Victorian Living Standards Decline: The cost of climate change, climate change mitigation and security 2020-2100

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6 December 2021

What's the objective here?

- Estimate the damage costs of climate change (CC) from three emission cases.
- Estimate the costs of CO_2 reduction including export replacement.
- From the perspective of average Victorian household.
- For an economy frozen in 2019-20.
- Answer the question does damage avoidance outweigh CO_2 reduction cost.
- In context of the emerging security crises.

Why average Victorian household ?

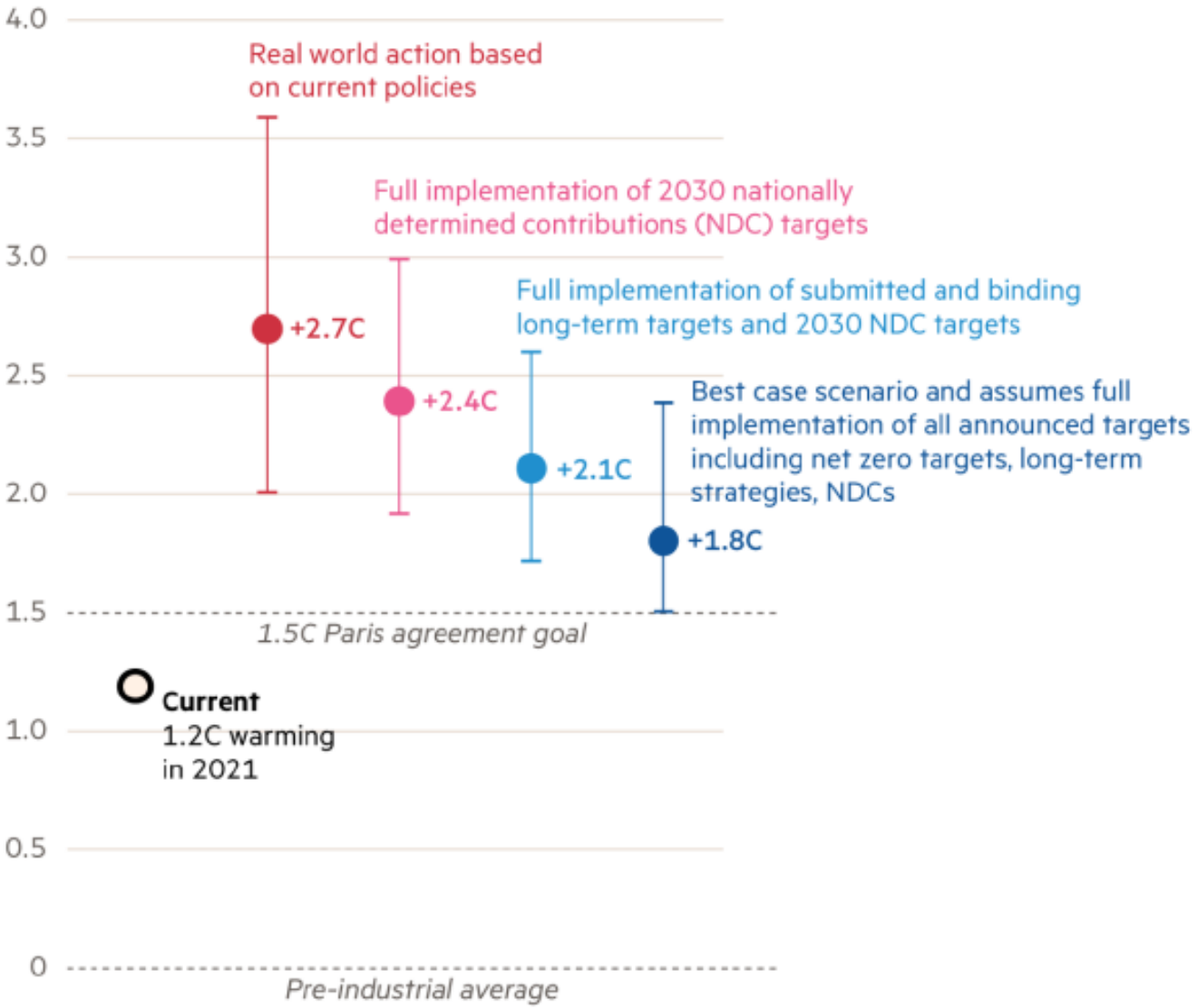
- **To make it most relevant.**
- **Household discretionary expenditure is the best indicator for measuring welfare costs.**
- **GDP change can increase with some costs.**
- **Climate change damage may boost GDP.**
- **Damage costs will boost insurance and taxes, increasing GDP but reducing welfare.**

What are the three global emission scenarios to 2100?

