could receive political support
  - 21st century values – including happiness, social progress, tolerance and innovation – have been developed in the context of a dynamic and flourishing economy – would they survive degrowth?

Criticisms of green growth and recent evidence

- **The current rate of growth in carbon productivity is – much – too low to achieve net zero – green growth isn't working yet.**
- **Strong version of green growth has limited empirical support and requires either:**
  - High investment multipliers (e.g. in a context of weak aggregate demand)
  - The elimination of market failures that would open up larger economic gains
  - Benefits to innovation and investment as firms seek to establish a competitive advantage
- **But wide range of empirical studies support weak version of green growth:**
  - Positive impacts of policy on innovation compensate for costs linked to regulation and taxation
  - Negative impacts of policy are small and may be positive under certain circumstances
  - But distributional effects – winners and losers (e.g. highly-polluting industries)
- **Stern and Stiglitz (2023) suggest that green growth could contribute to a new growth narrative, supported by, for example:**
  - Improved resource efficiency and increasing returns to scale;
  - Stronger "system" productivity, e.g., in energy and transport systems as well as in cities;
  - Faster move to the knowledge frontier due to increased social priorities, etc.

Green growth, degrowth and productivity: a bottom line

- **Degrowth is not an efficient nor an effective way of addressing climate change**
- **However, the current rate of improvements in carbon productivity is much too low to achieve net zero** – it will need to accelerate fast
- **The exclusive focus of green growth on growth of GDP and productivity is no longer justified:**
  - Need to focus less on GDP and more on other (complementary) measures, e.g. environmentally adjusted measures of productivity, contribution of natural capital, and living standards and wellbeing.
  - At the same time, standard measures of productivity have their role to play in understanding economic efficiency and in helping improve overall efficiency in resource use
- The main policy question is **how to (rapidly) achieve net zero, while also supporting living standards and productivity**

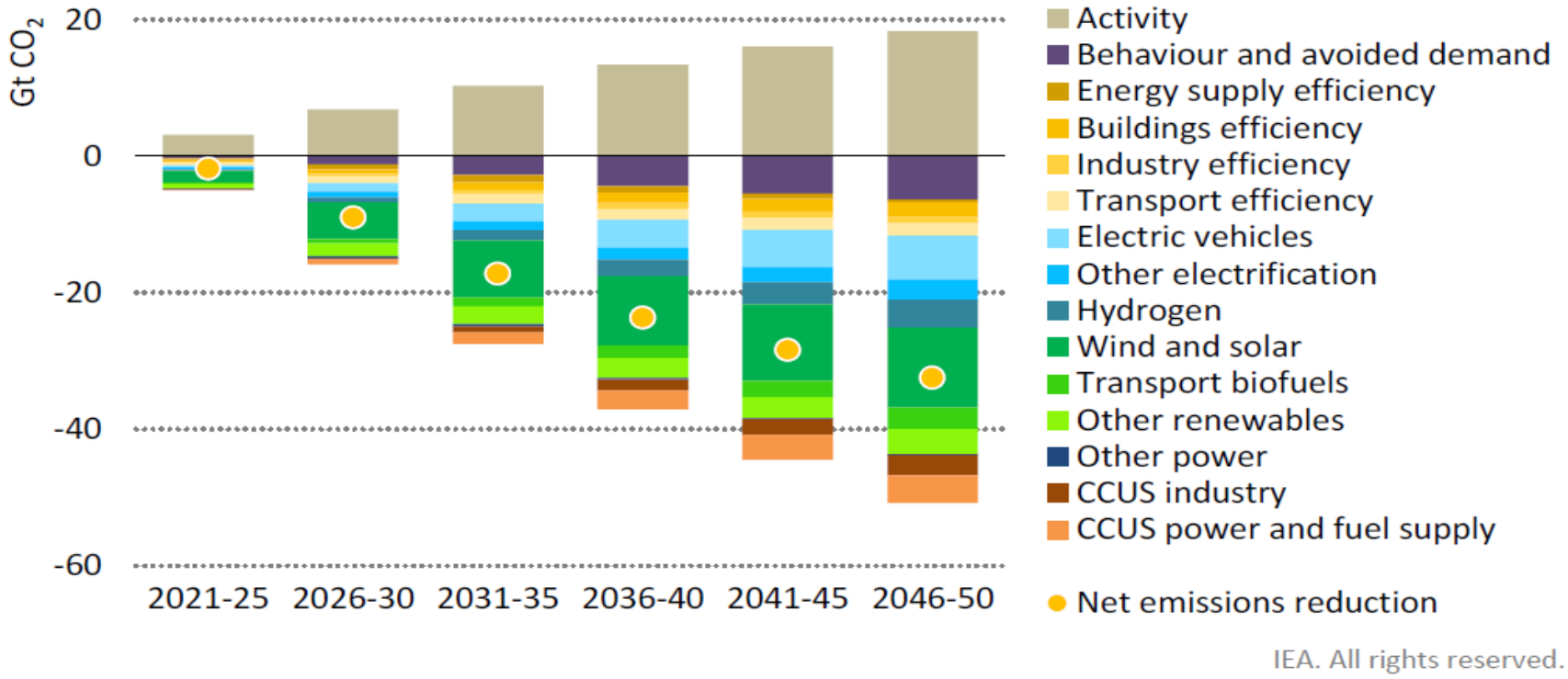
5. POLICY: ADRESSING CLIMATE CHANGE WHILE BOOSTING PRODUCTIVITY [AND A LITTLE ABOUT INNOVATION]