1. **Business as usual – US 2016-2020.**
2. **Pre COP26 current policies to IPCC Paris agreement.**
3. **ZNET 2050.**

Even on optimistic assumptions, warming is set to exceed 1.5C

Warming projections, global mean temperature increase by 2100 (C)



Nov 2021 update Source: Climate Action Tracker

Table 1.1 The three world emission scenarios to 2100						
	1975	2020	2040	2050	2075	2100
Annual emissions (gigatonnes CO_2e)						
Business as usual/4C	26.5	50.1	73.5	84.9	106.6	118.7
Current policies	26.5	50.1	55.1	54.8	47.2	41.9
ZNET 2050/1C	26.5	50.1	13.1	7.3	-10.8	-14.8
CO_2 concentration in atmosphere (parts per million)						
Business as usual/4C	331.2	414.3	482.8	525.2	657.2	814.9
Current policies	331.2	414.3	472.1	501.1	569.3	629.6
ZNET 2050/1C	331.2	414.3	446.1	451.2	443.6	427.6
Temperature change from pre-industrial times (Celsius)						
Business as usual/4C	0.2	1.1	1.7	2.1	3.0	4.0
Current policies	0.2	1.1	1.6	1.9	2.4	2.8
ZNET 2050/1C	0.2	1.1	1.4	1.4	1.4	1.2

How are damages estimated?

- **IPCC reports (2018 SR) and other modelling.**
- **Determine the general shape damages for each 1 degree rise within general 4 to 1 ratio between 1C and 4C 2020-2100.**
- **Determine damage upper and lower bounds.**
- **By setting Australia damage for each type at 2020 asset levels and economic activity.**
- **Calculate year by year to 2100 for each type.**

Table 1.5 Damage costs (BAU) – 2100 (per cent)	
Natural disasters	49.0
GDP/Labour productivity	35.7
Sea level rise	3.5
Defence	0.0
Agriculture price rise and other price increases	11.7
Total	**100.0**

Australia: A resource constrained economy – The framework

Given:

$$GDP = C + GC + IV + EX - IM$$

Where:

- **GDP = Gross domestic product.**
- **C = Household consumption.**
- **IV = Investment.**
- **EX = International exports of goods and services.**
- **IM = International imports of goods and services.**

Let:

- **GDP = $\overline{GDP}$ from labour and capital capacity constraints where – denotes a constraint.**
- **NT = EX – IM = $\overline{NT}$ from foreign debt constrained trade balance.**

Then:

$$\Delta C = -\Delta GC - \Delta IV$$

Where:

Δ denotes change from 2020 levels.

What ways do damage costs impact Victorian households?

- **Increase in prices for agriculture and insurance.**
- **Forced increases for real expenditure on insurance.**
- **In fully employed economy (most of 2019-20) increases in taxes, interest rates, general prices to release resources to fix the damage.**
- **Most damage cost formed at world or national level.**

Climate change damage: Impact on total expenditures of an average Victorian household								
	$cvm '000				Percent change from 2020 levels			
	2040	2050	2075	2100	2040	2050	2075	2100
Climate change damage - total expenditure								
Business as usual (BAU)	-4.6	-7.8	-19.4	-40.8	-3.5	-5.9	-14.9	-31.2
Pre-Cop26 policy settings	-2.2	-3.8	-7.7	-12.8	-1.7	-2.9	-5.9	-9.8
ZNET 2050	-1.2	-1.9	-2.9	-4.0	-0.9	-1.5	-2.2	-3.0
Climate change damage - Discretionary expenditure (excludes health, education, finance, insurance and energy costs)								
Business as usual (BAU)	-3.3	-5.7	-14.3	-29.0	-4.6	-7.8	-19.6	-39.9
Pre-Cop26 policy settings	-1.7	-2.8	-5.9	-9.7	-2.3	-3.9	-8.1	-13.3
ZNET 2050	-0.9	-1.5	-2.2	-3.0	-1.3	-2.0	-3.0	-4.2

Sniff test: What are the aggregate damage costs for Australia?