Addressing climate change while boosting productivity – key elements of policy

- Provide clear indication on **direction of change**
  - Carbon pricing and removal of fossil fuel subsidies – to address environmental externalities
  - Reduce policy uncertainty
- Foster **low-carbon innovation** (next slides)
- Preserve **competition**, contestability of markets and openness
- Strengthen **markets and demand** for low-carbon technologies, e.g. product **standardisation** (e.g., green hydrogen, sockets for EVs, etc.) and **supportive regulation** (e.g., heating, buildings, emissions standards, recycled content, etc.)
- **Public investment** (e.g. infrastructure) and **derisking** of private investment
- **Facilitate resource allocation,** address **incumbency and rent-seeking**
- **Make trade work for the transition** – e.g. facilitating trade in environmental goods and services, IPR frameworks that balance protection and diffusion, etc. …
- **Support workers in making the transition**, e.g. in updating skills

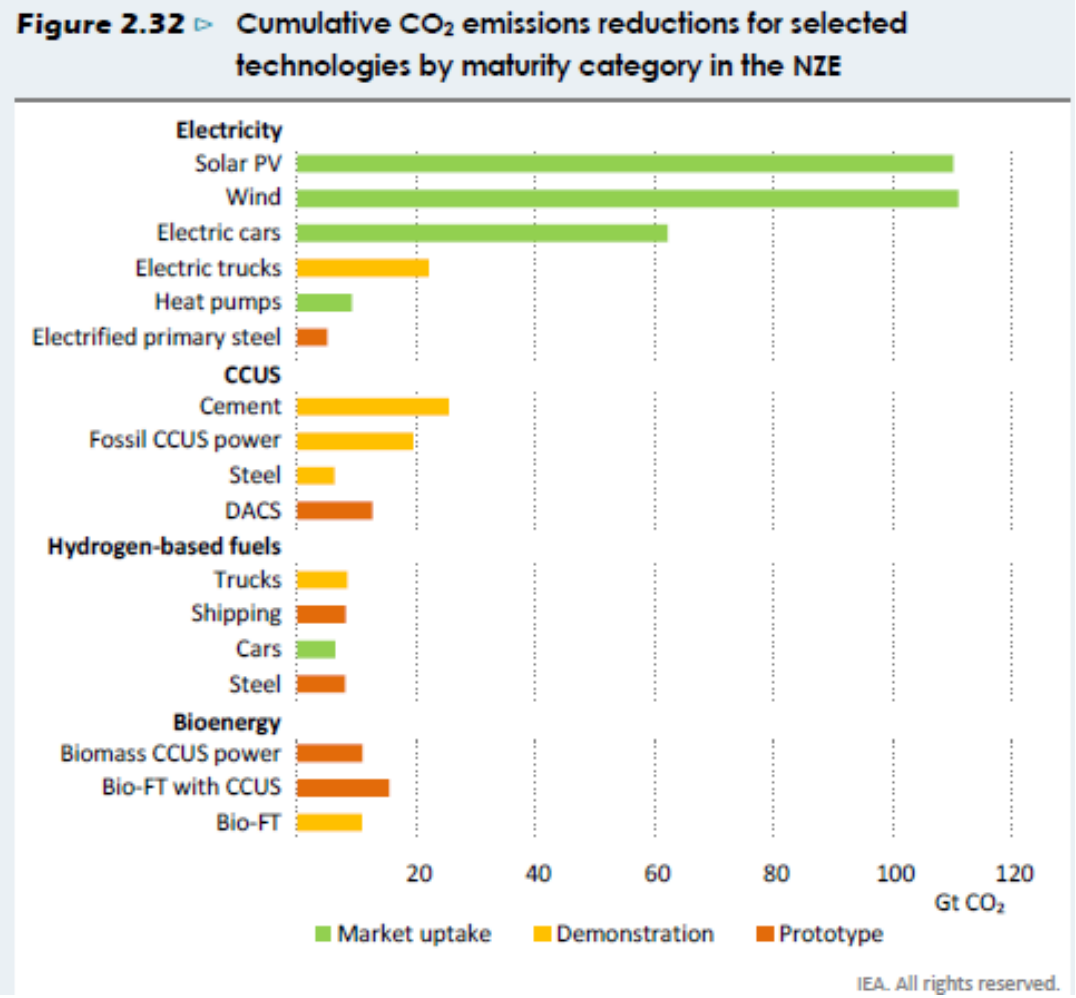
Climate neutrality requires a massive, system-wide technological shift