- **Cumulative Australia loss 2020-2100 from 2020 national levels $US 6.6 trillion for BAU from slide above or 3 times 2020 GDP.**
- **IPCC puts loss at $US 551 trillion for World (2018 Report).**
- **Australian share at 1% so in ball park.**

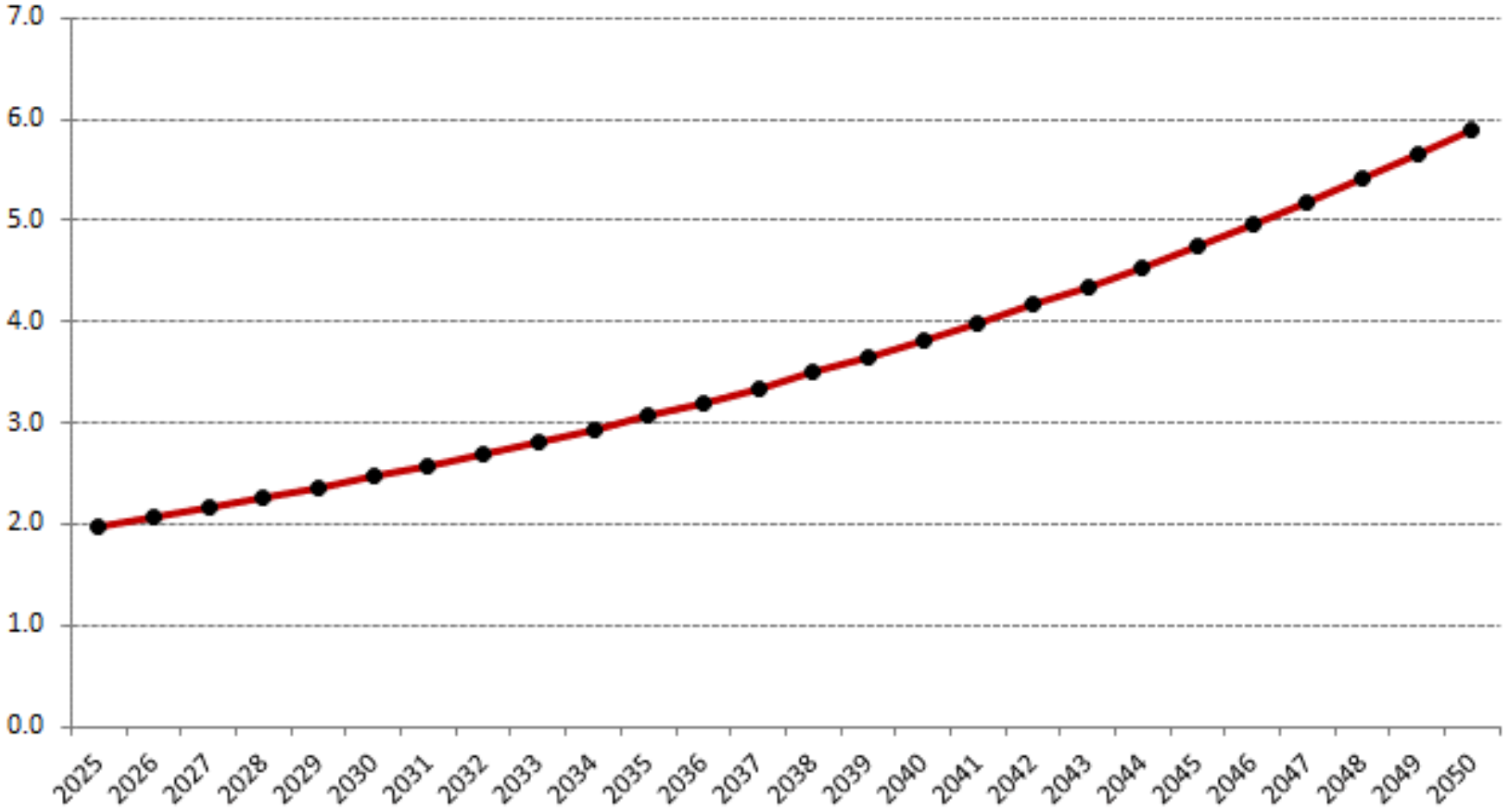
What is the CO_2 reduction strategy ?

- **Basic for 70% of emissions.**
- **Step one: obtain a 100% renewable source, namely electricity.**
- **Step two: convert oil and gas and other energy to electricity or renewable fuels.**
- **Step three: soil carbon and carbon capture storage for rest.**