Sources of CO_2 emission reductions in IEA's net-zero scenario



Source: IEA 2021

Existing technologies are key for 2030 objectives, but not enough for 2050

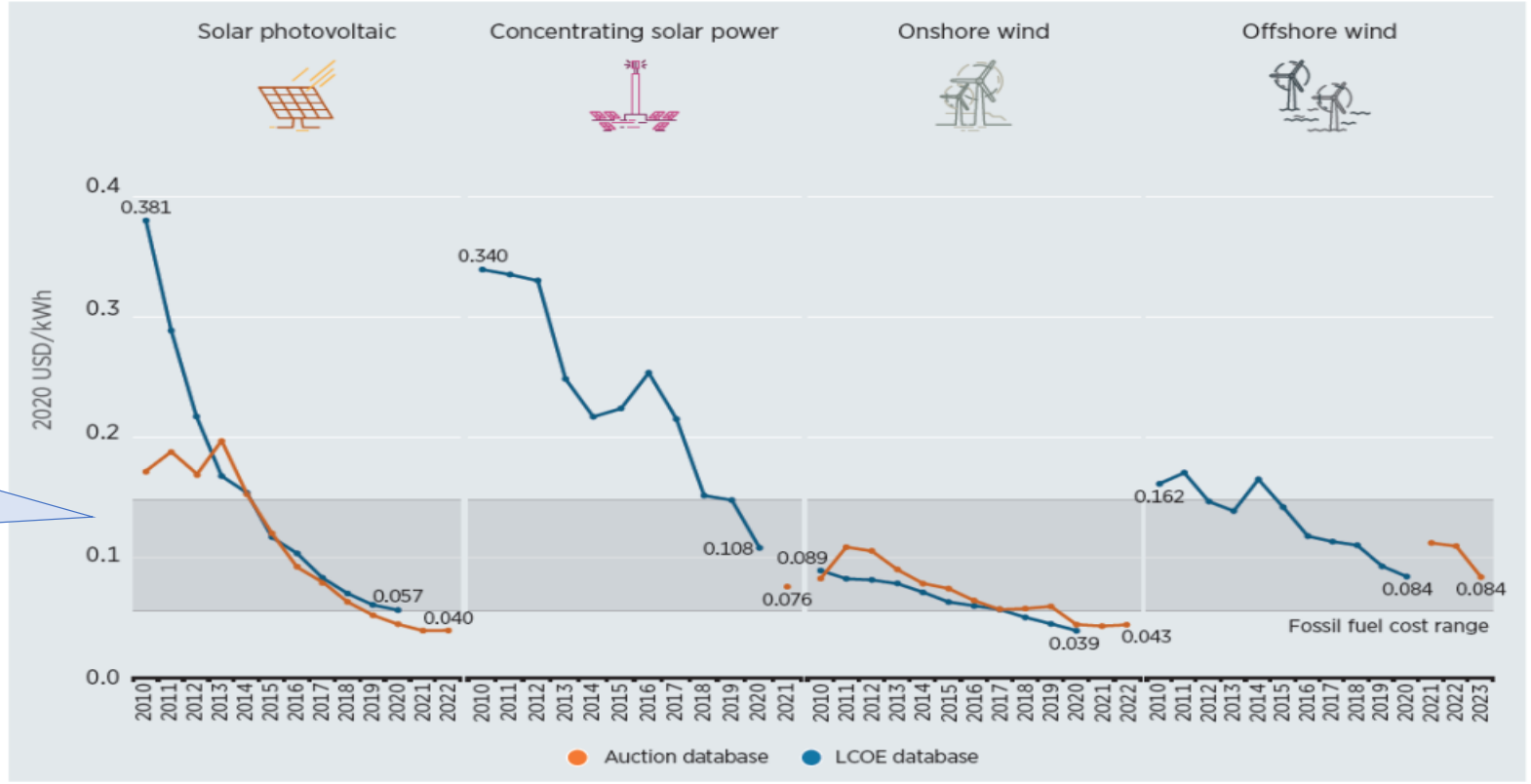


- In the IEA's net-zero scenario, most of the global reductions in CO_2 emissions **through 2030 come from technologies readily available today**
- But almost half the reductions in **2050** will have to come from technologies that are **currently