Table 4.1 The Electricity Sector Transformation Task			
	Unit	2020	Comment
Total capacity installed	MW	35542	
Required to replace non-renewable electricity production	MW	117170	National non-renewable electricity production was 188.5 terawatt hours estimated for 2019-20. However this capacity in renewables will have to be inflated by 2.3 given the difference in capacity utilisation rate between the two.
Renewable capacity required to replace petroleum products in transport (except aviation)	MW	143391	
Renewable capacity required to replace gas in energy use	MW	41780	
Total capacity required	MW	302341	
Supply from small scale solar	MW	33284	
Supply from large scale renewable	MW	269057	
Cumulative investment in electricity generating capacity 2021-2050 for ZNET 2050	$2018 million	511600	
Cumulative investment in battery capacity 2021-2050 for ZNET 2050	$2018 million	95878	
Cumulative investment in electricity transmission and distribution capacity 2021-2050 for ZNET 2050	$2018 million	370915	
Total cumulative electricity investment 2021-2050	$2018 million	978393	
Total cumulative investment household to be ZNET ready	$2018 million	21412	Focus on equipment replacement - little allowance for efficiency improvements
Total cumulative investment by industrial/commercial sector to be ZNET ready 2021-2050	$2018 million	48223	
Cumulative cost of other emission reduction 2021-2050	$2018 million	154325	
Total cumulative direct cost of ZNET 2021-2050		1202352	

Table 1.2 Australian ZNET 2050 costs (per cent of total)	
Replace existing non-renewable electricity production	16.5
Replace transport fuels with electricity	20.2
Replace gas with electricity	5.9
Battery investment to stabilise the grid	8.0
Extension of the electricity grid for higher volumes and remote supply sources	30.8
Household, commercial and industrial conversion to all electric energy source	5.8
Other emission reductions	12.8
Total	**100.0**
Total expenditure – $ 2018 billion	**1202.4**
Total expenditure –net of depreciation – $2018 billion	**856.5**

Distribution of National ZNET expenditure 2025-2050 (%)



Australia: Industry restructure costs – ZNET 2050		
Export loss – coal, oil and gas	150	$b
Capital investment in oil and gas sector	600	$b
Hydrogen exports to replace 80 Mt of LNG	28.5	mt
Renewable capacity to support hydrogen exports	641.0	GW
Renewable capital cost	758.3	$b
Western Green Energy Hub (W.A.) LNG export replacement equivalent	760.1	$b
Metallic mining capital output ratio	1.84	
Capital stock required for lithium, rare earths, copper, zinc, nickel, etc.	276	$b
Total capital stock required (gross of deprecation offsets)	1034.3	$b
Total capital stock required (net of depreciation offsets)	761.1	$b

The complementary crisis: Security

1. **A massive arms race is developing in the Indo-Pacific region.**

2. **China has an advantage in a number of military technologies at high scale and growing.**

3. **To maintain US security umbrella Australia may well have to increase defence expenditure to 4% of GDP. The nuclear submarines will take up at least 25% of this adding missiles, aircraft, AI and cyber technologies.**

4. **Cumulative National security expenditure would increase by $900 billion by 2050 compared to current levels.**

Climate change mitigation ZNET 2050 and security: Impact on total expenditures of an average Victorian household						
	$cvm '000			Percent change from 2020 levels		
	2040	2050	2100	2040	2050	2100
Total expenditure						
Direct climate change mitigation (electrification)	-3.4	-5.8	-4.6	-3.0	-5.1	-4.1
ZNET export replacement	-2.9	-4.5	-3.7	-2.6	-4.0	-3.3
Security	-3.9	-3.9	-3.9	-3.5	-3.5	-3.5
Total	-10.3	-14.3	-12.3	-9.1	-12.6	-10.8
Total including ZNET 2030 damage exc. security	-7.6	-12.3	-12.4	-6.5	-10.6	-10.4
Total exc. security compared to BAU damage	-2.9	-4.5	28.4	-3.0	-4.7	20.8
Total discretionary expenditure						
Direct climate change mitigation (electrification)	-2.6	-4.4	-3.5	-4.1	-6.9	-5.5
ZNET export replacement	-2.2	-3.4	-2.8	-3.5	-5.4	-4.4
Security	-3.0	-3.0	-3.0	-4.7	-4.7	-4.7
Total	-7.7	-10.7	-9.2	-12.2	-17.0	-14.6
Total including damage exc. security	-5.7	-9.3	-9.3	-8.8	-14.4	-14.1
Total exc. security compared to BAU damage	-2.4	-3.6	19.7	-4.2	-6.6	25.8

Cost of climate change mitigation: Core messages

1. **Future generations better off with ZNET 2050. Current older generation clearly not so, unless productivity growth can be accelerated from past trends. Problem: more capital investment required lowering short run living standards.**

2. **Resources will be severely constrained. Price mechanism and regulation essential . However this will only be accepted if cross price elasticity of substitution effects protect real incomes, e.g. car reduction with public transport increase at similar or lower cost.**