at the demonstration or prototype phase** – this has been reduced to **35%** in IEA's 2023 scenario update

Continuous innovation is key to reducing the costs of low-carbon technologies

Declining renewable energy costs since 2010

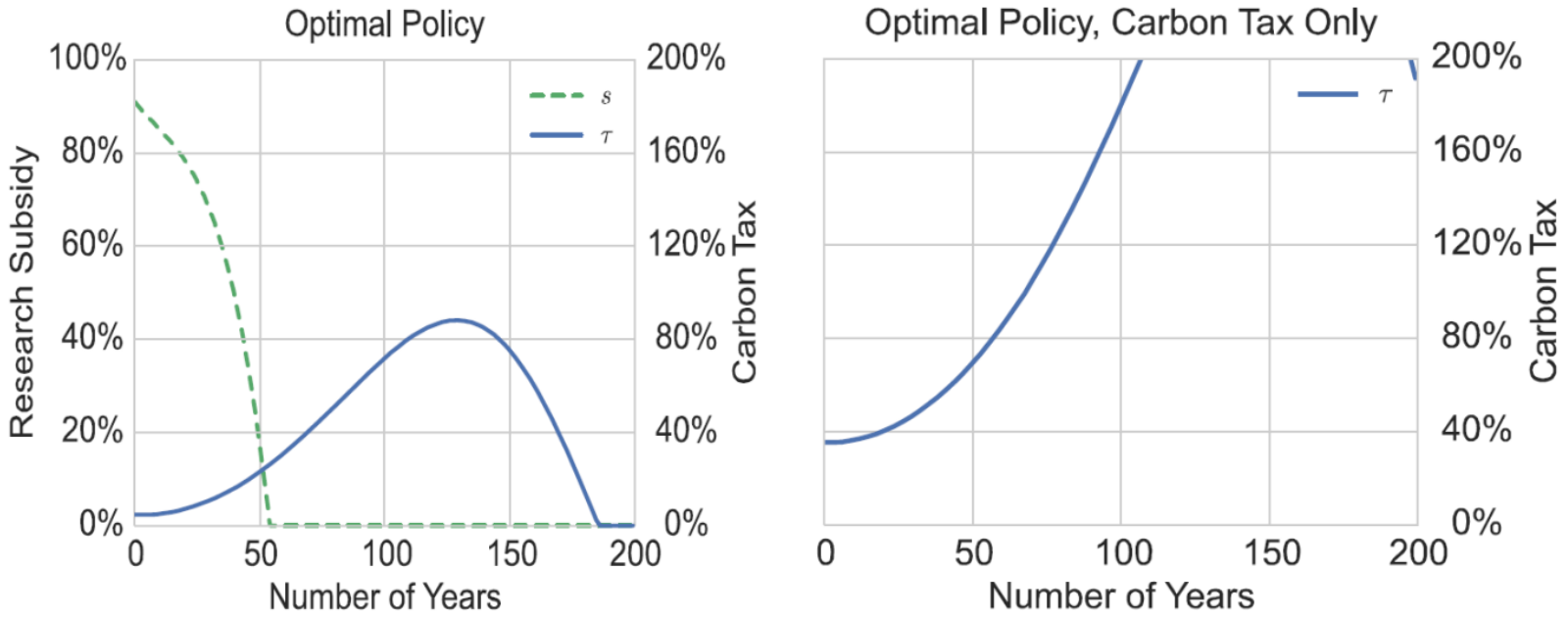
Fossil-fired power costs



Note: The grey band crossing the entire chart represents the fossil fuel-fired power generation cost range.
Source: IRENA Renewable Cost Database.

Innovation policies aimed at cost reductions can allow other policies to be less stringent

Support for clean research allows for much smaller carbon taxes



Source: Acemoglu et al., 2016.

STI policies need to be a cornerstone of climate policies

- **Reducing costs to make carbon-free technologies competitive** with their high-carbon alternatives should be a primary objective of climate policy

- **Innovation and industrial policies should constitute a cornerstone** of strategies to reach carbon neutrality
  - Theoretical justifications very strong
  - Can partially substitute for low carbon prices and support carbon pricing
  - Can facilitate the adoption of more ambitious climate policies
  - Can boost international technology diffusion to emerging economies

See: Cervantes, Criscuolo, Dechezlepretre and Pilat (2023) for further detail.

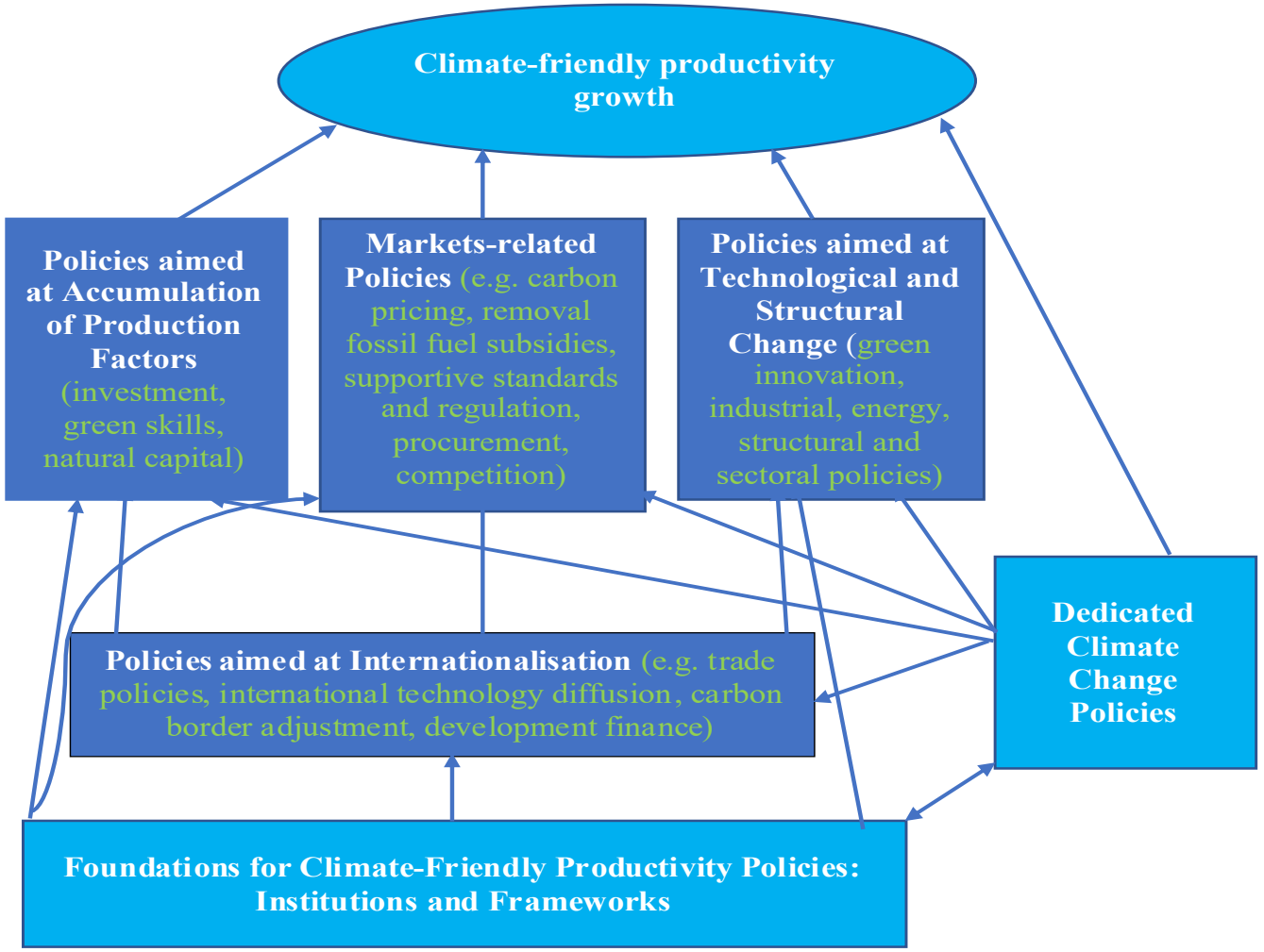
Encouraging innovation – globally and nationally

- **Globally** – a re-balancing of STI policies
  - Still mostly focus on diffusion existing technologies, not on necessary breakthrough technologies. Need greater **support for breakthrough technologies**, e.g. through mission-oriented policies, and better balance with **diffusion of existing technologies**
  - Greater use of **direct** support instruments, not just R&D tax credits – technology neutrality is not neutral in practice, as it tends to favours incumbents
  - Increased support for **demonstration projects** – currently too small compared to typical project needs
  - Strengthening of **international cooperation and technology diffusion, especially to developing countries**
- **Nationally** – for a small country:
  - Focus on **absorbing and diffusing** existing technologies, e.g. renewables
  - Mitigation & adaptation – context matters – **investment in own innovation important**
  - Consider **own strengths** and possible contributions to **frontier innovation**

Climate policies differ in several ways from standard policy frameworks for productivity

Some differences:

- More focus on **addressing environmental externalities** and making markets work
- **Directed** innovation & structural change
- Complementary **trade and international** policies to address global nature of the challenge
- Focus on accumulation of **specific production factors** (skills, infrastructure, natural capital)



Source: Adapted from Van Ark, de Vries and Pilat, 2023

Climate change policies that support productivity

- **Climate change policies deviate from standard productivity policies** – in theory, this would imply lower productivity growth
- However, **climate change policies reduce impacts of climate change on GDP and productivity**, so theoretical impact is not the right default
- **A good climate policy framework can reduce potential trade-offs, reduce costs and support productivity**, e.g. by:
  - Improving price signals, strengthening markets and supporting private investment
  - Ensuring competition and market openness
  - Implementing stable and predictable policies
  - Facilitating structural change and resource allocation
  - Active innovation policies that address technology gaps and foster diffusion, thus helping to accelerate the transition and reduce costs
  - International cooperation and coordination

6. CONCLUSIONS

Conclusions

- **Broaden the discussion on productivity and climate change** – greater focus on resource and materials productivity, natural capital, measures adjusted for environmental externalities – and look beyond GDP at wellbeing and living standards. Necessary **measurements** are increasingly available but need to be fully integrated in analysis and policy thinking.
- **Distinguish impacts of climate change and impacts of policy.** Until recently, mainstream economic studies significantly underestimated the costs of climate change. There is uncertainty on the likely costs of policy action on growth and productivity, with growing evidence that they may be modest and declining as **technological change reduces costs**.
- **Current rate of carbon productivity growth and rate of decoupling from GDP** is far below that needed for achieving net zero. Accelerating productivity growth in this area is urgent.
- **Degrowth is not an efficient or effective way of achieving net zero.** Rather, we need to design policies for net zero that to the best possible extent also support productivity growth. Policies to foster low-carbon innovation are key to such policies.
- **Economists need to engage more with the global discussion on climate change**, including by engaging more in interdisciplinary research.

Thank you, comments are welcome

Please contact me if you would like to quote the slides. Thank you.

Working paper planned as TPI paper (early 2024):

https://www.productivity.ac.uk

Contact:

dirkpilatparis@gmail.com

Twitter/X: @PilatSTI

Some suggestions for further reading

- Cervantes, M., C. Criscuolo, A. Dechezlepretre and D. Pilat (2023), "Driving Low-Carbon Innovations for Climate Neutrality", *OECD Science, Technology and Industry Policy Papers*, No. 143, OECD, Paris, http://doi.org/10.1787/8e6ae16b-en
- Stern, N. and J. Stiglitz (2023), "Climate Change and Growth", *Industrial and Corporate Change*, Vol. 32, pp. 277-303, https://doi.org/10.1093/icc/dtad008
- Stern, N., J. Stiglitz and C. Taylor (2022), "The Economics of Immense Risk, Urgent Action and Radical Change: Towards New Approaches to the Economics of Climate Change", *Journal of Economic Methodology*, Vol. 29, No. 3, 181-216, https://doi.org/10.1080/1350178X.2022.2040740
- Stern, N. (2022), "A Time for Action on Climate Change and a Time for Change in Economics", *The Economic Journal*, Vol. 132, 1259-1289, https://doi.org/10.1093/ej/ueac005
- Van Ark, B., K. de Vries and D. Pilat (2023), "Are Pro-Productivity Policies Fit for Purpose? Productivity Drivers and Policies in G-20 Economies", *Working Paper No. 038*, The Productivity Institute. https://www.productivity.ac.uk/wp-content/uploads/2023/09/WP038-Are-pro-productivity-policies-fit-for-purpose-270923.pdf

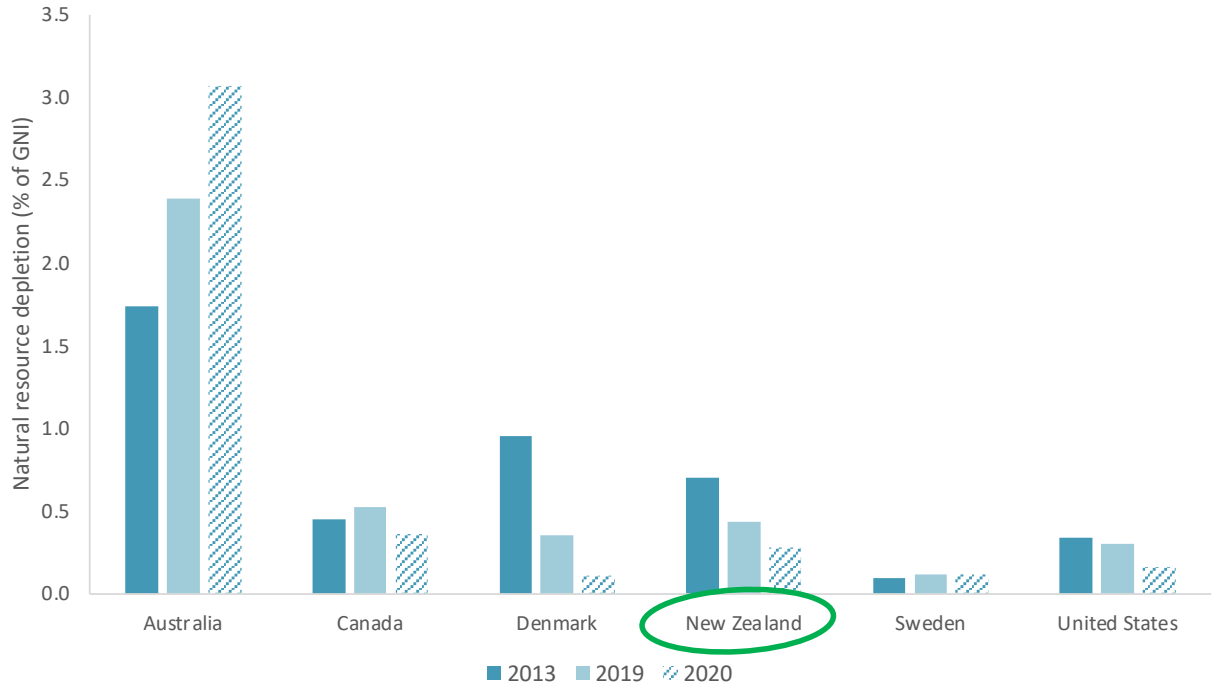
BACK-UP SLIDES

New Zealand's rate of natural resource depletion has slowed

- World Bank estimates show that several advanced countries **continue to deplete their natural resources**, although the rate has slowed in some (e.g. Denmark and New Zealand)
- World Bank estimates **exclude broader measures of natural capital**, e.g. linked to biodiversity and air and water quality

Disinvestment in natural capital, selected countries

Natural resource depreciation as a percentage of Gross National Income



Note: Natural resource depletion is the sum of net forest depletion, energy depletion, and mineral depletion.

Source: World Bank staff estimates report in New Zealand Productivity Commission (2023), "Productivity by the Numbers". Figure 4.8